Appendix A – Control Measures for SJVAPCD Regulatory Compliance (from PEIS/EIR)

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APPENDIX A

Control Measures for SJVAPCD Regulatory Compliance (from PEIS/EIR)

The project construction and operation would incorporate the measures listed in the San Joaquin River Restoration Program Environmental Draft Impact Statement/Report (PEIS/EIR) (Bureau of Reclamation and California Department of Water Resources, 2011), including mitigation strategies to comply with SJVAPCD Rule 9510 and Regulation VIII, to reduce air quality impacts associated with construction of the Project. A summary of the control measures taken from the PEIS/EIR is presented below.

Reduction of Ozone Precursor Emissions during Construction

The project will comply with the following general control measures required for construction emissions, as contained in SJVAPCD Rule 9510, Indirect Source Review (ISR):

- Exhaust emissions for construction equipment of greater than 50 horsepower that is used by, or associated with, the project will be reduced by 20 percent of the total NO_X and by 45 percent of the total PM_{10} exhaust emissions from the statewide average, as estimated by CARB. Construction emissions may be reduced on site by using add-on controls, cleaner fuels, or newer lower-emissions equipment, thus generating less pollution.
- Additional strategies for reducing construction emissions, including, but not limited to, the following:
    - Providing sufficient commercial electric power to the project site to avoid or minimize the use of portable electric generators.
    - Substituting electric-powered equipment for diesel engine-driven equipment.
    - Limiting the hours of operation of heavy-duty equipment and/or the amount of equipment used at any one time.
    - Minimizing idling time (e.g., 10-minute maximum).
- Replacing equipment that uses fossil fuels with electrically driven equivalents (provided that they are not run via a portable generator set).

Reduction of Particulate Emissions During Construction

The project will comply with SJVAPCD's Regulation VIII, Fugitive Dust PM_{10} Prohibitions, and will implement all applicable control measures. Regulation VIII contains the following required control measures, among others:

- Pre-water the site enough to limit visible dust emissions (VDE) to 20 percent opacity.
- Phase the work to reduce the amount of surface area disturbed at any one time.
- During active construction:
    - Apply enough water or chemical/organic stabilizers or suppressants to limit VDE to 20 percent opacity.
    - Construct and maintain wind barriers sufficient to limit VDE to 20 percent opacity.
    - Apply water or chemical/organic stabilizers or suppressants to unpaved access/haul roads and unpaved vehicle/equipment traffic areas in sufficient quantity to limit VDE to 20 percent opacity and meet the conditions of a stabilized unpaved road surface.
- Limit the speed of vehicles traveling on uncontrolled, unpaved access/haul roads within construction sites to a maximum of 15 miles per hour.
- Post speed-limit signs meeting the standards of the U.S. and California departments of transportation at the entrance to each construction site's uncontrolled, unpaved access/haul road. Speed-limit signs will also be posted at least every 500 feet and will be readable in both directions of travel along uncontrolled, unpaved access/haul roads.
- When handling bulk materials:
    - Apply water or chemical/organic stabilizers or suppressants in sufficient quantity to limit VDE to 20 percent opacity.
    - Construct and maintain wind barriers sufficient to limit VDE to 20 percent opacity and with less than 50 percent porosity.
- When storing bulk materials:
    - Comply with the conditions for a stabilized surface, as listed above.
    - Cover bulk materials stored outdoors with tarps, plastic, or other suitable material and anchor the covers to prevent their removal by wind action.
    - Construct and maintain wind barriers that are sufficient to limit VDE to 20 percent opacity and that have less than 50 percent porosity. If

using fences or wind barriers, apply water or chemical/organic stabilizers or suppressants to limit VDE to 20 percent opacity, or use a three-sided structure that is at least as high as the storage pile and has less than 50 percent porosity.

- Load all haul trucks such that the freeboard is not less than 6 inches when material is transported across any paved public-access road. Freeboard should be sufficient to limit VDE to 20-percent opacity.
- Apply enough water to the top of the load to limit VDE to 20 percent opacity.
- Cover haul trucks with a tarp or other suitable cover.
- Clean the interior of the cargo compartment or cover the cargo compartment before an empty truck leaves the site.
- Prevent carryout and trackout, or immediately remove carryout and trackout when it extends 50 feet or more from the nearest unpaved-surface exit point of a site.
- Clean up carryout and trackout using one of the following methods:
    - Manually sweeping and picking up.
    - Operating a rotary brush or broom accompanied or preceded by sufficient wetting to limit VDE to 20 percent opacity.
    - Operating a PM_{10}-efficient street sweeper that has a pickup efficiency of at least 80 percent.
    - Flushing with water, if curbs or gutters are not present and if using water would not result in a source of trackout material, adverse impacts on stormwater drainage systems, or violate any National Pollutant Discharge Elimination System permit program
- Submit a dust control plan to the Air Pollution Control Officer (APCO) before the start of any construction activity that would disturb 5 acres or more of surface area, or that would move, deposit, or relocate more than 2,500 cubic yards per day of bulk materials on at least 3 days. Do not begin construction activities until the APCO has approved or conditionally approved the dust control plan. Notify the APCO in writing, via fax or letter, within 10 days before earthmoving activities commence.

The project will implement the following SJVAPCD-recommended enhanced and additional control measures for all construction phases to further reduce fugitive PM_{10} dust emissions:

- Install sandbags or other erosion control measures to prevent silt runoff to public roadways from adjacent project areas with a slope greater than 1 percent.
- Suspend excavation and grading activity when winds exceed 20 miles per hour.

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Appendix B – Air Quality Regulatory Setting

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APPENDIX B

Air Quality Regulatory Setting

Federal

National Ambient Air Quality Standards

Federal air quality policies are regulated through the federal Clean Air Act (CAA). Pursuant to this act, the U.S. Environmental Protection Agency (USEPA) has established National Ambient Air Quality Standards (NAAQS) for the following air pollutants (termed "criteria" pollutants): carbon monoxide, ozone, nitrogen dioxide, sulfur dioxide, respirable particulate matter defined as particulate matter less than 10 micrometers in aerodynamic diameter (PM_{10}), fine particulate matter defined as particulate matter less than 2.5 micrometers in aerodynamic diameter, and lead. NAAQS represent the pollutant safety levels required to avoid specific adverse health effects associated with each pollutant. A region that is meeting the air quality standard for a given pollutant is designated as being in "attainment" for that pollutant. If the region is not meeting the air quality standard, then it is designated as being in "nonattainment" for that pollutant. Areas that were previously designated as nonattainment areas but have recently met the standard are designated as "maintenance" areas. Table B-1 summarizes state and federal standards. The primary standards have been established to protect public health. The secondary standards are intended to protect the nation's welfare and account for air pollutant impacts on soil, water, visibility, materials, vegetation, and other aspects of the general welfare.

General Conformity

The CAA was amended in 1977 to require each state to maintain a State Implementation Plan (SIP) for achieving compliance with NAAQS. In 1990, the CAA was amended again to strengthen regulation of both stationary and motor vehicle emission sources. Conformity to the SIP is defined under the 1990 Clean Air Act Amendments (CAAA) as "conformity to an implementation plan's purpose of eliminating or reducing the severity and number of violations of the NAAQS and achieving expeditious attainment of such standards."

Pursuant to CAA Section 176(c) requirements, USEPA promulgated Title 40 of the Code of Federal Regulations Part 51 (40 CFR 51), Subpart W, "Determining Conformity of General Federal Actions to State or Federal Implementation Plans," and 40 CFR Part 93, Subpart B, "Determining Conformity of General Federal Actions to State or Federal Implementation Plans" (see 58 Federal Register [FR] 63214, [November 30, 1993], as amended, 75 FR 17253 [April 5, 2010]). These regulations, commonly referred to as the General Conformity Rule, apply to all federal actions except for those federal actions which are excluded from review (e.g., stationary source emissions) or related to transportation plans, programs, and projects under Title 23 U.S. Code or the Federal Transit Act, which are subject to Transportation Conformity. The General Conformity Rule applies to all federal actions not addressed by the Transportation Conformity Rule.

40 CFR Part 51, Subpart W, applies in states that have an approved SIP revision adopting General Conformity regulations; 40 CFR Part 93, Subpart B, applies in states that do not have an approved SIP revision adopting General Conformity regulations.

The General Conformity Rule is used to determine if federal actions meet the requirements of the CAA and the applicable SIP by ensuring that air emissions related to the action do not do the following:

- Cause or contribute to new violations of a NAAQS.
- Increase the frequency or severity of any existing violation of a NAAQS.
- Delay timely attainment of a NAAQS or interim emission reduction.

A conformity determination under the General Conformity Rule is required if the federal agency determines that the action will occur in a nonattainment or maintenance area; one or more specific exemptions do not apply to the action; the action is not included in the federal agency's "presumed to conform" list; the emissions from the proposed action are not within the approved emissions budget for an applicable facility; and the total direct and indirect emissions of a pollutant (or its precursors), are at or above the de minimis levels established in the General Conformity regulations (75 FR 17255).

Conformity regulatory criteria are listed in 40 CFR 93.158. An action will be determined to conform to the applicable SIP if, for each pollutant that exceeds the de minimis emissions level in 40 CFR 93.153(b) or otherwise requires a conformity determination because of the total of direct and indirect emissions from the action, the action meets the requirements of 40 CFR 93.158(c).

In addition, federal activities may not cause or contribute to new violations of air quality standards, exacerbate existing violations, or interfere with timely attainment or required interim emissions reductions toward attainment. The proposed project is subject to review under the General Conformity Rule.

Table B-1.
Federal and California Ambient Air Quality Standards

Ambient Air Quality Standards						
Pollutant	Averaging Time	California Standards [1]		Federal Standards [2]		
		Concentration [3]	Method [4]	Primary [3,5]	Secondary [3,6]	Method [7]
Ozone (O_3)	1 Hour	0.09 ppm (180 µg/m^3)	Ultraviolet Photometry	—	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 µg/m^3)		0.075 ppm (147 µg/m^3)		
Respirable Particulate Matter (PM10)	24 Hour	50 µg/m^3	Gravimetric or Beta Attenuation	150 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 µg/m^3		—		
Fine Particulate Matter (PM2.5)	24 Hour	No Separate State Standard		35 µg/m^3	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 µg/m^3	Gravimetric or Beta Attenuation	15.0 µg/m^3		
Carbon Monoxide (CO)	8 Hour	9.0 ppm (10mg/m^3)	Non-Dispersive Infrared Photometry (NDIR)	9 ppm (10 mg/m^3)	None	Non-Dispersive Infrared Photometry (NDIR)
	1 Hour	20 ppm (23 mg/m^3)		35 ppm (40 mg/m^3)		
	8 Hour (Lake Tahoe)	6 ppm (7 mg/m^3)		—	—	—
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.030 ppm (57 µg/m3)	Gas Phase Chemiluminescence	53 ppb (100 µg/m^3) (see footnote 8)	Same as Primary Standard	Gas Phase Chemiluminescence
	1 Hour	0.18 ppm (339 µg/m^3)		100 ppb (188 µg/m^3) (see footnote 8)	None	
Sulfur Dioxide (SO_2)	24 Hour	0.04 ppm (105 µg/m^3)	Ultraviolet Fluorescence	—	—	Ultraviolet Flourescence; Spectrophotometry (Pararosaniline Method)[9]
	3 Hour	—		—	0.5 ppm (1300 µg/m^3) (see footnote 9)	
	1 Hour	0.25 ppm (655 µg/m^3)		75 ppb (196 µg/m^3) (see footnote 9)	—	
Lead[10]	30 Day Average	1.5 µg/m^3	Atomic Absorption	—	—	—
	Calendar Quarter	—		1.5 µg/m^3	Same as Primary Standard	High Volume Sampler and Atomic Absorption
	Rolling 3-Month Average[11]	—		0.15 µg/m^3		
Visibility Reducing Particles	8 Hour	Extinction coefficient of 0.23 per kilometer — visibility of ten miles or more (0.07 — 30 miles or more for Lake Tahoe) due to particles when relative humidity is less than 70 percent. Method: Beta Attenuation and Transmittance through Filter Tape.		No Federal Standards		
Sulfates	24 Hour	25 µg/m^3	Ion Chromatography			
Hydrogen Sulfide	1 Hour	0.03 ppm (42 µg/m^3)	Ultraviolet Fluorescence			
Vinyl Chloride[10]	24 Hour	0.01 ppm (26 µg/m^3)	Gas Chromatography			

See footnotes on next page ...

For more information please call ARB-PIO at (916) 322-2990 California Air Resources Board (09/08/10)

Table B-1.
State and Federal Ambient Air Quality Standards (Continued)

1. California standards for ozone, carbon monoxide (except Lake Tahoe), sulfur dioxide (1 and 24 hour), nitrogen dioxide, suspended particulate matter—PM10, PM2.5, and visibility reducing particles, are values that are not to be exceeded. All others are not to be equaled or exceeded. California ambient air quality standards are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

2. National standards (other than ozone, particulate matter, and those based on annual averages or annual arithmetic mean) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest eight hour concentration in a year, averaged over three years, is equal to or less than the standard. For PM10, the 24 hour standard is attained when the expected number of days per calendar year with a 24-hour average concentration above 150 $\mu g/m^3$ is equal to or less than one. For PM2.5, the 24 hour standard is attained when 98 percent of the daily concentrations, averaged over three years, are equal to or less than the standard. Contact U.S. EPA for further clarification and current federal policies.

3. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

4. Any equivalent procedure which can be shown to the satisfaction of the ARB to give equivalent results at or near the level of the air quality standard may be used.

5. National Primary Standards: The levels of air quality necessary, with an adequate margin of safety to protect the public health.

6. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

7. Reference method as described by the EPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" and must be approved by the EPA.

8. To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 0.100 ppm (effective January 22, 2010). Note that the EPA standards are in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the national standards to the California standards the units can be converted from ppb to ppm. In this case, the national standards of 53 ppb and 100 ppb are identical to 0.053 ppm and 0.100 ppm, respectively.

9. On June 2, 2010, the U.S. EPA established a new 1-hour SO_2 standard, effective August 23, 2010, which is based on the 3-year average of the annual 99th percentile of 1-hour daily maximum concentrations. EPA also proposed a new automated Federal Reference Method (FRM) using ultraviolet technology, but will retain the older pararosaniline methods until the new FRM have adequately permeated State monitoring networks. The EPA also revoked both the existing 24-hour SO_2 standard of 0.14 ppm and the annual primary SO_2 standard of 0.030 ppm, effective August 23, 2010. The secondary SO_2 standard was not revised at that time; however, the secondary standard is undergoing a separate review by EPA. Note that the new standard is in units of parts per billion (ppb). California standards are in units of parts per million (ppm). To directly compare the new primary national standard to the California standard the units can be converted to ppm. In this case, the national standard of 75 ppb is identical to 0.075 ppm.

10. The ARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

11. National lead standard, rolling 3-month average: final rule signed October 15, 2008.

For more information please call ARB-PIO at (916) 322-2990 **California Air Resources Board (09/08/10)**

Source: California Air Resources Board 2010.

Toxic Air Contaminants

USEPA has programs for identifying and regulating toxic air contaminants (TACs), or in USEPA terms, hazardous air pollutants. Title III of the CAAA directed USEPA to promulgate National Emissions Standards for Hazardous Air Pollutants. The CAAA also required USEPA to promulgate vehicle or fuel standards containing reasonable requirements to control toxic emissions. Performance criteria were established to limit mobile source air toxics.

State

California Clean Air Act and California Environmental Quality Act

The California Air Resources Board (CARB) oversees California air quality policies and is responsible for preparing and submitting the SIP to USEPA. California has also established ambient air quality standards, known as the California Ambient Air Quality Standards (CAAQS), which are generally more stringent than the corresponding federal standards and incorporate additional standards for sulfates, hydrogen sulfide, vinyl chloride, and visibility reducing particles. The current CAAQS are summarized in Table B-1.

The California Clean Air Act requires nonattainment areas to achieve and maintain the health-based CAAQS by the earliest practicable date. The California Clean Air Act is administered by CARB at the state level and by local air quality management districts at the regional level; the air districts are required to develop plans and control programs for attaining the state standards.

The proposed project is also subject to evaluation under the California Environmental Quality Act (CEQA). CEQA [Section 21000 et seq.] and CEQA Guidelines [Section 15000 et seq.] require state and local agencies to identify the significant environmental impacts of their actions, including potential significant air quality and climate change impacts, and to avoid or mitigate those impacts, when feasible.

Toxic Air Contaminants

TACs in California are primarily regulated through the Tanner Air Toxics Act (Assembly Bill [AB] 1807) and the Air Toxics Hot Spots Information and Assessment Act of 1987 (AB 2588). AB 1807 sets forth a formal procedure for CARB to designate substances as TACs. Research, public participation, and scientific peer review must occur before CARB can designate a substance as a TAC. CARB published the *Air Quality and Land Use Handbook: A Community Health Perspective*, which provides guidance concerning land use compatibility with TAC sources (CARB 2005). Although not a law or adopted policy, the handbook offers advisory recommendations for siting sensitive receptors near uses associated with TACs, such as freeways and high-traffic roads, commercial distribution centers, rail yards, ports, refineries, dry cleaners, gasoline stations, and industrial facilities.

Asbestos

CARB has adopted two airborne toxic control measures for controlling naturally occurring asbestos: the Asbestos Airborne Toxic Control Measure for Surfacing Applications and the Asbestos Airborne Toxic Control Measure for Construction, Grading, Quarrying, and Surface Mining Operations. Also, USEPA is responsible for enforcing regulations relating to asbestos renovations and demolitions; however, USEPA can delegate this authority to state and local agencies. CARB and local air districts have been delegated authority to enforce the Federal National Emission Standards for Hazardous Air Pollutants regulations for asbestos.

Regional and Local

The San Joaquin Valley Air Pollution Control District (SJVAPCD) is responsible for implementing air quality regulations, including developing plans and control measures for stationary sources of air pollution to meet the NAAQS and CAAQS; implementing permit programs for the construction, modification, and operation of sources of air pollution; and enforcing air pollution statutes and regulations governing stationary sources. The following regulations that may be relevant to the project, as administered by the SJVAPCD with CARB oversight, were identified and considered for this analysis:

- SJVAPCD Rule 2280 Portable Equipment Registration
- SJVAPCD Rule 4201 and Rule 4202 Particulate Matter Concentration and Emission Rates
- SJVAPCD Rule 4301 Fuel Burning Equipment
- SJVAPCD Regulation VIII – Fugitive PM10 Prohibitions
- SJVAPCD Rule 9510 Indirect Source Review
- SJVAPCD CEQA Guidelines

According to Regulation VIII, the SJVAPCD requires the implementation of control measures for fugitive dust emission sources. Table 6-2 in the *Guide for Assessing and Mitigating Air Quality Impacts* (SJVAPCD 2002) also contains mandatory control measures for reducing fugitive dust emissions.

SJVAPCD adopted the Indirect Source Rule (Rule 9510) in December 2005 to meet the SJVAPCD's emission reduction commitments in the PM_{10} and ozone attainment plans. Development projects subject to Indirect Source Review regulation are required to reduce construction exhaust nitrogen oxide and PM_{10} emissions by 20 percent and 45 percent, respectively. Baseline operation exhaust nitrogen oxide and PM_{10} emissions are required to be reduced by 33.3 percent and 50 percent, respectively, over 10 years. If the project were unable to achieve the reductions as required by Indirect Source Review, the project would be required to pay the required offsite mitigation fees.

Literature Cited

California Air Resources Board (CARB). 2005. Air Quality and Land Use Handbook: A Community Health Perspective.

-------- 2010. Ambient Air Quality Standards. September 8.

San Joaquin Valley Air Pollution Control District (SJVAPCD). 2002. Guide for Assessing and Mitigating Air Quality Impacts.

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Appendix C – Emission Calculations

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Appendix C
Emission Calculations – Total Project Emission Summary

Construction Emissions - 2013

2013	ROG	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2
	tons/year	tons/year	tons/year	tons/year	tons/year	tons/year	tons/year
Off-Road Construction Equipment Exhaust	0.52	2.44	4.41	0.000	0.21	0.19	521.9
Haul Truck/Working Vehicle Exhaust	0.03	0.16	0.46	0.001	0.02	0.02	80.6
Worker Commute Exhaust	0.00	0.14	0.01	0.000	0.00	0.00	24.0
Fugitive Dust	NA	NA	NA	NA	2.12	0.34	NA
2013 Total Construction Emissions	0.55	2.74	4.87	0.001	2.35	0.55	626.5

Construction Emissions - 2014

2014	ROG	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2
	tons/year	tons/year	tons/year	tons/year	tons/year	tons/year	tons/year
Off-Road Construction Equipment Exhaust	0.33	1.67	2.76	0.000	0.13	0.12	349.4
Haul Truck/Working Vehicle Exhaust	0.02	0.11	0.32	0.001	0.01	0.01	63.5
Worker Commute Exhaust	0.00	0.10	0.01	0.000	0.00	0.00	18.9
Fugitive Dust	NA	NA	NA	NA	1.56	0.25	NA
2014 Total Construction Emissions	0.35	1.88	3.09	0.001	1.71	0.38	431.7

Operation Emissions

Project Operation (2015 and after)	ROG	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2
	tons/year	tons/year	tons/year	tons/year	tons/year	tons/year	tons/year
Off-Road Equipment Exhaust	0.0033	0.0161	0.0263	0.0000	0.0013	0.0012	3.65
On-Road Vehicles	0.0000	0.0002	0.0008	0.0000	0.0000	0.0000	0.15
Emergency Engine	0.0012	0.0306	0.0207	0.0000	0.0001	0.0001	4.22
Annual Operation	0.005	0.047	0.048	0.000	0.001	0.001	8.024

1.4 Project Emissions

	ROG	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2
	tons/year	tons/year	tons/year	tons/year	tons/year	tons/year	tons/year
2013 (construction)	0.55	2.74	4.87	0.00	2.35	0.55	626.46
2014 (construction)	0.35	1.88	3.09	0.00	1.71	0.38	431.73
2015 and beyond (operation)	0.00	0.05	0.05	0.00	0.00	0.00	8.02
SJVAPCD CEQA Threshold	10	NA	10	NA	15	15	NA
Exceed SJVAPCD CEQA Threshold?	No	NA	No	NA	No	No	NA
General Conformity De Minimis Threshold	10	100	10	100	100	100	NA
Exceed General Conformity De minimis Threshold?	No	No	No	No	No	No	NA

Appendix C
Emission Calculations – Construction Emissions, Summary of Off-Road Equipment Exhaust and Fugitive Dust

Phase	Year	Period	# working days	Emission Sources	ROG	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2
					tons	tons	tons	tons	tons	tons	tons
			44	Off-Road Construction Equipment Exhaust	0.06	0.30	0.54	0.00	0.02	0.02	69.12
Demolition	2013	02/27/2013-04/30/2013	44	Fugitive Dust	NA	NA	NA	NA	0.22	0.05	NA
			25	Off-Road Construction Equipment Exhaust	0.12	0.49	0.97	0.00	0.04	0.04	113.07
Grading	2013	01/25/2013-02/27/2013	25	Fugitive Dust	NA	NA	NA	NA	0.125	0.026	NA
			176	Off-Road Construction Equipment Exhaust	0.34	1.65	2.89	0.00	0.14	0.13	339.68
	2013	05/01/2013-12/31/2013	176	Fugitive Dust	NA	NA	NA	NA	0.88	0.18	NA
			171	Off-Road Construction Equipment Exhaust	0.33	1.67	2.76	0.00	0.13	0.12	349.38
Construction	2014	01/01/2014-09/09/2014	171	Fugitive Dust	NA	NA	NA	NA	0.86	0.18	NA
			22	Off-Road Construction Equipment Exhaust	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Facility Testing	2014	09/10/2014-10/07/2014	22	Fugitive Dust	NA	NA	NA	NA	NA	NA	NA
	2013			Off-Road Construction Equipment Exhaust	0.517	2.445	4.405	0.000	0.210	0.193	521.865
				Fugitive Dust	NA	NA	NA	NA	1.225	0.255	NA
	2014			Off-Road Construction Equipment Exhaust	0.328	1.666	2.762	0.00	0.132	0.121	349.4
Total				Fugitive Dust	NA	NA	NA	NA	0.855	0.178	NA

Notes:

1. Emissions were obtained from the URBEMIS output, except those indicated in note 2. Project-specific equipment were used for URBEMIS modeling.

2. Fugitive dust PM_{10} emissions during constructions were calculated using the URBEMIS default emission factor of 10 lb/day/acre. $PM_{2.5}$ emissions were estimated using a $PM_{2.5}$ to PM_{10} ratio of 0.208. Fugitive dust emissions from onsite construction equipment movements were assumed to be accounted for by the 10 lb/acre/day emissions; therefore, these were not calculated separately.

Fugitive PM_{10} EF	Maximum daily disturbed area	PM_{10} Emissions	$PM_{2.5}$ Emissions
lb/day/acre	acre/day	tons/day	tons/day
10	1	0.005	0.00104
$PM_{2.5}$ to PM_{10} ratio:		0.208	(Source: South Coast AQMD Updated CEIDARS Table with $PM_{2.5}$ Fractions, SCAQMD 2006)

3. Number of working days were assumed to be 22 days per month.

4. No off-road equipment would be used during equipment testing.

Appendix C
Emission Calculations – Construction Emissions Summary of On-Road Vehicle Exhaust Emissions

Construction Emissions - Vehicle Emission Factors: 2013

	Vehicle Emission Factors (g/mile)						
Emission Source	**ROG**	**CO**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**
Worker Commute	0.039	1.713	0.145	0.003	0.03	0.015	296.2
Onsite working vehicles/pickups	0.182	4.049	0.426	0.007	0.082	0.064	715.0
Material Hauling Trucks	0.603	3.056	10.483	0.017	0.415	0.344	1753.4

Construction Emissions - Vehicle Emission Factors: 2014

	Vehicle Emission Factors (g/mile)						
Emission Source	**ROG**	**CO**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**
Worker Commute	0.032	1.525	0.127	0.003	0.03	0.015	295.5
Onsite working vehicles/pickups	0.161	3.702	0.385	0.007	0.082	0.064	715.3
Material Hauling Trucks	0.55	2.769	9.218	0.017	0.375	0.307	1753.4

Construction Emissions - On-Road Vehicle Exhaust Emissions

Phase	**Year**	**Period**	**Emission Sources**	**Number of Vehicles**	**Number of Roundtrips/ Day**	**VMT/ Roundtrip**	**Number of Working Days**	**VMT**	**ROG**	**CO**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**	**CO_2**
									tons	**tons**	**tons**	**tons**	**tons**	**tons**	**tons**
Demolition	2013	02/27/2013-04/30/2013	Worker Commute	20	1	15	44	13,200	0.0006	0.025	0.002	0.00004	0.0004	0.0002	4.3
	2013		Onsite working vehicles/pickups	5	1	5	44	1,100	0.0002	0.005	0.001	0.00001	0.0001	0.0001	0.9
	2013		Material Hauling Trucks	1	4	40	44	7,040	0.0047	0.024	0.081	0.0001	0.0032	0.0027	13.6
Grading	2013	01/25/2013-02/27/2013	Worker Commute	20	1	15	25	7,500	0.0003	0.014	0.001	0.00002	0.0002	0.0001	2.4
	2013		Onsite working vehicles/pickups	5	1	5	25	625	0.0001	0.003	0.000	0.00000	0.0001	0.0000	0.5
	2013		Material Hauling Trucks	1	4	40	25	4,000	0.0027	0.013	0.046	0.00007	0.0018	0.0015	7.7
Construction	2013	05/01/2013-12/31/2013	Worker Commute	20	1	15	176	52,800	0.0023	0.100	0.008	0.00017	0.0017	0.0009	17.2
	2013		Onsite working vehicles/pickups	5	1	5	176	4,400	0.0009	0.020	0.002	0.00003	0.0004	0.0003	3.5
	2013		Material Hauling Trucks	1	4	40	176	28,160	0.0187	0.095	0.325	0.00053	0.0129	0.0107	54.4
	2014	01/01/2014-09/09/2014	Worker Commute	20	1	15	171	51,300	0.0018	0.086	0.007	0.00017	0.0017	0.0008	16.7
	2014		Onsite working vehicles/pickups	5	1	5	171	4,275	0.0008	0.017	0.002	0.00003	0.0004	0.0003	3.4
	2014		Material Hauling Trucks	1	4	40	171	27,360	0.0166	0.084	0.278	0.00051	0.0113	0.0093	52.9
Facility Testing	2014	09/10/2014-10/07/2014	Worker Commute	20	1	15	22	6,600	0.0002	0.011	0.001	0.00002	0.0002	0.0001	2.2
	2014		Onsite working vehicles/pickups	5	1	5	22	550	0.0001	0.002	0.000	0.00000	0.0000	0.0000	0.4
	2014		Material Hauling Trucks	1	4	40	22	3,520	0.0021	0.011	0.036	0.00007	0.0015	0.0012	6.8
Total	2013		Worker Commute						0.003	0.139	0.012	0.000	0.002	0.001	24.0
			Onsite working vehicles/pickups						0.001	0.027	0.003	0.000	0.001	0.000	4.8
			Material Hauling Trucks						0.026	0.132	0.453	0.001	0.018	0.015	75.8
	2014		Worker Commute						0.002	0.097	0.008	0.000	0.002	0.001	18.9
			Onsite working vehicles/pickups						0.001	0.020	0.002	0.000	0.000	0.000	3.8
			Material Hauling Trucks						0.019	0.094	0.314	0.001	0.013	0.010	59.7

Notes:

1. Emission factors are from the EMFAC2007 v. 2.3 model using the California vehicle fleet for the year 2013 and 2014. Worker commute and haul trucks are assumed to be traveling at a speed of 40 miles per hour. Onsite working pickups and trucks are assumed to travel at 15 miles per hour.
2. Light-duty auto emission factors were used for worker commute emissions. Onsite working pickups and trucks were assumed to be light duty trucks. Haul trucks were assumed to be heavy-duty diesel trucks to be conservative
3. Number of working days were assumed to be 22 days/month, except for Grading, which is 6 days per week.

Appendix C

Emission Calculations – Construction Emissions, Vehicle Travel on Unpaved Surfaces

Emission Factor (USEPA AP-42 13.2.1):

EF^{1} = (k [(s/12)^a] [(W/3)^b](365-P)/365 lb/vehicle mile traveled (vmt)

	k	s	W	a	b	P	EF (lb/VMT)
PM_{10}	1.5	8.5	12	0.9	0.45	40	1.83
$PM_{2.5}$	0.15	8.5	12	0.9	0.45	40	0.18

1. Emission factors were calculated using USEPA AP-42 13.2.1.

Calculation factors:

Parameters	Description	Assumptions	Note
s	Silt Loading (%)	8.5	for construction site scrapper routes
W	Mean Vehicle Weight (tons)	12	for heavy duty trucks (8-16 tons)
P	Number of Days > 0.01 in. Precipitation:	40	EPA AP-42 13.2.2
N	Days in a year	365	

Silt content were obtained from SCAQMD CEQA Handbook,
Weight of trucks were obtained from SCAQMD CEQA Handbook, Table A9-9-D-3.

Construction Emissions - Unpaved Road Fugitive Dust Emissions

Phase	Year	Period	Number of Vehicles	Number of Roundtrips/Day	VMT/ Roundtrip on Unpaved Roads	Number of Working Days	VMT	PM_{10} dust	$PM_{2.5}$ dust
								tons	tons
Demolition	2013	02/27/2013-04/30/2013	1	4	1	44	176	0.1608	0.02
Grading	2013	01/25/2013-02/27/2013	1	4	1	25	100	0.0914	0.01
Construction	2013	05/01/2013-12/31/2013	1	4	1	176	704	0.6432	0.06
Construction	2014	01/01/2014-09/09/2014	1	4	1	171	684	0.6250	0.06
Facility Testing	2014	09/10/2014-10/07/2014	1	4	1	22	88	0.0804	0.01
	2013		Material Hauling Trucks					0.895	0.090
Total	2014		Material Hauling Trucks					0.705	0.071

Appendix C
Emission Calculations – Operation Emissions

Off-Road Equipment

	Year	# Working Days	ROG	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2
			tons	tons	tons	tons	tons	tons	tons
Off-Road Equipment	2015 and beyond	5	0.00	0.02	0.03	0.00	0.00	0.00	3.65

On-Road Vehicles

			Emission Factor							Emissions						
		VMT	ROG	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2	ROG	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2
		per year	g/mile	g/mile	g/mile	g/mile	g/mile	g/mile	g/mile	ton/year	ton/year	ton/year	ton/year	ton/year	ton/year	ton/year
Maintenance vehicles	2015 and beyond	80	0.55	2.769	9.218	0.017	0.375	0.307	1753.407	0.00005	0.00024	0.00081	0.00000	0.00003	0.00003	0.15462

Note: To be conservative, emission factors for 2014 were used for project operation emission estimate. Maintenance vehicles were assumed to be heavy-duty diesel trucks.

Emergency Generator Engine Emissions
Stationary Combustion Emission Factors

	Emission Factors [1, 2, 3]								
	ROG	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
Fuel Type	(g/bhp-hr)	(g/bhp-hr)	(g/bhp-hr)	(g/bhp-hr)	(g/bhp-hr)	(g/bhp-hr)	(kg/MMBtu)	(kg/MMBtu)	(kg/MMBtu)
Diesel	0.14	3.70	2.50	0.0024	0.015	0.015	73.96	0.003	0.0006

Notes:
[1] VOC, NOx, CO, and PM emission factors taken as the CARB Tier 4 Interim Standards for 100 hp to 175 hp engines (source: http://www.arb.ca.gov/msprog/ordiesel/documents/Off-Road_Diesel_Stds.xls).
[2] SOx emission factor estimated based on a fuel density of 7.05 lb/gallon and a sulfur content of 15 ppm, and a conversion factor of 0.05 gallons/hp-hr.
[3] CO_2 emission factors from Table 12.1 and CH_4 and N_2O emission factors from Table 12.9 of The Climate Registry *General Reporting Protocol* , Version 1.1, May 2008 as updated through January 2012.

Engine Emissions

HP rating	150	hp
Operating hours	50	hours/year
Diesel usage	7.5	gallon/hour
Diesel heating value	0.138	MMBtu/gallon

	ROG	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
	ton/year	ton/year	ton/year	ton/year	ton/year	ton/year	ton/year	ton/year	ton/year
Emissions	0.0012	0.0306	0.0207	0.00002	0.00012	0.00012	4.219	0.00017	0.00003

Heating value of diesel used 0.138 MMBtu/gallon, per Table 12.1 of The Climate Registry General Reporting Protocol, Version 1.1, May 2008 as updated through January 2012.

Total Operation Emissions

Total Operation Emissions	ROG	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$	CO_2	CH_4	N_2O
	ton/year	ton/year	ton/year	ton/year	ton/year	ton/year	ton/year	ton/year	ton/year
Off-Road	0.0033	0.0161	0.0263	0.00000	0.0013	0.0012	3.65	0.00	0.00
On-Road	0.00005	0.000244	0.00081	0.00000	0.0000	0.00003	0.15	0.00	0.00
Emergency engine	0.0012	0.0306	0.0207	0.00002	0.0001	0.0001	4.22	0.00017	0.00003

Appendix C
Emission Calculations

Urbemis 2007 Version 9.2.4

Combined Annual Emissions Reports (Tons/Year)

File Name: C:\project\HMRD\EA2012\Arroyo 01122012.urb924

Project Name: Arroyo Canal Construction Emissions

Project Location: San Joaquin Valley APCD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

CONSTRUCTION EMISSION ESTIMATES

	ROG	NO_x	CO	SO_2	PM_{10} Dust	PM_{10} Exhaust	PM_{10}	$PM_{2.5}$ Dust	$PM_{2.5}$ Exhaust	$PM_{2.5}$	CO_2
2013 TOTALS (tons/year unmitigated)	0.53	4.52	2.74	0.00	0.12	0.21	0.33	0.02	0.20	0.22	572.66
2014 TOTALS (tons/year unmitigated)	0.34	2.87	1.88	0.00	0.00	0.14	0.14	0.00	0.13	0.13	393.07

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Annual Tons Per Year, Unmitigated

	ROG	NO_x	CO	SO_2	PM_{10} Dust	PM_{10} Exhaust	PM_{10}	$PM_{2.5}$ Dust	$PM_{2.5}$ Exhaust	$PM_{2.5}$	CO_2
2013	0.53	4.52	2.74	0.00	0.12	0.21	0.33	0.02	0.20	0.22	572.66
Mass Grading 01/27/2013-02/27/2013	0.12	0.98	0.53	0.00	0.12	0.04	0.16	0.02	0.04	0.06	117.19
Mass Grading Dust	0.00	0.00	0.00	0.00	0.12	0.00	0.12	0.02	0.00	0.02	0.00
Mass Grading Off-Road Diesel	0.12	0.97	0.49	0.00	0.00	0.04	0.04	0.00	0.04	0.04	113.07
Mass Grading On-Road Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mass Grading Worker Trips	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.12
Demolition 02/25/2013-04/30/2013	0.06	0.54	0.33	0.00	0.00	0.03	0.03	0.00	0.02	0.02	73.33
Fugitive Dust	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Demo Off-Road Diesel	0.06	0.54	0.30	0.00	0.00	0.02	0.02	0.00	0.02	0.02	69.12
Demo On-Road Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Demo Worker Trips	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.21
Building 05/01/2013-09/09/2014	0.35	3.01	1.88	0.00	0.00	0.15	0.15	0.00	0.13	0.14	382.14
Building Off-Road Diesel	0.34	2.89	1.65	0.00	0.00	0.14	0.14	0.00	0.13	0.13	339.68
Building Vendor Trips	0.01	0.11	0.09	0.00	0.00	0.00	0.01	0.00	0.00	0.00	26.06
Building Worker Trips	0.00	0.01	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.39

2014	0.34	2.87	1.88	0.00	0.00	0.14	0.14	0.00	0.13	0.13	393.07
Building 05/01/2013-09/09/2014	0.34	2.87	1.88	0.00	0.00	0.14	0.14	0.00	0.13	0.13	393.07
Building Off-Road Diesel	0.33	2.76	1.67	0.00	0.00	0.13	0.13	0.00	0.12	0.12	349.38
Building Vendor Trips	0.01	0.10	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.81
Building Worker Trips	0.00	0.01	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.87

Phase Assumptions

Phase: Demolition 2/25/2013 - 4/30/2013 - Demolition

Building Volume Total (cubic feet): 2000

Building Volume Daily (cubic feet): 40

On-Road Truck Travel (VMT): 0

Off-Road Equipment:

1 Concrete/Industrial Saws (10 hp) operating at a 0.73 load factor for 3 hours per day

1 Excavators (168 hp) operating at a 0.57 load factor for 4 hours per day

2 Generator Sets (135 hp) operating at a 0.74 load factor for 8 hours per day

1 Other Equipment (190 hp) operating at a 0.62 load factor for 8 hours per day

1 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 4 hours per day

1 Water Trucks (189 hp) operating at a 0.5 load factor for 4 hours per day

Phase: Mass Grading 1/27/2013 - 2/27/2013 - Site Preparation

Total Acres Disturbed: 23

Maximum Daily Acreage Disturbed: 1

Fugitive Dust Level of Detail: Default

10 lbs per acre-day

On-Road Truck Travel (VMT): 0

Off-Road Equipment:

1 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

1 Forklifts (145 hp) operating at a 0.3 load factor for 2 hours per day

2 Generator Sets (135 hp) operating at a 0.74 load factor for 8 hours per day

1 Graders (174 hp) operating at a 0.61 load factor for 4 hours per day

1 Off Highway Trucks (479 hp) operating at a 0.57 load factor for 8 hours per day

1 Plate Compactors (8 hp) operating at a 0.43 load factor for 2 hours per day

2 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 6 hours per day

2 Scrapers (313 hp) operating at a 0.72 load factor for 8 hours per day

2 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 6 hours per day

1 Water Trucks (189 hp) operating at a 0.5 load factor for 4 hours per day

Phase: Building Construction 5/1/2013 - 9/9/2014 - Construction

Off-Road Equipment:

2 Cranes (399 hp) operating at a 0.43 load factor for 2 hours per day

1 Excavators (168 hp) operating at a 0.57 load factor for 4 hours per day

1 Forklifts (145 hp) operating at a 0.3 load factor for 1 hours per day

2 Generator Sets (135 hp) operating at a 0.74 load factor for 8 hours per day

1 Graders (174 hp) operating at a 0.61 load factor for 1 hours per day

1 Other Equipment (190 hp) operating at a 0.62 load factor for 3 hours per day

1 Plate Compactors (8 hp) operating at a 0.43 load factor for 0.5 hours per day

1 Rubber Tired Dozers (357 hp) operating at a 0.59 load factor for 4 hours per day

3 Tractors/Loaders/Backhoes (108 hp) operating at a 0.55 load factor for 4 hours per day

1 Water Trucks (189 hp) operating at a 0.5 load factor for 4 hours per day

Appendix C
Emission Calculations

Urbemis 2007 Version 9.2.4

Combined Annual Emissions Reports (Tons/Year)

File Name:

Project Name: Arroyo operation

Project Location: California Statewide

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

Summary Report:

CONSTRUCTION EMISSION ESTIMATES

	ROG	NO_x	CO	SO_2	PM_{10} Dust	PM_{10} Exhaust	PM_{10}	$PM_{2.5}$ Dust	$PM_{2.5}$ Exhaust	$PM_{2.5}$	CO_2
2015 TOTALS (tons/year unmitigated)	0.0033	0.0263	0.0161	0.0000	0.0000	0.0013	0.0013	0.0000	0.0012	0.0012	3.6461

Construction Unmitigated Detail Report:

CONSTRUCTION EMISSION ESTIMATES Annual Tons Per Year, Unmitigated

	ROG	NO_x	CO	SO_2	PM_{10} Dust	PM_{10} Exhaust	PM_{10}	$PM_{2.5}$ Dust	$PM_{2.5}$ Exhaust	$PM_{2.5}$	CO_2
2015	0.00	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.65
Building 01/01/2015-01/07/2015	0.00	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.65
Building Off-Road Diesel	0.00	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.65
Building Vendor Trips	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Building Worker Trips	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Phase Assumptions

Phase: Building Construction 1/1/2015 - 1/7/2015 - site maintenance

Off-Road Equipment:

1 Excavators (168 hp) operating at a 0.57 load factor for 8 hours per day

1 Other General Industrial Equipment (238 hp) operating at a 0.51 load factor for 8 hours per day

1 Pumps (53 hp) operating at a 0.74 load factor for 8 hours per day

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Appendix D – Fish Species within the Study Area

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APPENDIX D

Fish Species within the Study Area

Fish Species Considered but Dismissed

Delta Smelt

The U.S. Fish and Wildlife Service (USFWS) species list (USFWS 2012) includes delta smelt as potentially present in the study area. The USFWS listed delta smelt as a "threatened" species under the federal Endangered Species Act (ESA) in March 1993 (58 Code of Federal Regulations 12854). Delta smelt also is listed as a "threatened" species under the California Endangered Species Act (CESA). Critical habitat for delta smelt has been designated by USFWS and is located downstream of the project area, in the Sacramento River and San Joaquin River Delta (Delta) (59 Federal Register [FR] 65256).

A euryhaline fish, delta smelt is endemic to the upper Sacramento-San Joaquin estuary. As a euryhaline species, delta smelt tolerate wide-ranging salinities, but rarely occur in waters with salinities greater than 14 parts per thousand (Moyle et al. 1992, as cited in Swanson et al. 2000). Similarly, delta smelt tolerate a wide range of water temperatures, as they have been found at water temperatures ranging from 42.8 degrees Fahrenheit (°F) to 82.4°F (Moyle 2002). They occur in the Delta primarily below Isleton on the Sacramento River, below Mossdale on the San Joaquin River, and in Suisun Bay. They move into freshwater when spawning (ranging from January to July) and can occur in (1) the Sacramento River, as high as Sacramento; (2) the Mokelumne River system; (3) the Cache Slough region; (4) the Delta; and (5) the Montezuma Slough area of the estuary (USFWS 1996). Delta smelt is an open-water, or pelagic, species, and is not associated with structures. Delta smelt may use nearshore habitats for spawning, but free-swimming life stages mainly occupy offshore waters.

On the basis of its distribution, range, and habitat conditions in the study area (i.e., non-saline waters), delta smelt is not expected to occur in the study area and, therefore, is not further evaluated in this document.

San Joaquin Roach

The San Joaquin roach, a native freshwater minnow, is found throughout the Sacramento-San Joaquin drainage system (Moyle 2002). California roach, of which the Pit and San Joaquin roach are subspecies, are generally found in small, warm intermittent streams, and dense populations are frequently found in isolated pools (Moyle et al. 1982; Moyle 2002). Roach are tolerant of relatively high temperatures (86°F to 95°F) and low oxygen levels (1 part per million to 2 parts per million) (Taylor et al. 1982). Suitable roach habitat generally includes low flow, moderate gradients, warm temperatures, and edge mats of duckweed and water fern (Moyle 2002). They are most abundant in mid-elevation streams in the Sierra foothills and in the lower reaches of some coastal streams (Moyle 2002). Because this type of habitat does not occur near Sack Dam, it is unlikely that San Joaquin roach would be present in the study area; therefore, San Joaquin roach is not further evaluated in this document.

Hardhead

Hardhead, a California Species of Special Concern, is a large, native cyprinid (minnow) species that is widely distributed throughout the Sacramento-San Joaquin River system, though it is absent from the valley reaches of the San Joaquin River (Moyle 2002). Hardhead generally occur in large, undisturbed low- to mid-elevation rivers and streams of the region (Moyle 2002). Although hardhead are no longer common in the San Joaquin river drainage, they are still fairly common in the mainstem Sacramento River, in the lower reaches of the American and Feather rivers, and in some smaller tributary streams (e.g., Deer, Pine, and Clear creeks) (Moyle 2002). Historically, hardhead were very abundant in reservoirs; however, most reservoir populations were temporary due to the introduction of nonnative predatory species (Moyle 2002). Hardhead may be found in a few reservoirs, such as the Redinger and Kerkhoff Reservoirs on the San Joaquin River, which are used for hydroelectric power generation; however, the San Joaquin River Restoration Program (SJRRP) (2010) reports that hardhead only occupy Reaches 1 and 2 of the San Joaquin River. SJRRP (2010) reports that hardhead may be found in a few reservoirs on the San Joaquin River, upstream from Millerton Lake.

Considering what has been reported regarding habitat utilization and occurrences in the San Joaquin River, there is a limited potential that hardhead could be present in the study area; therefore, hardhead is not further evaluated in this document.

Green Sturgeon

The Southern distinct population segment (DPS) of North American green sturgeon was listed as threatened under the ESA on April 7, 2006 (71 FR 17757). The Southern DPS of green sturgeon includes all green sturgeon populations south of the Eel River, with the only known spawning population being in the Sacramento River (NMFS 2009). Critical habitat for green sturgeon has been identified (74 FR 52300); however, the San Joaquin River upstream of the Delta was not included in the designation.

Known historical and current spawning occurs in the Sacramento River (Adams et al. 2002, Beamesderfer et al. 2004, Adams et al. 2007). Currently, Keswick and Shasta dams on the mainstem of the Sacramento River block passage to the upper river. Although no historical accounts exist for identified green sturgeon spawning occurring above the current dam sites, suitable spawning habitat existed, and based on habitat assessments done for Chinook salmon, the geographic extent of spawning has been reduced because of the impassable barriers constructed on the river.

Spawning in the San Joaquin River system has not been recorded historically or observed recently, but alterations of the San Joaquin River and its tributaries (Stanislaus, Tuolumne, and Merced rivers) occurred early in the European settlement of the region. During the latter half of the 1800s, impassable barriers were built on these tributaries where the water courses left the foothills and entered the valley floor. Therefore, these low-elevation dams have blocked potentially suitable spawning habitats located farther upstream for approximately a century. Additional destruction of riparian and stream channel habitat by industrialized gold dredging further disturbed any valley floor habitat that was still available for sturgeon spawning. Additional impacts on the watershed include the increased loads of selenium entering the system through agricultural practices in the western side of the San Joaquin Valley. Green sturgeon have recently been

identified by University of California at Davis researchers as being highly sensitive to selenium levels. Currently, only white sturgeon have been encountered in the San Joaquin River system upstream of the Delta, and adults have been captured by sport anglers as far upstream on the San Joaquin River as Hills Ferry and Mud Slough (2007 sturgeon report card – CDFG 2008, as cited in NMFS 2009). These locations are near the confluence of the Merced River with the mainstem San Joaquin River.

Considering what has been reported regarding occurrences in the San Joaquin River, there is a limited potential that green sturgeon could be present in the study area; therefore, green sturgeon is not further evaluated in this document.

Evaluated Species of Primary Management Concern

Species of primary management concern evaluated in this analysis include those that are recreationally or commercially important and have special status (i.e., Central Valley fall-run/late-fall-run Chinook salmon[1], Central Valley steelhead, Pacific lamprey, and Sacramento splittail). Spring-run Chinook salmon are also considered in the analysis because of their near-future reintroduction into the San Joaquin River.

Chinook Salmon

Chinook salmon is the most important commercial species of anadromous fish in California. Chinook salmon have evolved a broad array of life history patterns that allow them to take advantage of diverse riverine conditions throughout the year. Four principal life history variants are recognized and are named for the timing of their spawning runs: fall-run, late-fall-run, winter-run, and spring-run. The San Joaquin River currently supports fall-run and late-fall-run Chinook salmon.

Beginning with the California Gold Rush in 1849, the salmon and steelhead populations in the San Joaquin River and its three major tributaries began to decline. In the early twentieth century, construction of Kerckhoff Dam in the upper San Joaquin River reduced access to upstream spawning/rearing habitat for salmon. Increased irrigation diversions within the lower river (e.g., Arroyo Canal) hindered upstream migration of fall-migrating salmon and steelhead and diverted out-migrating juvenile salmon to agricultural fields. During this period, salmon, and steelhead numbers declined, but a

[1] National Marine Fisheries Service (NMFS) recognizes the late-fall-run Chinook salmon in the Central Valley fall-run evolutionarily significant unit (ESU) (Moyle 2002). On April 15, 2004, NMFS published a notice in the FR acknowledging establishment of a species of concern list, addition of species to the species of concern list, description of factors for identifying species of concern, and revision of the candidate species list. In this notice, NMFS announced the Central Valley Fall-run and Late-Fall-run Chinook Salmon ESU change in status from a candidate species to a species of concern. In 1999, the Central Valley ESU underwent a status review after NMFS received a petition for listing. Pursuant to that review, NMFS found that the species did not warrant listing as threatened or endangered under the ESA, but sufficient concerns remained to justify addition to the candidate species list. Therefore, according to NMFS' April 15, 2004 interpretation of the ESA provisions, the Central Valley ESU now qualifies as a species of concern, rather than a candidate species (69 FR 19977).

fair-sized spring-run Chinook salmon population remained. However, fall-run Chinook salmon numbers had declined noticeably.

A fisheries biological assessment, with an incorporated essential fish habitat assessment, is being prepared for the Proposed Action. The biological assessment assesses the potential impacts of the Proposed Action on Central Valley steelhead DPS, fall- and spring-run Chinook salmon.

Central Valley Fall-/Late-Fall-Run Chinook Salmon Evolutionarily Significant Unit

Central Valley fall-run and late-fall-run Chinook salmon are considered by NMFS to be the same ESU (64 FR 50394–50415, September 16, 1999). Fall-run Chinook salmon is the most abundant and widespread salmon run in California (Mills et al. 1997). NMFS (1999) determined that listing this ESU as threatened was not warranted (64 FR 50394–50415, September 16, 1999), but subsequently classified it as a species of concern because of specific risk factors (69 FR 19975, April 15, 2004).

In the San Joaquin River Basin, fall-run Chinook salmon historically spawned in the mainstem San Joaquin River upstream from the Merced River confluence and in the mainstem channels of the major tributaries (Yoshiyama et al. 1996). Currently, however, they are limited to the Merced, Stanislaus, and Tuolumne rivers, where they spawn and rear downstream from mainstem dams. Fall-run Chinook salmon in these areas are supported in part by hatchery stock in the Merced River (Bureau of Reclamation and California Department of Water Resources 2011). Fall-run Chinook salmon in the San Joaquin tributaries typically spawn from late October through December, peaking in mid-November (SJRRP 2010). Late-fall-run Chinook salmon spawn from January to early April, peaking in January (Williams 2006).

California Department of Fish and Game (CDFG) has operated a barrier (Hills Ferry Barrier [HFB][2]) at the confluence of the Merced River with the San Joaquin River since the early 1990s to prevent adult fall-run Chinook salmon from migrating farther up the San Joaquin River into warmer temperatures and unsuitable habitat. Although the HFB prevents Central Valley fall-run and late-fall-run Chinook salmon from accessing the study area, fall-run and late-fall-run Chinook salmon have been infrequently observed upstream of HFB and at Sack Dam since operation of the HFB began in 1992 (SJRRP 2011). SJRRP interim flows may increase the opportunity for Chinook salmon to migrate upstream of HFB. In November 2010, 22 fall-run Chinook salmon passed the HFB and were found upstream at Sack Dam, Mendota Pool, and upstream canals (Portz et al. 2011).

[2] The HFB is a resistance weir that allows water, small fish, and particles to pass but prevent larger fish such as adult Chinook salmon from passing upstream. The barrier has been operated by DFG on the San Joaquin River since 1992. The barrier is usually installed and operated from mid-September through December each year. The barrier's effective sustained flow capacity is 1,000 cfs, with the ability to withstand short-duration flows up to 1,500 cfs. The HFB has not been operated in the spring when juvenile salmon and steelhead are emigrating from the downstream tributaries. The opportunity for these juveniles to access the San Joaquin River upstream of the Merced River has been extremely low due to inhospitable water flow and

With the continued operation of the HFB to exclude Chinook salmon from passing upstream, the potential for Central Valley fall-run and late-fall-run Chinook salmon to occur in the study area is low. In addition to interim flows that may accommodate their presence (i.e., migratory habitat), extreme flood conditions[3] may increase the probability of their presence. In summary, because there is a moderate potential for Central Valley fall-run Chinook salmon to get past the HFB when it operates during interim and high flood flows, they could occur in the study area.

Central Valley Spring-Run Chinook Salmon Evolutionarily Significant Unit

The Central Valley spring-run Chinook salmon is listed as threatened under the ESA and is listed as threatened under the CESA. The ESU includes all naturally spawned populations of spring-run Chinook in the Sacramento River and its tributaries in California, including the Feather River, as well as the Feather River Hatchery spring-run Chinook program (70 FR 37160). Critical habitat was established on September 2, 2005, and became effective on January 2, 2006 (70 FR 52488). In accordance with the San Joaquin River Restoration Settlement Act, the spring-run Chinook salmon reintroduced under the San Joaquin River Restoration Program would be considered an experimental population under §10(j) of the ESA.

Historically, spring-run Chinook salmon occupied the upper and middle reaches (1,000 to 6,000 feet) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud, and Pit rivers, with smaller populations in most tributaries having sufficient habitat for over-summering adults (Stone 1874; Rutter 1904; Clark 1929, as cited in USFWS 2011). In the San Joaquin River, spring-run Chinook salmon historically spawned as far upstream as the present site of Mammoth Pool Reservoir (RM 322), where their upstream migration was historically blocked by a natural velocity barrier (SJRRP 2010). Construction of Friant Dam began in 1939 and was completed in 1942, blocking access to upstream habitat. Nevertheless, runs of 30,000 to 56,000 spring-run Chinook salmon were reported in the years after Friant Dam was constructed, with salmon holding in the pools and spawning in riffles downstream from the dam (SJRRP 2010). Friant Dam began filling in 1944 and, in the late 1940s, began to divert increasing amounts of water into canals to support agriculture (SJRRP 2010). Flows into the mainstem San Joaquin River were reduced to the point that the river ran dry in the vicinity of Gravelly Ford (SJRRP 2010).

Because of alterations to the system, the upper San Joaquin River, from Friant Dam downstream to the confluence with the Merced River, no longer supports spring-run Chinook salmon (USFWS 2011). By 1950, the entire run of spring-run Chinook salmon was extirpated from the San Joaquin River (Fry 1961, as cited in SJRRP 2010). The last

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water quality conditions. However, Interim Flows will likely provide conditions that could allow emigrating juvenile salmon and steelhead to stray upstream of the Merced River.

[3] Under the interim flows that are expected during the construction period, the likelihood for steelhead, Chinook salmon, and other anadromous or migratory fish to occur in the Project Area is associated with flood conditions. Construction would not proceed if flood conditions occurred (i.e., high flow).

documented run of spring-run Chinook salmon in the upper San Joaquin River, consisting of only 36 individuals, was observed in 1950 (Warner 1991, as cited in USFWS 2011). Since the 1950s, the remaining Chinook salmon in the San Joaquin basin consist only of fall-run populations found in major tributaries to the lower San Joaquin River.

USFWS (2011) provides a detailed life history description of spring-run Chinook salmon. In summary, adults enter freshwater in the spring (typically from March through June), hold over the summer, and spawn in the fall, and the juveniles typically spend a year or more in freshwater before emigrating.

The case of *NRDC et al. v. Kirk Rodgers et al.*, reached a Stipulation of Settlement (Settlement). The Settlement established two primary goals, one of which was the Restoration Goal:

> *To restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence with the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.*

To achieve the Restoration Goal, the Settlement calls out the need for the reintroduction of Chinook salmon. Paragraph 14 of the Settlement indicates that the Restoration Goal shall include the reintroduction of spring-run and fall-run Chinook salmon to the San Joaquin River between Friant Dam and the confluence of the Merced River. In addition, Paragraph 14 of the Settlement requires the USFWS to submit an ESA §10(a)1(A) permit application to the NMFS for the reintroduction of spring-run Chinook salmon. The San Joaquin River Restoration Settlement Act (Public Law [PL] 111-11) indicates that spring-run Chinook shall be reintroduced into the San Joaquin River pursuant to §10(j) of the ESA, provided that the Secretary of Commerce "finds that a permit for the reintroduction of California Central Valley spring-run Chinook may be issued pursuant to §10(a)1(A) of the Endangered Species Act." In December 2011, USFWS fulfilled the Settlement's Paragraph 14 requirement to submit a §10(a)1(A) enhancement of species permit application.

Spring-run Chinook salmon are required, according to the Settlement, to be reintroduced into the Restoration Area by December 31, 2012. In the early years of the Reintroduction Program, USFWS anticipates that a number of major passage impediments will still be in place in the Restoration Area. To meet the Settlement mandated reintroduction date of December 31, 2012, there may be a need to implement a trap and haul program to move reintroduced fish through the river system. This would require moving juveniles downstream of structures (e.g., Sack Dam) or unscreened diversions/bypasses (e.g., Arroyo Canal), and may require moving returning adults upstream around passage barriers, including structural or biological barriers, (e.g., temperature or dissolved oxygen migration barriers) (USFWS 2011).

The Settlement's requirement to reintroduce spring-run Chinook salmon into the San Joaquin River by December 31, 2012, creates the potential for juvenile spring-run Chinook salmon to occur within the study area during construction. Construction is scheduled from January 2013 through October 2014.

Central Valley Steelhead Distinct Population Segment

The Central Valley steelhead DPS includes all naturally spawned populations of anadromous steelhead below natural and human-made impassable barriers in the Sacramento and San Joaquin rivers and their tributaries, excluding steelhead from San Francisco and San Pablo bays and their tributaries. This species also includes anadromous steelhead from two artificial propagation programs: the Federal Coleman Nimbus Fish Hatchery and State Feather River Fish Hatchery. The Central Valley steelhead DPS is listed as federally threatened (71 FR 834–862, January 5, 2006), but is not listed under CESA.

The historical distribution of steelhead in the Central Valley is not known, but in rivers where the species still occurs, steelhead are normally more widely distributed than Chinook salmon (Voight and Gale 1998, as cited in McEwan 2001; Yoshiyama et al. 1996). Steelhead are typically tributary spawners.

Lindley et al. (2006) found that *O. mykiss* were widely distributed throughout the Central Valley, but that populations were relatively less abundant in the San Joaquin River tributaries than in Sacramento River tributaries because of natural barriers to migration. Also, many small tributaries to the major San Joaquin River tributaries have too high a gradient or too little flow to have supported *O. mykiss*; consequently, steelhead were likely restricted to the mainstems and larger tributaries (Lindley et al. 2006).

The steelhead population in the mainstem San Joaquin River is considered extirpated; however, small populations of steelhead persist in the lower San Joaquin River tributaries (i.e., the Stanislaus and Tuolumne rivers and possibly the Merced River) (McEwan 2001; Zimmerman et al. 2008). Naturally spawning populations may exist in many other streams but remain undetected because of the lack of monitoring or research programs.

There is moderate potential for Central Valley steelhead to get past the HFB when it is operating (during high flood flows) and to be present in the San Joaquin River system after early December, when the HFB is removed.

Adult steelhead immigration into Central Valley streams typically begins in June, peaks in September, and continues through February or March (Hallock et al. 1961 and Bailey 1954, both as cited in McEwan and Jackson 1996). Optimal immigration and holding temperatures have been reported to range from 46°F to 52°F (CDFG 1991, as cited in HDR 2007). Spawning occurs primarily from January through March, but may begin as early as late December and may extend through April (Hallock et al. 1961, cited in McEwan and Jackson 1996). Optimal spawning temperatures have been reported to range from 39°F to 52°F (CDFG 1991, as cited in HDR 2007). Unlike Chinook salmon, many steelhead do not die after spawning. Those that survive return to the ocean and may spawn again in future years. Female steelhead construct redds in suitable gravels, primarily in pool tailouts and heads of riffles. In the Central Valley, adult winter-run steelhead generally return at ages 2 and 3 and range in size from 2 to 12 pounds (Reynolds et al. 1993). Increased water temperatures may trigger movement, but some steelhead ascend into freshwater without any apparent environmental cues (Barnhart 1991).

Steelhead eggs incubate in the redds for 3 to 14 weeks, depending on water temperatures (Shapovalov and Taft 1954; Barnhart 1991, as cited in FWUA and NRDC 2002). Optimal egg incubation temperatures have been reported to range from 48°F to 52°F (CDFG 1991, as cited in HDR 2007). After hatching, alevins (newly hatched fish still attached to the yolk sac) remain in the gravel for an additional 2 to 5 weeks, while absorbing their yolk sacs, and emerge in spring or early summer (Barnhart 1991). Upon emergence, fry (young fish) inhale air at the stream surface to fill their air bladders, absorb the remains of their yolks, and start to feed actively, often in schools (Barnhart 1991; NMFS 1996, as cited in FWUA and NRDC 2002). Fry move to shallow-water, low-velocity habitats, such as stream margins and low-gradient riffles, and forage in open areas lacking instream cover (Hartman 1965; Everest et al. 1986; Fontaine 1988, as cited in FWUA and NRDC 2002). As fry increase in size and their swimming abilities improve during late summer and fall, they increasingly use areas with cover and exhibit a preference for higher-velocity, deeper mid-channel areas near the thalweg (lowest point in the stream channel) (Hartman 1965; Everest and Chapman 1972; Fontaine 1988, as cited in FWUA and NRDC 2002).

Juvenile steelhead (parr) rear in freshwater before outmigrating to the ocean as smolts. Juvenile steelhead occupy a wide range of habitats, preferring deep pools as well as higher-velocity rapid and cascade habitats (Bisson et al. 1982 and 1988, as cited in FWUA and NRDC 2002). The time that parr spend in freshwater appears to be related to growth rate, with larger, faster-growing members of a cohort smolting earlier (Peven et al., 1994, as cited in FWUA and NRDC 2002). During the winter period of inactivity, steelhead prefer low-velocity pool habitats with large rocky substrate or woody debris for cover (Hartman 1965; Swales et al. 1986; Raleigh et al. 1984; Fontaine 1988, as cited in FWUA and NRDC 2002). During periods of low temperatures (less than 44.6^{o}F) and high flows associated with the winter months, juvenile steelhead seek refuge in interstitial spaces in cobble and boulder substrates (Bustard and Narver 1975; Everest et al. 1986, as cited in FWUA and NRDC 2002). Juveniles' winter hiding behavior reduces their metabolism and food intake requirements and minimizes their exposure to predation and high flows (Bustard and Narver 1975 as cited in FWUA and NRDC 2002), but substantial mortality still appears to occur during winter.

Preferred water temperatures for fry and juvenile steelhead rearing are reported to range from 45°F to 65°F (NMFS 2002). Each degree increase between 65°F and the upper lethal limit of 75°F reportedly becomes increasingly less suitable and thermally more stressful for the fish (Bovee 1978). Although the reported preferred water temperatures for fry and juvenile steelhead rearing range from 45°F to 65°F, most literature on steelhead smoltification suggests water temperatures of 52°F (Adams et al. 1975; Myrick and Cech 2001; Rich 1987, as cited in Lower Yuba Accord RMT 2010), or less than 55°F (U.S. Environmental Protection Agency 2003; McCullough et al. 2001; Wedemeyer et al. 1980; Zaugg and Wagner 1973, as cited in Lower Yuba Accord RMT 2010) for successful smoltification to occur.

Juvenile emigration typically occurs from April through June. Emigration appears to be more closely associated with size than age, with 6 to 8 inches being most common size for downstream migrants. Juveniles remain in freshwater for 2 to 4 years before emigrating to the ocean. Most steelhead south of Alaska and British Columbia smolt

after a period of 2 years in freshwater and spend 2 years in the ocean before returning to their natal streams to spawn. Populations in Oregon and California, however, have higher frequencies of adults returning after only 1 year in the ocean (Busby et al. 1996).

Similar to fall-run and late-fall-run Chinook salmon, steelhead are excluded from the study area by the HFB; however, they are only excluded through mid-December. Although Central Valley steelhead are not known to use the study area as a migration corridor and have a very limited occurrence in the mainstem San Joaquin River, including the major tributaries, there is moderate likelihood of adult steelhead occurring in the study area.

Sacramento Splittail

USFWS removed Sacramento splittail from the list of threatened species on September 22, 2003, and did not identify it as a candidate for listing under the ESA. However, Sacramento splittail are identified as a California Species of Special Concern and, informally, as a federal Species of Concern. Sacramento splittail are endemic to the Sacramento and San Joaquin rivers, the Delta, and San Francisco Bay. In the San Joaquin River, they have been documented as far upstream as the town of Friant (Rutter 1908, as cited in SJRRP 2010).

Sacramento splittail spawning can occur anytime between late February and early July, but peak spawning occurs in March and April (Moyle 2002). Adult splittail move upstream in late November through late January, foraging in flooded areas along the main rivers, bypasses, and tidal freshwater marsh areas before spawning (Moyle et al. 2004). Feeding in flooded riparian areas before spawning may contribute to spawning success and survival of adults after spawning (Moyle et al. 2001). Splittail appear to concentrate their reproductive effort in wet years when potential success is greatly enhanced by the availability of inundated floodplain habitat (Meng and Moyle 1995; Sommer et al. 1997). Splittail are fractional spawners, with individuals spawning over several months (Wang 1995). Attraction flows are necessary to initiate travel onto floodplains where spawning occurs (Moyle et al. 2004). Spawning generally occurs in water with depths of 3 to 6 feet over submerged vegetation, where eggs adhere to vegetation or debris until hatching (Moyle 2002; Wang 1986). Older fish are generally the first to spawn (Caywood 1974).

Eggs begin to hatch in 3 to 7 days, depending on temperature (Bailey et al. 2000; Moyle 2002). After hatching, splittail larvae remain in shallow, weedy areas until water recedes, and they migrate downstream (Meng and Moyle 1995). Most larval splittail remain in flooded riparian areas for 10 to 14 days, likely feeding in submerged vegetation before moving into deeper water as they become stronger swimmers (Wang 1986; Sommer et al. 1997). Juvenile Sacramento splittail prefer shallow-water habitat with emergent vegetation during rearing (Meng and Moyle 1995). Most juveniles move downstream in response to flow pulses into shallow, productive bay and estuarine waters from April to August (Meng and Moyle 1995; Moyle 2002). Floodplain habitat offers high-quality food and production, and low predator densities to increase juvenile growth and survival.

Non-breeding splittail are found in temperatures up to 75°F (24 degrees Celsius [°C]) (Young and Cech 1996). Juveniles and adults have optimal growth at 68°F (20°C), with physiological distress above 84°F (29°C) (Young and Cech 1995). Splittail have a high

tolerance for variable environmental conditions (Young and Cech 1996), and are generally opportunistic feeders. Prey includes mysid shrimp, clams, and some terrestrial invertebrates. Splittail are also known to withstand very low dissolved oxygen levels (less than 1 milligram oxygen l-1), a wide range of water temperatures (41.0°F to 75.2°F), and salinities of 6 to 10 parts per thousand (Moyle et al. 2004).

On the basis of the habitat present in the study area, it is unlikely that splittail spawn in the vicinity of the study area. Therefore, in the study area, Sacramento splittail habitat use may be restricted to infrequent upstream migration episodes and incidental rearing during the downstream movement portion of their early life history, which may most likely occur between late February and July.

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Appendix E – Field Survey Methods and Results Technical Memorandum

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Arroyo Canal Fish Screen and Sack Dam Fish Passage Project

Field Survey Methods and Results Technical Memorandum

Vegetation, Wildlife Habitat, and Geologic and Geomorphic Resources

SAN JOAQUIN RIVER RESTORATION PROGRAM

April 2012

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Table of Contents

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List of Abbreviations and Acronyms

CDFG	California Department of Fish and Game
CDWR	California Department of Water Resources
cfs	cubic-feet-per-second
CGS	California Geological Survey
CIWTG	California Interagency Wildlife Task Group
CNDDB	California Natural Diversity Database
CNPR	California Native Plant Rank
CNPS	California Native Plant Society
CWHR	California Wildlife Habitat Relationships System
EA/IS	Environmental Assessment/Initial Study
ESA	Endangered Species Act
FC	candidates for listing under the Federal Endangered Species Act
FE	endangered under the Federal Endangered Species Act
FP	Fully Protected in California
FT	threatened under the Federal Endangered Species Act
GIS	Geographical Information System
HMRD	Henry Miller Reclamation District #2131
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
NRCS	Natural Resources Conservation Service
NRDC	National Resources Defense Council
Project	Arroyo Canal Fish Screen and Sack Dam Fish Passage Project
Reclamation	United States Department of the Interior, Bureau of Reclamation
SE	endangered under the California Endangered Species Act
Settlement	Stipulation of Settlement
SJRRP	San Joaquin River Restoration Program
SSC	California Species of Special Concern
ST	threatened under the California Endangered Species Act
TM	Technical Memorandum
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

This Technical Memorandum (TM) was prepared by the San Joaquin River Restoration Program (SJRRP) Team as a document in support of preparing an Environmental Assessment/Initial Study (EA/IS) for the Arroyo Canal Fish Screen and Sack Dam Fish Passage Project (Proposed Action). The purpose for circulating this document at this time is to facilitate early coordination regarding initial concepts and approaches currently under consideration by the SJRRP Team with the Settling Parties, Third Parties, other stakeholders, and interested members of the public. Therefore, the content of this document may not necessarily be included in the EA/IS.

This TM does not present findings, decisions, or policy statements of any of the Implementing Agencies. Additionally, all information presented in this document is intended to be consistent with the Stipulation of Settlement (Settlement). To the extent inconsistencies exist, the Settlement should be the controlling document and the information in this document will be revised before its inclusion in future documents. While the SJRRP Team is not requesting formal comments on this document, all comments received will be considered in refining the concepts and approaches described herein to the extent possible.

1.0 INTRODUCTION

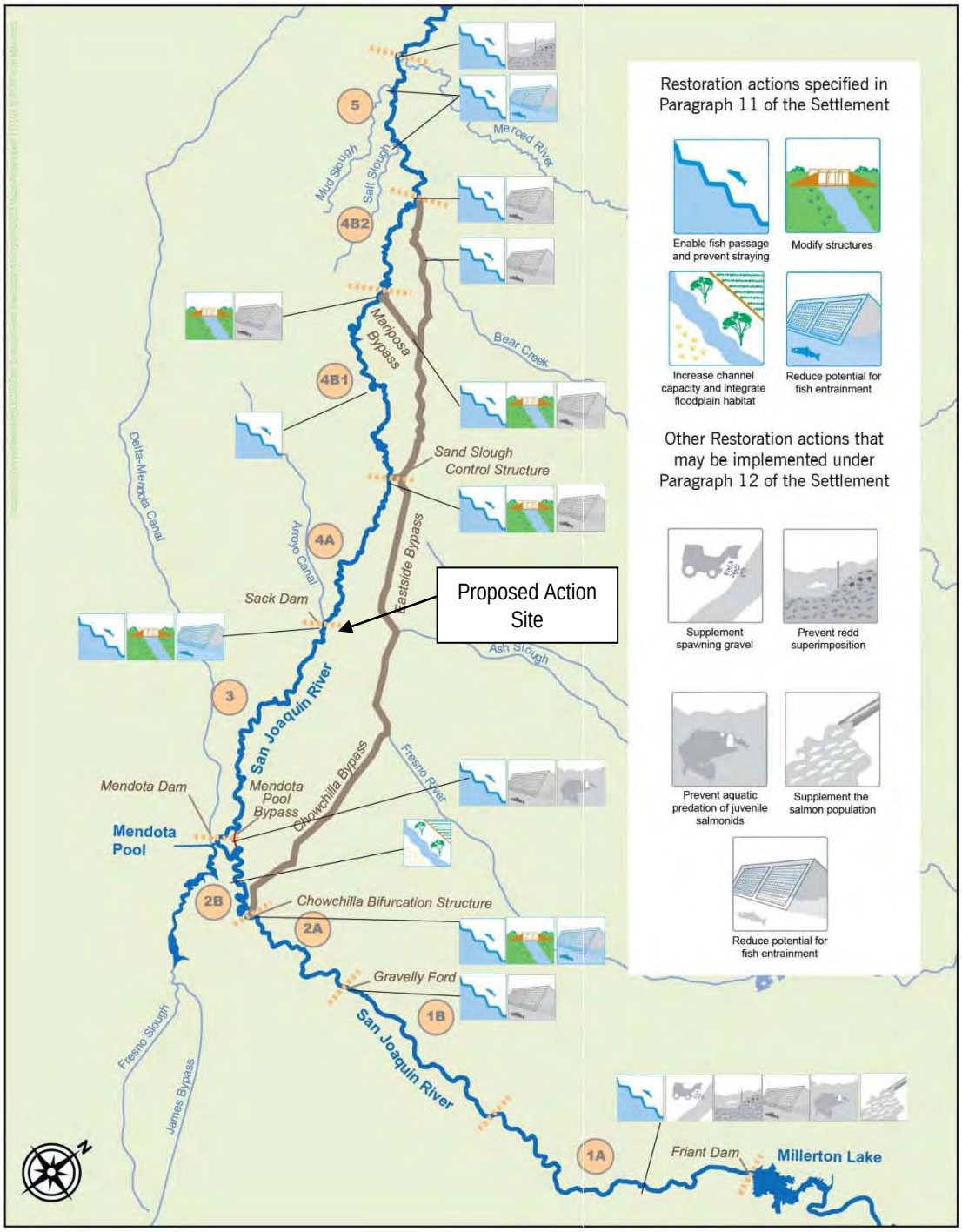
This Field Survey Methods and Results, Vegetation, Wildlife Habitat, and Geologic and Geomorphic Resources, Technical Memorandum (TM) provides baseline information necessary to characterize existing environmental conditions in the Environmental Assessment/Initial Study (EA/IS) for the Arroyo Canal Fish Screen and Sack Dam Fish Passage Project (Proposed Action). The Proposed Action represents one component of Phase 1 of the overall San Joaquin River Restoration Program (SJRRP). This information will also be used to support the acquisition of permit approvals. The SJRRP was established in late 2006 to implement the Stipulation of Settlement (Settlement) in *Natural Resources Defense Council (NRDC), et al. v. Kirk Rodgers, et al*. Figure 1-1 illustrates the overall SJRRP restoration and Proposed Action area.

The U.S. Department of the Interior, Bureau of Reclamation (Reclamation), as the Federal lead agency under the National Environmental Policy Act (NEPA), prepared this TM to present baseline information resulting from a vegetation survey and wildlife habitat assessment survey, as well as from channel morphology mapping and characterization of bank conditions. This information will be used to support the description of the affected environment in the EA/IS. Federal authorization for implementing the Settlement is provided in the San Joaquin River Restoration Settlement Act (Public Law 111-11).

This TM specifically covers information needed for the biological resources section of the EA/IS being prepared by the Project Team under contract with Reclamation and composed of WRIME, ICF International, Stillwater Sciences, and HDR.

1.1 Purpose of this Technical Memorandum

The *Existing Environmental Conditions Data Needs and Survey Approach Technical Memorandum* (Reclamation 2012) for the Arroyo Canal Fish Screen and Sack Dam Fish Passage Project documented the need for several field surveys to provide necessary baseline information for the environmental impact assessment of the Proposed Action and its alternatives. These included a vegetation survey and wildlife habitat assessment survey, to facilitate the analysis of Proposed Action impacts on biological resources, and channel morphology mapping and characterization of bank conditions to support the analysis of Proposed Action impacts on Geologic and Geomorphic Resources. This TM summarizes the methods and results of these surveys and addresses comments received from U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service.

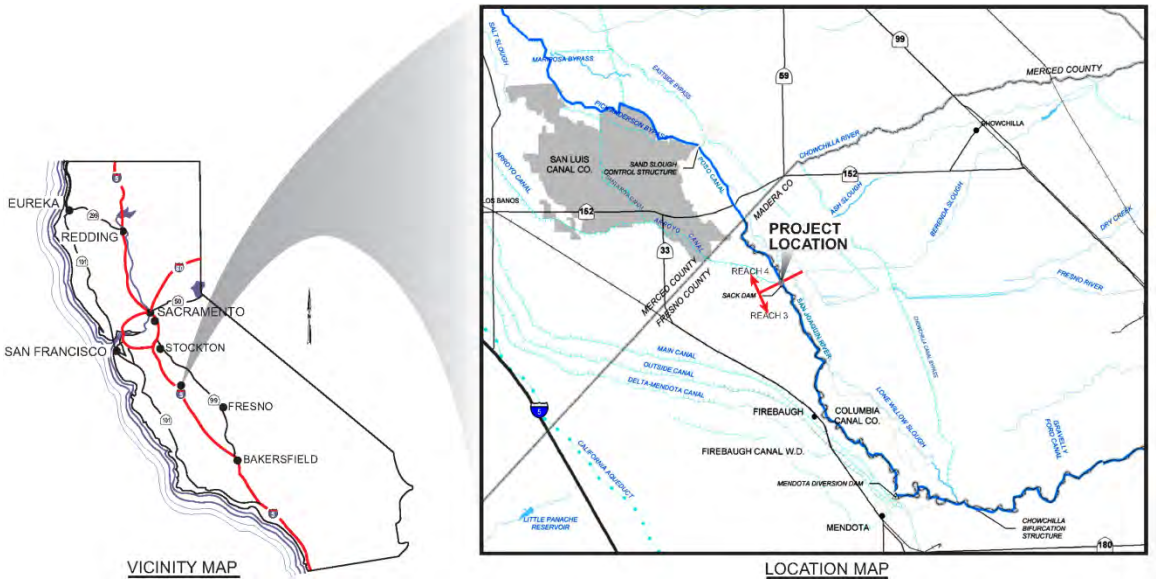


Source: Reclamation and DWR, 2011

Figure 1-1. Overview of SJRRP Restoration Area and Proposed Action Site

1.2 Overview of the Arroyo Canal Fish Screen and Sack Dam Fish Passage Project

The Proposed Action is located in Fresno and Madera counties, approximately 7 miles southeast of Dos Palos, California (see Figure 1-2). Sack Dam is on the San Joaquin River in the western region of the San Joaquin Valley, just north of Arroyo Canal. The facilities are owned and operated by Henry Miller Reclamation District #2131 (HMRD).



Source: CH2M HILL, 2012

Figure 1-2. Regional Map

The purpose of the Proposed Action is to implement Settlement-required Phase 1 improvements at the existing Arroyo Canal and Sack Dam facilities on the San Joaquin River as authorized and directed by Public Law 111-11.

The following are the "Phase 1 improvements" in paragraph 11 of the Settlement (numbers in parentheses are from the Settlement, page 9) related to the Arroyo Canal and Sack Dam:

- *Screening the Arroyo Canal water diversion immediately upstream of Sack Dam to prevent entrainment of anadromous fish* (Item 6), and
- *Modifications at Sack Dam adequate to ensure fish passage* (Item 7).

The Proposed Action, shown in Figure 1-3, includes the following key components (CH2M HILL 2012):

- Construct a new Sack Dam to accommodate fish passage and improve operational control under the scheduled Restoration Flow regime.

- Demolish the existing Sack Dam structure, and recontour the resulting disturbed channel.
- Provide stabilization improvements to the east side of the San Joaquin River channel between the east abutment of Sack Dam and the adjacent levee.
- Construct a new 700-cubic-feet-per-second (cfs) positive barrier fish screen structure within the Arroyo Canal in a single vee configuration with profile bar screens. The fish screen would be designed to meet the criteria and/or recommendations of the California Department of Fish and Game (CDFG) and NOAA–National Marine Fisheries Service (NMFS).
- Construct a new trash-rack structure at the head of the Arroyo Canal, upstream of the new fish screen structure, with an automated raking mechanism.
- Construct a new transport channel/fish ladder, beginning at the downstream end of the vee screen and terminating at the west abutment of Sack Dam. The transport channel/fish ladder would convey downstream migrating fish and accommodate upstream migrating fish past Sack Dam.
- Construct a defined work bench area adjacent to the west abutment of Sack Dam to facilitate operation and maintenance access to the dam and the Arroyo Canal approach channel.
- Construct a new control building to accommodate mechanical, electrical, and instrumentation and control equipment related to Proposed Action improvements.
- Construct a new equipment storage building to accommodate maintenance equipment related to Proposed Action improvements.
- Replace an existing bridge across the Poso Canal (located immediately north of the Arroyo Canal) to accommodate project operation and maintenance equipment access needs.
- Construct a new bridge across the Poso Canal to facilitate site access from Valeria Avenue during inclement weather conditions. This bridge would also be designed to accommodate project operation and maintenance equipment.

Figure 1-3 shows the key details of the Proposed Action in the area around the Sack Dam and transport channel/fish ladder, including the existing and proposed Sack Dam, the proposed transport channel/fish ladder, and other detail.

Figure 1-4 shows the construction sequencing, including the location of the potential contractor staging areas on the east and west side of the San Joaquin River, temporary haul road, potential material borrow areas in the immediate vicinity of the dam, and the temporary diversion channel or cofferdam. The anticipated project disturbance area is also indicated.

Figure 1-5 shows details of the location of potential material borrow areas along the levee on the north side of the Arroyo Canal between the San Joaquin River and Temple Santa Rita Canal.

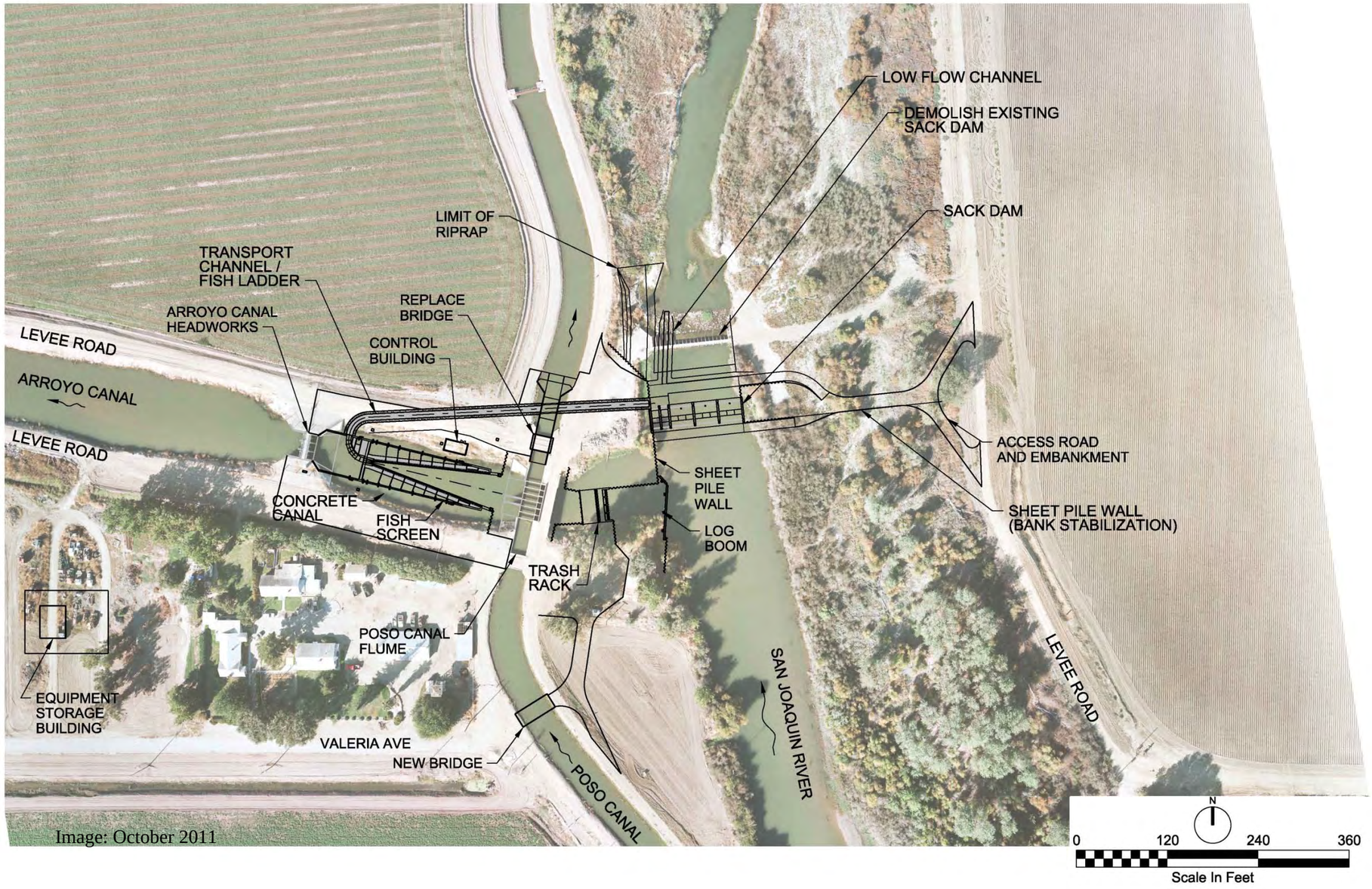
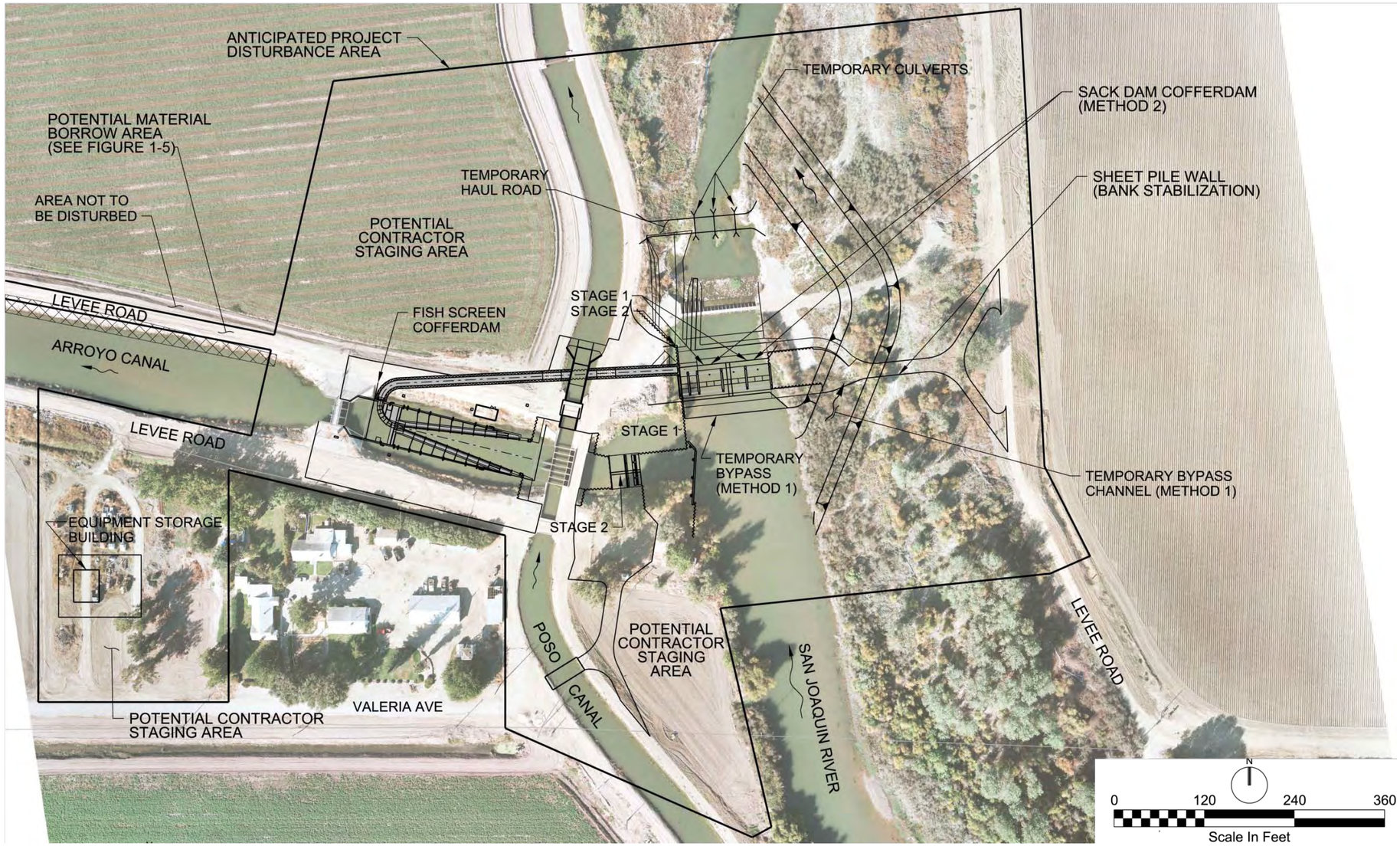


Image – October 2011

Source: CH2M HILL 2012

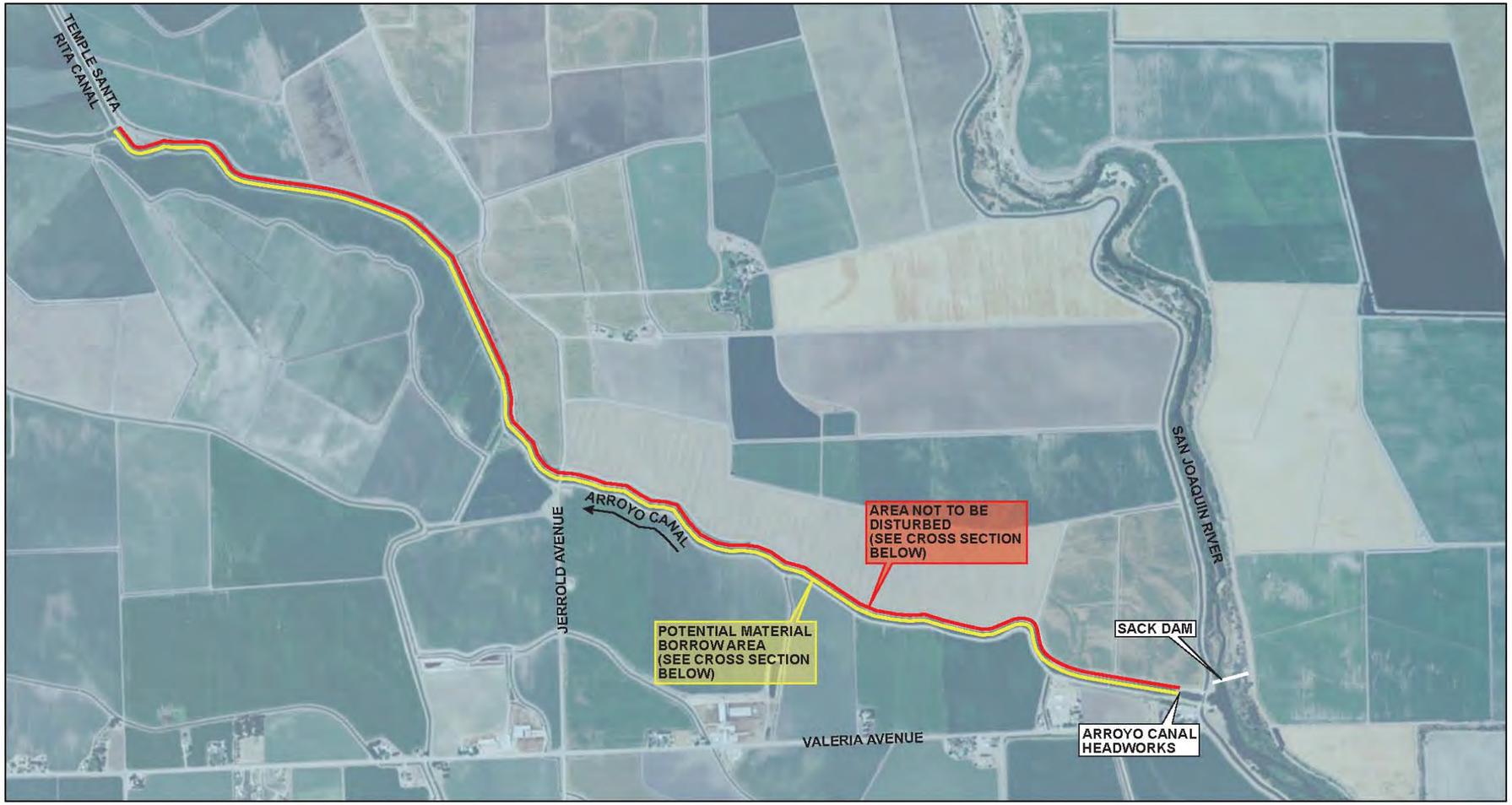
Figure 1-3. Proposed Action Site Plan



Source: CH2M HILL 2012

Image – October 2011

Figure 1-4. Construction Sequencing



Source: CH2M HILL 2012

Figure 1-5. Potential Material Borrow Areas

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2.0 BIOLOGICAL RESOURCES

2.1 Background

To assess the potential impacts of the Proposed Action and its alternatives on special-status plant and animal species, the potential for these species to occur in the Proposed Action area needed to be determined. Potential occurrence was determined based on the presence of suitable habitat in the Proposed Action area or presence/absence of the species. For this Proposed Action, special-status plants and wildlife include species with the following designations:

- Listed as endangered under the Federal Endangered Species Act (ESA) (FE),
- Listed as threatened under the Federal ESA (FT),
- Candidates for listing under the Federal ESA (FC),
- Classified as a species of concern by NOAA Fisheries Service,
- Listed as endangered under the California ESA (SE),
- Listed as threatened under the California ESA (ST),
- Fully Protected in California (FP),
- California Species of Special Concern (SSC),
- California Native Plant Rank (CNPR) 1A [extirpated] (CNPR 1A) (formerly California Native Plant Society [CNPS] List 1A),
- CNPR 1B (CNPR 1B), and
- CNPR 2 (CNPR 2).

2.2 Vegetation Survey

Per the *Data Needs and Survey Approach Technical Memorandum* for the Proposed Action, a general vegetation survey was conducted to:

1. Document non-native invasive aquatic plants and their extent;
2. Identify fine-scale vegetation patterns in order to make accurate estimates of potential Proposed Action impacts to wetland, riparian, and upland vegetation types;
3. Document habitat conditions for special-status plant species with the potential to occur in the Proposed Action area; and
4. Document the location, stem count, and other details of any blue elderberry (*Sambucus mexicana*) shrubs in the Proposed Action area.

If the general vegetation survey indicated that a special-status plant had high potential to occur in the Proposed Action area, a CDFG- and/or USFWS-protocol special-status plant survey (USFWS 1996, CDFG 2009a) would be conducted.

2.2.1 Methods

Existing Information Review

To assess the potential impacts of the Proposed Action on botanical resources, the vegetation types (particularly sensitive vegetation types such as wetlands and riparian woodlands) and special-status plant species in the Proposed Action area were identified. Existing botanical resource information for the Proposed Action area was reviewed, including:

- CDFG. 2010. California Natural Diversity Database (CNDDB). Electronic database. CDFG, Sacramento, California. Accessed on 17 March 2010.
- CNPS. 2010. Inventory of rare and endangered plants. Electronic database. CNPS, Sacramento, California. Accessed on 17 March 2010.
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- Natural Resources Conservation Service (NRCS). 1962. Soil Survey of Madera Area, California.
- NRCS. 1971. Soil Survey, Eastern Fresno Area, California.
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- U.S. Department of the Interior, Bureau of Reclamation (Reclamation) and California Department of Water Resources (DWR). 2011. Draft Program Environmental Impact Statement/Program Environmental Impact Report (PEIS/R) for the San Joaquin River Restoration Program (SJRRP).
- U. S. Fish and Wildlife Service (USFWS). 2010. Federal endangered and threatened species that occur in or may be affected by projects in the U.S. Geological Survey (USGS) 7.5 minute quads selected.

Based on the review of this existing information, in particular the CNDDB and CNPS species lists for the USGS quadrangles overlaying and adjacent to the Proposed Action area (Oxalis, Poso Farm, Delta Ranch, Santa Rita Bridge, Bliss Ranch, Chowchilla, Dos Palos, Firebaugh NE, Hammonds Ranch, Broadview Farms, Firebaugh, and Mendota Dam), a list of special-status species with the potential to occur in the Proposed Action vicinity was compiled. Existing information was also used to characterize coarse-level habitat conditions (e.g., presence of alkali soils, vernal pools, etc.) in the Proposed Action area. The distribution and habitat preferences of the special-status species were compared with coarse-level habitat conditions in the Proposed Action area to create a

refined list of special-status species with the potential to occur in the Proposed Action area.

Also based on the review of this existing information, in particular Moise and Hendrickson (2002), an initial list of the vegetation types in the Proposed Action area was generated. Moise and Hendrickson's (2002) vegetation map covered the Proposed Action area and served as the preliminary field base map, using 2009 aerial photography, for the vegetation survey.

Field Survey

On 29 April 2010, the entire Proposed Action area was traversed on foot along meandering transects by a plant ecologist (Zooey Diggory, Stillwater Sciences). The survey was conducted to overlap with blooming period of early-blooming species on the refined list of special-status species for the Proposed Action area. This ensured that if any of these species had the potential to occur at the site they could be identified to species, and that if site conditions warranted a CDFG-protocol special-status plant survey, the early blooming survey would be completed.

To identify and map the vegetation types in the Proposed Action area, sample sites were surveyed using the CNPS rapid assessment protocol (CNPS Vegetation Committee 2004). At each sample site, the occurrence and percent cover of dominant and characteristic plant species (following USDA (2010) PLANTS database nomenclature) in three height strata—low (<0.5 m [1.6 ft]), medium (0.4–5 m [1.3–16 ft]), and high (>5 m [16 ft])—were recorded, and a photograph was taken. Per the CNPS rapid assessment protocol, additional information on site history and physical conditions, as well as sample site location (using a hand-held Geographic Positioning System [GPS] unit), were also recorded. Each sample site was assigned a preliminary vegetation alliance determination, based on a cursory review of the species occurrence and percent cover data in the field, which was ultimately finalized in the office (see Data Analysis section below). The boundaries of each preliminary vegetation alliance were delineated on the field base map (because this was such a localized effort, a minimum map unit standard was not used). A quality assurance/quality control (QA/QC) check for completeness and errors was performed on all field data, including data forms and mapping unit boundaries, shortly after collection and before leaving the field.

To identify any early-blooming special-status plants in the Proposed Action area, the field survey also followed the *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (CDFG 2009a) for state-listed or CNPR plant species and *Guidelines for Conducting and Reporting Botanical Inventories for Federally Listed, Proposed and Candidate Plants* (USFWS 1996) for federally-listed plants. Specifically, the survey was conducted by a plant ecologist with (1) experience conducting floristic field surveys; (2) knowledge of plant taxonomy and plant community ecology and classification; (3) familiarity with the plant species of the area; (4) familiarity with appropriate Federal and California statutes related to plants and plant collecting; and (5) experience with analyzing effects of a project on native plant species and communities. The survey was comprehensive for vascular plants such that "every plant taxon that occurs on site is identified to the taxonomic level necessary to

determine rarity and listing status" (CDFG 2009a), using taxonomic keys for the region (i.e., Hickman 1993).

In addition, during the field survey, the species and general extent of non-native invasive terrestrial and aquatic plants were documented. The location, stem count, and other details of elderberry shrubs in the Proposed Action area were to be recorded, but there are none in the Proposed Action area.

Data Analysis

The completed CNPS rapid assessment data forms were entered into a Microsoft® Access database shortly after returning from the field to store, organize, and analyze the vegetation sampling data. All entered data were checked for transcription errors and corrected as necessary. The database was queried to derive the full list of preliminary vegetation alliances mapped in the field and the vegetation composition data associated with each alliance. Using the vegetation composition data, each preliminary vegetation alliance was keyed using the second edition of *A Manual of California Vegetation* (Sawyer et al. 2009) to determine final vegetation alliances. The database was then updated with these final vegetation alliance names.

The field mapping was integrated into a Geographical Information System (GIS) by scanning the field maps at 600 dots per inch (dpi) resolution, digitizing the field-delineated mapping boundaries, and entering GPS point data for vegetation and sample points. Digitized mapping boundaries were checked for accuracy by the field plant ecologist and corrected as necessary. Finally, each mapping unit was designated with a final vegetation alliance name or land cover type (e.g., developed) in GIS.

2.2.2 Results

Special-status Species List

Many of the species on the initial list of special-status species with the potential to occur in the Proposed Action vicinity were removed from further consideration based on habitat conditions at the Proposed Action area, which has an elevation of 40–43 m (131–141 ft), and does not contain any vernal pools or alkali soils. The refined list of special-status species with the potential to occur in the Proposed Action area is presented in Table 2-1.

Table 2-1. Special-Status Plant Species with Potential to Occur in the Proposed Action Area

Common Name *Scientific Name*	Status[1] (Federal/ State/CNPR)	Distribution in California	Habitat Associations	Elevation (meters)	Blooming Period	Potential to Occur in Proposed Action Area
Heartscale *Atriplex cordulata*	--/--/1B	West edge of the Central Valley	Chenopod scrub, meadows and seeps, valley and foothill grassland (sandy)/saline or alkaline	1–375	Apr–Oct	Documented in Proposed Action quadrangles; **unlikely** to occur in the Proposed Action area (only one patch of soil with moderate alkalinity at downstream end of Proposed Action area).
Lesser saltscale *Atriplex minuscula*	--/--/1B	Southern San Joaquin Valley	Chenopod scrub, playas, valley and foothill grassland/alkaline, sandy soil	15–200	May–Oct	Documented in Proposed Action quadrangles; **unlikely** to occur in the Proposed Action area.
Subtle orache *Atriplex subtilis*	--/--/1B	Known from fewer than 20 occurrences including locations in Fresno, King, Madera, and Merced counties	Valley and foothill grassland	40–100	Jun–Aug	Documented in adjacent quadrangles; **moderate** potential to occur in Proposed Action area
Lost Hills crownscale *Atriplex vallicola*	--/--/1B	Lost Hills, vicinity of McKittrick in Kern County, scattered locations in Fresno and Merced counties	Alkali sink, alkaline vernal pool, saltbush scrub	50–635	Apr–Aug	Documented in adjacent quadrangles; **unlikely** to occur in Proposed Action area.
Hispid bird's-beak *Cordylanthus mollis* ssp. *hispidus*	--/--/1B	Scattered locations in San Joaquin Valley from Solano County to Kern County	Meadows, grasslands, and playas on alkaline soils	1–155	Jun–Sep	Documented in adjacent quadrangles; **unlikely** to occur in Proposed Action area.

Common Name *Scientific Name*	Status[1] (Federal/ State/CNPR)	Distribution in California	Habitat Associations	Elevation (meters)	Blooming Period	Potential to Occur in Proposed Action Area
Palmate-bracted bird's-beak *Cordylanthus palmatus*	FE/SE/1B	Glenn, Colusa, Yolo, Alameda, Madera, and Fresno counties	Chenopod scrub, alkaline grasslands	5–155	May–Oct	Documented in Proposed Action quadrangles; **unlikely** to occur in Proposed Action area.
Hoover's cryptantha *Cryptantha hooveri*	--/--/1A	Assumed extinct in California; previously in Madera and Stanislaus counties	Inland dunes, valley and foothill grassland	9–150	Apr–May	Documented in external quadrangles; **moderate** potential to occur in Proposed Action area.
Recurved larkspur *Delphinium recurvatum*	--/--/1B	San Joaquin Valley and central valley of the South Coast Ranges, Contra Costa County to Kern County	Subalkaline soils in annual grassland, saltbush scrub, cismontane woodland, and vernal pools	3–750	Mar–Jun	Documented in adjacent quadrangles; **moderate** potential to occur in grasslands in Proposed Action area.
Four-angled spikerush *Eleocharis quadrangulata*	--/--/2	Central Valley	Freshwater marshes, lake and pond margins	<457	Jul–Sep	Documented in SJRRP study area; **moderate** potential to occur in ponded areas in Proposed Action area.
Delta button-celery *Eryngium racemosum*	--/SE/1B	San Joaquin River delta and floodplains	Seasonally-inundated depressions along floodplains	5–23	Jul–Oct	Documented in external quadrangles; **moderate** potential to occur in ponded areas in Proposed Action area.
Munz's tidy-tips *Layia munzii*	--/--/1B	Western San Joaquin Valley and interior foothills valleys from Fresno County to San Luis Obispo County	Chenopod scrub, grasslands, flats and hillsides in alkaline clay soils	150–700	Mar–Apr	Documented in adjacent quadrangles; **unlikely** to occur in Proposed Action area.

Common Name *Scientific Name*	Status[1] (Federal/ State/CNPR)	Distribution in California	Habitat Associations	Elevation (meters)	Blooming Period	Potential to Occur in Proposed Action Area
Slender-leaved pondweed *Potamogeton filiformis*	--/--/2	Central Sierra Nevada, San Joaquin Valley, San Francisco Bay Area, and Modoc Plateau	Shallow freshwater marshes	300–2,150	May–Jul	Documented in SJRRP study area; **unlikely** to occur in Proposed Action area.
Hartweg's golden sunburst *Pseudobahia bahiifolia*	FE/SE/1B	Eastern side of Sacramento and San Joaquin Valleys and adjacent foothills; historically as far north as Yuba County	Predominantly on northern slopes of rocky, bare or grassy areas along rolling hills, and adjacent to vernal pools and streams	15–150	Mar–Apr	Documented in SJRRP study area; **unlikely** to occur in Proposed Action area.
Sanford's arrowhead *Sagittaria sanfordii*	--/--/1B	Scattered locations in Central Valley and Coast Range	Freshwater marshes, sloughs, canals, and other slow-moving water habitats	n/a	May–Aug	Documented in SJRRP study area; **moderate** potential to occur in ponded areas in Proposed Action area.
Chaparral ragwort *Senecio aphanactis*	--/--/2	Fresno and Merced counties	Chaparral, cismontane woodland, coastal scrub/sometimes alkaline	15–800	Jan-Apr	Documented in external quadrangles; **unlikely** to occur in Proposed Action area.
Wright's trichocoronis *Trichocoronis wrightii* var. *wrightii*	--/--/2	Central Valley and south coast	Alkaline meadows, marshes and swamps, riparian forests, and vernal pools	n/a	May–Sept	Documented in SJRRP study area; **moderate** potential to occur in Proposed Action area.

[1]Status:
Federal
FE =listed as endangered under the Federal ESA
-- =no status
State
SE = listed as endangered under the California ESA
-- =no status
California Native Plant Rank (CNPR)
1B = rare, threatened, or endangered in California and elsewhere
2 = rare, threatened, or endangered in California, but more common elsewhere

Vegetation Map and Types

Six vegetation sample sites were surveyed and approximately 19 acres of upland, riparian, and wetland vegetation were mapped in the Proposed Action area (Figure 2-1)[1]. The Proposed Action area vegetation data are summarized in Table 2-2. Sample site vegetation rapid assessment field forms are included in Appendix A.

Table 2-2. Vegetation Types in the Proposed Action Area

Vegetation Type	Area	
	hectares	acres
Agriculture	0.37	0.92
Arundo donax herbaceous semi-natural stand	0.22	0.55
Disturbed/Developed	0.20	0.50
Eucalyptus spp. woodland semi-natural stand	0.12	0.30
Mediterranean California naturalized annual and perennial herbaceous group	1.66	4.11
Populus fremontii woodland alliance	1.90	4.70
Salix exigua shrubland alliance	1.37	3.38
Salix goodingii woodland alliance	1.51	3.73
Typha spp. herbaceous alliance	0.49	1.20
Total	7.85	19.39

Vegetation in the Proposed Action area is confined to the narrow floodplains between the river channel and the left- and right-bank levees (Figure 2-1). Agricultural fields (primarily alfalfa, tomato, and corn) occur outside the levees. In general, the portion of the Proposed Action area upstream of Sack Dam is composed of native riparian woodland and shrubland vegetation types (Figure 2-1, Table 2-2). Notable exceptions are a large patch of non-native invasive giant reed (*Arundo donax*) in the center of the channel at the southern-most extent of the Proposed Action area, and disturbed/developed areas (a fallow field, barn, and parking area) on the left bank upstream and downstream of Arroyo Canal (Figure 2-1). A narrow fringe of wetland vegetation runs along much of

[1] The official Proposed Action area was revised subsequent to the field surveys reported in this tech memo; the Proposed Action area was significantly decreased in the north and south, and slightly increased to the east and west. This does not affect the results of the surveys, however, as the only portion of the revised Proposed Action area that was not surveyed is in agricultural production.

the right bank. The Proposed Action area at and downstream of Sack Dam is composed of non-native annual grassland, with native riparian woodland adjacent to both levees (Figure 2-1, Table 2-2).

Seven different vegetation groups, alliances, or semi-natural stands were mapped in the Proposed Action area. These vegetation groups, alliances, and semi-natural stand types are summarized in Table 2-2 and described in terms of distribution and composition in the sections below (mapping units other than vegetation types, such as agriculture and disturbed/developed, that appear in the vegetation map [Figure 2-1] are not described). A list of all species observed during the field survey is provided in Appendix B.

Figure 2-1. Vegetation Types in the Proposed Action Area.

Arundo donax semi-natural stands

Arundo donax semi-natural stands include areas where giant reed dominates (generally >50% relative cover, and often >50% total cover). These stands usually have a dense, continuous herbaceous layer, typically 2–5 m (7–16 ft) tall (Sawyer et al. 2009). In the Proposed Action area, narrowleaf willow (*Salix exigua*), California rose (*Rosa californica*) and Mexican rush (*Juncus mexicanus*) are interspersed or present in smaller inclusions within the stand, but never at cover levels sufficient to be co-dominant with giant reed. Trees, primarily Fremont cottonwood (*Populus fremontii*) and willows (*Salix* spp.), may occur as emergents (<10% cover). Because of its height, dense growth pattern, and general physical structure it commonly dominates the middle stratum (0.5–5 m [1.6–16 ft], also known as the shrub stratum), or co-dominates with woody shrubs (Sawyer et al. 2009).

One *Arundo donax* semi-natural stand occurs in the middle of the San Joaquin River channel at the southern-most extent of the Proposed Action area, where it is surrounded by a fringe of *Typha* spp. herbaceous alliance (Figure 2-1). In addition, there is one giant reed plant on the left bank just upstream of Arroyo Canal. Giant reed is listed as one of the most widespread invasive plants in California (Cal-IPC 2007) and is the focus of mapping and eradication efforts on the San Joaquin River.

Eucalyptus spp. semi-natural woodland stands

Eucalyptus spp. semi-natural woodland stands are dominated by one or more gum species in the tree canopy (Sawyer et al. 2009). In the Proposed Action area, Fremont cottonwood, Goodding's willow (*Salix gooddingii*), and walnut (*Juglans* sp.) are interspersed within the stand. The tree canopy can be intermittent to continuous, with trees generally <50 m (164 ft), and the shrub and herbaceous layers are sparse to intermittent (Sawyer et al. 2009).

Two *Eucalyptus* spp. semi-natural stands occur around the barn in the disturbed/developed area south of the Arroyo Canal (Figure 2-1). Eucalyptus trees, which have been intentionally planted throughout California as windbreaks and ornamental plants, are listed as limited to moderate invasive species in California (Cal-IPC 2007).

Mediterranean California naturalized annual and perennial herbaceous group

The Mediterranean California naturalized annual and perennial herbaceous group (naturalized annual grassland group in Figure 2-1) includes a number of grass- and forb-dominated herbaceous alliances and associations (Sawyer et al. 2009). In the Proposed Action area, this group is dominated by shortpod mustard (*Hirschfeldia incana*) and/or by non-native bromes (*Bromus* spp.) (Appendix A). Perennial ryegrass (*Lolium perenne*), poison hemlock (*Conium maculatum*), blessed milkthistle (*Silybum marianum*), and burr chervil (*Anthriscus caucalis*) are common associated species (Appendix B). Emergent shrubs and trees, such as Goodding's willow, common buttonbush (*Cephalanthus occidentalis*), and California rose are occasionally present at low levels (<5% cover) (Appendix A).

Mediterranean California naturalized annual and perennial herbaceous group dominates the left- and right-bank floodplain at and downstream of Sack Dam (Figure 2-1).

Populus fremontii woodland alliance
This alliance is dominated by Fremont cottonwood in the tree layer, although a variety of trees may co-dominate (Sawyer et al. 2009). In the Proposed Action area this includes primarily Goodding's willow (Appendix A). The *Populus fremontii* woodland alliance can have an open to continuous canopy, typically <25 m (82 ft) tall (Sawyer et al. 2009). In the Proposed Action area, the shrub layer is generally absent, and the herbaceous layer is dominated by mugwort (*Artemisia douglasiana*) and non-native bromes and ryegrass (Appendix A).

The right-bank floodplain south of Sack Dam is composed primarily of *Populus fremontii* woodland alliance (Figure 2-1).

Salix exigua shrubland alliance
The *Salix exigua* shrubland alliance is dominated by narrowleaf willow, although a variety of shrubs and emergent trees may co-dominate or be present at low cover (Sawyer et al. 2009). In the Proposed Action area these can include Northern California black walnut (*Juglans hindsii*), Goodding's willow, and California rose (Appendix A). This alliance usually has a dense, continuous shrub layer, typically <7 m (23 ft) tall (Sawyer et al. 2009). In the Proposed Action area, the herbaceous layer is dominated by non-native shortpod mustard and bromes, but transitions to California blackberry (*Rubus ursinus*) farther south (Appendix A).

Salix exigua shrubland alliance covers the left bank south of Arroyo Canal and the right bank near Sack Dam (Figure 2-1). In particular, this alliance covers the sand and debris berm that is occasionally replaced on the right bank just upstream of Sack Dam to keep flows directed into Arroyo Canal.

Salix gooddingii woodland alliance
This alliance is dominated by Goodding's willow in the tree layer, although a variety of trees may co-dominate (Sawyer et al. 2009). In the Proposed Action area these include Northern California black walnut, Oregon ash (*Fraxinus latifolia*), and Fremont cottonwood (Appendix A). This alliance can have an open to continuous canopy, typically <30 m (98 ft) tall (Sawyer et al. 2009). In the Proposed Action area, the shrub layer is dominated by California blackberry and saplings of the tree species listed above. Mugwort, rushes (*Juncus* spp.), and non-native bromes dominate the herbaceous layer (Appendix A).

Salix gooddingii woodland alliance occurs as a single patch on the right-bank floodplain south of Sack Dam, and along the left- and right-bank levees north of Sack Dam (Figure 2-1).

Typha spp. herbaceous alliance
The *Typha* spp. alliance is a densely vegetated alliance dominated by one or more cattail species (Sawyer et al. 2009). A tree layer is absent and the low (<1.5 m [5 ft])

herbaceous understory is moderate to sparse (Sawyer et al. 2009). In the Proposed Action area other associated species include smartweed (*Polygonum* spp.), bulrushes (*Schoenoplectus* spp.), and rushes. In the Proposed Action area, the *Typha* spp. alliance generally contains inclusions of *Ludwigia peploides* provisional semi-natural herbaceous stands. This alliance is dominated by one or more water primrose species *(Ludwigia* spp.) as emergent or floating plants on the water surface (Sawyer et al. 2009).

The *Typha* spp. herbaceous alliance, with inclusions of *Ludwigia peploides* provisional semi-natural herbaceous stands, occurs along the right bank of the San Joaquin River upstream of Sack Dam and as a fringe surrounding the *Arundo donax* semi-natural stand in the center of the river channel (Figure 2-1).

Special-status Plant Species

No special-status plants were identified during the field survey, although the survey was conducted prior to the blooming period of several special-status species with moderate potential to occur in the Proposed Action area (Table 2-1). Appendix B provides a list of all the species observed in the Proposed Action area during the field survey.

Non-native Invasive Plant Species

While many non-native plant species occur in the Proposed Action area (see Appendix B), three are of particular relevance to the Proposed Action. Giant reed, as well as the floating aquatic plants parrot feather (*Myriophyllum aquaticum*) and floating primrose, are all listed as highly invasive plants in California that are known to spread rapidly in most aquatic and riparian systems (Cal-IPC 2007). Proposed Action activities have the potential to disturb and distribute these species downstream. In the Proposed Action area there is currently one large isolated patch of giant reed in the center of the San Joaquin River channel (Figure 2-1) and one individual plant of giant reed on the left bank upstream of Arroyo Canal. At the time of the survey, there were several small patches of parrot feather near the Arroyo Canal entrance, and floating primrose lined much of the right bank.

Elderberry Shrubs

On 29 April 2010, concurrent with the vegetation survey, the entire Proposed Action area was searched on foot along meandering transects for blue elderberry shrubs. No blue elderberry shrubs, the host plant of the endangered Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), were identified in the Proposed Action area during the field survey.

2.3 Wildlife Habitat Assessment Survey

A habitat assessment survey was conducted to document the habitat potential for and presence of special-status wildlife species in the Proposed Action area, determine the need for additional wildlife surveys (e.g., protocol-level surveys and/or pre-construction surveys), and to serve as the basis of assessing potential Proposed Action impacts on special-status wildlife species.

2.3.1 Methods

Existing Information Review

To assess the potential impacts of the Proposed Action on terrestrial wildlife resources (including terrestrial invertebrates, amphibians, reptiles, birds, and mammals), the available wildlife habitats, existing wildlife communities, and special-status species potentially occurring in the Proposed Action area were identified. Existing terrestrial wildlife resource information for the Proposed Action area was reviewed, including:

- CDFG. 2009. Special animals list, July 2009. CDFG, Biogeographic Data Branch, Sacramento, California.
- CDFG. 2010. CNDDB. Electronic database. CDFG, Sacramento, California. Accessed on 17 March 2010.
- CDFG and California Interagency Wildlife Task Group (CIWTG). 2008. California Wildlife Habitat Relationships System (CWHR), Version 8.2. Personal computer program. Biogeographic Data Branch, CDFG, Sacramento, California.
- Entrix. 2009. Grasslands Bypass Project, 2010-2019, Environmental Impact Statement and Environmental Impact Report, Final 2009. Prepared for Reclamation, South Central California Area and Mid-Pacific Region offices, and San Luis & Delta Mendota Water Authority.
- McBain & Trush, Inc. 2002. San Joaquin River Restoration Study Background Report. Prepared for Friant Water Users Authority, Lindsay, CA, and Natural Resources Defense Council, San Francisco, California.
- Stillwater Sciences. 2003. Restoration Objectives for the San Joaquin River. Prepared for Friant Water Users Authority, Lindsay, California, and Natural Resources Defense Council, San Francisco, California.
- Reclamation. 2009. SJRRP Water Year 2010 Interim Flows Project Environmental Assessment/Initial Study.
- Reclamation and DWR. 2011. Draft PEIS/R for the SJRRP. .
- USFWS. 1998. Recovery Plan for Upland Species of the San Joaquin Valley, California. Region 1, Portland, Oregon.
- USFWS. 2010. Federal endangered and threatened species that occur in or may be affected by projects in the USGS 7.5 minute quads selected.
- USFWS Recovery Plans and Designated Critical Habitat Listings for Federally-listed species.

Based on the review of this existing information, in particular the CNDDB and USFWS species lists for the two USGS quadrangles overlaying the Proposed Action area (Oxalis and Poso Farm) and the ten quadrangles adjacent to the Proposed Action area (Delta Ranch, Santa Rita Bridge, Bliss Ranch, Chowchilla, Dos Palos, Firebaugh NE, Hammonds Ranch, Broadview Farms, Firebaugh, and Mendota Dam), a list of special-status wildlife species with the potential to occur in the Proposed Action vicinity was compiled (Appendix C). The distribution and habitat preferences of these species were

compared with habitat conditions in the Proposed Action area to create a refined list of special-status species with the potential to occur in the Proposed Action area.

Field Survey

On 18 May 2010, a wildlife biologist (Holly Shepley, Stillwater Sciences) conducted the on-site habitat assessment. Ms. Shepley slowly walked meandering transects throughout the entire Proposed Action area between the hours of 0900 and 1445. The habitat assessment included a qualitative evaluation of terrestrial and aquatic habitats for special-status species identified during the existing information review. The assessment was based on habitat types, habitat elements (e.g., burrows, large trees, nesting sites), and evidence of wildlife activity. Ms. Shepley was equipped with binoculars, GPS receiver, camera, and notebook to document existing site conditions and any incidentally observed animal species and sign. The initial habitat assessment survey did not incorporate protocol-level surveys for any wildlife species.

2.3.2 Results

Forty-nine special-status wildlife species (fish, terrestrial invertebrates, amphibians, reptiles, birds, and mammals) were identified from the database queries and literature searches described in Section 2.3.1 as having potential to occur in the Proposed Action area (Appendix C). Thirty-two of these species were eliminated from further consideration, since no suitable habitat is present in the Proposed Action area, or the Proposed Action area is outside of the species' range (Appendix C). Seventeen special-status wildlife species have low, moderate, or high potential to occur within the Proposed Action area. Special-status species for which suitable habitat was determined to be present are identified in Table 2-3 and discussed in further detail below. Two of the special-status species identified as having the potential to occur in the Proposed Action area—Pacific pond turtle and Swainson's hawk—were documented during the habitat assessment (Appendix D). Other wildlife species observed during the habitat assessment are listed in Appendix D.

Table 2-3. Special-Status Wildlife Species with Potential to Occur in the Proposed Action Area.

Common Name *Scientific Name*	Query Sources	Status[a] (Federal /State)	Habitat Associations	Potential to Occur in Proposed Action Area
FISH				
Central Valley Fall/Late Fall-run Chinook salmon[2] *Onchorhynchus tshawytscha*	SJRRP PEIS/EIR	FSC/–	Accessible streams in California's Central Valley and associated estuaries and marine waters; historically abundant in San Joaquin River but now largely extirpated upstream of the Merced River confluence.	Low; Although the Hills Ferry Barrier (HFB)[3] operates with the intention of excluding fall-run Chinook salmon from passing upstream, interim flows that may accommodate their presence (i.e., migratory habitat) or extreme flood conditions may increase the probability of their presence.
Central Valley steelhead *Onchorhynchus mykiss*	SJRRP PEIS/EIR	FT/–	Accessible streams in California's Central Valley and associated estuaries and marine waters; historically abundant in San Joaquin River but now largely extirpated upstream of the Merced River confluence.	Low; steelhead are considered extirpated from the Action Area; however, there is low potential for Central Valley steelhead to get past the HFB when it is operating (during high flood flows) and to be present in the San Joaquin River system after early December, when the HFB is removed

[2] Central Valley Fall/Late Fall-run Chinook salmon will not be included as part of the ESA consultation, but are included in this table as they will be part of the Essential Fish Habitat Assessment consultation.

[3] The HFB is a resistance weir that allows water, small fish, and particles to pass but prevent larger fish such as adult Chinook salmon from passing upstream. The barrier has been operated by CDFG on the San Joaquin River since 1992. The barrier is usually installed and operated from mid-September through December each year. The barrier's effective sustained flow capacity is 1,000 cfs, with the ability to withstand short-duration flows up to 1,500 cfs. The HFB has not been operated in the spring when juvenile salmon and steelhead are emigrating from the downstream tributaries. The opportunity for these juveniles to access the San Joaquin River upstream of the Merced River has been extremely low due to inhospitable water flow and water quality conditions. However, Interim Flows will likely provide conditions that could allow emigrating juvenile salmon and steelhead to stray upstream of the Merced River.

Common Name ***Scientific Name***	**Query Sources**	**Status**[a] **(Federal /State)**	**Habitat Associations**	**Potential to Occur in Proposed Action Area**
AMPHIBIANS				
Western spadefoot *Spea hammondii*	CWHR	–/SSC	Areas with sparse vegetation and/or short grasses in sandy or gravelly soils; primarily in washes, river floodplains, alluvial fans, playas, alkali flats, among grasslands, chaparral, or pine-oak woodlands; breeds in ephemeral rainpools with no predators.	Moderate; while there may be excessive vegetation cover, western spadefoots may breed in nearby ephemeral rain pools in spring.
REPTILES				
Pacific pond turtle *Actinemys marmorata*	CNDDB, CWHR	–/SSC	Permanent, slow-moving fresh or brackish water with available basking sites and adjacent open habitats or forest for nesting	Present; observed during habitat assessment surveys.
Coast horned lizard *Phrynosoma coronatum*	SJRRP PEIS/R	–/SSC	Open areas with sandy soil and/or patches of loose soil and low/scattered vegetation in scrublands, grasslands, conifer forests, and woodlands; frequently found near ant hills.	Low; habitat in Proposed Action area of limited suitability due to excessive vegetation cover and compact soils.
California legless lizard *Anniella pulchra*	CNDDB	–/SSC	Sparsely vegetated areas; warm, moist, loose soil for burrowing.	Low; habitat in Proposed Action area of limited suitability due to excessive vegetation cover and compact soils.
Giant garter snake *Thamnophis gigas*	CNDDB, USFWS, CWHR	FT/ST	Sloughs, canals, low- gradient streams, freshwater marsh, irrigation ditches, and/or rice fields; requires grassy banks for basking, emergent vegetation for cover, and areas of high ground protected from flooding during winter.	Low; suitable habitat nearby but not within Proposed Action area.

Common Name *Scientific Name*	Query Sources	Status[a] (Federal /State)	Habitat Associations	Potential to Occur in Proposed Action Area
BIRDS				
Redhead *Aythya americana*	BIOS	–/SSC	Freshwater emergent wetlands with dense stands of cattails and bulrush interspersed with areas of deep, open water; forage and rest on large, deep bodies of water.	Moderate; suitable habitat present.
White-tailed kite *Elanus leucurus*	SJRRP PEIS/R	–/FP	Lowland grasslands and wetlands with open areas; nests in trees near open foraging area.	Moderate; suitable foraging and nesting habitat present.
Northern harrier *Circus cyaneus*	CNDDB, BIOS	–/SSC	Nests, forages, and roosts in wetlands or along rivers or lakes, but also in grasslands, meadows, or grain fields.	Moderate; suitable foraging habitat present.
Swainson's hawk *Buteo swainsoni*	CNDDB	–/ST	Nests in oaks or cottonwoods in or near riparian habitats. Forages in grasslands, irrigated pastures, and grain fields.	Present; observed during habitat assessment surveys.
Short-eared owl *Asio flammeus*	BIOS	–/SSC	Irrigated alfalfa or grain fields, ungrazed grasslands, old pastures, and salt or freshwater marshlands.	Low; suitable nesting habitat present but foraging habitat limited.
Least Bell's vireo *Vireo bellii pusillus*	SJRRP PEIS/R	FE/SE	Nests in dense vegetative cover of riparian areas; often nests in willow or mulefat; forages in dense, stratified canopy.	Low; suitable habitat present but species is rare.
Yellow warbler *Dendroica petechia*	SJRRP PEIS/R	–/SSC	Open-canopy, deciduous riparian woodland in close proximity to water along streams or wet meadows.	Moderate; suitable foraging habitat present.
Yellow-breasted chat *Icteria virens*	BIOS	–/SSC	Early successional riparian habitats with a dense shrub layer and an open canopy.	Low; while suitable habitat is present, species is uncommon in region of Proposed Action area.

Common Name ***Scientific Name***	**Query Sources**	**Status[a]** **(Federal /State)**	**Habitat Associations**	**Potential to Occur in Proposed Action Area**
MAMMALS				
Pallid bat *Antrozous pallidus*	CWHR	–/SSC	Roosts in trees, caves, crevices, and buildings; feeds in a variety of open habitats.	Moderate; suitable day roost and foraging habitat present.
Western red bat *Lasiurus blossevillii*	CNDDB, CWHR	–/SSC	Riparian forests, woodlands near streams, fields and orchards.	Moderate; suitable roosting and foraging habitat present.
San Joaquin kit fox *Vulpes macrotis mutica*	CNDDB,USFWS, CWHR	FE/–	Annual grasslands or open areas dominated by scattered brush, shrubs, and scrub.	Low; suitable denning habitat is not present, but individuals may disperse through Proposed Action area.
California ringtail *Bassariscus astutus raptor*	SJRRP PEIS/R	–/FP	Mixture of forest and shrub habitats in association with rocky areas or riparian habitats, low to middle elevations.	Low; suitable habitat present, but ringtail are unlikely to occur on the valley floor.

[1]Status: **Federal**
FE = listed as endangered under the Federal ESA
FSC = species of concern
FT = listed as threatened under the Federal ESA
– = no status

State
FP = Fully Protected
SE = listed as endangered under the California ESA
SSC = Species of Special Concern
ST = listed as threatened under the California ESA
– = no status

Central Valley Fall/Late Fall-run Chinook Salmon

In the San Joaquin Basin, fall Chinook historically spawned in the mainstem San Joaquin River upstream of the Merced River confluence and in the mainstem channels of the major tributaries. By the 1920s, reduced autumn flows in the mainstem San Joaquin River nearly eliminated fall-run Chinook salmon, although a small run did persist.

In the San Joaquin system, adult fall Chinook typically enter spawning streams from October through December (when they may be passing through the Proposed Action area), with spawning peaking in early to mid-November. The duration of incubation varies depending on water temperature but generally extends over a two to three month period. After hatching, alevins remain in the gravel for two to three weeks, absorbing most of their yolk sac before emerging into the water column. Upon emergence, fry swim or are displaced downstream. In general, fry (length <50 mm) and juveniles (length >50 mm) outmigrate from the spawning areas between January and May (when they may again be passing through the Proposed Action area). Outmigration of larger juveniles generally occurs from April through June with smolts entering the ocean between April and July. A small number of juveniles may remain in freshwater over the summer and outmigrate as yearlings.

CDFG currently operates the Hills Ferry artificial fish barrier on the San Joaquin River to direct migrating adult salmon into the Merced River and prevent them from entering the upper San Joaquin River and Proposed Action area. Despite the barrier, fall-run Chinook salmon occasionally stray up the San Joaquin River, especially during wet years. In 2010, fall-run Chinook salmon were observed at Sack Dam. While the Proposed Action area does not contain any spawning or rearing habitat for this species, they may migrate through the Proposed Action area during migration and emigration events. No fish were observed in the Proposed Action area during the wildlife habitat assessment.

Central Valley Steelhead

Steelhead (*Oncorhynchus mykiss*) is the anadromous form of rainbow trout. Steelhead typically migrate to the ocean after spending 1–4 (usually 2) years in fresh water and may remain at sea for 1–3 years before returning to spawn in freshwater. Unlike most other salmonid species, steelhead are iteroparous, or capable of returning to spawn more than once before dying. Most individuals, however, spawn only once. Spawning typically occurs from December through June, and redds (nests) are constructed in gravel substrate. The eggs incubate in the gravels and hatch as alevins (larval fish that are nourished by a yolk sac), which remain in the gravel for several weeks, before emerging as free-swimming fry.

Steelhead abundance and distribution in the San Joaquin River basin have substantially decreased, and steelhead have been extirpated from the Proposed Action area as a result of water development and flow management, dams, and water elevated water temperatures (Reclamation and DWR 2011). As with fall-run Chinook salmon, there is potential for Central Valley steelhead to get past the Hills Ferry barrier when it is in operation and to be present in the San Joaquin River system after early December when the artificial barrier is removed. While the Proposed Action area does not contain any

spawning or rearing habitat for this species, they may migrate through the Proposed Action area during migration and emigration events. No fish were observed in the Proposed Action area during the wildlife habitat assessment.

Western Spadefoot

Western spadefoot (*Spea hammondii*), a species of toad, is a California SSC. This species is found in California from near Redding south throughout the Central Valley and nearby foothills and through the Coast Ranges south of Monterey Bay, from sea level to approximately 1,363 m (4,460 ft) (Zeiner et al. 1988, Stebbins 2003). Western spadefoots prefer areas with sparse vegetation and/or short grasses in sandy or gravelly soils, primarily in washes, river floodplains, alluvial fans, playas, and alkali flats (Stebbins 2003). Spadefoots typically occur in grasslands, though they may also be found in valley-foothill hardwood woodlands, chaparral, or pine-oak woodlands (Zeiner et al. 1988, Stebbins 2003). During the spring rainy season, spadefoots breed primarily in ephemeral rain pools, though they may also breed in streams with fairly isolated pools that lack predators (e.g., fishes, bullfrogs, crayfish) (Jennings and Hayes 1994). Dormancy during the long dry-season is spent in self-excavated burrows that individuals dig using the sharp-edged spade-like projection on their rear foot (USFWS 2005).

There are no documented CNDDB occurrence records for western spadefoots in the Proposed Action area; although they have been documented in nearby San Luis National Wildlife Refuge and Great Valley Grasslands State Park (McBain & Trush, Inc. 2002). While the Proposed Action area probably has too much vegetation cover for this species, western spadefoots may breed in nearby ephemeral rain pools in spring.

Pacific Pond Turtle

Pacific pond turtle (formerly western pond turtle) (*Actinemys marmorata*) is a California SSC. In California it is found from the Oregon border along the Coast Ranges to the Mexican border, and west of the crest of the Cascades and Sierras. Pacific pond turtles inhabit fresh or brackish water characterized by areas of deep water, low flow velocities, moderate amounts of riparian vegetation, warm water and/or ample basking sites, and underwater cover elements such as large woody debris and rocks (Jennings and Hayes 1994). Along major rivers, Pacific pond turtles are often concentrated in areas of optimal habitat, often in side channel and backwater areas. Turtles may move to off-channel habitats, such as oxbows, during periods of high flows (Holland 1994). Although adults are habitat generalists, hatchlings and juveniles require very specialized habitat for survival through their first few years. Hatchlings spend much of their time feeding in shallow water with dense vegetation of submergents or short emergents (Jennings and Hayes 1994). Although an aquatic reptile, Pacific pond turtles spend time on land basking, overwintering, and nesting, up to 1 km (0.6 mi) away from aquatic habitats (Holland 1994).

Two pond turtles were observed in the Proposed Action area during the habitat assessment, in the San Joaquin River upstream of Sack Dam. There is also suitable upland basking and nesting habitat in the Proposed Action area.

Coast Horned Lizard

California horned lizard (*Phrynosoma coronatum*), a California SSC, is endemic to California. It has a patchy distribution from Shasta County south along the edges of the Sacramento Valley into the South Coast Ranges, San Joaquin Valley, and Sierra Nevada foothills to Los Angeles, Santa Barbara, and Ventura counties (Jennings and Hayes 1994). This species is found from sea level to almost 2,400 m (8,000 ft) in elevation (Stebbins 2003). Habitat types used by California horned lizards include riparian woodlands, chamise chaparral, annual grassland, alkali flats, sandy washes, and occasionally agricultural areas with sandy soil. California horned lizard habitat is typically comprised of unvegetated areas near scattered shrubs with a gravelly-sandy or sandy loam substrate. California horned lizards shelter in burrows that they excavate themselves, or that are excavated by small mammals (Jennings and Hayes 1994). The active period for California horned lizards is generally from April through October. This species mainly eats harvester ants, but also feeds on beetles and other insects.

Likelihood for occurrence of coast horned lizard in the Proposed Action area is low. While there are some sandy patches with low stature vegetation, the majority of the Proposed Action area has excessive vegetation cover and soils that are too compact for burrowing. There are no documented CNDDB occurrence records for California horned lizards in the Proposed Action area.

California Legless Lizard

California legless lizard (*Anniella pulchra*)[4] is a California SSC. The range of the California legless lizard extends from the south shore of the San Joaquin River in Contra Costa County south along the coast, the interior Coast Ranges, and portions of the San Joaquin Valley to northern Baja California (Stebbins 2003). Because it constructs its own burrows, the California legless lizard is restricted to sandy or loamy soils. Vegetation types associated with the California legless lizard include dunes near beaches, chaparral, pine-oak woodland, sycamores, cottonwoods, or oaks (Jennings and Hayes 1994). It is not found in rocky soils or soils disturbed by mining, agriculture, or other human uses (Jennings and Hayes 1994).

Likelihood for occurrence of California legless lizard in the Proposed Action area is low. While there are some sandy patches with low stature vegetation, the majority of the Proposed Action area has excessive vegetation cover and soils that are too compact for burrowing. There are no documented CNDDB occurrence records for California legless lizards within a 16-km (10-mi) radius of the Proposed Action area.

Giant Garter Snake

Giant garter snake (*Thamnophis gigas*) is listed as threatened under both the Federal and California ESAs. The giant garter snake currently is found from Butte Creek near Gridley (19 km [12 mi] south of Chico) in Butte County south to the Mendota Wildlife

[4] California legless lizard (Anniella pulchra) was previously split into two subspecies: silvery legless lizard (Anniella pulchra pulchra) and black legless lizard (Anniella pulchra nigra); however, these subspecies are no longer recognized since evidence shows that they "do not correspond with separated or partially separated lineages" (Crother et al. 2003).

Area (16 km [10 mi] west of Fresno) (Fisher et al. 1994). Currently, the USFWS recognizes 13 separate populations of giant garter snakes spanning the following 11 counties: Butte, Colusa, Glenn, Sutter, Yolo, Solano, Sacramento, San Joaquin, Stanislaus, Merced, and Fresno (USFWS 1999). This species inhabits marshes, sloughs, ponds, low-gradient streams, agricultural wetlands (predominantly rice fields) and associated waterways including irrigation and drainage canals and ditches, and adjacent uplands. The three main habitat components required by giant garter snakes are: (1) adequate water and emergent, herbaceous wetland vegetation—such as bulrush or cattails—during the active season for foraging and escape cover; (2) grassy banks and openings in waterside vegetation for basking; and (3) higher elevation uplands with terrestrial burrows or crevices for cover, hibernation, and refugia from seasonal floods (USFWS 1999, Fisher et al. 1994). Giant garter snakes are active mostly during the daytime, requiring low-lying vegetation or open areas adjacent to water to bask. The active season for the giant garter snake is generally early April through late October, while the inactive period lasts from roughly late October to mid- or late March (USFWS 1999).

While there are no documented CNDDB occurrences for giant garter snake within 8 km (5 mi) of the Proposed Action area, there are six documented CNDDB occurrence records of this species within 16 km (10 mi). Moderately suitable giant garter snake habitat is present near—but outside of—the Proposed Action area where there is a concentration of bulrush and cattails along the right bank of the San Joaquin River upstream of Sack Dam. There is also suitable habitat in nearby irrigation canals; the ditch (seepage drain) between the northern Arroyo Canal levee road and the adjacent agricultural field appears to support at least some water year-round (primarily as a result of irrigation return flow) and contains tules and cattails that could provide cover and foraging habitat for GGS. Areas with a dense tree canopy are typically unsuitable as they do not provide appropriate basking opportunities. The Proposed Action area is near the southern extent of this species' range.

Redhead

Redhead (*Aythya americana*), a diving duck and summer resident of California, is a California SSC. Redheads have been documented breeding in the northeast, Central Valley, Southern coasts, and southern desert. This species of duck prefers freshwater emergent wetlands with dense stands of cattails and bulrush interspersed with areas of deep (>1 m), open bodies of water (Beedy and Deuel 2008). Redheads nest in permanent or semipermanent wetlands of at least 0.4 ha, with vegetation up to around 1 m tall and approximately 75% open water (Beedy and Deuel 2008).

The open water of the San Joaquin River provides suitable foraging and loafing habitat for redheads. There is an estimated 0.49 ha (1.2 ac) of *Typha* spp. (cattail and bulrush) habitat available, which is close to the minimum typically needed for this species to nest.

White-tailed Kite

White-tailed kite (*Elanus leucurus*) is Fully Protected by CDFG. White-tailed kite is a resident (breeding and wintering) species throughout central and coastal California up to the western edge of the foothills of the Sierra Nevada; California constitutes the

stronghold of the North American breeding range (Zeiner et al. 1990a, Dunk 1995). They are non-migratory, but may make slight seasonal range shifts in coastal areas during winter (Zeiner et al. 1990a). White-tailed kites breed in lowland grasslands, oak woodlands or savannah, and wetlands with open areas. Riparian corridors represent a preferred landscape characteristic for kites in both the breeding and non-breeding season (Erichsen 1995). Groves of trees are required for perching and nesting, though kites do not seem to associate with particular tree species (Dunk 1995). Preferred foraging sites include open and un-grazed grasslands, agricultural fields, wetlands, and meadows that support large populations of small mammals. White-tailed kite's year-round diet consists of >95% small mammals (Dunk 1995, Erichsen 1995) but can also include birds, insects, and reptiles. White-tailed kites breed from February through October, although peak breeding occurs from May through August (Zeiner et al. 1990a).

There is moderately suitable foraging habitat for white-tailed kites in agricultural fields near the Proposed Action area, and suitable nesting habitat for white-tailed kites within small groves of trees near the Proposed Action area.

Northern Harrier

Northern harrier (*Circus cyaneus*) is a California SSC. It is a fairly common winter visitor, and small numbers remain in California to breed. The breeding population now appears to be restricted to north coastal lowlands, the central coast, the northern Central Valley, Klamath Basin, and Great Basin (MacWhirter et al. 1996, Davis and Niemela 2008). Meadows, marshes, and wetlands are optimal habitat types; other suitable habitats include grasslands, ungrazed or lightly grazed pastures, and grain fields (Davis and Niemela 2008). Northern harriers nest on the ground in shrubby vegetation, usually along the edge of marshes. Nests are constructed of larger plants (e.g., willows, cattails) at the base with grasses and sedges lining the interior. Northern harriers feed primarily on voles or other small mammals; birds, frogs, reptiles, and invertebrates make up the rest of their diet (MacWhirter et al. 1996). This highly territorial species breeds from April through September, with peak breeding during June and July (Zeiner et al. 1990a).

There are no documented CNDDB occurrence records for northern harrier within a 16-km (10-mi) radius of the Proposed Action area; however, they have been documented in nearby San Luis National Wildlife Refuge (McBain & Trush, Inc. 2002). There is moderately suitable foraging habitat for northern harrier within and near the Proposed Action area, although available habitats are likely incompatible with northern harrier nesting because of the lack of an extensive meadow, marsh, or wetland.

Swainson's Hawk

Swainson's hawk (*Buteo swainsoni*), a migratory raptor that is a spring and summer resident in California's Central Valley, is listed as threatened under the California ESA. Throughout its range, the Swainson's hawk nests almost exclusively in only a few species of trees, such as oaks, cottonwoods, sycamores, or willows (Schlorff and Bloom 1983, CDFG 1994) near large, sparsely vegetated flatlands characterized by valleys, plateaus, broad flood plains, and large open expanses (Bloom 1980). Though Swainson's hawk is not an obligate riparian species, the availability of nesting substrate is closely tied to riparian areas, usually associated with main river channels (Bloom 1980, Estep 1989).

Nesting sites tend to be adjacent or within close proximity to suitable foraging grounds, which may include recently harvested hay, wheat, or alfalfa crops, low-growing crops such as beets or tomatoes, open pasture, non-flooded rice fields, or post-harvest cereal grain crops (Bloom 1980; CDFG 1992, 1994). Swainson's hawks forage in open areas with reduced vegetative cover that provides good visibility of prey items such as voles, ground squirrels, pocket gophers, and deer mice; they cannot forage in tall crops that grow much higher than native grasses which make prey more difficult to find (CDFG 1994).

Migrating Swainson's hawks first arrive in the Central Valley in mid-March through May and migrate south in September and October (Zeiner et al. 1990a). Breeding occurs from late March to late August, with peak activity from late May through July (Zeiner et al. 1990a). Most clutches are completed by mid-April with fledging occurring from July to mid-August (Estep 1989). Incubation is approximately 34–35 days, with first flight typically occurring when young are 38–46 days old (Bechard et al. 2010). Reproductive success is influenced by distance between nest site and foraging grounds. The farther a hawk travels to forage, the less food it can bring back to the nest, and consequently the fewer young the pair can support (Estep 1989).

There are nine documented CNDDB occurrence records for Swainson's hawk within 8 km (5 mi) of the Proposed Action area. Two Swainson's hawks were observed foraging within and near the Proposed Action area. There are several suitable nesting trees, and there is a high likelihood that Swainson's hawks use the Proposed Action area for nesting in spring and summer.

Short-eared Owl

Short-eared owl (*Asio flammeus*), a California SSC, is a year-round resident throughout much of the State. The breeding range for this species includes northern coastal areas, the northeastern plateau, the San Francisco Bay Delta, the San Joaquin valley, and the east side of the Sierra from Lake Tahoe to Inyo County (Zeiner et al. 1990a), though recent breeding from coastal central California and the San Joaquin Valley has been episodic (Roberson 2008).

Preferred habitats include open, treeless areas with abundant voles and small mammals (Zeiner et al. 1990a, Roberson 2008), with enough vegetation to conceal nesting females (Wiggins et al. 2006). Examples of suitable habitats include salt- and freshwater marshes, irrigated alfalfa or grain fields, and level, open, dry, ungrazed grasslands and old pastures (Roberson 2008, Ivey et al. 2003). Short-eared owls nest on dry ground in dense herbaceous cover; in wetlands, nest sites are in dry microsites (Howard 1994).

There are no documented CNDDB occurrence records for short-eared owl in the Proposed Action area; however, they have been documented in nearby San Luis National Wildlife Refuge (McBain & Trush, Inc. 2002). While there is moderately suitable nesting habitat for short-eared owls, vegetation may be too dense and extensive to support foraging.

Least Bell's Vireo

Least Bell's vireo (*Vireo bellii pusillus*) is listed as endangered under the Federal and California ESAs. When the subspecies was listed in 1986, the breeding range of least Bell's vireo was limited primarily from Santa Barbara County south to San Diego County. Since its listing, least Bell's vireo populations have been returning to their historical range (Kus 2002). Breeding has been documented near Gilroy (Santa Clara County) and along the Santa Clara River (Ventura County), Mojave River (San Bernardino County) and San Joaquin River (San Joaquin County) (Kus 2002, River Partners 2005). Critical habitat for the species has been designated in Santa Barbara, Ventura, Los Angeles, San Bernardino, Riverside, and San Diego counties (USFWS 1992).

Least Bell's vireos primarily occupy riparian habitats along open water or dry parts of intermittent streams, generally below 460 m (1,500 ft) in elevation (Kus 2002). They are generally associated with the following vegetation types: southern willow scrub; cottonwood forest; mule fat scrub; sycamore alluvial woodland; coast live oak riparian forest; arroyo willow riparian forest; wild blackberry; and mesquite in desert localities (Kus 2002). Most vireo territories contain both dense vegetative cover within 1–2 meters of the ground, the preferred habitat for nesting, and a dense, stratified overstory canopy, the preferred habitat for foraging (Goldwasser 1981, USFWS 1998a). Least Bell's vireos have been observed to maintain territories that include upland habitats adjacent to riparian areas, such as coastal sage scrub (USFWS 1998a). Upland habitats have also been documented for foraging and for nesting when early spring floods inundate riparian areas (Kus and Miner 1989, USFWS 1998a).

Least Bell's vireos generally arrive in California from mid- to late-March for a breeding season that typically ends in late September (Kus 2002). During this period they are known to breed almost exclusively within riparian habitats (USFWS 1998a). Least Bell's vireos have been documented to return to the same breeding site year after year (Greaves 1989).

Riparian areas in the Proposed Action area may provide appropriate nesting and foraging habitat for least Bell's vireo, however likelihood is low. While least Bell's vireo was previously reported as having been extirpated from the San Joaquin Valley, the species is currently reported as returning to its historic range and has recently been documented breeding in the San Joaquin National Wildlife Refuge (Reclamation 2009a).

Yellow Warbler

Yellow warbler (*Dendroica petechia*), a California SSC, is a summer resident that breeds throughout much of California except the Central Valley, southern Californian deserts, and high Sierra Nevada (Zeiner et al. 1990a, Heath 1998, Heath 2008). The largest concentrations of breeding pairs occur in northeastern California in Modoc National Forest and Shasta County, as well as the Cascade Range and Sierra Nevada (Heath 2008). The preferred habitat of yellow warblers includes open-canopy, deciduous riparian vegetation in close proximity to water, often along streams or wet meadows (Heath 2008). Frequently nesting in small willows and alders, yellow warblers are also associated with cottonwoods, Oregon ash, and other riparian shrubs and trees depending

upon the geographic region (Zeiner et al. 1990a, Heath 2008). The species also occasionally nests in montane chaparral in open coniferous forests (Heath 2008). Breeding occurs from mid-April through early August, with peak activity in June (Zeiner et al. 1990a). Yellow warblers nest 0.6 to 5 m (2 to 16 ft) above ground, at the base of branches (branch forks) in small deciduous trees and shrubs, often in willow thickets (Zeiner et al. 1990a, Lowther et al. 1999). Birds forage for insects within the shrub and tree canopy, occasionally feeding on the wing or eating fruit (Zeiner et al. 1990a, Lowther et al. 1999).

Riparian areas in the Proposed Action area may provide foraging habitat for yellow warblers; however the Proposed Action area is outside of the species' breeding range.

Yellow-breasted Chat

Yellow-breasted chat (*Icteria virens*), a migrant and summer resident distributed across much of California, is a State SSC. This species breeds mainly in northwestern California and the low- and mid-elevation Sierra Nevada, with sporadic occurrences documented in northeastern California (e.g., Lassen, Modoc, and Mono counties), the northern portion of the Central Valley, the San Francisco Bay-Delta region, central coast, and portions of southern California and southern deserts (Eckerle and Thompson 2001, Comrack 2008). Suitable elevations range up to 2,050 m (6,500 ft), the higher elevation occurrences are on the eastern side of the Sierra Nevada. Yellow-breasted chats can be found in dense thickets of willows or other brushy areas of riparian woodlands (Zeiner et al. 1990a, Ricketts and Kus 2000). The species prefers areas with an open-canopy and close proximity to water along streams or wet meadows; however, the preferred understory for nesting sites is thick and often includes a tangle of blackberry and wild grape (Zeiner et al. 1990a, Comrack 2008). Yellow-breasted chats form pairs and begin nesting in early May (Zeiner et al. 1990a). A few taller trees are necessary to use as perches for singing (Comrack 2008). This species forages in low, dense riparian shrubland on a variety of spiders, insects, and berries gleaned from vegetation (Zeiner et al. 1990a, Ricketts and Kus 2000).

The likelihood for occurrence within the survey area and in the vicinity of the Proposed Action is low. While some foraging and nesting habitat is present in riparian vegetation in the Proposed Action area, yellow-breasted chats are uncommon in this region of California.

Pallid Bat

Pallid bat (*Antrozous pallidus*), a State SSC, is fairly widespread in California. Pallid bats occupy a variety of habitats, from arid deserts to grasslands to conifer forests and riparian areas. Roosts (including day, night, and maternity roosts) are typically located in rock crevices and cliffs, but can also be found in tree hollows and caves (Hermanson and O'Shea 1983, Lewis 1994, Pierson et al. 1996, Pierson et al. 2001). In more urban settings, roosts are frequently associated with human structures such as abandoned buildings, abandoned mines, and bridges (Pierson et al. 1996, Pierson et al. 2001). Overwintering roosts require relatively cool and stable temperatures out of direct sunlight. Pallid bats typically glean prey from the ground, and may forage 1.6–4.8 km (1–3 mi) from their day roost (Zeiner et al. 1990b).

The pallid bat is a colonial species, with a typical maternal colony size of 50–300 (Hermanson and O'Shea 1983, Lewis 1994, Pierson et al. 1996). Breeding occurs from late October to February. With the average litter size of two, the young are born between April and July and are typically weaned in August (Sherwin and Rambaldini 2005).

Pallid bats may roost in the Proposed Action area within the riparian forest, and may forage over the Proposed Action site and nearby fields. Pallid bats do not likely use trees near the Proposed Action area as maternity roosts, as the species typically uses rock crevices for reproduction and rearing young.

Western Red Bat

Western red bat (*Lasiurus blossevillii*) is a California SSC. In California, western red bats have been observed near the Pacific Coast, Central Valley, and the Sierra Nevada. Usually found at lower elevations, recent acoustic surveys in California have documented that western red bats, while relatively rare, are broadly distributed up to 2,500 m (8,202 ft) in the Sierra Nevada (Pierson et al. 2000, 2001; Pierson and Rainey 2003). Western red bat roosts have often been observed in edge habitats—near streams, fields, orchards, or urban areas (Zeiner et al. 1990b). This species roosts non-colonially in dense canopies and within tree foliage, beneath overhanging leaves (Constantine 1959, Shump and Shump 1982), from 0.6 to 12 m (2 to 40 ft) above ground level (Zeiner et al. 1990b). Studies in the Central Valley found that summering populations of western red bats are substantially more abundant in remnant riparian stands of cottonwood or sycamore greater than 50 m (164 ft) wide than in younger, less extensive stands (Pierson et al. 2000). Western red bats may forage up to 0.5–1.0 km (0.3–0.6 mi) from their day roost (Zeiner 1990b), at both canopy height and low over the ground (Shump and Shump 1982). This species feeds primarily on small moths, but its diet may include a variety of other insects such as crickets, beetles, and cicadas (Zeiner et al.1990b).

Western red bats mate in August and September. Breeding females are found in association with the same cover requirements as for roost sites, and with cottonwood/sycamore riparian habitat along large river drainages in the Central Valley (Ziener et al. 1990b, Pierson and Rainey 2003). Fertilization is delayed until March or April. After an 80- to 90-day gestation period, pups are born from late-May through early-July.

Western red bats may roost (including maternity roosts) near the Proposed Action area in the riparian forest or cottonwoods, and may forage over the Proposed Action area and nearby fields.

San Joaquin Kit Fox

San Joaquin kit fox (*Vulpes macrotis mutica*) is Federally-listed as endangered and State listed as threatened. While a comprehensive survey of the range of kit fox has not been conducted, kit foxes are known to inhabit the San Joaquin Valley floor and the foothills of the coast range, Sierra Nevada, and Tehachapi mountains; from southern Kern County northwest to Contra Costa County and east to Madera County (USFWS 1998b). The largest extant populations of kit foxes are in western Kern County and in the Carrizo Plain in San Luis Obispo County (USFWS 1998b). There are three recognized larger

"core" populations and a number of smaller "satellite" kit fox populations within their range (USFWS 1998b). The most favorable habitats for San Joaquin kit foxes include saltbush scrub, arid grasslands, alkali sink, and heavily grazed mesic grasslands (Cypher et al. 2007). Agricultural, industrial, and urban development are deemed to be the primary factors responsible for impacts on kit fox habitat in the San Joaquin Valley, because of associated habitat fragmentation and anthropogenic disturbance (USFWS 1998b, Cypher et al. 2005). Agricultural lands are typically unsuitable kit fox habitat, as they are subject to intense ground disturbance and lack suitable prey (Cypher et al. 2007).

There is one documented CNDDB occurrence record for San Joaquin kit fox within 8 km (5 mi) of the Proposed Action area. While the Proposed Action area provides very limited denning opportunities, San Joaquin kit fox may occasionally use the Proposed Action area as dispersal habitat.

California Ringtail

California ringtail (*Bassariscus astutus*), a nocturnal carnivore in the raccoon family, is a California FP species. Ringtails are active year-long and widely distributed throughout California as a non-migratory resident, ranging over the entire State with the exception of the extreme northeast corner and the southern portions of the San Joaquin Valley (Orloff 1988). The highly developed agricultural portions of the San Joaquin Valley are considered unsuitable for ringtail (Orloff 1988). Little is known about the specific habitat requirements of California ringtails; they are found in a variety of environments including riparian, shrub, and forest in close association with rocky areas or riparian habitats (Jameson and Peeters 2004), and are usually not found more than 1 km (0.6 mi) from permanent water. Dens may be located in rock crevices, tree cavities, logs, snags, abandoned burrows, or woodrat nests (Zeiner et al. 1990b). The mating season occurs from February to May, and young are born around May and June (Zeiner et al. 1990b). Ringtails eat mainly rodents (woodrats and mice) and rabbits, although they also forage on fruits, berries, nuts, birds, reptiles, and invertebrates (Zeiner et al. 1990b, Jameson and Peeters 2004).

Riparian forest and scrub within the Proposed Action area provides suitable habitat, although the likelihood of occurrence is low due to surrounding agricultural land uses that are unsuitable and the paucity of sightings in the vicinity.

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3.0 GEOLOGIC AND GEOMORPHIC RESOURCES

3.1 Background

To assess the potential impacts of the Proposed Action and its alternatives on Geologic and Geomorphic Resources, several aspects of the river's physical characteristics and morphologic processes, including soil conditions, geologic hazards, current and historic channel and floodplain morphology, sediment transport regime, and bank characteristics, needed to be characterized. Per the *Data Needs and Survey Approach Technical Memorandum* for the Proposed Action, this characterization is based on existing information and a field survey of the Proposed Action area.

3.2 Soils, Mineral Resources, and Geologic Hazards

Per the *Data Needs and Survey Approach Technical Memorandum* for the Proposed Action, an evaluation on the existing conditions of soils, mineral resources, and geologic hazards in the Proposed Action area was conducted. This evaluation relied primarily upon the review of existing information sources. Soil conditions were further evaluated during a survey of the Proposed Action area.

3.2.1 Methods

To assess soil conditions, mineral resources, and geologic hazards in the Proposed Action area, existing relevant information was reviewed, including the following published reports, maps, and datasets:

- California Geological Survey (CGS). 2010. Geologic map of California. Scale 1:750,000. Original compilation and interpretation by C. W. Jennings in 1977. Updated version by C. Gutierrez, W. A. Bryant, G. Saucedo, and C. Wills in 2010.
- CGS. 2010. Fault activity map of California. Scale 1:750,000. Original compilation and interpretation by C. W. Jennings and W. A. Bryant in 1977 and 1994. Updated version by M. Patel, E. Sander, J. Thompson, B. Wanish, and M. Fonseca in 2010.
- McBain & Trush, Inc. 2002. San Joaquin River Restoration Study Background Report. Prepared for Friant Water Users Authority, Lindsay, California, and Natural Resources Defense Council, San Francisco, California.
- NRCS. 1962. Soil Survey of Madera Area, California.
- NRCS. 1971. Soil Survey, Eastern Fresno Area, California.
- NRCS. 1998. Soil Survey of Fresno County, California, Western Part.

- NRCS. 2010. Custom soil resource report for Fresno County, California, western part; and Madera area, California. NRCS Web Soil Survey online database. http://websoilsurvey.nrcs.usda.gov/app/. Accessed 18 November 2010.
- Reclamation and DWR. 2011. Draft PEIS/R for the SJRRP. SCH # 2007081125.

These existing information sources provide valuable information at a regional scale in the Proposed Action vicinity. The soils and geologic maps provide information at a reach scale within the Proposed Action area; however, a survey of the Proposed Action area was conducted to further characterize soil conditions at a more detailed level. On 17 June 2010, the entire Proposed Action area was traversed by foot and in a boat by a geologist/geomorphologist (Glen Leverich, Stillwater Sciences). Visual observations of soil exposures throughout the Reach 3 and 4A portions of the Proposed Action area were made on the earthen flood control levees, floodplain areas inside of the levees (where present), and the active river banks. Select measurements of soil particle sizes were also taken. Characterization of river bed and bank sediment texture is discussed below in Section 3.3.

Information pertaining to geologic hazards including faulting, seismicity, deformation, subsidence, and liquefaction was obtained from the SJRRP PEIS/R (Reclamation and DWR 2011) and available USGS and CGS maps and databases.

3.2.2 Results

Soils

The valley floor of the Central Valley Province, in which the Proposed Action area is situated, is composed of unconsolidated to semi-consolidated, continental alluvium that has deposited continuously during the Quaternary Period (last 2 million years) (CGS 2010a). The Sierra Nevada and Coast ranges are the source of these sediments, while the San Joaquin River and its tributaries together serve as the conduits through which these sediments are transported downstream to the valley floor. The texture of soils along the valley floor and streambanks in the Proposed Action vicinity has been classified primarily as a sandy loam without clay (i.e., valley basin soils, imperfectly drained) that possess moderate erosion potential (Reclamation and DWR 2011). In general, a “sandy loam” soil classification describes a soil material that is composed of more than one-half sand and less than one-half silt and has low to no internal cohesion, or strength. A review of mapped soils in the Proposed Action area confirms that soils present on the valley floor (i.e., agriculture fields) outside of the flood control levees and on the floodplain and river banks inside of the levees are predominantly composed of fine sandy loam (NRCS 2010) (Table 3-1). Observations of soil exposures on the river floodplain inside of the levees further confirmed that the dominant soil texture present in the Proposed Action area is a sandy loam with some organics.

Table 3-1. Soil Types Mapped by the NRCS in the Proposed Action Area[1]

Mapping area[2]	Map unit symbol	Map unit name
Fresno County (CA653) – river left side of the Proposed Action area	320	Elnido **sandy loam**, drained, 0 to 1% slopes
	941	Bisgani-Elnido association, 0 to 1% slopes
Madera Area (CA651) – river right side of the Proposed Action area	CmdA	Columbia **fine sandy loam**, moderately deep and deep over hardpan 0 to 1% slopes
	CmtA	Columbia **fine sandy loam**, moderately deep and deep over temple soils, 0 to 1% slopes
	CoA	Columbia **loamy sand**, 0 to 1% slopes
	CotA	Columbia **loamy sand**, over temple soils, 0 to 1% slopes
	CrB	Columbia soils, channeled, to 8% slopes
	FcbA	Foster **loams**, moderately deep and deep over temple soils, moderately saline-alkali, 0 to 1% slopes
	Rh	Riverwash

[1]Source: NRCS (2010).

[2]Within the Proposed Action area, the San Joaquin River forms the boundary between Fresno and Madera counties.

Mineral Resources

There are limited mineral resources in the vicinity of the Proposed Action area and it is situated well downstream of the primary aggregate extraction areas located in Reach 1 (McBain & Trush, Inc. 2002). Although gold was historically mined from the San Joaquin River bed, there are no current gold extraction operations remaining on any part of the river (Reclamation and DWR 2011).

Geologic Hazards

Minor tectonic activity occurs in the San Joaquin Valley as part of the overall motion of the microplate that comprises the Sierra Nevada mountains and the Central Valley, which accommodates motion between the North American Plate to the east and the Pacific Plate to the west (Reclamation and DWR 2011). Right-lateral movement of this microplate relative to the North American Plate has been estimated at 10 to 14 mm per year (0.4 to 0.6 inches per year), while its right-lateral motion compared to the Pacific Plate to the west is nearly four times higher, at 38 to 40 mm per year (1.5 to 1.6 inches per year) (Wakabayashi and Sawyer 2001 as cited in Reclamation 2009a).

Several mapped active and inactive faults lie along the valley margins and mountain foothills with relatively few faults present on the valley floor. In proximity to the Proposed Action area, the San Andreas Fault Zone lies approximately 75 km (46 mi) to the southwest within the Coast Range while the Bear Mountains Fault Zone (part of the

Foothills Fault System) lies approximately 80 km (50 mi) to the northeast within the Sierra Nevada foothills (CGS 2010b). Both of these fault zones are classified by the CGS as being "active" based on evidence of geologically recent movement, as determined with historical seismicity records (decadal to centennial time scale) or with measured displacement estimated to have occurred during the Quaternary Period, or the past 2 million years. The closest active fault to the Proposed Action area is the San Joaquin Fault, which is positioned 28 km (17 mi) to the southwest (along Interstate 5) and is believed to have experienced displacement between 11,700 and 700,000 years before present.

The paucity of active and inactive faults within the San Joaquin Valley indicates that deformation is minimal relative to deformation in the bordering mountain ranges. Lettis and Unruh (1991) reported that the valley sediments are deformed into a broad, asymmetrical trough with its axis positioned approximately 19 to 31 km (12 to 19 mi) west of the San Joaquin River. Subsidence in the valley is active and has been estimated at least 0.2 to 0.4 mm per year (0.008 to 0.016 inches per year) (Lettis and Unruh 1991). Subsidence has been attributed to both tectonic activity (i.e., Coast Range thrust motion) and human induced impacts, chiefly from groundwater pumping for irrigation (i.e., hydrocompaction).

The hazard potential from earthquake groundshaking is low throughout much of the central portions of the San Joaquin Valley. Review of a groundshaking hazard map published by the CGS (Branum et al. 2008) reveals that there have been no historical earthquakes measuring greater than Magnitude 5 recorded in the Proposed Action vicinity. Accordingly, risks of liquefaction—the process by which saturated, unconsolidated sediments (or soils) are transformed into a semi-fluid substance during seismic events—in the Proposed Action vicinity are considered to be low because of the low risk of earthquake and groundshaking hazard risk (Reclamation and DWR 2011). However, liquefaction risks do exist because unconsolidated sediments and shallow groundwater (or irrigated surface soils) occur throughout the valley.

3.3 Channel Morphology Mapping and Characterization of Bank Conditions

Per the *Data Needs and Survey Approach Technical Memorandum* for the Proposed Action, a general channel morphology mapping survey and streambank conditions assessment were conducted to characterize geomorphic features of the river corridor. The survey and assessment were focused in the reach downstream of Sack Dam where the Proposed Action could potentially impact these features. The types of approaches utilized and the specific features considered in the mapping survey and bank conditions assessment included:

1. Delineation of bar-pool-riffle morphologic units;
2. Measurement of maximum pool depths;

3. Delineation of alluvial deposits and active sediment storage (e.g., point-bars, mid-channel bars);
4. Mapping of riparian vegetation and large woody debris (LWD);
5. Mapping of any deviation of the sediment texture from the expected sand-dominated sediment facies;
6. Characterization of bank conditions (e.g., substrate size, bank strength, vegetation influence); and
7. Identification of bank erosion or other sediment sources.

3.3.1 Methods

Existing information review

To assess channel morphology and bank conditions, existing relevant information for the Proposed Action area was reviewed. Specifically, the following published reports, maps, and datasets were reviewed, in addition to those information sources listed above in Section 3.2.1:

- Geomorphology and hydrology:
    - CDWR. Stream gauging records for water year 2010 from the former USGS gauge San Joaquin River near Dos Palos #SDP, 15-minute data. CDWR CDEC website: http://cdec.water.ca.gov/cgi-progs/staMeta?station_id=SDP
    - Jones and Stokes Associates and Mussetter Engineering Inc. (JSA and MEI). 1998. Analysis of Physical Processes and Riparian Habitat Potential of the San Joaquin River – Friant Dam to the Merced River, California. Prepared for the SJRRP.
    - MEI. 2000. Hydraulic and Sediment Continuity Modeling of the San Joaquin River from Mendota Dam to the Merced River. Prepared for the Reclamation, Contract No. 99-CP-20-2080.
    - McBain & Trush, Inc. 2002. San Joaquin River Restoration Study Background Report. Prepared for Friant Water Users Authority, Lindsay, California, and Natural Resources Defense Council, San Francisco, California.
    - Stillwater Sciences. 2003. Restoration Objectives for the San Joaquin River. Prepared for Friant Water Users Authority, Lindsay, California, and Natural Resources Defense Council, San Francisco, California.
    - USGS. Stream gauging records for water years 1940 – 1954 from USGS 11256000 San Joaquin River near Dos Palos. USGS website: http://waterdata.usgs.gov/ca/nwis/inventory/?site_no=11256000&agency_cd=USGS&amp.
- Historical and current aerial photography:
    - USGS. 1998. Aerial photographic coverage of the Central Valley taken 15 August 1998, accessed from Google Earth, 2010.

  - USDA National Agricultural Imagery Program (NAIP). 2009. Aerial photographic coverage of the Central Valley taken 25 May 2009, accessed from Google Earth, 2010.

- Topographic and bathymetric survey data:
  - Reclamation. 2010. April 2010 bathymetric data collection on the San Joaquin River. Report: SRH-2010-17. Prepared by the Reclamation, Technical Service Center, Denver, Colorado, Sedimentation and River Hydraulics Group, 86-68240. July.
  - Reclamation. 2010. Digital elevation model (DEM) of Reach 3 and 4A of the San Joaquin River, compiled by Reclamation using 2008 LIDAR and 1998 and 2010 bathymetric survey data.

These existing information sources provide valuable information at a reach scale, which is important for characterizing general physical process in the Proposed Action area. The morphodynamics[5] of the river in the general Proposed Action area were initially assessed for this study by utilizing the available published information (e.g., McBain & Trush, Inc. 2002), aerial photographs (1998 and 2009), and topographic/bathymetric data recently compiled and provided by Reclamation (E. Holburn-Gordon, pers. comm., 2010). However, the vast majority of these information sources did not describe geomorphic conditions at a sufficiently fine scale to allow for an adequate review of existing conditions in the Proposed Action area. Specifically, local channel geometry, substrate texture, active erosional and depositional processes, and LWD loading and replenishment sources needed to be further surveyed in the field to adequately characterize existing conditions in the Proposed Action area.

Field Survey

On 17 June 2010, the entire river channel in the Proposed Action area was traversed by foot and boat by a geologist/geomorphologist (Glen Leverich, Stillwater Sciences). A geomorphic map representing the key geomorphic attributes of the river channel was compiled on geo-rectified aerial photographs (6 June 2009 photo date) of the channel upstream and downstream of Sack Dam. The mapped attributes include: bar-pool-riffle units, alluvial deposits and active sediment storage, riparian vegetation and LWD, channel bed and bar texture, bank composition, and bank erosion. The mapping extended 620 m (2,030 ft) upstream (i.e., Reach 3) and 1,320 m (4,330 ft) downstream of Sack Dam. This roughly corresponds to a survey extent that was 7 and 14 times bankfull width (i.e., distance between the levees) in the upstream and downstream directions, respectively. Many photographs were taken throughout the Proposed Action area to capture specific elements for subsequent re-evaluation in the data analysis. Pool depths were measured throughout the study reaches in order to assist with the delineation of pool units; specific measurements are not presented herein because the values are dependent on the river stage during the time of measurement.

[5] River morphodynamics is generally referred to as the study of the evolution of riverine systems in response to the erosion and deposition of sediment.

Data Analysis

The field mapping was integrated into a GIS by scanning the field maps at 600 dpi resolution, digitizing the field-delineated mapping boundaries, and entering GPS point data for point bars, pools, riffles, cut banks, and LWD locations. Digitized mapping boundaries were checked for accuracy by the field geomorphologist and corrected as necessary. Finally, the GIS-generated shapefiles were overlain on a DEM of the Proposed Action area. This DEM is a composite of three different elevation datasets that were recently compiled by Reclamation (E. Holburn-Gordon, pers. comm., 2010): (1) subaerial surfaces outside of the wetted channel were generated from LiDAR survey data collected in 2008; (2) bathymetric data for Reach 3 collected in 2010; and (3) bathymetric data for Reach 4A collected in 1998. Although the Reach 4A bathymetry data contained in this DEM are over 10 years old, the channel morphology they represent (i.e., planform, width, and bed morphology) appears very similar to the morphology exhibited in 2009 aerial photographs and our 2010 field survey and, therefore, this dataset was considered to be appropriate for use in our channel morphology analysis.

The DEM was specifically used in this analysis to determine specific channel characteristics upstream and downstream of the dam, including thalweg[6] location, thalweg slope, and river width between the confining levees (i.e., bankfull width). In Reach 4A where the Proposed Action could potentially have the greatest impact, the widths and depths of the inset channel that is bounded by the cut banks was also determined.

To evaluate changes in the river channel at the t area, aerial photographs from 1998 and 2009 (accessed from Google Earth) were used in GIS to compare the channel planform and general bed and floodplain morphology during the past decade. Available river discharge records for the Proposed Action area combined with the field survey data were evaluated to estimate the discharge in Reach 4A when these aerial photographs were taken.

3.3.2 Results

Existing Channel Morphology Conditions

The channel in the vicinity of the Proposed Action is a meandering, sand-bedded, single-thread channel. The channel upstream of Sack Dam is moderately confined; historically by natural floodplain levees and splays, but currently confined on both banks by man-made structures including canal embankments and flood protection levees. Downstream of Sack Dam, the same man-made structures (e.g., levees and Poso Canal) border the river, but the active river channel is significantly narrower than above the dam due to the reduction in base flow as water above the dam is diverted into Arroyo Canal. The active channel here is bordered by a narrow floodplain with dense vegetation that is also contained within the flood control levees.

[6] Thalweg refers to a continuous trace along the length of a stream channel that follows the lowest portions of the channel bed.

The geomorphic map, which was compiled in a GIS using field survey data, is presented in Figure 3-1. As represented in Figure 3-1, the wetted channel above the dam is bordered by a poorly defined wetted-channel margin that is densely vegetated with riparian trees, shrubs, and aquatic plants. Exposures of banks are rare along the wetted margin, but where they are visible the banks were observed to be composed of a sandy loam with some organics. Dense exposures of tree and shrub roots are present along these few observed streambanks, which undoubtedly provide bank strength to the generally cohesion-less bank substrates throughout the reach. There were 24 LWD pieces and/or clusters located throughout this reach, which were situated along the wetted channel margin typically along the outer bend of the river and adjacent to riparian forest cover, which is presumably the local source of the LWD. The curvature of the river and the projection of tree roots from the banks into the river would likely serve to trap floating LWD originating from upstream sources. A large mid-channel sand bar that is densely vegetated is situated approximately 420 m (1,370 ft) upstream of Sack Dam. Due to the inundated nature of Reach 3 above the dam, it was not possible to note bed morphologic characteristics during the field survey, apart from occasionally measuring channel depths and inspecting bed sediment texture. Review of the bathymetric data represented in the DEM provided by Reclamation determined that there are no distinguishable bed forms, such as bars or pools (besides the mid-channel island bar), and that the bed morphology is generally plane bedded, or flat. The dominant bed substrate throughout this reach is coarse sand.

Below the dam in Reach 4A, the active channel is considerably narrower, confined between cut banks exhibiting active bank erosion processes (e.g., block failure, toe scour), and host to a few bar-pool-riffle features. There are geomorphic indicators that the channel in this reach has a relatively greater potential to meander within the confines of the flood protection levees; however, consideration of the low flows conveyed through this reach and of general channel morphology viewable in aerial photographs suggests that lateral change in the river's planform geometry is slow to non-existent, at least on a decadal time frame (see below). Throughout the entire length, the active channel is bordered by steep, cut banks that are composed of a sandy loam with organics and support a reasonably dense stand of riparian trees and shrubs, albeit less dense than above the dam. The density of exposed roots on the bank surfaces is high, which serves to provide cohesion to the sandy, generally cohesion-less bank materials. Vegetation in this reach has undoubtedly encroached on the floodplain toward the narrower active channel, but there is evidence of episodic scouring of vegetation on the streambanks and floodplain. Pieces and/or clusters of LWD located in this reach appeared to be concentrated more in the downstream portion adjacent to the riparian forest. There are several point bars and pools in this study reach, with only one clearly delineated bar-pool-riffle unit that is positioned 370 m (1,200 ft) downstream of the dam. All point bars noted in this reach function as sediment storage zones that have the potential to continue growing laterally and/or vertically or to be scoured during large sediment transporting events. The reduction of flow, particularly peak flows, into this reach has undoubtedly contributed to the stability of these bars over the last several decades (see below), in that the magnitude and frequency of sediment transporting events has been much reduced over the past several decades. A first-order approximation of the threshold of entrainment of the median particle size present in this reach (D_{50}≈0.8 mm) indicates that

the bed should be quite mobile during a bankfull flow in the active channel. It is not known, however, how frequently bankfull flow within the active channel boundaries presently occurs, but determining this will be a necessary component of any future analysis of potential impacts from the alternatives.[7]

The existing channel morphometric characteristics in the Proposed Action area are summarized in Table 3-2. An inventory summary of the surveyed LWD in the Proposed Action area is presented in Table 3-3. Photographs depicting representative characteristics of the Proposed Action area are presented in Figures 3-2, 3-3, and 3-4.

[7] Reclamation is presently conducting a hydraulic and sediment transport modeling effort throughout the SJRRP area, which will provide a better understanding of the sediment transport dynamics, under both existing and with-Proposed Action scenarios, in the Proposed Action area.

Table 3-2. Channel Morphometric Characteristics in the Surveyed Portion of the Proposed Action Area

Reach	Surveyed thalweg length		Surveyed thalweg slope	Average distance between flood control levees[1]		Average active channel width[2]		Average active channel depth[3]		Sinuosity
	(m)	(ft)		(m)	(ft)	(m)	(ft)	(m)	(ft)	
3	725	2,380	0.0077	152	500	NA	NA	NA	NA	1.05
4A	1,335	4,380	0.011	122	399	22	71	1.4	4.6	1.03

[1] This parameter is referenced by other studies to represent "bankfull width".
[2] The active channel is defined in Reach 4A to represent the wetted channel between the cut banks (see Figure 3-2).
[3] The active channel depth was determined by assuming that the wetted channel was filled up to the top of the cut banks.

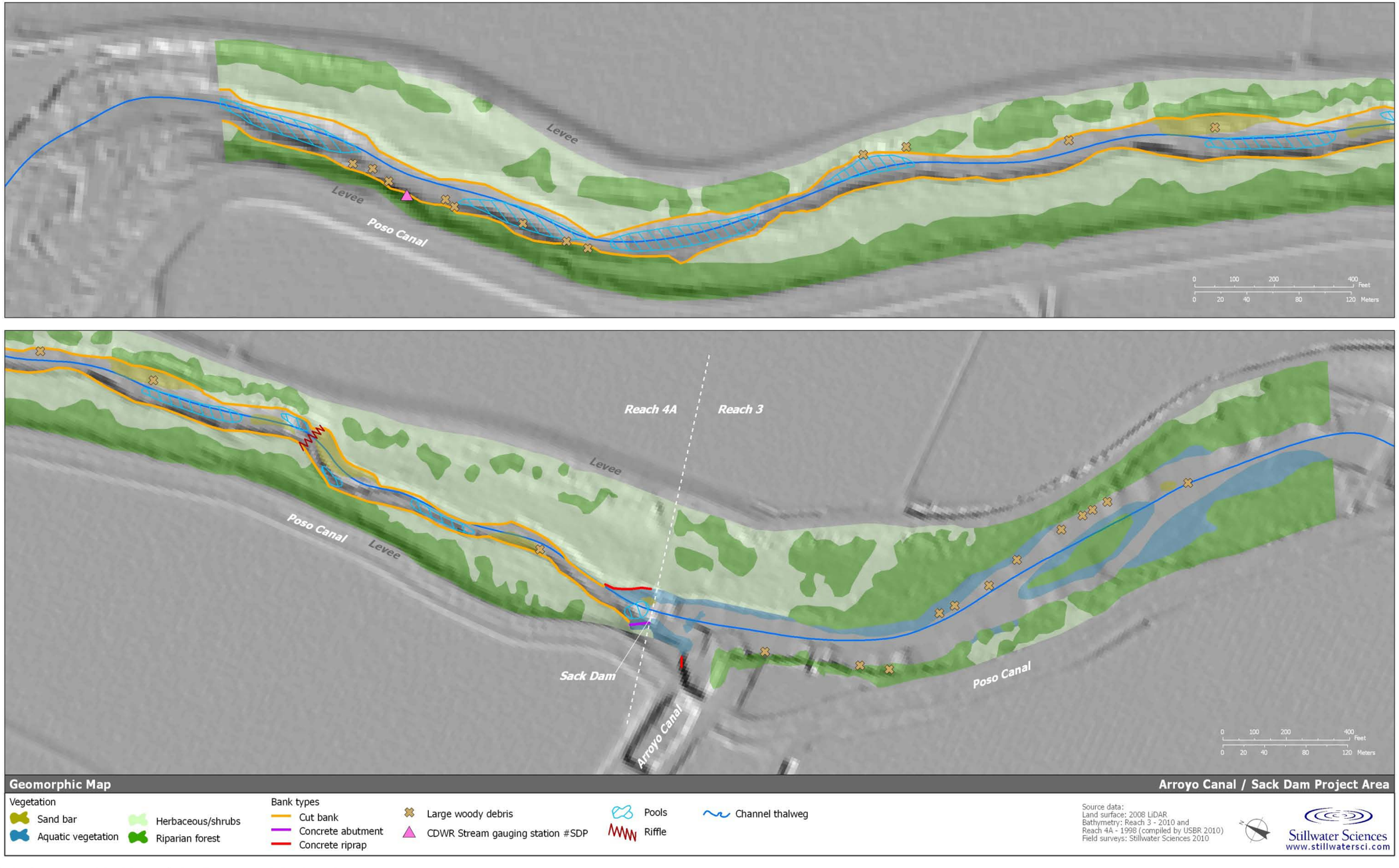

Figure 3-1. Geomorphic Map of the Proposed Action Area

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Table 3-3. Inventory of LWD in the Proposed Action Area

LWD ID, ordered from upstream to downstream	GPS waypoint #	Coordinates[1]	River reach	Position in river	LWD assemblage type	Approximate diameter of dominant LWD trunk (inches)
1	178	36.979929° N, -120.496514° W	3	middle	individual	8
2	181	36.980498° N, -120.497063° W		right bank	individual	24
3	183	36.980585° N, -120.497211° W		right bank	individual	12
4	184	36.980645° N, -120.497309° W		right bank	individual	6
5	185	36.980760° N, -120.497542° W		right bank	cluster	8
6	187	36.981004° N, -120.498039° W		right bank	individual	8
7	188	36.981129° N, -120.498418° W		river right in aquatic vegetation	individual	6
8	189	36.981329° N, -120.498770° W			individual	6
9	190	36.981422° N, -120.498912° W			individual	6
10	170	36.981616° N, -120.499691° W		left bank	individual	8
11	168	36.981862° N, -120.499784° W		left bank	individual	16
12	165	36.982661° N, -120.500074° W		left bank	individual	16
13	198	36.984805° N, -120.500080° W	4A	left bank, above water	individual	6
14	212	36.988467° N, -120.500155° W		river right on point bar	individual	4
15	215	36.989464° N, -120.500378° W		right bank	cluster	<4
16	217	36.990578° N, -120.500562° W		right bank	individual	20
17	218	36.990869° N, -120.500661° W		right bank	individual	24
18	220	36.992710° N, -120.501675° W		left bank	cluster	<4
19	221	36.992860° N, -120.501634° W		left bank	cluster	<4
20	222	36.993171° N, -120.501514° W		left bank	cluster	<4
21	223	36.993652° N, -120.501423° W		left bank	cluster	<4
22	224	36.993718° N, -120.501367° W		left bank	cluster	<4

LWD ID, ordered from upstream to downstream	GPS waypoint #	Coordinates[1]	River reach	Position in river	LWD assemblage type	Approximate diameter of dominant LWD trunk (inches)
23	225	36.993986° N, -120.501356° W		left bank	cluster	<4
24	226	36.994119° N, -120.501256° W		left bank	cluster	<4

[1] Coordinate system: WGS84.

Figure 3-2. Photograph of Reach 3 Looking Upstream from Sack Dam. The river depth was approximately 2 m (6 ft) and dense riparian and aquatic vegetation bordered the wetted perimeter, with some LWD distributed throughout the surveyed area.

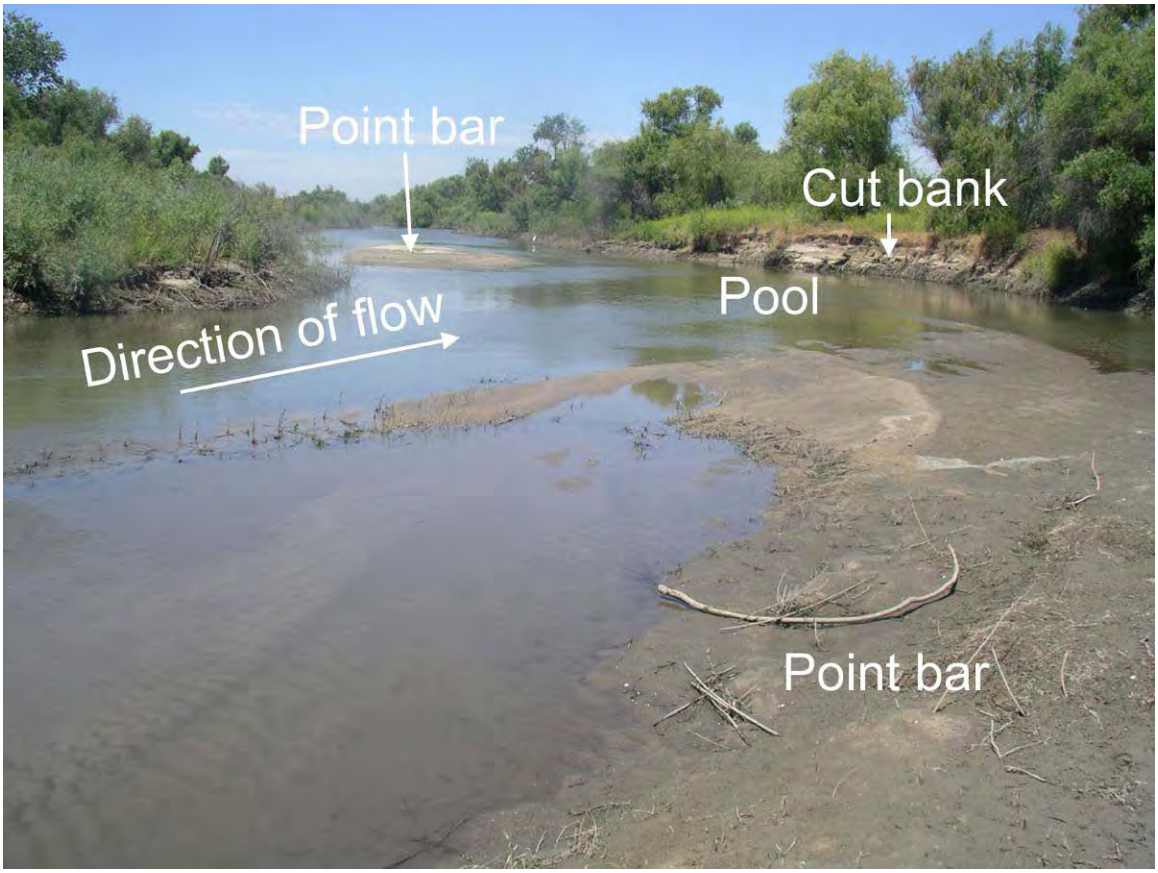

Figure 3-3. Photograph Highlighting Key Features Present in a Bar-Pool Morphologic Unit of the Surveyed Segment of Reach 4A Downstream of Sack Dam. The river thalweg swings back over from river left to river right as it is topographically steered by the sandy point bars toward the eroding cut bank. Photo taken at 36.986753° N, -120.500083° W on 17 June 2010.

Figure 3-4. Photograph of Actively Eroding, Sandy, Vertical Cut Bank on River Right in the Surveyed Segment of Reach 4A. The top of bank was measured to be 2 m (7 ft) above the water surface. A high density of plant roots provided additional bank strength to the sandy riverbanks. Photo taken at 36.987330° N, -120.499843°W on 17 June 2010.

Changes in the Channel Morphology

Previous studies utilizing historical channel cross sections found there was an overall decrease in channel width, depth, and thalweg elevation during the period of 1914 to 1998 (e.g., JSA and MEI 1998) (Table 3-4). Significant changes in the channel morphology, but particularly in planform and sinuosity, were also noted in these other studies (e.g., McBain & Trush, Inc. 2002). Based on our review of the aerial photographs taken of the Proposed Action area in 1998 and 2009, analysis of the DEM, and consideration of our field survey data, we determined that very little physical change has occurred upstream or, more importantly, downstream of Sack Dam during this recent period (Figure 3-5). Most notable in the aerial photographs is that the planform of the active channel in both reaches has been essentially fixed over time by the position of Sack Dam. Also visible in the aerial photographs and confirmed in the field, is that inundation of the floodplain in Reach 4A has occurred at least once in recent years. This finding is based on evidence of vegetation scour and overbank sand deposition (i.e., bare

sandy surfaces seen outside of the wetted channel downstream of the dam). However, despite the occurrence of these infrequent high flow events, migration of the channel banks and bars appears to have been minimal.

Table 3-4. Channel Morphometric Characteristics in the Vicinity of the Proposed Action Area Based on Other Studies[1]

Reach	Cross-section (RM)	Bankfull width (ft)		Bankfull depth (ft)		Width-depth ratio		Change in thalweg elevation: 1914–1998 (ft)	Sediment size[2]			
		1998	Change since 1914	1998	Change since 1914	1998	Change since 1914		Sample number (RM)	D_{16} (mm)	D_{50} (mm)	D_{84} (mm)
3	XS 29 (201.6)	384	-406	14	+0.8	27	-33	-10.8	S-6 (199)	0.55	1.60	8.0
	XS 36 (193.7)	307	-153	12.9	-6.1	24	0	-1.5	S-5 (197)	0.52	0.97	1.7
4A	XS 48 (178.8)	279	-81	9.8	-1.2	29	-4	-3.9	S-4 (174)	0.32	0.75	1.6
	XS 53 (171.0)	234	+74	18.0	+2	13	+3	-2.2	NA	NA	NA	NA

[1] Source: JSA and MEI (1998).

[2] Bulk sediment samples collected near cross sections; Source: JSA and MEI (1998)

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Figure 3-5. Comparison of 1998 and 2009 Aerial Photographs of the Proposed Action Area. There has been relatively little change in the river morphology during this period. Discharge in Reach 4A is assumed to be approximately 2.8 $m^3 s^{-1}$ (100 cfs) based on similarities between the wetted channel width visible here and the width observed during our field survey. Note that the river stage in Reach 3 was higher when the 1998 photograph was taken than when the 2009 photograph was taken, while the stage in Reach 4A was nearly the same when the 1998 and 2009 photographs were taken.

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APPENDIX A

VEGETATION RAPID ASSESSMENT FIELD FORMS

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CALIFORNIA NATIVE PLANT SOCIETY - VEGETATION RAPID ASSESSMENT FIELD FORM

(Revised Sept. 20, 2004)

For Office Use:	Final database #:	Final vegetation type name:	Alliance SALIX EXIGUA SHRUBLAND Association

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #:	Air photo #:	Date:	Name(s) of surveyors:
SD1	—	4/29/10	ZED

GPS waypoint #: SD1 GPS name: 2173 GPS datum: (NAD 27) NAD83 Is GPS within stand? (Yes) / No

If No, cite from GPS point to stand, the distance _____(in meters) and bearing _____(in degrees) GPS Error: ± 6 ft (m)

UTM field reading: UTME ~~722~~ 0722539 UTMN 4095896 UTM zone: 10S

Elevation: 35 ft / (m) Photograph #'s: 6661

Topography: convex___ flat___ concave___ undulating X | top___ upper___ mid___ lower___ bottom___

Geology: SAAL Soil Texture: MSN Rock: %Large___ %Small___ %Bare/Fine:___ %Litter: 10 %BA Stems: 90

Slope exposure (circle one and/or enter actual °): NE_____ NW_____ SE_____ SW_____ Flat__ Variable X

Slope steepness (circle one and enter actual °): 0°__ 1-5° X 5-25°____ > 25°____ Upland or (Wetland/Riparian) (circle one)

Site history, stand age, and comments: Right bank of SJR across from Arroyo canal intake

Type/ Level of disturbance (*use codes*): 15 / M ___/___ ___/___ ___/___ ___/___ ___/___ ___/___ ___/___

II. VEGETATION DESCRIPTION

Field-assessed vegetation alliance name: Salix exigua shrubland

Field-assessed association name (optional): _____

Size of stand: <1 acre X 1-5 acres___ >5 acres___ Adjacent alliances: open water, disturbed non-native grassland

Tree: T1 (<1" dbh), T2 (1-6" dbh), T3 (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

If Tree, list 1-3 dominant overstory spp.: _____

Shrub: S1 seedling (<3 yr. old), (S2) young (<1% dead), S3 mature (1-25% dead), S4 decadent (>25% dead)

Herbaceous: H1 (<12" plant ht.), (H2) (>12" ht.) Desert Palm/Joshua Tree: 1 (<1.5" base diameter), 2 (1.5-6" diam.), 3 (>6" diam.)

Desert Riparian Tree/Shrub: 1 (<2ft. stem ht.), 2 (2-10ft. ht.), 3 (10-20ft. ht.), 4 (>20ft. ht.)

% Overstory Conifer/Hardwood Tree cover: —/— Shrub cover: 60 Herbaceous cover: 80 Total Veg cover: 100

Overstory Conifer/Hardwood height: —/— Tall Shrub/Low Shrub height: 03/02 Herbaceous height: 01

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species (List up to 12 major species), Stratum, and Approximate % cover: (Jepson Manual nomenclature please)

Stratum categories: T=tall, M=medium, L=low; *% cover intervals for reference*: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%

Strata	Species	% cover	Strata	Species	% cover
M	Sal. exigua	60			
S	Hirschfeldia incana	20		these are replaced by RUSA	
S	Bromus madritensis (E)	20		further south	

Major non-native species - With % cover: _____

Unusual species: Juncus sp. ©, Hydrocotyle sp. © waters edge

III. PROBLEMS WITH INTERPRETATION

Confidence in identification: (L, M, H) H Explain consistent

Other identification problems (describe): _____

Polygon is more than one type: (Yes, No) N (Note: type with greatest coverage in polygon should be entered in above section)

Other types: _____ _____ _____

Has the vegetation changed since air photo taken? (Yes, No) N If Yes, how? What has changed (write N/A if so)? _____

CALIFORNIA NATIVE PLANT SOCIETY - VEGETATION RAPID ASSESSMENT FIELD FORM

(Revised Sept. 20, 2004)

For Office Use:	Final database #:	Final vegetation type name:	Alliance SALIX GOODDINGII WOODLAND Association

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #:	Air photo #:	Date:	Name(s) of surveyors:
SD2		4/29/10	ZED

GPS waypoint #: SD2 GPS name: 217 3 GPS datum: (NAD 27) NAD83 Is GPS within stand? (Yes) No

If No, cite from GPS point to stand, the distance _____(in meters) and bearing _____(in degrees) GPS Error: ± 7 ft / (m)

UTM field reading: UTME 0722531 UTMN 4095817 UTM zone: 10S

Elevation: 35 ft (m) Photograph #'s: 662

Topography: convex___ flat___ concave___ undulating X | top___ upper___ mid___ lower___ bottom___

Geology: SAAL Soil Texture: MSN Rock: %Large___ %Small ___ %Bare/Fine: ___ %Litter: ___ %BA Stems: 100

Slope exposure (circle one and/or enter actual °): NE_____ NW_____ SE_____ SW_____ Flat__ Variable X

Slope steepness (circle one and enter actual °): 0°__ 1-5°____ 5-25°____ > 25°____ Upland or (Wetland/Riparian) (circle one)

Site history, stand age, and comments: Infrequently flooded floodplain + back channel

Type/ Level of disturbance (*use codes*): ___/___ ___/___ ___/___ ___/___ ___/___ ___/___ ___/___ ___/___ ___/___

II. VEGETATION DESCRIPTION

Field-assessed vegetation alliance name: Salix goodingii woodland

Field-assessed association name (optional): _____

Size of stand: <1 acre X 1-5 acres___ >5 acres___ Adjacent alliances: open water, DOFR

Tree: T1 (<1" dbh), (T2) (1-6" dbh), T3 (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

If Tree, list 1-3 dominant overstory spp.: Salix gooddingii,

Shrub: S1 seedling (<3 yr. old), (S2) young (<1% dead), S3 mature (1-25% dead), S4 decadent (>25% dead)

Herbaceous: H1 (<12" plant ht.), (H2) (>12" ht.) Desert Palm/Joshua Tree: 1 (<1.5" base diameter), 2 (1.5-6" diam.), 3 (>6" diam.)

Desert Riparian Tree/Shrub: 1 (<2ft. stem ht.), 2 (2-10ft. ht.), 3 (10-20ft. ht.), 4 (>20ft. ht.)

% Overstory Conifer/Hardwood Tree cover: — / 15 Shrub cover: 75 Herbaceous cover: 10 Total Veg cover: 100

Overstory Conifer/Hardwood height: — / 04 Tall Shrub/Low Shrub height: 03 / 02 Herbaceous height: 02

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species (List up to 12 major species), Stratum, and Approximate % cover: (Jepson Manual nomenclature please)

Stratum categories: T=tall, M=medium, L=low; *% cover intervals for reference*: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%

Strata	Species	% cover	Strata	Species (In other parts of polygon)	% cover
M	SALIX	10	H	POFR	20
S	Juncus hindsii	5	L	Artemisia dracunculus	40
S	SALIX	15	L	Juncus sp. (E)	20
			L	Bromus spp.	20

Major non-native species - With % cover: —

Unusual species: Salix sp. (E) Rosa sp. NIF

III. PROBLEMS WITH INTERPRETATION

Confidence in identification: (L, M, H) H Explain _____

Other identification problems (describe): _____

Polygon is more than one type: (Yes, No) N (Note: type with greatest coverage in polygon should be entered in above section)

Other types: _____

Has the vegetation changed since air photo taken? (Yes, No) N If Yes, how? What has changed (write N/A if so)? _____

CALIFORNIA NATIVE PLANT SOCIETY - VEGETATION RAPID ASSESSMENT FIELD FORM

(Revised Sept. 20, 2004)

For Office Use:	Final database #:	Final vegetation type name:	Alliance POPULUS FREMONTII WOODLAND Association

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #: SD3	Air photo #: —	Date: 4/29/10	Name(s) of surveyors: ZED

GPS waypoint #: SD3 GPS name: 2173 GPS datum: (NAD 27) NAD83 Is GPS within stand? (Yes) / No

If No, cite from GPS point to stand, the distance _____ (in meters) and bearing _____ (in degrees) GPS Error: ± 5 ft (m)

UTM field reading: UTME 0722594 UTMN 4095855 UTM zone: 10S

Elevation: 35 ft (m) Photograph #'s: 663

Topography: convex___ flat X concave___ undulating___ | top___ upper___ mid___ lower___ bottom___

Geology: SAAL Soil Texture: MESN Rock: %Large___ %Small ___ %Bare/Fine: 5 %Litter: ___ %BA Stems: 95

Slope exposure (circle one and/or enter actual °): NE_____ NW_____ SE_____ SW_____ Flat X Variable__

Slope steepness (circle one and enter actual °): 0° X 1-5° ____ 5-25° ____ > 25° ____ Upland or (Wetland/Riparian) (circle one)

Site history, stand age, and comments: Infrequently flooded floodplain

Type/ Level of disturbance (*use codes*): L /___ ___/___ ___/___ ___/___ ___/___ ___/___ ___/___ ___/___ ___/___

II. VEGETATION DESCRIPTION

Field-assessed vegetation alliance name: POFR woodland

Field-assessed association name (optional): _____

Size of stand: <1 acre X 1-5 acres___ >5 acres___ Adjacent alliances: SAEX, disturbed, ag

Tree: T1 (<1" dbh), T2 (1-6" dbh), T3 (6-11" dbh), (T4) (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

If Tree, list 1-3 dominant overstory spp.: POFR, SAGO

Shrub: S1 seedling (<3 yr. old), S2 young (<1% dead), (S3) mature (1-25% dead), S4 decadent (>25% dead)

Herbaceous: H1 (<12" plant ht.), (H2) (>12" ht.) Desert Palm/Joshua Tree: 1 (<1.5" base diameter), 2 (1.5-6" diam.), 3 (>6" diam.)

Desert Riparian Tree/Shrub: 1 (<2ft. stem ht.), 2 (2-10ft. ht.), 3 (10-20ft. ht.), 4 (>20ft. ht.)

% Overstory Conifer/Hardwood Tree cover: — / 30 Shrub cover: 10 Herbaceous cover: 95 Total Veg cover: 100

Overstory Conifer/Hardwood height: — / 00 Tall Shrub/Low Shrub height: 04 / 03 Herbaceous height: 01

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species (List up to 12 major species), Stratum, and Approximate % cover: (Jepson Manual nomenclature please)

Stratum categories: T=tall, M=medium, L=low; *% cover intervals for reference*: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%

Strata	Species	% cover		Strata	Species	% cover
T	POFR	20		L	Lolium perenne	10
T	SAGO	10				
M	SAGO	10				
L	Artemesia douglasiana	30				
L	Bromus madritensis	20				

Major non-native species - With % cover: Bromus 1 Avena 30%

Unusual species: Claytonia perfoliata, ~~Bromus~~ Anthriscus caucalis

III. PROBLEMS WITH INTERPRETATION

Confidence in identification: (L, M, H) H Explain _____

Other identification problems (describe): _____

Polygon is more than one type: (Yes, No) N (Note: type with greatest coverage in polygon should be entered in above section)

Other types: _____

Has the vegetation changed since air photo taken? (Yes, No) N If Yes, how? What has changed (write N/A if so)? _____

CALIFORNIA NATIVE PLANT SOCIETY - VEGETATION RAPID ASSESSMENT FIELD FORM

(Revised Sept. 20, 2004)

For Office Use:	Final database #:	Final vegetation type name:	Alliance MED. CA ANN. + PER. HERB. GROUP Association

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #:	Air photo #:	Date:	Name(s) of surveyors:
SD4	—	4/29/10	ZED

GPS waypoint #: SD4 GPS name: 21733 GPS datum: (NAD 27) NAD83 Is GPS within stand? (Yes) / No

If No, cite from GPS point to stand, the distance _____(in meters) and bearing _____(in degrees) GPS Error: ± 5 ft / (m)

UTM field reading: UTME 0722541 UTMN 4096099 UTM zone: 10S

Elevation: 32 ft / (m) Photograph #'s: 6605, 6604

Topography: convex____ flat____ concave____ undulating X | top____ upper____ mid____ lower____ bottom____

Geology: SAAL Soil Texture: MESN Rock: %Large____ %Small____ %Bare/Fine: 5 %Litter: ____ %BA Stems: 95

Slope exposure (circle one and/or enter actual °): NE_____ NW_____ SE_____ SW_____ Flat X Variable__

Slope steepness (circle one and enter actual °): 0° X 1-5°____ 5-25°____ > 25°____ Upland or (Wetland/Riparian) (circle one)

Site history, stand age, and comments: disturbed floodplain; rarely flooded but 4WD + berm maintenance disturbs site

Type/ Level of disturbance (*use codes*): 02/L 15/H ___/___ ___/___ ___/___ ___/___ ___/___ ___/___

II. VEGETATION DESCRIPTION

Field-assessed vegetation alliance name: Non-native herbaceous

Field-assessed association name (optional): _____

Size of stand: <1 acre X 1-5 acres___ >5 acres___ Adjacent alliances: open water, SAEX, SASO

Tree: T1 (<1" dbh), T2 (1-6" dbh), T3 (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

If Tree, list 1-3 dominant overstory spp.: _____

Shrub: S1 seedling (<3 yr. old), S2 young (<1% dead), S3 mature (1-25% dead), S4 decadent (>25% dead)

Herbaceous: H1 (<12" plant ht.), (H2) (>12" ht.) Desert Palm/Joshua Tree: 1 (<1.5" base diameter), 2 (1.5-6" diam.), 3 (>6" diam.)

Desert Riparian Tree/Shrub: 1 (<2ft. stem ht.), 2 (2-10ft. ht.), 3 (10-20ft. ht.), 4 (>20ft. ht.)

% Overstory Conifer/Hardwood Tree cover: — / — Shrub cover: — Herbaceous cover: 95 Total Veg cover: 95

Overstory Conifer/Hardwood height: — / — Tall Shrub/Low Shrub height: — / — Herbaceous height: 01

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species (List up to 12 major species), Stratum, and Approximate % cover: (Jepson Manual nomenclature please)

Stratum categories: T=tall, M=medium, L=low; *% cover intervals for reference*: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%

Strata	Species	% cover	Strata	Species	% cover
L	Hirschfeldia incana	50	L	Medicago sativa	2
L	Bromus madritensis	25	L	Artem. douglasiana	5
L	Lolium perenne	20			
L	Erodium sp	2			
L	Epilobium sp (young)	2			

Major non-native species - With % cover: _____

Unusual species: _____

III. PROBLEMS WITH INTERPRETATION

Confidence in identification: (L, M, H) H Explain _____

Other identification problems (describe): _____

Polygon is more than one type: (Yes, No) N (Note: type with greatest coverage in polygon should be entered in above section)

Other types: _____

Has the vegetation changed since air photo taken? (Yes, No) N If Yes, how? What has changed (write N/A if so)? _____

CALIFORNIA NATIVE PLANT SOCIETY - VEGETATION RAPID ASSESSMENT FIELD FORM

(Revised Sept. 20, 2004)

For Office Use:	Final database #:	Final vegetation type name:	Alliance SALIX EXIGUA SHRUBLAND Association

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #:	Air photo #:	Date:	Name(s) of surveyors:
SDS	—	4/29/10	LED

GPS waypoint #: SDS GPS name: 217 [illegible]3 GPS datum: (NAD 27) NAD83 Is GPS within stand? (Yes) No

If No, cite from GPS point to stand, the distance _____(in meters) and bearing _____(in degrees) GPS Error: ± 5 ft (m)

UTM field reading: UTME 0722516 UTMN 4095795 UTM zone: 10S

Elevation: 36 ft / (m) Photograph #'s: 6040

Topography: convex X flat___ concave___ undulating___ | top___ upper___ mid___ lower___ bottom___

Geology: SAAL Soil Texture: MESN Rock: %Large___ %Small___ %Bare/Fine: 5 %Litter: ___ %BA Stems: 95

Slope exposure (circle one and/or enter actual °): NE Y NW___ SE___ SW___ Flat___ Variable___

Slope steepness (circle one and enter actual °): 0°___ 1-5° X 5-25°___ >25°___ Upland or (Wetland/Riparian) (circle one)

Site history, stand age, and comments: Left bank of SJR upstream of Lerdo Canal

Type/ Level of disturbance (*use codes*): 15 / M ___/___ ___/___ ___/___ ___/___ ___/___ ___/___ ___/___

II. VEGETATION DESCRIPTION

Field-assessed vegetation alliance name: SAEX shrubland

Field-assessed association name (optional): _____

Size of stand: <1 acre X 1-5 acres___ >5 acres___ Adjacent alliances: Disturbed, open water

Tree: T1 (<1" dbh), (T2) (1-6" dbh), T3 (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

If Tree, list 1-3 dominant overstory spp.: Juglans sp., SAGO

Shrub: S1 seedling (<3 yr. old), S2 young (<1% dead), (S3) mature (1-25% dead), S4 decadent (>25% dead)

Herbaceous: H1 (<12" plant ht.), (H2) (>12" ht.) Desert Palm/Joshua Tree: 1 (<1.5" base diameter), 2 (1.5-6" diam.), 3 (>6" diam.)

Desert Riparian Tree/Shrub: 1 (<2ft. stem ht.), 2 (2-10ft. ht.), 3 (10-20ft. ht.), 4 (>20ft. ht.)

% Overstory Conifer/Hardwood Tree cover: — / 2 Shrub cover: 100 Herbaceous cover: 5 Total Veg cover: 100

Overstory Conifer/Hardwood height: — / 04 Tall Shrub/Low Shrub height: 04 / 03 Herbaceous height: 01

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species (List up to 12 major species), Stratum, and Approximate % cover: (Jepson Manual nomenclature please)

Stratum categories: T=tall, M=medium, L=low; *% cover intervals for reference*: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%

Strata	Species	% cover	Strata	Species	% cover
H	SAGO	1	L	Bromus diandrus	2
H	Juglans hindsii	1			
M	SAEX	50			
M	Rosa californica	50			
L	Equisetum sp.	2			

Major non-native species - With % cover: Bromus diandrus 2%

Unusual species: Cephalanthus occidentalis

III. PROBLEMS WITH INTERPRETATION

Confidence in identification: (L, M, H) H Explain _____

Other identification problems (describe): _____

Polygon is more than one type: (Yes, No) N (Note: type with greatest coverage in polygon should be entered in above section)

Other types: _____

Has the vegetation changed since air photo taken? (Yes, No) N If Yes, how? What has changed (write N/A if so)? _____

CALIFORNIA NATIVE PLANT SOCIETY - VEGETATION RAPID ASSESSMENT FIELD FORM

(Revised Sept. 20, 2004)

For Office Use:	Final database #:	Final vegetation type name:	Alliance NED. CA ANN. + PER. HERB GROUP Association

I. LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #:	Air photo #:	Date:	Name(s) of surveyors:
SD6	-	4/29/10	ZED

GPS waypoint #: SD6 GPS name: 2173 GPS datum: (NAD 27) NAD83 Is GPS within stand? (Yes) No

If No, cite from GPS point to stand, the distance _____(in meters) and bearing _____(in degrees) GPS Error: ± 3 ft / (m)

UTM field reading: UTME 0722467 UTMN 4096094 UTM zone: 10S

Elevation: 34 ft / (m) Photograph #'s: 007

Topography: convex___ flat___ concave___ undulating X | top___ upper___ mid___ lower___ bottom___

Geology: SAAL Soil Texture: MESN Rock: %Large___ %Small___ %Bare/Fine: 1 %Litter: 2 %BA Stems: 97

Slope exposure (circle one and/or enter actual °): NE_____ NW_____ SE_____ SW_____ Flat X Variable__

Slope steepness (circle one and enter actual °): 0° X 1-5° ____ 5-25°____ > 25°____ Upland or (Wetland/Riparian) (circle one)

Site history, stand age, and comments: Disturbed floodplain; only infrequently flooded
Lots of dead wood

Type/ Level of disturbance (*use codes*): ___/___ ___/___ ___/___ ___/___ ___/___ ___/___ ___/___ ___/___

II. VEGETATION DESCRIPTION

Field-assessed vegetation alliance name: Non-native herbaceous

Field-assessed association name (optional): _____

Size of stand: <1 acre X 1-5 acres___ >5 acres___ Adjacent alliances: Open water, AG, SAGO

Tree: T1 (<1" dbh), T2 (1-6" dbh), (T3) (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)

If Tree, list 1-3 dominant overstory spp.: SAGO

Shrub: S1 seedling (<3 yr. old), S2 young (<1% dead), S3 mature (1-25% dead), (S4) decadent (>25% dead)

Herbaceous: H1 (<12" plant ht.), (H2) (>12" ht.) Desert Palm/Joshua Tree: 1 (<1.5" base diameter), 2 (1.5-6" diam.), 3 (>6" diam.)

Desert Riparian Tree/Shrub: 1 (<2ft. stem ht.), 2 (2-10ft. ht.), 3 (10-20ft. ht.), 4 (>20ft. ht.)

% Overstory Conifer/Hardwood Tree cover: — / 2 Shrub cover: 5 Herbaceous cover: 95 Total Veg cover: 100

Overstory Conifer/Hardwood height: ~ / 06 Tall Shrub/Low Shrub height: 04 / 03 Herbaceous height: 01

Height classes: 01=<1/2m 02=1/2-1m 03=1-2m 04=2-5m 05=5-10m 06=10-15m 07=15-20m 08=20-35m 09=35-50m 10=>50m

Species (List up to 12 major species), Stratum, and Approximate % cover: (Jepson Manual nomenclature please)

Stratum categories: T=tall, M=medium, L=low; *% cover intervals for reference*: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%

Strata	Species	% cover	Strata	Species	% cover
T	SAGO	1	L	Bromus sp.	30
M	SAGO	5	L	Hirschfeldia incana	20
M	CEOC	1	L	Conium maculatum (Hemlock)	10
M	Rosa californica	1	L	Sisymbrium officinale	10
L	Artemisia douglasiana	2	L	Anthriscus caulalis	10

Major non-native species - With % cover: Bromus, Hirschfeldia

Unusual species: _____

III. PROBLEMS WITH INTERPRETATION

Confidence in identification: (L, M, H) H Explain _____

Other identification problems (describe): _____

Polygon is more than one type: (Yes, No) N (Note: type with greatest coverage in polygon should be entered in above section)

Other types: _____

Has the vegetation changed since air photo taken? (Yes, No) N If Yes, how? What has changed (write N/A if so)? _____

APPENDIX B

PLANT SPECIES OBSERVED IN THE PROPOSED ACTION AREA ON 29 APRIL 2010

Scientific Name	Common Name	Family	Native?
Acer negundo	boxelder	Aceraceae	yes
Ambrosia psilostachya	Cuman ragweed	Asteraceae	yes
Amsinckia menziesii var. *menziesii*	Menzies' fiddleneck	Boraginaceae	yes
Anaphalis sp.	pearly everlasting	Asteraceae	
Anthriscus caucalis	burr chervil	Apiaceae	no
Artemisia douglasiana	mugwort	Asteraceae	yes
Arundo donax	giant reed	Poaceae	no
Azolla sp.	mosquitofern	Azollaceae	
Baccharis salicifolia	mule's fat	Asteraceae	yes
Bromus diandrus	ripgut brome	Poaceae	no
Bromus hordeaceous	soft brome	Poaceae	no
Bromus madritensis	compact brome	Poaceae	no
Bromus rubens	red brome	Poaceae	no
Calandrinia ciliata	fringed redmaids	Portulacaceae	yes
Carex amplifolia	bigleaf sedge	Cyperaceae	yes
Cephalanthus occidentalis	common buttonbush	Rubiaceae	yes
Chenopodium album	lambsquarters	Chenopodiaceae	no
Claytonia perfoliata	miner's lettuce	Portulacaceae	yes
Conium maculatum	poison hemlock	Apiaceae	no
Convolvulus arvensis	field bindweed	Convolvulaceae	no

Scientific Name	Common Name	Family	Native?
Cynodon dactylon	Bermudagrass	Poaceae	no
Datura wrightii	sacred thorn-apple	Solanaceae	yes
Echinochloa sp.	cockspur grass	Poaceae	no
Elymus glaucus	blue wildrye	Poaceae	yes
Epilobium angustifolium ssp. *circumvagum*	fireweed	Onagraceae	yes
Epilobium sp.	willowherb	Onagraceae	
Equisetum sp.	horsetail	Equisetaceae	yes
Erodium botrys	longbeak stork's bill	Geraniaceae	no
Erodium sp.	stork's bill	Geraniaceae	
Eucalyptus sp.	gum	Myrtaceae	no
Fraxinus latifolia	Oregon ash	Oleaceae	yes
Grindelia sp.	gumweed	Asteraceae	yes
Heliotropium curassavicum	salt heliotrope	Boraginaceae	yes
Heterotheca grandiflora	telegraphweed	Asteraceae	yes
Hirschfeldia incana	shortpod mustard	Brassicaceae	no
Hordeum murinum	mouse barley	Poaceae	no
Juglans hindsii	Northern California black walnut	Juglandaceae	yes
Juncus bufonius	toad rush	Juncaceae	yes
Juncus mexicanus	Mexican rush	Juncaceae	yes
Juncus sp.	rush	Juncaceae	yes
Lactuca serriola	prickly lettuce	Asteraceae	no
Lolium perenne	perennial ryegrass	Poaceae	no
Lotus sp.	trefoil	Fabaceae	
Ludwigia peploides	floating primrose	Onagraceae	yes
Lupinus sp.	lupine	Fabaceae	yes

Scientific Name	Common Name	Family	Native?
Madia sp.	tarweed	Asteraceae	
Malva sylvestris	high mallow	Malvaceae	no
Matricaria discoidea	disc mayweed	Asteraceae	no
Medicago sativa	alfalfa	Fabaceae	no
Melilotus albus	annual white sweetclover	Fabaceae	no
Melilotus indicus	annual yellow sweetclover	Fabaceae	no
Mentha pulegium	pennyroyal	Lamiaceae	no
Myriophyllum aquaticum	parrot feather	Haloragaceae	no
Nicotiana glauca	tree tobacco	Solanaceae	no
Phalaris aquatica	bulbous canarygrass	Poaceae	no
Phyla nodiflora	turkey tangle fogfruit	Verbenaceae	yes
Poa annua	annual bluegrass	Poaceae	no
Polygonum sp.	smartweed	Polygonaceae	
Polypogon monspeliensis	annual rabbitsfoot grass	Poaceae	no
Populus fremontii	Fremont cottonwood	Salicaceae	yes
Punica sp.	pomegranate	Punicaceae	no
Quercus lobata	valley oak	Fagaceae	yes
Rosa californica	California rose	Rosaceae	yes
Rubus discolor	Himalayan blackberry	Rosaceae	no
Rubus ursinus	California blackberry	Rosaceae	yes
Rumex crispus	curly dock	Polygonaceae	no
Salix exigua	narrowleaf willow	Salicaceae	yes
Salix gooddingii	Goodding's willow	Salicaceae	yes
Salix lasiolepis	arroyo willow	Salicaceae	yes
Schoenoplectus sp.	bulrush	Cyperaceae	yes

Scientific Name	Common Name	Family	Native?
Senecio vulgaris	old-man-in-the-Spring	Asteraceae	no
Silybum marianum	blessed milkthistle	Asteraceae	no
Sonchus asper	spiny sowthistle	Asteraceae	no
Typha sp.	cattail	Typhaceae	yes
Urtica dioica	stinging nettle	Urticaceae	yes
Veronica peregrina ssp. *xalapensis*	hairy purslane speedwell	Scrophulariaceae	yes
Viscum sp.	mistletoe	Viscaceae	yes
Xanthium strumarium	rough cockleburr	Asteraceae	yes

APPENDIX C

SPECIAL-STATUS WILDLIFE SPECIES SCOPING LIST FOR THE PROPOSED ACTION AREA

Common Name ***Scientific Name***	**Query Sources**	**Status[a] (Federal/ State)**	**Distribution in California**	**Habitat Associations**	**Potential to Occur in Proposed Action Area**
FISH					
Central Valley Fall/Late Fall-run Chinook salmon[8] *Onchorhynchus tshawytscha*	SJRRP PEIS/EIR	FSC/–	Accessible streams in California's Central Valley and associated estuaries and marine waters.	Historically abundant in San Joaquin River but now largely extirpated upstream of the Merced River confluence.	Low; Although the Hills Ferry Barrier (HFB)9 operates with the intention of excluding fall-run Chinook salmon from passing upstream, interim flows that may accommodate their presence (i.e., migratory habitat) or extreme flood conditions may increase the probability of their presence..

[8] Central Valley Fall/Late Fall-run Chinook salmon will not be included as part of the ESA consultation, but are included in this table as they will be part of the Essential Fish Habitat Assessment consultation.

[9] The HFB is a resistance weir that allows water, small fish, and particles to pass but prevent larger fish such as adult Chinook salmon from passing upstream. The barrier has been operated by CDFG on the San Joaquin River since 1992. The barrier is usually installed and operated from mid-September through December each year. The barrier's effective sustained flow capacity is 1,000 cfs, with the ability to withstand short-duration flows up to 1,500 cfs. The HFB has not been operated in the spring when juvenile salmon and steelhead are emigrating from the downstream tributaries. The opportunity for these juveniles to access the San Joaquin River upstream of the Merced River has been extremely low due to inhospitable water flow and water quality conditions. However, Interim Flows will likely provide conditions that could allow emigrating juvenile salmon and steelhead to stray upstream of the Merced River.

Common Name *Scientific Name*	Query Sources	Status[a] (Federal/ State)	Distribution in California	Habitat Associations	Potential to Occur in Proposed Action Area
Central Valley steelhead *Onchorhynchus mykiss*	SJRRP PEIS/EIR	FT/–	Accessible streams in California's Central Valley and associated estuaries and marine waters.	Historically abundant in San Joaquin River but now largely extirpated upstream of the Merced River confluence.	Low; steelhead are considered extirpated from the Action Area; however, there is low potential for Central Valley steelhead to get past the HFB when it is operating (during high flood flows) and to be present in the San Joaquin River system after early December, when the HFB is removed
INVERTEBRATES					
Longhorn fairy shrimp *Branchinecta longiantenna*	USFWS	FE/–	Four known populations in San Luis Obispo, Merced, Alameda and Contra Costa counties.	Vernal pools; also found in sandstone rock outcrop pools, grass-bottomed pools, and claypan pools.	Unlikely; no vernal pools in Proposed Action area.
Vernal pool fairy shrimp *Branchinecta lynchi*	USFWS	FT/–	Central Valley, central and south Coast Ranges from Tehama County to Santa Barbara County. Isolated populations also in Riverside County.	Vernal pools; also found in sandstone rock outcrop pools; does not occur in areas subject to flooding from large rivers or other waterways.	Unlikely; no vernal pools in Proposed Action area.
Vernal pool tadpole shrimp *Lepidurus packardi*	USFWS	FE/–	Shasta County south to Merced County.	Occurs in vernal pools and other seasonal wetlands in open grasslands; does not occur in areas subject to flooding from large rivers or other waterways.	Unlikely; no vernal pools in Proposed Action area.

Common Name ***Scientific Name***	**Query Sources**	**Status[a] (Federal/ State)**	**Distribution in California**	**Habitat Associations**	**Potential to Occur in Proposed Action Area**
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	USFWS	FT/–	Streamside habitats below 910 m (3,000 ft) throughout the Central Valley where host plants are present.	Host plant *Sambucus* sp. (blue elderberry) in riparian and oak savanna habitats	Unlikely; no host plants identified in the Proposed Action area.
AMPHIBIANS					
California tiger salamander *Ambystoma californiense*	USFWS, CWHR	FT/SSC	Central Valley from Butte County south to northeastern San Luis Obispo County and Sierra Nevada foothills, up to approximately 305 m (1,000 ft).	Annual grasslands and oak woodlands. Rodent burrows, rock crevices, or fallen logs used by adults for cover during summer dormancy. Breeding habitat includes seasonal ponds, lakes, or vernal pools.	Unlikely; no seasonal ponds, lakes, or vernal pools in Proposed Action area.
Western spadefoot *Spea hammondii*	CWHR	–/SSC	Near Redding south throughout the Central Valley and nearby foothills; Coast Ranges south of Monterey Bay; and coastal southern California south of the Transverse mountains and west of the Peninsular mountains; mostly below 910 m (3,000 ft).	Areas with sparse vegetation and/or short grasses in sandy or gravelly soils; primarily in washes, river floodplains, alluvial fans, playas, alkali flats, among grasslands, chaparral, or pine-oak woodlands; breeds in ephemeral rainpools with no predators.	Moderate; while there may be excessive vegetation cover, western spadefoots may breed in nearby ephemeral rain pools in spring.

Common Name ***Scientific Name***	**Query Sources**	**Status[a] (Federal/ State)**	**Distribution in California**	**Habitat Associations**	**Potential to Occur in Proposed Action Area**
California red-legged frog *Rana draytonii*	USFWS	FT/SSC	Largely restricted to coastal drainages on the central coast from Mendocino County to Baja California; in the Sierra foothills south to Tulare and possibly Kern counties; sea level to 2,440 m (8,000 ft)	Still or slow-moving water with emergent and overhanging vegetation, including wetlands, wet meadows, ponds, lakes, and low-gradient, slow moving stream reaches with permanent pools.	Unlikely; although historically known to occur in the Central Valley, the California red-legged frog is at present considered extirpated from the region (USFWS 2002).
REPTILES					
Pacific pond turtle *Actinemys marmorata*	CNDDB, CWHR	–/SSC	From the Oregon border along the coast ranges to the Mexican border, and west of the crest of the Cascades and Sierras	Permanent, slow-moving fresh or brackish water with available basking sites and adjacent open habitats or forest for nesting	Present; observed during habitat assessment surveys.
Blunt-nosed leopard lizard *Gambelia sila*	CNDDB, USFWS, CWHR	FE/SE, FP	San Joaquin Valley and nearby foothills, from Santa Barbara County and western Kern County north to southern Merced County; from 30–730 m (100–2,400 ft).	Open, flat, sparely vegetated areas of semiarid grasslands, alkali flats, and washes in sandy, gravelly, or loamy soils; avoids densely vegetated areas.	Unlikely; habitat in Proposed Action area not suitable due to excessive vegetation cover and compact soils.
Coast horned lizard *Phrynosoma coronatum*	SJRRP PEIS/R	–/SSC	West of deserts and Cascade-Sierran highlands, as far north as Shasta Reservoir; from sea level to 2,440 m (8,000 ft).	Open areas with sandy soil and/or patches of loose soil and low/scattered vegetation in scrublands, grasslands, conifer forests, and woodlands; frequently found near ant hills.	Low; habitat in Proposed Action area of limited suitability due to excessive vegetation cover and compact soils.

Common Name ***Scientific Name***	**Query Sources**	**Status[a] (Federal/ State)**	**Distribution in California**	**Habitat Associations**	**Potential to Occur in Proposed Action Area**
California legless lizard *Anniella pulchra*	CNDDB	–/SSC	Northern Contra Costa County south to northwestern Baja California; scattered occurrences in San Joaquin Valley, along the southern Sierra Nevada mountains, and in the western Mojave Desert.	Sparsely vegetated areas; warm, moist, loose soil for burrowing.	Low; habitat in Proposed Action area of limited suitability due to excessive vegetation cover and compact soils.
San Joaquin coachwhip *Masticophis flagellum ruddockii*	SJRRP PEIS/R	–/SSC	From the Sacramento Valley (Colusa County) southward to San Joaquin Valley (Kern County) and westward into the South Coast Ranges; an isolated population in the Sutter Buttes; from near 20 m (66 ft) to 900 m (2,950 ft) elevation.	Open, dry, treeless areas, including grassland and saltbush scrub. As refuge, uses rodent burrows, shaded vegetation, and surface objects.	Unlikely; habitat in Proposed Action area not suitable due to excessive vegetation cover.
Giant garter snake *Thamnophis gigas*	CNDDB, USFWS, CWHR	FT/ST	Central Valley from the vicinity of Burrel in Fresno County north to near Chico in Butte County; has been extirpated from areas south of Fresno.	Sloughs, canals, low-gradient streams and freshwater marsh habitats where there is a prey base of small fish and amphibians; also found in irrigation ditches and rice fields; requires grassy banks and emergent vegetation for basking and areas of high ground protected from flooding during winter.	Low; suitable habitat present nearby but not within Proposed Action area.

Common Name *Scientific Name*	Query Sources	Status[a] (Federal/ State)	Distribution in California	Habitat Associations	Potential to Occur in Proposed Action Area
BIRDS					
Fulvous whistling-duck *Dendrocygna bicolor*	BIOS	–/SSC	Summer resident; Fresno, Kings, and Imperial counties.	Freshwater and coastal marshes; uses rice fields and tall-grass areas flooded to a depth of <0.5 m, with some use of adjacent uplands.	Unlikely; marsh habitat not sufficiently expansive.
Redhead *Aythya americana*	BIOS	–/SSC	Summer resident; breeds in northeastern California, Central Valley, Southern coasts, and southern desert.	Freshwater emergent wetlands with dense stands of cattails (*Typha* spp.) and bulrush (*Schoenoplectus* spp.) interspersed with areas of deep, open water; forage and rest on large, deep bodies of water.	Moderate; suitable habitat present.
Least bittern *Ixobrychus exilis*	BIOS	–/SSC	Primarily a summer resident; breeds in northeastern California, Central Coast, Central Valley, southern coast, and southern deserts.	Freshwater and brackish marshes with dense aquatic or semi-aquatic vegetation interspersed with clumps of woody vegetation and open water.	Unlikely; marsh habitat not sufficiently expansive.
White-tailed kite *Elanus leucurus*	SJRRP PEIS/R	–/SFP	Year-round resident; found in nearly all lowlands of California west of the Sierra Nevada mountains and the southeast deserts.	Lowland grasslands and wetlands with open areas; nests in trees near open foraging area	Moderate; suitable foraging and nesting habitat present.
Northern harrier *Circus cyaneus*	CNDDB, BIOS	–/SSC	Year-round resident; scattered throughout California; in the northwest, nests largely within coastal lowlands from Del Norte County south to Bodega Head in Sonoma County, inland to Napa County	Nests, forages, and roosts in wetlands or along rivers or lakes, but also in grasslands, meadows, or grain fields.	Moderate; suitable foraging habitat present.

Common Name ***Scientific Name***	**Query Sources**	**Status[a] (Federal/ State)**	**Distribution in California**	**Habitat Associations**	**Potential to Occur in Proposed Action Area**
Swainson's hawk *Buteo swainsoni*	CNDDB	–/ST	Summer resident; breeds in lower Sacramento and San Joaquin Valleys, the Klamath Basin, and Butte Valley. Highest nesting densities occur near Davis and Woodland, Yolo County.	Nests in oaks or cottonwoods in or near riparian habitats. Forages in grasslands, irrigated pastures, and grain fields.	Present; observed during habitat assessment surveys.
Greater sandhill crane *Grus canadensis tabida*	SJRRP PEIS/R	–/ST,FP	Winter visitor and migrant; scattered locations in the Central Valley; breeds in extreme northeastern California.	Forages in freshwater marshes and grasslands as well as harvested rice fields, corn stubble, barley and newly-planted grain fields.	Unlikely; marsh habitat not sufficiently expansive.
Lesser sandhill crane *Grus canadensis canadensis*	SJRRP PEIS/R	–/SSC	Winter visitor and migrant; scattered locations in the Central Valley.	Forages in freshwater marshes and grasslands as well as harvested rice fields, corn stubble, barley and newly-planted grain fields.	Unlikely; marsh habitat not sufficiently expansive.
Mountain plover *Charadrius montanus*	CNDDB, BIOS	–/SSC	Winter visitor; found in the Central Valley south of Yuba County, along the coast in parts of San Luis Obispo, Santa Barbara, Ventura, and San Diego Counties; parts of Imperial, Riverside, Kern, and Los Angeles Counties.	Occupies open plains or rolling hills with short grasses or very sparse vegetation; nearby bodies of water are not needed; may use newly plowed or sprouting grainfields.	Unlikely; habitat in Proposed Action area not suitable due to excessive vegetation cover.
Black tern *Chlidonias niger*	BIOS	–/SSC	Migrant and summer resident; breeds in northeastern California and in scattered locations throughout the Central Valley.	Nest semi-colonially in protected areas of marshes.	Unlikely; marsh habitat not sufficiently expansive.

Common Name ***Scientific Name***	**Query Sources**	**Status[a] (Federal/ State)**	**Distribution in California**	**Habitat Associations**	**Potential to Occur in Proposed Action Area**
Western yellow-billed cuckoo *Coccyzus americanus*	CNDDB, USFWS	FC/–	Summer resident, breeds in limited portions of the Sacramento River and the South Fork Kern River; small populations may nest in Butte, Yuba, Sutter, San Bernardino, Riverside, Inyo, Los Angeles, and Imperial counties	Summer resident of valley foothill and desert riparian habitats; nests in open woodland with clearings and low, dense, scrubby vegetation.	Unlikely; outside of species' breeding range
Western burrowing owl *Athene cunicularia hypugea*	CNDDB, BIOS	–/SSC	Year-round resident throughout much of the state; Central Valley, northeastern plateau, southeastern deserts, and coastal areas. Rare along south coast.	Level, open, dry, heavily grazed or low-stature grassland or desert vegetation with available burrows.	Unlikely; habitat in Proposed Action area not suitable due to excessive vegetation cover.
Short-eared owl *Asio flammeus*	BIOS	–/SSC	Year-round resident in certain areas; breeding in California episodic and a widespread winter migrant, found primarily in the Central Valley, in the western Sierra Nevada foothills, and along the coastline.	Irrigated alfalfa or grain fields, ungrazed grasslands, old pastures, and salt or freshwater marshlands.	Low; suitable nesting habitat present but foraging habitat limited.
Loggerhead shrike *Lanius ludovicianus*	BIOS	–/SSC	Year-round resident in most areas; much of California except for the forested coastal slope and the high elevations of the Sierra Nevada, southern Cascades, and Transverse Ranges.	Open shrubland or woodlands with short vegetation and and/or bare ground for hunting; some tall shrubs, trees, fences or power lines for perching; typically nest in isolated trees or large shrubs.	Unlikely; habitat in Proposed Action area not suitable due to excessive vegetation cover.

Common Name ***Scientific Name***	**Query Sources**	**Status[a] (Federal/ State)**	**Distribution in California**	**Habitat Associations**	**Potential to Occur in Proposed Action Area**
Least Bell's vireo *Vireo bellii pusillus*	SJRRP PEIS/R	FE/SE	Summer resident; breeds in scattered locations around southern California	Nests in dense vegetative cover of riparian areas; often nests in willow or mulefat; forages in dense, stratified canopy.	Low; suitable habitat present but species is rare.
Bank swallow *Riparia riparia*	CNDDB	–/ST	Summer resident; occurs along the Sacramento River from Tehama County to Sacramento County, along the Feather and lower American Rivers; and in the plains east of the Cascade Range in Modoc, Lassen, and northern Siskiyou Counties. Small populations near the coast from San Francisco County to Monterey County.	Nests in vertical bluffs or banks, usually adjacent to water, where the soil consists of sand or sandy loam.	Unlikely; habitat in Proposed Action area not suitable due to lack of vertical banks.
Yellow warbler *Dendroica petechia*	SJRRP PEIS/R	–/SSC	Summer resident; nests in most of California with the exception most of the Central Valley, high Sierras, and Mojave and Colorado deserts.	Open-canopy, deciduous riparian woodland in close proximity to water along streams or wet meadows.	Moderate; suitable foraging habitat present.
Yellow-breasted chat *Icteria virens*	BIOS	–/SSC	Uncommon summer resident and migrant in coastal California and in foothills of the Sierra Nevada.	Early successional riparian habitats with a dense shrub layer and an open canopy	Low; while suitable habitat is present, species is uncommon in region of Proposed Action area.

Common Name ***Scientific Name***	**Query Sources**	**Status[a] (Federal/ State)**	**Distribution in California**	**Habitat Associations**	**Potential to Occur in Proposed Action Area**
Oregon vesper sparrow *Pooecetes gramineus affinis*	BIOS	–/SSC	Winter visitor in northern and eastern California.	Grasslands; open ground with little vegetation or short grass and low annuals; including stubble fields, meadows, and road edges.	Unlikely; habitat in Proposed Action area not suitable due to excessive vegetation cover.
Grasshopper sparrow *Ammodramus savannarum*	BIOS	–/SSC	Summer resident; nests in Mendocino, Trinity, and Tehama counties south, west of the Cascade–Sierra Nevada axis and southeastern deserts, to San Diego County.	Typically found in moderately open grasslands with scattered shrubs.	Unlikely; habitat in Proposed Action area not suitable due to excessive vegetation cover.
Tricolored blackbird *Agelaius tricolor*	CNDDB, BIOS	–/SSC	Permanent residents, but make extensive migrations both in breeding season and winter. Common locally throughout Central Valley and in coastal areas from Sonoma County south.	Feeds in grasslands and agriculture fields; nesting habitat components include open accessible water, a protected nesting substrate (including flooded or thorny vegetation), and a suitable nearby foraging space with adequate insect prey.	Unlikely; marsh habitat not sufficiently expansive.
Yellow-headed blackbird *Xanthocephalus xanthocephalus*	CNDDB, BIOS	–/SSC	Primarily a migrant and summer resi-dent, though small numbers remain in winter; Central Valley, northeastern California, central and southern coasts, and southern deserts.	Breeds almost entirely in open marshes with relatively deep water and tall emergent vegetation such as such as bulrush (*Schoenoplectus* spp.) or cattails (*Typha* spp.); nests are typically in moderately dense vegetation; forage within wetlands and surrounding grasslands and/or croplands.	Unlikely; marsh habitat not sufficiently expansive.

Common Name *Scientific Name*	Query Sources	Status[a] (Federal/ State)	Distribution in California	Habitat Associations	Potential to Occur in Proposed Action Area
MAMMALS					
Pallid bat *Antrozous pallidus*	CWHR	–/SSC	Throughout California except for the high Sierra Nevada and from Del Norte and western Siskiyou Counties to northern Mendocino County	Roosts in trees, caves, crevices, and buildings; feeds in a variety of open habitats.	Moderate; suitable day roost and foraging habitat present.
Spotted bat *Euderma maculatum*	SJRRP PEIS/R	–/SSC	Small number of localities identified in California; mostly found in the foothills, mountains and desert regions of southern California.	Roosts in horizontal rock crevices of arid deserts, grasslands, and mixed coniferous forests; may occasionally use caves and buildings.	Unlikely; habitat in Proposed Action area not suitable due to lack of rocky outcrops.
Western red bat *Lasiurus blossevillii*	CNDDB, CWHR	–/SSC	Near the Pacific Coast, Central Valley, and the Sierra Nevada.	Riparian forests, woodlands near streams, fields and orchards.	Moderate; suitable roosting and foraging habitat present.
Townsend's western big-eared bat *Corynorhinus townsendii*	CWHR	–/SSC	Throughout California, found in all but subalpine and alpine habitats, details of distribution not well-known.	Most abundant in mesic habitats, also found in oak woodlands, desert, vegetated drainages, caves or cave-like structures (including mines, tunnels, and buildings).	Unlikely; habitat in Proposed Action area not suitable due to lack of caves or mines.
Western mastiff bat *Eumops perotis californicus*	CNDDB	–/SSC	Found mostly in southern half of California.	Primarily a cliff-dwelling species though may be found in crevices in large boulders and buildings; open, semi-arid to arid habitats.	Unlikely; habitat in Proposed Action area not suitable due to lack of rocky outcrops.

Common Name ***Scientific Name***	**Query Sources**	**Status[a] (Federal/ State)**	**Distribution in California**	**Habitat Associations**	**Potential to Occur in Proposed Action Area**
San Joaquin kit fox *Vulpes macrotis mutica*	CNDDB, USFWS, CWHR	FE/–	San Joaquin Valley floor and surrounding foothills of the coastal ranges, Sierra Nevada, and Tehachapi mountains.	Annual grasslands or open areas dominated by scattered brush, shrubs, and scrub.	Low; while denning habitat is not suitable, individuals may disperse through Proposed Action area.
California ringtail *Bassariscus astutus raptor*	SJRRP PEIS/R	–/SFP	Widely distributed, though greatest abundance in northern California and Sierra Nevada foothills.	Mixture of forest and shrub habitats in association with rocky areas or riparian habitats, low to middle elevations.	Low; suitable habitat present, but ringtail are unlikely to occur on the valley floor.
American badger *Taxidea taxus*	CNDDB, CWHR	–/SSC	Throughout the state except in the humid coastal forests of Del Norte County and the northwest portion of Humboldt County.	Shrubland, open grasslands, fields, and alpine meadows with friable soils.	Unlikely; habitat in Proposed Action area not suitable due to excessive vegetation cover.
Nelson's antelope squirrel *Ammospermophilus nelsoni*	CNDDB, CWHR	–/ST	San Joaquin Valley floor and adjacent foothills, elevations of 50 m (165 ft) to around 1,100 m (3,609 ft).	Dry, sparsely vegetated, loam soils in arid grassland, shrubland, and alkali sink habitats.	Unlikely; habitat in Proposed Action area not suitable due to excessive vegetation cover.

Common Name ***Scientific Name***	**Query Sources**	**Status[a] (Federal/ State)**	**Distribution in California**	**Habitat Associations**	**Potential to Occur in Proposed Action Area**
Giant kangaroo rat *Dipodomys ingens*	USFWS, CWHR	FE/–	Western Fresno and Eastern San Benito Counties; Kettleman Hills in Kings County; San Juan Creek Valley in San Luis Obispo County; western Kern County; eastern San Luis Obispo County; and Cuyama Valley in Santa Barbara and San Luis Obispo Counties.	Fine sandy-loam soils supporting sparse annual grass and forb vegetation; occasionally found in low-density alkali desert scrub.	Unlikely; habitat in Proposed Action area not suitable due to excessive vegetation cover.
Fresno kangaroo rat *Dipodomys nitratoides exilis*	CNDDB, USFWS, CWHR	FE/–	Historically occurred on the San Joaquin Valley floor. One individual captured twice in the Alkali Sink Ecological Reserve, west of Fresno.	Sands and saline sandy soils in flat chenopod scrub and annual grassland communities.	Unlikely; habitat in Proposed Action area not suitable due to excessive vegetation cover, outside of species' range.
Riparian (San Joaquin Valley) woodrat *Neotoma fuscipes riparia*	SJRRP PEIS/R	FE/SSC	Single known extant population restricted to Stanislaus River in Caswell Memorial State Park	In riparian areas with willows and dense oak, evergreen, and/or shrubby overstory.	Unlikely; outside of species' range.
Southern grasshopper mouse *Onychomys torridus ramona*	CWHR	–/SSC	Southward from Los Angeles County to the Mexican border, generally west of the desert.	Flat, sandy, Valley floor habitats.	Unlikely; outside of species' range.
Riparian brush rabbit *Sylvilagus bachmani riparius*	SJRRP PEIS/R	FE/SE	Single, known extant population restricted to the Stanislaus River in Caswell Memorial State Park.[1]	Brushy understory of Valley riparian forests.[1]	Unlikely; outside of species' range.

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APPENDIX D

WILDLIFE SPECIES OBSERVED IN THE PROPOSED ACTION AREA ON 18 MAY 2010

Common Name	*Scientific Name*
Amphibians	
bullfrog	*Rana catesbeiana*
Reptiles	
Pacific pond turtle	*Actinemys marmorata*
western fence lizard	*Sceloporus occidentalis*
Birds	
mallard	*Anas platyrhynchos*
California quail	*Callipepla californica*
great egret	*Ardea alba*
Swainson's hawk	*Buteo swansoni*
red-tailed hawk	*Buteo jamaicensis*
American coot	*Fulica americana*
mourning dove	*Zenaida macroura*
Anna's hummingbird	*Calypte anna*
western wood pewee	*Contopus sordidulus*
black phoebe	*Sayornis nigricans*
western kingbird	*Tyrannus verticalis*
western scrub- jay	*Aphelocoma californica*
American crow	*Corvus brachyrhyncos*
cliff swallow	*Petrochelidon pyrrhonota*
barn swallow	*Hirundo rustica*
American robin	*Turdus migratorius*
California thrasher	*Toxostoma redivivum*
spotted towhee	*Pipilo maculatus*
lark sparrow	*Chondestes grammacus*
song sparrow	*Melospiza melodia*
red-winged blackbird	*Agelaius phoeniceus*
Brewer's blackbird	*Euphagus cyanocephalus*
brown-headed cowbird	*Molothrus ater*
house finch	*Carpodacus mexicanus*
American goldfinch	*Spinus tristis*
house sparrow	*Passer domesticus*
Mammals	
domestic dog[1]	*Canis lupus familiaris*[1]
raccoon[1]	*Procyon lotor*[1]
American beaver[1]	*Castor canadensis*[1]

[1] Identified by sign (tracks, scat).

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Appendix F – Field Survey Methods and Results
Technical Memorandum Supplement #1

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Arroyo Canal Fish Screen and Sack Dam Fish Passage Project

Field Survey Methods and Results Technical Memorandum– Supplement #1

Expanded Vegetation Map, Expanded Wildlife Habitat Assessment, and Swainson's Hawk Survey

SAN JOAQUIN RIVER RESTORATION PROGRAM

April 2012

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Table of Contents

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List of Abbreviations and Acronyms

CDFG	California Department of Fish and Game
CESA	California Endangered Species Act
cfs	cubic-feet-per-second
dpi	dots per inch
EA/IS	Environmental Assessment/Initial Study
GIS	Geographical Information System
HFB	Hills Ferry Barrier
HMRD	Henry Miller Reclamation District #2131
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NRDC	National Resources Defense Council
Proposed Action	Arroyo Canal Fish Screen and Sack Dam Fish Passage Project
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Settlement	Stipulation of Settlement
TM	Technical Memorandum
USFWS	U.S. Fish and Wildlife Service

This Technical Memorandum (TM) was prepared by the San Joaquin River Restoration Program (SJRRP) Team as a document in support of preparing an Environmental Assessment/Initial Study (EA/IS) for the Arroyo Canal Fish Screen and Sack Dam Fish Passage Project (Proposed Action). The purpose for circulating this document at this time is to facilitate early coordination regarding initial concepts and approaches currently under consideration by the SJRRP Team with the Settling Parties, Third Parties, other stakeholders, and interested members of the public. Therefore, the content of this document may not necessarily be included in the EA/IS.

This TM does not present findings, decisions, or policy statements of any of the Implementing Agencies. Additionally, all information presented in this document is intended to be consistent with the Stipulation of Settlement (Settlement). To the extent inconsistencies exist, the Settlement should be the controlling document and the information in this document will be revised before its inclusion in future documents. While the SJRRP Team is not requesting formal comments on this document, all comments received will be considered in refining the concepts and approaches described herein to the extent possible.

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1.0 INTRODUCTION

This Field Survey Methods and Results Supplement #1, Expanded Vegetation Map, Expanded Wildlife Habitat Assessment, and Swainson's Hawk Survey, Technical Memorandum (TM) provides baseline information necessary to characterize existing environmental conditions for biological resources in the Environmental Assessment/Initial Study (EA/IS) for the Arroyo Canal Fish Screen and Sack Dam Fish Passage Project (Proposed Action). The Proposed Action represents one component of Phase 1 of the overall San Joaquin River Restoration Program (SJRRP). This information will also be used to support the acquisition of permit approvals. The SJRRP was established in late 2006 to implement the Stipulation of Settlement (Settlement) in *National Resources Defense Council (NRDC), et al. v. Kirk Rodgers, et al*. Figure 1-1 illustrates the overall SJRRP restoration and Proposed Action area.

The U.S. Department of the Interior, Bureau of Reclamation (Reclamation), as the Federal lead agency under the National Environmental Policy Act (NEPA), prepared this TM to present the baseline information yielded from biological resource field surveys. This information will be used to support the description of the affected environment in the EA/IS. Federal authorization for implementing the Settlement is provided in the San Joaquin River Restoration Settlement Act (Public Law 111-11).

This TM specifically covers information needed for the biological resources section of the EA/IS being prepared by the Project Team under contract with Reclamation and composed of WRIME, ICF International, Stillwater Sciences, and HDR.

1.1 Purpose of this Technical Memorandum

Vegetation, wildlife habitat, and geomorphic field surveys were recommended to characterize existing environmental conditions as described in the *Existing Environmental Conditions Data Needs and Survey Approach TM for the Arroyo Canal Fish Screen and Sack Dam Fish Passage Project* (Reclamation 2012a). This TM was prepared to address changes to the disturbance area for the Proposed Action (Proposed Action area) and resulting data gaps for the original Proposed Action area as reported in the *Field Survey Methods and Results TM – Vegetation, Wildlife Habitat, and Geologic and Geomorphic Resources– for the Arroyo Canal Fish Screen and Sack Dam Fish Passage Improvement Project* (Reclamation 2012b). With the official Proposed Action area refined, it was determined that confirmation of the presence of Swainson's hawks would be necessary to support the characterization of existing (or baseline) conditions for the environmental impact assessment of the Proposed Action and its alternatives.

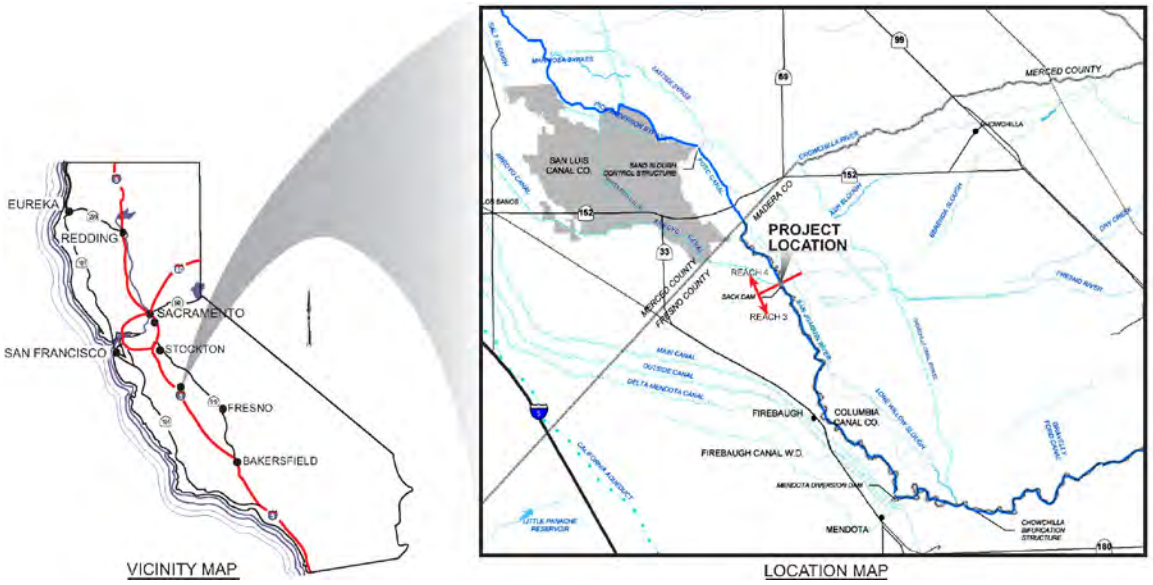
This technical memorandum summarizes the methods and results of these surveys, including an expanded vegetation map, expanded wildlife habitat assessment, and Swainson's hawk survey.

Source: Reclamation and DWR, 2011

Figure 1-1. Overview of SJRRP Restoration Area and the Proposed Action Site

1.2 Overview of the Arroyo Canal Fish Screen and Sack Dam Fish Passage Project

The Proposed Action is located in Fresno and Madera counties, approximately 7 miles southeast of Dos Palos, California (see Figure 1-2). Sack Dam is on the San Joaquin River in the western region of the San Joaquin Valley, just north of Arroyo Canal. The facilities are owned and operated by Henry Miller Reclamation District #2131 (HMRD).



Source: CH2M HILL, 2012

Figure 1-2. Regional Map

The purpose of the Proposed Action is to implement Settlement-required Phase 1 improvements at the existing Arroyo Canal and Sack Dam facilities on the San Joaquin River as authorized and directed by Public Law 111-11.

The following are the "Phase 1 improvements" in paragraph 11 of the Settlement (numbers in parentheses are from the Settlement, page 9) related to the Arroyo Canal and Sack Dam:

- *Screening the Arroyo Canal water diversion immediately upstream of Sack Dam to prevent entrainment of anadromous fish* (Item 6), and
- *Modifications at Sack Dam adequate to ensure fish passage* (Item 7).

The Proposed Action, shown in Figure 1-3, includes the following key components (CH2M HILL 2012):

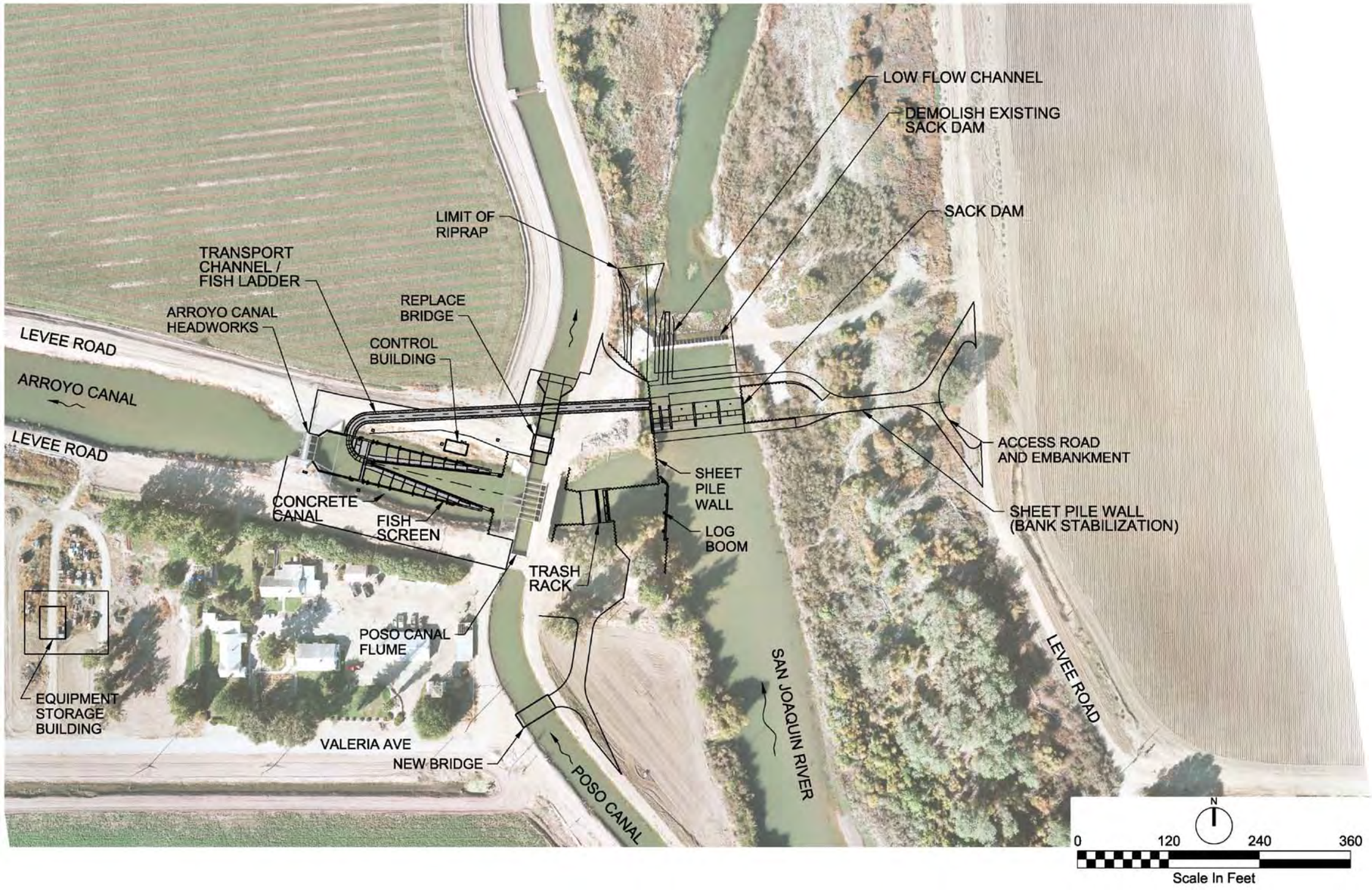
- Construct a new Sack Dam to accommodate fish passage and improve operational control under the scheduled Restoration Flow regime.

- Demolish the existing Sack Dam structure, and recontour the resulting disturbed channel.
- Provide stabilization improvements to the east side of the San Joaquin River channel between the east abutment of Sack Dam and the adjacent levee.
- Construct a new 700-cubic-feet-per-second (cfs) positive barrier fish screen structure within the Arroyo Canal in a single vee configuration with profile bar screens. The fish screen would be designed to meet the criteria and/or recommendations of the California Department of Fish and Game (CDFG) and NOAA–National Marine Fisheries Service (NMFS).
- Construct a new trash-rack structure at the head of the Arroyo Canal, upstream of the new fish screen structure, with an automated raking mechanism.
- Construct a new transport channel/fish ladder, beginning at the downstream end of the vee screen and terminating at the west abutment of Sack Dam. The transport channel/fish ladder would convey downstream migrating fish and accommodate upstream migrating fish past Sack Dam.
- Construct a defined work bench area adjacent to the west abutment of Sack Dam to facilitate operation and maintenance access to the dam and the Arroyo Canal approach channel.
- Construct a new control building to accommodate mechanical, electrical, and instrumentation and control equipment related to Proposed Action improvements.
- Construct a new equipment storage building to accommodate maintenance equipment related to Proposed Action improvements.
- Replace an existing bridge across the Poso Canal (located immediately north of the Arroyo Canal) to accommodate project operation and maintenance equipment access needs.
- Construct a new bridge across the Poso Canal to facilitate site access from Valeria Avenue during inclement weather conditions. This bridge would also be designed to accommodate project operation and maintenance equipment.

Figure 1-3 shows the key details of the Proposed Action in the area around the Sack Dam and transport channel/fish ladder, including the existing and proposed Sack Dam, the proposed transport channel/fish ladder, and other detail.

Figure 1-4 shows the construction sequencing, including the location of the potential contractor staging areas on the east and west side of the San Joaquin River, temporary haul road, potential material borrow areas in the immediate vicinity of the dam, and the temporary diversion channel or cofferdam. The anticipated project disturbance area is also indicated.

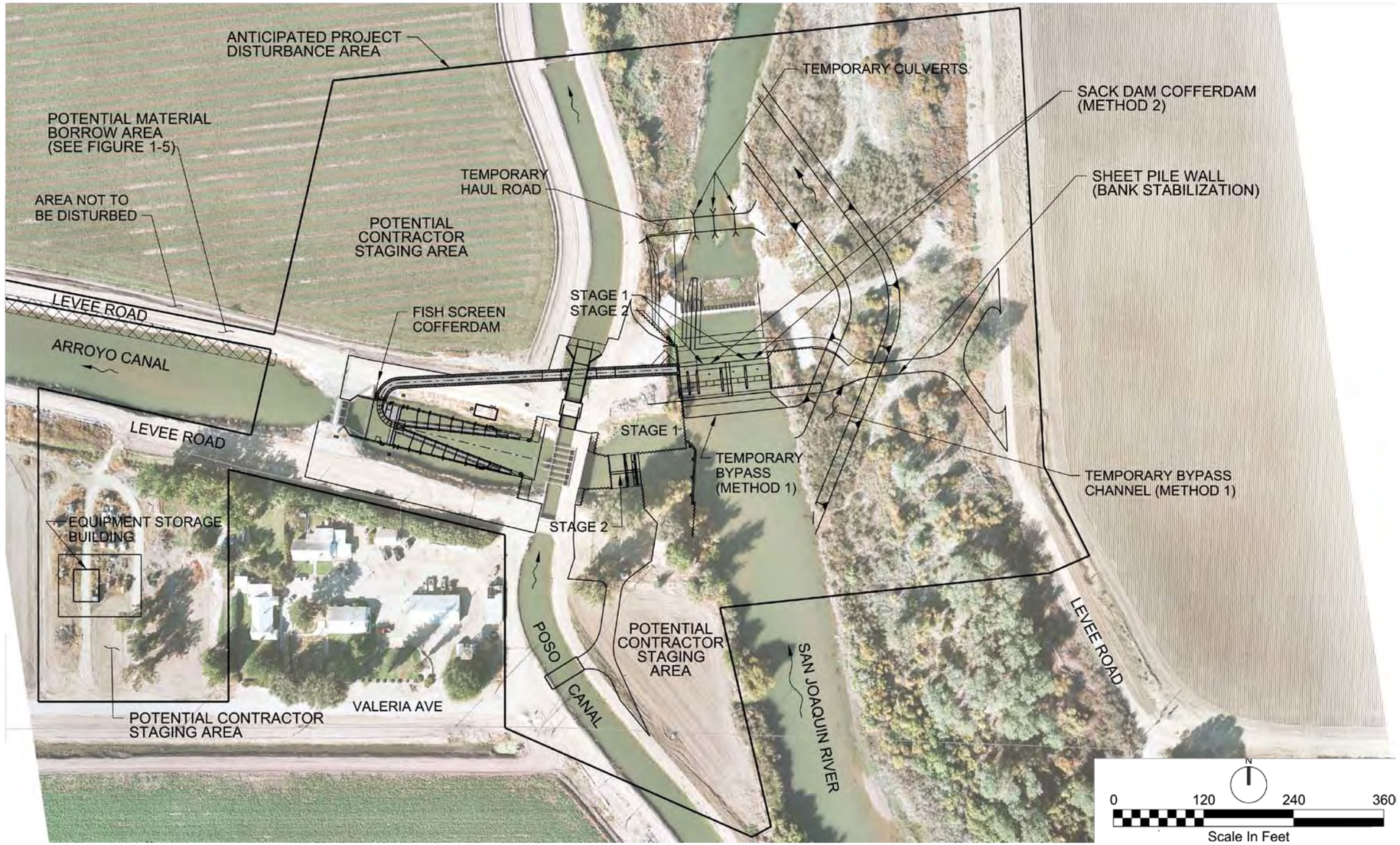
Figure 1-5 shows details of the location of potential material borrow areas along the levee on the north side of the Arroyo Canal between the San Joaquin River and Temple Santa Rita Canal.



Source: CH2M HILL 2012

Image – October 2011

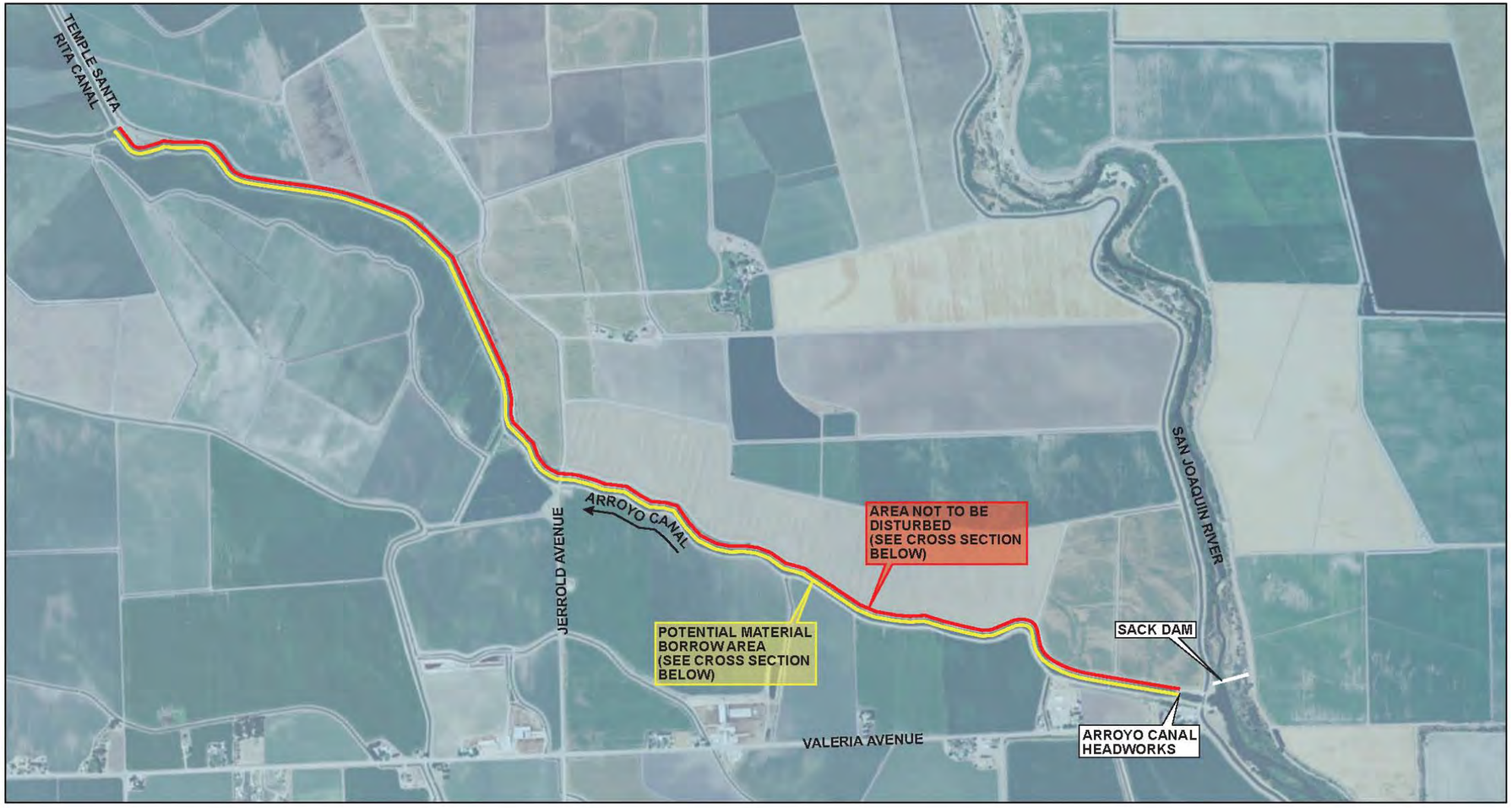
Figure 1-3. Proposed Action Site Plan



Source: CH2M HILL 2012

Image – October 2011

Figure 1-4. Construction Sequencing



Source: CH2M HILL 2012

Figure 1-5. Potential Material Borrow Areas

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2.0 EXPANDED VEGETATION SURVEY

2.1 Background

On April 29, 2010, per the *Existing Environmental Conditions Data Needs and Survey Approach TM* for the Proposed Action (Reclamation 2012a), a general vegetation survey was conducted to:

1. Document non-native invasive aquatic plants and their extent;

2. Identify fine-scale vegetation patterns in order to make accurate estimates of potential Proposed Action impacts to wetland, riparian, and upland vegetation types;

3. Document habitat conditions for special-status plant species with the potential to occur in the Proposed Action area; and

4. Document the location, stem count, and other details of any blue elderberry (*Sambucus mexicana*) shrubs in the Proposed Action area, which is the host plant of the endangered Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*).

The results of this survey were reported in *Field Survey Methods and Results – Vegetation, Wildlife Habitat, and Geologic and Geomorphic Resources* (Reclamation 2012b). Subsequent to the 2010 survey, the Proposed Action area was refined. Compared to the earlier field survey extent, the Proposed Action area was significantly decreased in the north and south (i.e., upstream and downstream of Sack Dam), and slightly increased to the east and west (i.e., to include portions of adjacent agricultural fields). In addition, the upper surface of the north levee road along Arroyo Canal, for a three-mile stretch starting at the intersection with Poso Canal, was identified as a potential borrow area for Proposed Action fill material. While the previous vegetation survey determined that no special-status plants have the potential to occur in the Proposed Action area, a survey of the previously unsurveyed portions of the refined Proposed Action area was necessary to provide the baseline vegetation information necessary for the environmental impact assessment of the Proposed Action and its alternatives. More specifically, this survey enabled for verification to determine if any blue elderberry shrubs occur in the refined Proposed Action area.

2.2 Methods

2.2.1 Field Survey

On April 11, 2011, the previously unsurveyed portion of the refined Proposed Action area was accessed and viewed from established roadways (access to the survey area was

constrained by landowner permission) by a plant ecologist/wetlands specialist (Zooey Diggory, Stillwater Sciences). The boundaries of different vegetation types were delineated on an aerial photograph base map of the Proposed Action area, and a list of the dominant plant species observed in each delineated vegetation type was recorded to assist with vegetation classification. Because the vegetation types in the unsurveyed portion of the refined Proposed Action area conformed to previously mapped and classified vegetation types, no sample sites were surveyed. Vegetation classification followed the second edition of *A Manual of California Vegetation* (Sawyer et al. 2009)

During the April 11, 2011 field survey, no elderberry shrubs were documented in the Proposed Action area.

2.2.2 Data Analysis

The field mapping was integrated into a Geographical Information System (GIS) by scanning the field maps at 600 dots per inch (dpi) resolution and digitizing the field-delineated mapping boundaries. Digitized mapping boundaries were checked for accuracy by the field plant ecologist and corrected as necessary. Finally, each mapping unit was designated with a final vegetation alliance name or land cover type (e.g., developed) in GIS.

2.3 Results

2.3.1 Vegetation Map

Three vegetation/land cover types were mapped in the previously unsurveyed portion of the refined Proposed Action area: agriculture, disturbed/developed, and Mediterranean California naturalized annual and perennial herbaceous group (Figure 2-1a and b). At the time of the survey, alfalfa and new planted tomatoes were being grown in the west and east agricultural areas, respectively (Figure 2-1a and b). Vegetation types in the refined Proposed Action area (from a combination of the 2010 and 2011 survey efforts) are depicted in Figure 2-1a and b, and summarized in Table 2-1. These vegetation types are described in detail in *Field Survey Methods and Results – Vegetation, Wildlife Habitat, and Geologic and Geomorphic Resources* (Reclamation 2012b). No additional plant species were observed during the 2011 field survey from those previously reported in Appendix B of the *Field Survey Methods and Results – Vegetation, Wildlife Habitat, and Geologic and Geomorphic Resources* (Reclamation 2012b). The portion of the Arroyo Canal levee road which may be used as a borrow area for Proposed Action fill material is almost entirely unvegetated as a result of recurring and recent dredge deposits and was classified as developed/disturbed (Figure 2-1a). A seepage drain is adjacent to a portion of the northern Arroyo Canal levee road. While the seepage drain is just outside the Proposed Action area and located on private property that could not be accessed during the April 11, 2011 survey, vegetation in and adjacent to the seepage drain is best characterized as *Typha* spp. herbaceous alliance with patches of Mediterranean California naturalized annual and perennial herbaceous group and *Salix gooddingii* woodland alliance (photos of the seepage drain are included in Figure 3-2). There are also several

large cottonwood trees along the seepage drain where Arroyo Canal crosses Jerrold Avenue (see Figure 3-2).

Table 2-1. Vegetation Types in the Arroyo Canal-Sack Dam Proposed Action Area (Including the Borrow Area)

Vegetation Type	Area	
	acres	hectares
Agriculture	7.0	2.8
Disturbed/Developed	73.1	29.6
Eucalyptus spp. woodland semi-natural stand	0.30	0.1
Mediterranean California naturalized annual and perennial herbaceous group	2.8	1.1
Populus fremontii woodland alliance	2.5	1.0
Salix exigua shrubland alliance	1.9	0.8
Salix goodingii woodland alliance	2.0	0.8
Typha spp. herbaceous alliance	0.1	0.05
Total	89.7	36.3

2.3.2 Elderberry Shrubs

Concurrent with the vegetation survey, the previously unsurveyed portions of the refined Proposed Action area were accessed and viewed for blue elderberry shrubs. No blue elderberry shrubs were identified in the Proposed Action area during either the 2010 or 2011 field survey.

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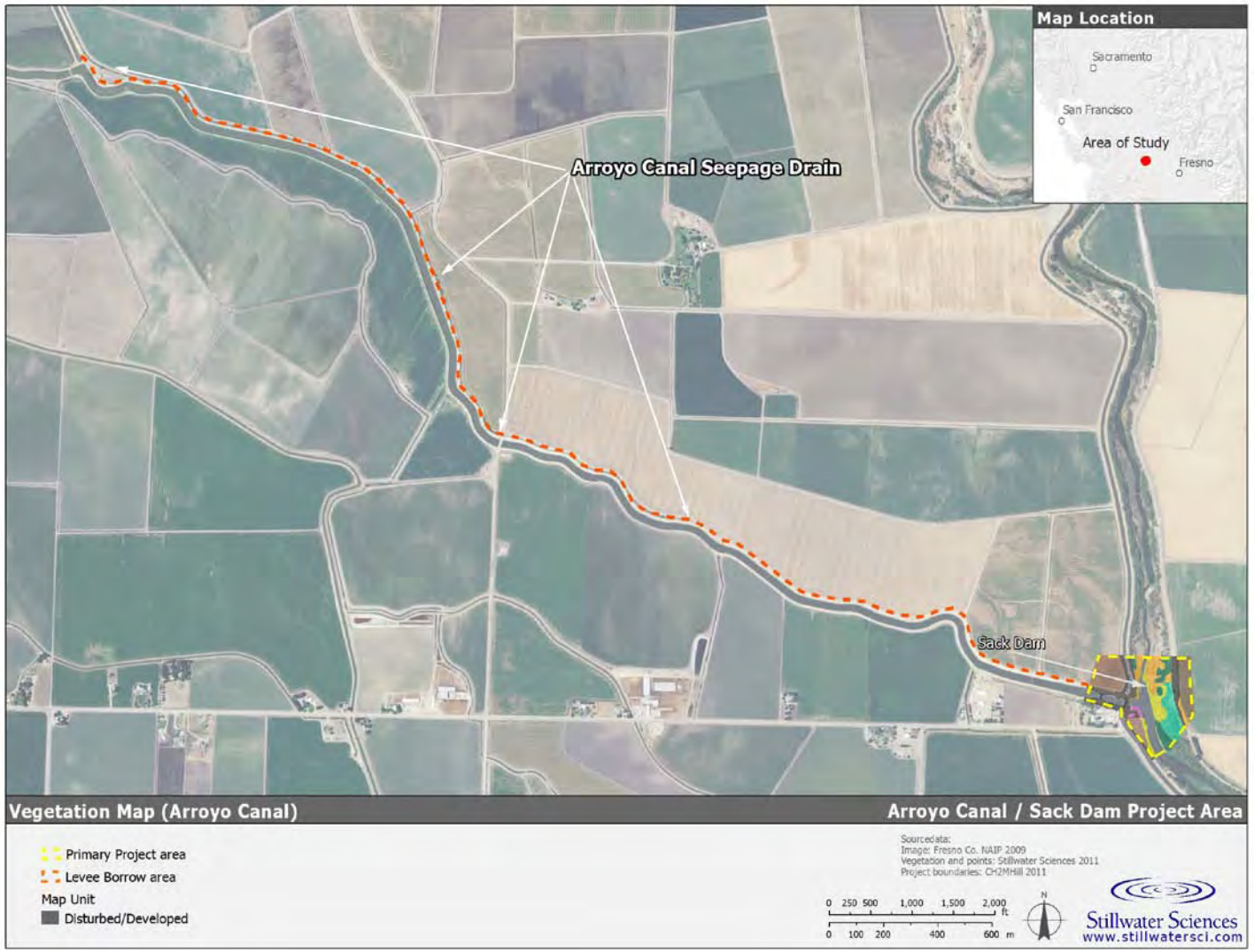
* Note that the Primary Project Area depicted here is the original boundary used for the surveys. It has since been revised to that shown in Figure 1-4.

Figure 2-1a. Vegetation Types in the Proposed Action Area



* Note that the Primary Project Area depicted here is the original boundary used for the surveys. It has since been revised to that shown in Figure 1-4.

Figure 2-1b. Vegetation Types in the Proposed Action Area

3.0 EXPANDED WILDLIFE HABITAT ASSESSMENT

3.1 Background

On May 18, 2010 a wildlife habitat assessment was conducted to document the habitat potential for and presence of special-status wildlife species in the Proposed Action area, determine the need for additional wildlife surveys (e.g., protocol-level surveys and/or pre-construction surveys), and establish baseline conditions for the EA/IS (Reclamation 2012a). The results of this survey were reported in *Field Survey Methods and Results – Vegetation, Wildlife Habitat, and Geologic and Geomorphic Resources* (Reclamation 2012b). Subsequent to the 2010 survey, the Proposed Action area was refined. Compared to the field survey extent, the Proposed Action area was significantly decreased in the north and south (i.e., upstream and downstream of Sack Dam), and slightly increased to the east and west (i.e., to include portions of adjacent agricultural fields). In addition, the upper surface of the north levee road along Arroyo Canal, for a three-mile stretch starting at the intersection with Poso Canal, was identified as a potential borrow area for Proposed Action fill material. A survey of the previously unsurveyed portions of the refined Proposed Action area was necessary to confirm baseline conditions for terrestrial wildlife potentially occurring in the Proposed Action area.

3.2 Methods

On April 11, 2011, a wildlife biologist (Steven Wood, Stillwater Sciences) accessed and viewed the previously unsurveyed portions of the refined Proposed Action area from established roadways (access to the survey area was constrained by landowner permission) between the hours of 0730 and 1200 to assess wildlife habitat conditions. The habitat assessment included a qualitative evaluation of terrestrial and aquatic habitats for special-status species identified in *Field Survey Methods and Results – Vegetation, Wildlife Habitat, and Geologic and Geomorphic Resources* (Reclamation 2012b). The assessment was based on habitat types, habitat elements (e.g., burrows, large trees, nesting sites), and evidence of wildlife activity. Mr. Wood was equipped with binoculars, Global Positioning System (GPS) receiver, camera, and notebook to document existing site conditions and any incidentally observed animal species and sign.

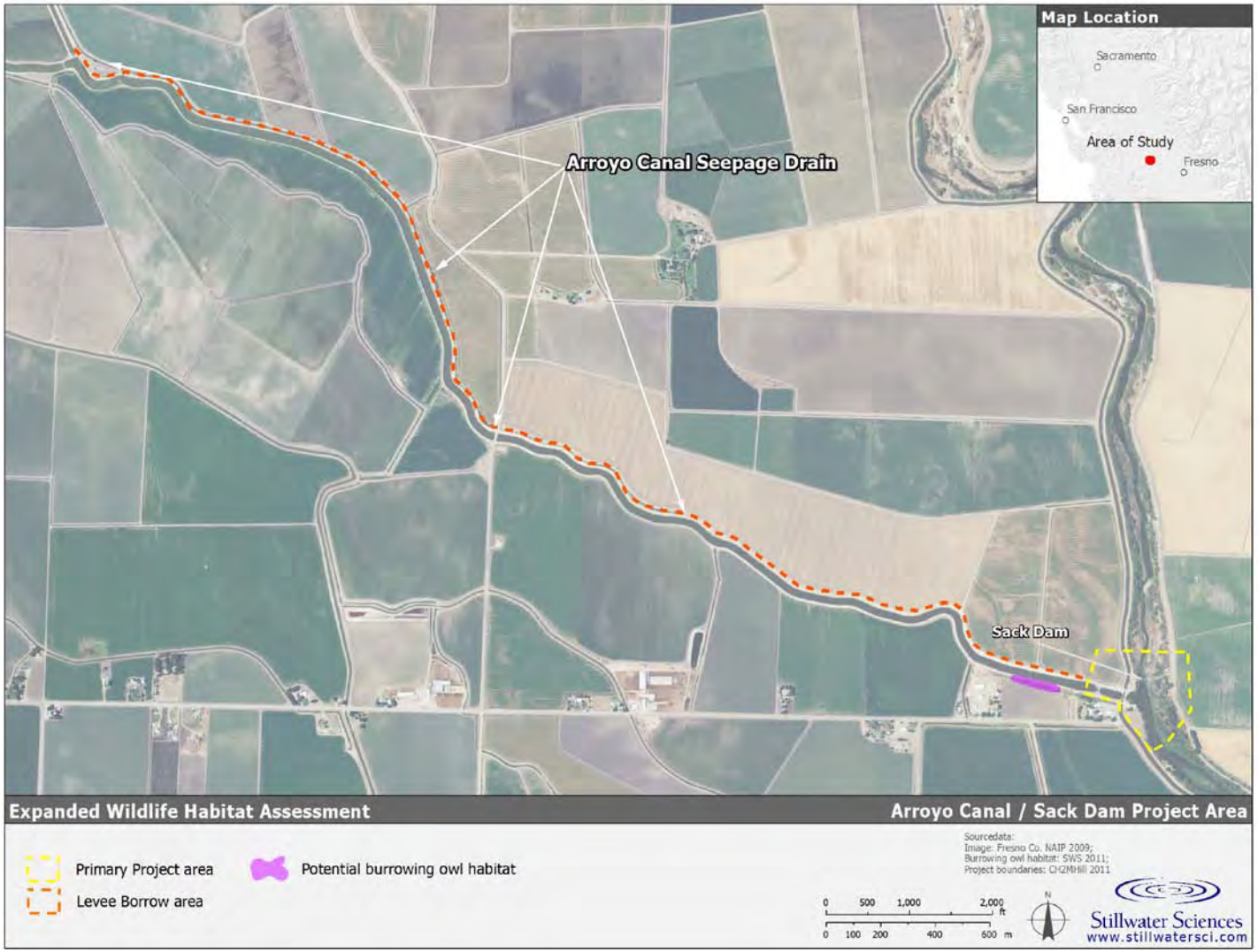
3.3 Results

Potential habitat for western burrowing owl and nesting habitat for northern harrier were identified in the previously unsurveyed portions of the Proposed Action area. Additional habitat for giant garter snake was also identified outside the Proposed Action area. Potential habitat for burrowing owl occurs in several concrete debris piles adjacent to the

southern Arroyo Canal levee road, just west of the intersection with Poso Canal, and at the upper margins of the seepage drain adjacent to Arroyo Canal (Figure 3-1), where numerous suitable burrows were observed (Figure 3-2). Two northern harriers were observed in the alfalfa field adjacent to the northern Arroyo Canal levee road and suitable nesting habitat is likely present in this area (the field could not be surveyed due to landowner access constraints). The seepage drain adjacent to Arroyo Canal appears to support at least some water throughout the year (primarily as a result of irrigation return flow) and contains tules and cattails that could support giant garter snake (Figure 3-2). The seepage drain is outside the Proposed Action area and will not be subject to project disturbance. In addition, a nesting pair of Swainson's hawks was observed in the Proposed Action area (see Section 4 for details).

Special-status species for which suitable habitat was determined to be present in the Proposed Action area are identified in Table 3-1[1]. Most of these species were already discussed in detail in *Field Survey Methods and Results – Vegetation, Wildlife Habitat, and Geologic and Geomorphic Resources* (Reclamation 2012b), with the exception of Western burrowing owl, which is discussed in detail below. Three of the special-status species identified as having the potential to occur in the Proposed Action area—Swainson's hawk, northern harrier, and Pacific pond turtle—were documented during the 2010 and 2011 habitat assessments. All wildlife species observed during the 2010 and 2011 habitat assessments combined are listed in Table 3-2.

[1] This table is slightly revised from that in *Field Survey Methods and Results – Vegetation, Wildlife Habitat, and Geologic and Geomorphic Resources* (Reclamation 2012b); western burrowing owl has been added.



* Note that the Primary Project Area depicted here is the original boundary used for the surveys. It has since been revised to that shown in Figure 1-4.

Figure 3-1. Location of the Seepage Drain Adjacent to Arroyo Canal

Looking west on the northern Arroyo Canal levee road; Jerrold Avenue in middle-ground (photo courtesy J. Stock, ICF International).

Looking east from the top of the northern Arroyo Canal levee road.

Looking north from the northern Arroyo Canal levee road; burrows in middle-ground.

Looking east from the northern Arroyo Canal levee road (photo courtesy J. Stock, ICF International).

Figure 3-2. Habitat Elements in the Seepage Drain Adjacent to Arroyo Canal

Table 3-1. Special-Status Wildlife Species with Potential to Occur in the Proposed Action Area

Common Name *Scientific Name*	Query[1] Sources	Status[2] (Federal /State)	Habitat Associations	Potential to Occur in Proposed Action Area
FISH				
Central Valley Fall/ Late Fall-run Chinook salmon[2] *Oncorhynchus tshawytscha*	SJRRP PEIS/EIR	FSC/–	Accessible streams in California's Central Valley and associated estuaries and marine waters; historically abundant in San Joaquin River but now largely extirpated upstream of the Merced River confluence.	Low; Although the Hills Ferry Barrier (HFB)[3] operates with the intention of excluding fall-run Chinook salmon from passing upstream, interim flows that may accommodate their presence (i.e., migratory habitat) or extreme flood conditions may increase the probability of their presence.
Central Valley steelhead *Oncorhynchus mykiss*	SJRRP PEIS/EIR	FT/–	Accessible streams in California's Central Valley and associated estuaries and marine waters; historically abundant in San Joaquin River but now largely extirpated upstream of the Merced River confluence.	Low; steelhead are considered extirpated from the Action Area; however, there is low potential for Central Valley steelhead to get past the HFB when it is operating (during high flood flows) and to be present in the San Joaquin River system after early December, when the HFB is removed

[2] Central Valley Fall/Late Fall-run Chinook salmon will not be included as part of the ESA consultation, but are included in this table as they will be part of the Essential Fish Habitat Assessment consultation.

[3] The HFB is a resistance weir that allows water, small fish, and particles to pass but prevent larger fish such as adult Chinook salmon from passing upstream. The barrier has been operated by CDFG on the San Joaquin River since 1992. The barrier is usually installed and operated from mid-September through December each year. The barrier's effective sustained flow capacity is 1,000 cfs, with the ability to withstand short-duration flows up to 1,500 cfs. The HFB has not been operated in the spring when juvenile salmon and steelhead are emigrating from the downstream tributaries. The opportunity for these juveniles to access the San Joaquin River upstream of the Merced River has been extremely low due to inhospitable water flow and water quality conditions. However, Interim Flows will likely provide conditions that could allow emigrating juvenile salmon and steelhead to stray upstream of the Merced River.

Common Name *Scientific Name*	Query[1] Sources	Status[2] (Federal /State)	Habitat Associations	Potential to Occur in Proposed Action Area
AMPHIBIANS				
Western spadefoot *Spea hammondii*	CWHR	–/SSC	Areas with sparse vegetation and/or short grasses in sandy or gravelly soils; primarily in washes, river floodplains, alluvial fans, playas, alkali flats, among grasslands, chaparral, or pine-oak woodlands; breeds in ephemeral rainpools with no predators.	Moderate; while there may be excessive vegetation cover, western spadefoots may breed in nearby ephemeral rain pools in spring.
REPTILES				
Pacific pond turtle *Actinemys marmorata*	CNDDB, CWHR	–/SSC	Permanent, slow-moving fresh or brackish water with available basking sites and adjacent open habitats or forest for nesting	Present; observed during habitat assessment surveys.
Coast horned lizard *Phrynosoma coronatum*	SJRRP PEIS/R	–/SSC	Open areas with sandy soil and/or patches of loose soil and low/scattered vegetation in scrublands, grasslands, conifer forests, and woodlands; frequently found near ant hills.	Low; habitat in Proposed Action area of limited suitability due to excessive vegetation cover and compact soils.
California legless lizard *Anniella pulchra*	CNDDB	–/SSC	Sparsely vegetated areas; warm, moist, loose soil for burrowing.	Low; habitat in Proposed Action area of limited suitability due to excessive vegetation cover and compact soils.
Giant garter snake *Thamnophis gigas*	CNDDB, USFWS, CWHR	FT/ST	Sloughs, canals, low- gradient streams, freshwater marsh, irrigation ditches, and/or rice fields; requires grassy banks for basking, emergent vegetation for cover, and areas of high ground protected from flooding during winter.	Low; suitable habitat present nearby but not within the Proposed Action area.
BIRDS				
Redhead *Aythya americana*	CWHR	–/SSC	Freshwater emergent wetlands with dense stands of cattails and bulrush interspersed with areas of deep, open water; forage and rest on large, deep bodies of water.	Moderate; suitable habitat present.
White-tailed kite *Elanus leucurus*	SJRRP PEIS/R	–/FP	Lowland grasslands and wetlands with open areas; nests in trees near open foraging area.	Moderate; suitable foraging and nesting habitat present.
Northern harrier *Circus cyaneus*	CNDDB, CWHR	–/SSC	Nests, forages, and roosts in wetlands or along rivers or lakes, but also in grasslands, meadows, or grain fields.	Moderate; suitable foraging habitat present.
Swainson's hawk *Buteo swainsoni*	CNDDB	–/ST	Nests in oaks or cottonwoods in or near riparian habitats. Forages in grasslands, irrigated pastures, and grain fields.	Present; observed during habitat assessment surveys.
Western burrowing owl *Athene cunicularia hypugea*	CNDDB, CWHR	–/SSC	Occupy burrows in open, dry, heavily grazed or low- stature grassland or desert vegetation; also use burrows in roadsides or levees surrounded by agriculture or in urban environments.	Moderate; suitable nesting and foraging habitat present.

Common Name *Scientific Name*	Query[1] Sources	Status[2] (Federal /State)	Habitat Associations	Potential to Occur in Proposed Action Area
Short-eared owl *Asio flammeus*	CWHR	–/SSC	Irrigated alfalfa or grain fields, ungrazed grasslands, old pastures, and salt or freshwater marshlands.	Low; suitable nesting habitat present but foraging habitat limited.
Least Bell's vireo *Vireo bellii pusillus*	SJRRP PEIS/R	FE/SE	Nests in dense vegetative cover of riparian areas; often nests in willow or mulefat; forages in dense, stratified canopy.	Low; suitable habitat present but species is rare.
Yellow warbler *Dendroica petechia*	SJRRP PEIS/R	–/SSC	Open-canopy, deciduous riparian woodland in close proximity to water along streams or wet meadows.	Moderate; suitable foraging habitat present.
Yellow-breasted chat *Icteria virens*	CWHR	–/SSC	Early successional riparian habitats with a dense shrub layer and an open canopy.	Low; while suitable habitat is present, species is uncommon in region of Proposed Action area.
MAMMALS				
Pallid bat *Antrozous pallidus*	CWHR	–/SSC	Roosts in trees, caves, crevices, and buildings; feeds in a variety of open habitats.	Moderate; suitable day roost and foraging habitat present.
Western red bat *Lasiurus blossevillii*	CNDDB, CWHR	–/SSC	Riparian forests, woodlands near streams, fields and orchards.	Moderate; suitable roosting and foraging habitat present.
San Joaquin kit fox *Vulpes macrotis mutica*	CNDDB, USFWS, CWHR	FE/–	Annual grasslands or open areas dominated by scattered brush, shrubs, and scrub.	Low; suitable denning habitat is not present, but individuals may disperse through Proposed Action area.
California ringtail *Bassariscus astutus raptor*	SJRRP PEIS/R	–/FP	Mixture of forest and shrub habitats in association with rocky areas or riparian habitats, low to middle elevations.	Low; suitable habitat present, but ringtail are unlikely to occur on the valley floor.

[1]CNDDB = CDFG (2010)
CWHR = CDFG and CIWTG (2008)
SJRRP PEIS/R = Reclamation and CDWR (2011)
USFWS = USFWS (2010)

[2]Status:

Federal	**State**
FE = listed as endangered under the Federal ESA	FP = Fully Protected
FSC = species of concern	SE = listed as endangered under the California ESA
FT = listed as threatened under the Federal ESA	SSC = Species of Special Concern
– = no status	ST = listed as threatened under the California ESA
	– = no status

Western Burrowing Owl

The western burrowing owl (*Athene cunicularia hypugea*), a California Species of Special Concern, is a year-round resident through much of the state. Western burrowing owl is widely distributed in suitable habitats throughout the lowlands of California—including in the Central Valley and southeast deserts—and is rare along the coast north of Marin County and east of the Sierra Nevada crest (Small 1994, Gervais et al. 2008). Local distributions of western burrowing owl have changed considerably due to urbanization and agriculture (Gervais et al. 2008).

The burrowing owl is found primarily in sparse, open grasslands or shrublands characterized by low-growing vegetation, but may be found in areas highly altered by human activity including airports, golf courses, and cemeteries (Haug et al. 1993).

Burrows are the essential component of western burrowing owl habitat, which the species uses for nesting and roosting. Individuals primarily use burrows made by ground squirrels (*Spermophilus beecheyi*), though may also use those excavated by other fossorial mammals including badger (*Taxidea taxus*) and coyote (*Canis latrans*) (Gervais et al. 2008). Western burrowing owls may also excavate their own burrows (Haug et al. 1993, Gervais et al. 2008). Western burrowing owls may be found occupying human-made structures such as levees, culverts, pipes, or debris piles (California Burrowing Owl Consortium 1993, Gervais et al. 2008), and have been found on the edge of drains and canals that border agriculture fields (Rosenburg and Haley 2004).

Burrowing owls are monogamous and breed from March through August, with peak activity occurring in April and May, though breeding can begin as early as February and end as late as December (Zeiner et al. 1990, Rosenberg and Haley 2004).

Table 3-2. Wildlife Species Observed in the Proposed Action Area on May 18, 2010 and April 11, 2011

Common Name	*Scientific Name*
BIRDS	
mallard	*Anas platyrhynchos*
California quail	*Callipepla californica*
great egret	*Ardea alba*
Swainson's hawk	*Buteo swansoni*
red-tailed hawk	*Buteo jamaicensis*
American coot	*Fulica americana*
mourning dove	*Zenaida macroura*
Anna's hummingbird	*Calypte anna*
western wood pewee	*Contopus sordidulus*
black phoebe	*Sayornis nigricans*
western kingbird	*Tyrannus verticalis*
western scrub- jay	*Aphelocoma californica*
American crow	*Corvus brachyrhyncos*
cliff swallow	*Petrochelidon pyrrhonota*
barn swallow	*Hirundo rustica*
American robin	*Turdus migratorius*
California thrasher	*Toxostoma redivivum*
spotted towhee	*Pipilo maculatus*
lark sparrow	*Chondestes grammacus*
song sparrow	*Melospiza melodia*
red-winged blackbird	*Agelaius phoeniceus*
Brewer's blackbird	*Euphagus cyanocephalus*
brown-headed cowbird	*Molothrus ater*
house finch	*Carpodacus mexicanus*
American goldfinch	*Spinus tristis*
Eurasian collared dove	*Streptopelia decaocto*
wood duck	*Aix sponsa*
canvasback	*Aythya valisineria*
marsh wren	*Cistothorus palustris*
downy woodpecker	*Picoides pubescens*
yellow-rumped warbler	*Dendroica coronata*
loggerhead shrike	*Lanius ludovicianus*
golden-crowned sparrow	*Zonotrichia querula*
White-crowned sparrow	*Zonotrichia leucophrys*
Lincoln's sparrow	*Melospiza lincolnii*
savannah sparrow	*Passerculus sandwichensis*
yellow-billed magpie	*Pica nuttalli*
killdeer	*Charadrius vociferus*
spotted sandpiper	*Actitis macularia*
belted kingfisher	*Ceryle alcyon*
white-tailed kite	*Elanus leucurus*
Caspian tern	*Sterna caspia*
American bittern	*Botaurus lentiginosus*
great horned owl	*Bubo virginianus*
house sparrow	*Passer domesticus*
AMPHIBIANS	
bullfrog	*Rana catesbeiana*

Common Name	*Scientific Name*
REPTILES	
Pacific pond turtle	*Actinemys marmorata*
western fence lizard	*Sceloporus occidentalis*
MAMMALS	
domestic dog[1]	*Canis lupus familiaris*[1]
raccoon[1]	*Procyon lotor*[1]
American beaver[1]	*Castor canadensis*[1]

[1] Identified by sign (tracks, scat).

4.0 SWAINSON'S HAWK SURVEY

4.1 Background

The Swainson's hawk (*Buteo swainsoni)* is listed as a California state threatened species under the California Endangered Species Act (CESA). Swainson's hawks were once found throughout lowland California, but are now restricted to suitable nesting and foraging habitat in portions of the Central Valley and Great Basin (CDFG 1994). Central Valley populations are centered in Sacramento, San Joaquin, and Yolo counties. Swainson's hawks may have historically maintained a population in excess of 17,000 pairs, but in 1994 the statewide population was estimated to be approximately 800 pairs (CDFG 1994, Bloom 1980 as cited in CDFG 1994). Nesting habitat loss from riverbank protection projects, foraging habitat loss from the conversion of agricultural lands, shooting, pesticide poisoning of prey animals and hawks on wintering grounds, competition from other raptors, and human disturbance at nest sites are the primary threats to Swainson's hawks in California (CDFG 1994, Estep 1989, as cited in CDFG 1994).

During the wildlife habitat assessment on May 18, 2010, several Swainson's hawks were observed in the Proposed Action area, but whether or not they were nesting in the Proposed Action area could not be confirmed (Reclamation 2012b). It was determined that a survey should be conducted to confirm the presence of nesting Swainson's hawk within a ½-mile radius of the Proposed Action area and provide the baseline information necessary to assess potential impacts of the Proposed Action and its alternatives on Swainson's hawks.

4.2 Methods

Prior to any field surveys, aerial photographs were analyzed to determine the extent of available habitat for Swainson's hawks in and around the Proposed Action area. Observation occurred on April 11, 2011 by a wildlife biologist/experienced ornithologist (Steven Wood, Stillwater Sciences), and consisted of walking both the left and right river margins, as well as any other areas with suitable riparian tree nesting habitat, within a ½-mile radius of the Proposed Action area, as well as along the lower 3 miles of the Arroyo Canal levee road. Periodically the observer stopped and scanned with binoculars to identify potential Swainson's hawk nest structures within tree canopies. Once these structures were located, a point of observation was chosen from which all nest structures could be viewed simultaneously with a spotting scope to determine which, if any, nest structures were active. Nest structures were viewed until species occupancy was confirmed.

4.3 Results

Three nesting structures were located within a ½-mile radius of the Proposed Action area during the survey. No nesting structures were identified along the Arroyo Canal levee road. One nest was confirmed to be occupied by Swainson's hawks, another by red-tailed hawks, and the third nest was unoccupied at the time of the survey. A pair of Swainson's hawks were observed performing aerial courtship displays and tending a nest placed on a clump of mistletoe in a cottonwood tree on the right bank of the San Joaquin River, just outside the southern boundary of the Proposed Action area (Figure 4-1).

* Note that the Primary Project Area depicted here is the original boundary used for the surveys. It has since been revised to that shown in Figure 1-4.

Figure 4-1. Swainson's Hawk Nest in the Proposed Action Area

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Appendix G – Special-Status Terrestrial Wildlife Species Scoping List and Species Accounts for the Study Area

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APPENDIX G

Special-Status Terrestrial Wildlife Species Scoping List and Species Accounts for the Study Area

Special-status terrestrial wildlife species are presented in Table G-1 and terrestrial wildlife species accounts follow.

Table G-1.
Special-Status Terrestrial Wildlife Species Scoping List for the Study Area

Common Name *Scientific Name*	Query Source[1]	Status[2] (Federal/ State)	Distribution in California	Habitat Associations	Potential to Occur in Study Area
INVERTEBRATES					
Longhorn fairy shrimp *Branchinecta longiantenna*	USFWS	FE/–	Four known populations in San Luis Obispo, Merced, Alameda, and Contra Costa counties.	Vernal pools; also found in sandstone rock outcrop pools, grass-bottomed pools, and claypan pools.	None; no vernal pools in study area.
Vernal pool fairy shrimp *Branchinecta lynchi*	USFWS	FT/–	Central Valley, central and south Coast Ranges from Tehama County to Santa Barbara County. Isolated populations also in Riverside County.	Vernal pools; also found in sandstone rock outcrop pools; does not occur in areas subject to flooding from large rivers or other waterways.	None; no vernal pools in study area.
Vernal pool tadpole shrimp *Lepidurus packardi*	USFWS	FE/–	Shasta County south to Merced County.	Occurs in vernal pools and other seasonal wetlands in open grasslands; does not occur in areas subject to flooding from large rivers or other waterways.	None; no vernal pools in study area.
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	USFWS	FT/–	Streamside habitats below 3,000 feet throughout the Central Valley, where host plants are present.	Host plant *Sambucus* sp. (blue elderberry) in riparian and oak savanna habitats.	None; no host plants identified in the study area.
AMPHIBIANS					
California tiger salamander *Ambystoma californiense*	USFWS, CWHR	FT/SSC	Central Valley from Butte County south to northeastern San Luis Obispo County and Sierra Nevada foothills, up to approximately 1,000 feet.	Annual grasslands and oak woodlands. Rodent burrows, rock crevices, or fallen logs used by adults for cover during summer dormancy. Breeding habitat includes seasonal ponds, lakes, or vernal pools.	None; no seasonal ponds, lakes, or vernal pools in study area.

Table G-1.
Special-Status Terrestrial Wildlife Species Scoping List for the Study Area

Common Name *Scientific Name*	Query Source[1]	Status[2] (Federal/ State)	Distribution in California	Habitat Associations	Potential to Occur in Study Area
Western spadefoot *Spea hammondii*	CWHR	–/SSC	Near Redding, south throughout the Central Valley and nearby foothills; Coast Ranges south of Monterey Bay; and coastal southern California south of the Transverse Mountains and west of the Peninsular Mountains; mostly below 3,000 feet.	Areas with sparse vegetation and/or short grasses in sandy or gravelly soils; primarily in washes, river floodplains, alluvial fans, playas, alkali flats, among grasslands, chaparral, or pine-oak woodlands; breeds in ephemeral rain pools with no predators.	Low; potential for dispersal; possible breeding habitat in nearby ephemeral rain pools if present outside of study area.
California red-legged frog *Rana draytonii*	USFWS	FT/SSC	Largely restricted to coastal drainages on the central coast from Mendocino County to Baja California; in the Sierra foothills south to Tulare and, possibly, Kern counties; sea level to 8,000 feet.	Still or slow-moving water with emergent and overhanging vegetation, including wetlands, wet meadows, ponds, lakes, and low-gradient, slow-moving stream reaches with permanent pools.	None; although historically known to occur in the Central Valley, the California red-legged frog is considered extirpated from the region (USFWS 2002).
REPTILES					
Pacific pond turtle *Actinemys marmorata*	CNDDB, CWHR	–/SSC	From the Oregon border along the coast ranges to the Mexican border, and west of the crest of the Cascades and Sierras.	Permanent, slow-moving fresh or brackish water with available basking sites and adjacent open habitats or forest for nesting.	Present; observed during habitat assessment surveys.
Blunt-nosed leopard lizard *Gambelia sila*	CNDDB, USFWS, CWHR	FE/SE, FP	San Joaquin Valley and nearby foothills, from Santa Barbara County and western Kern County north to southern Merced County; from 100 feet to 2,400 feet.	Open, flat, sparely vegetated areas of semiarid grasslands, alkali flats, and washes in sandy, gravelly, or loamy soils; avoids densely vegetated areas.	Low; habitat in study area not suitable because of excessive vegetative cover, compact soils, and lack of wide expansive areas for running.

Table G-1.
Special-Status Terrestrial Wildlife Species Scoping List for the Study Area

Common Name *Scientific Name*	Query Source[1]	Status[2] (Federal/ State)	Distribution in California	Habitat Associations	Potential to Occur in Study Area
Coast horned lizard *Phrynosoma coronatum*	SJRRP PEIS/R	–/SSC	West of deserts and Cascade-Sierran highlands, as far north as Shasta Reservoir; from sea level to 8,000 feet.	Open areas with sandy soil and/or patches of loose soil and low/scattered vegetation in scrublands, grasslands, conifer forests, and woodlands; frequently found near ant hills.	Low; habitat in study area of limited suitability because of excessive vegetation cover and compact soils.
California legless lizard *Anniella pulchra*	CNDDB	–/SSC	Northern Contra Costa County south to northwestern Baja California; scattered occurrences in San Joaquin Valley, along the southern Sierra Nevada mountains, and in the western Mojave Desert.	Sparsely vegetated areas; warm, moist, loose soil for burrowing.	Low; habitat in study area of limited suitability because of excessive vegetation cover and compact soils.
San Joaquin coachwhip *Masticophis flagellum ruddockii*	SJRRP PEIS/R	–/SSC	From the Sacramento Valley (Colusa County) south to San Joaquin Valley (Kern County) and west into the South Coast Ranges; an isolated population in the Sutter Buttes; from near 66 feet to 2,950 feet elevation.	Open, dry, treeless areas, including grassland and saltbush scrub. Uses rodent burrows, shaded vegetation, and surface objects as refuge.	None; habitat in study area not suitable because of excessive vegetation cover.
Giant garter snake *Thamnophis gigas*	CNDDB, USFWS, CWHR	FT/ST	Central Valley from near Burrel in Fresno County north to near Chico in Butte County; has been extirpated from areas south of Fresno.	Sloughs, canals, low-gradient streams, and freshwater marsh habitats where there is a prey base of small fish and amphibians; also found in irrigation ditches and rice fields; requires grassy banks and emergent vegetation for basking and areas of high ground protected from flooding during winter.	Low; suitable habitat present near, but outside of, the study area.

Table G-1.
Special-Status Terrestrial Wildlife Species Scoping List for the Study Area

Common Name *Scientific Name*	Query Source[1]	Status[2] (Federal/ State)	Distribution in California	Habitat Associations	Potential to Occur in Study Area
BIRDS					
Fulvous whistling-duck *Dendrocygna bicolor*	CWHR	–/SSC	Summer resident; Fresno, Kings, and Imperial counties.	Freshwater and coastal marshes; uses rice fields and tall-grass areas flooded to a depth of less than 0.5 meter, with some use of adjacent uplands.	None; marsh habitat not sufficiently expansive.
Redhead *Aythya americana*	CWHR	–/SSC	Summer resident; breeds in northeastern California, Central Valley, southern coasts, and southern desert.	Freshwater emergent wetlands with dense stands of cattails (*Typha* spp.) and bulrush (*Schoenoplectus* spp.) interspersed with areas of deep, open water; forage and rest on large, deep bodies of water.	Low; suitable breeding habitat present upstream of the study area.
Least bittern *Ixobrychus exilis*	CWHR	–/SSC	Primarily a summer resident; breeds in northeastern California, Central Coast, Central Valley, southern coasts, and southern deserts.	Freshwater and brackish marshes with dense aquatic or semiaquatic vegetation interspersed with clumps of woody vegetation and open water.	None; marsh habitat not sufficiently expansive.
White-tailed kite *Elanus leucurus*	SJRRP PEIS/R	–/FP	Year-round resident; found in nearly all lowlands of California west of the Sierra Nevada mountains and the southeast deserts.	Lowland grasslands and wetlands with open areas; nests in trees near open foraging area.	Moderate; suitable foraging and nesting habitat present.
Northern harrier *Circus cyaneus*	CNDDB, CWHR	–/SSC	Year-round resident; scattered throughout California; in the northwest, nests largely within coastal lowlands from Del Norte County south to Bodega Head in Sonoma County, inland to Napa County.	Nests, forages, and roosts in wetlands or along rivers or lakes, but also in grasslands, meadows, or grain fields.	Present; observed foraging in adjacent agriculture; potential for nesting.
Swainson's hawk *Buteo swainsoni*	CNDDB	–/ST	Summer resident; breeds in lower Sacramento and San Joaquin valleys, the Klamath Basin, and Butte Valley. Highest nesting densities occur near Davis and Woodland, Yolo County.	Nests in oaks or cottonwoods in or near riparian habitats; forages in grasslands, irrigated pastures, and grain fields.	Present; observed during habitat assessment surveys.

Table G-1.
Special-Status Terrestrial Wildlife Species Scoping List for the Study Area

Common Name *Scientific Name*	Query Source[1]	Status[2] (Federal/ State)	Distribution in California	Habitat Associations	Potential to Occur in Study Area
Greater sandhill crane *Grus canadensis tabida*	SJRRP PEIS/R	–/ST,FP	Winter visitor and migrant; scattered locations in the Central Valley; breeds in extreme northeastern California.	Forages in freshwater marshes and grasslands as well as harvested rice fields, corn stubble, barley, and newly planted grain fields.	None; marsh habitat not sufficiently expansive.
Lesser sandhill crane *Grus canadensis canadensis*	SJRRP PEIS/R	–/SSC	Winter visitor and migrant; scattered locations in the Central Valley.	Forages in freshwater marshes and grasslands as well as harvested rice fields, corn stubble, barley, and newly planted grain fields.	None; marsh habitat not sufficiently expansive.
Mountain plover *Charadrius montanus*	CNDDB, CWHR	–/SSC	Winter visitor; found in the Central Valley south of Yuba County, along the coast in parts of San Luis Obispo, Santa Barbara, Ventura, and San Diego counties; parts of Imperial, Riverside, Kern, and Los Angeles counties.	Occupies open plains or rolling hills with short grasses or very sparse vegetation; nearby bodies of water are not needed; may use newly plowed or sprouting grain fields.	None; habitat in study area not suitable because of excessive vegetation cover.
Black tern *Chlidonias niger*	CWHR	–/SSC	Migrant and summer resident; breeds in northeastern California and in scattered locations throughout the Central Valley.	Nests semi-colonially in protected areas of marshes.	None; marsh habitat not sufficiently expansive.
Western yellow-billed cuckoo *Coccyzus americanus*	CNDDB, USFWS	FC/–	Summer resident, breeds in limited portions of the Sacramento River and the South Fork Kern River; small populations may nest in Butte, Yuba, Sutter, San Bernardino, Riverside, Inyo, Los Angeles, and Imperial counties.	Summer resident of valley foothill and desert riparian habitats; nests in open woodland with clearings and low, dense, scrubby vegetation.	None; outside of species' breeding range.
Western burrowing owl *Athene cunicularia hypugea*	CNDDB, CWHR	–/SSC	Year-round resident throughout much of the state; Central Valley, northeastern plateau, southeastern deserts, and coastal areas. Rare along south coast.	Level, open, dry, heavily grazed or low-stature grassland or desert vegetation with available burrows.	Moderate; suitable nesting and foraging habitat present near the study area.

Table G-1.
Special-Status Terrestrial Wildlife Species Scoping List for the Study Area

Common Name *Scientific Name*	Query Source[1]	Status[2] (Federal/ State)	Distribution in California	Habitat Associations	Potential to Occur in Study Area
Short-eared owl *Asio flammeus*	CWHR	–/SSC	Year-round resident in certain areas; breeding in California episodic and a widespread winter migrant, found primarily in the Central Valley, in the western Sierra Nevada foothills, and along the coastline.	Irrigated alfalfa or grain fields, ungrazed grasslands, old pastures, and salt or freshwater marshlands.	Low; suitable nesting habitat present but foraging habitat limited.
Loggerhead shrike *Lanius ludovicianus*	CWHR	–/SSC	Year-round resident in most areas; much of California except for the forested coastal slope and the high elevations of the Sierra Nevada, southern Cascade, and Transverse Ranges.	Open shrubland or woodlands with short vegetation and and/or bare ground for hunting; some tall shrubs, trees, fences, or power lines for perching; typically nest in isolated trees or large shrubs.	Present; observed during habitat assessment surveys.
Least Bell's vireo *Vireo bellii pusillus*	SJRRP PEIS/R	FE/SE	Summer resident; breeds in scattered locations around southern California.	Nests in dense vegetative cover of riparian areas; often nests in willow or mulefat; forages in dense, stratified canopy.	Low; suitable habitat present but species is rare.
Bank swallow *Riparia riparia*	CNDDB	–/ST	Summer resident; occurs along the Sacramento River from Tehama County to Sacramento County, along the Feather and lower American rivers; and in the plains east of the Cascade Range in Modoc, Lassen, and northern Siskiyou counties. Small populations near the coast from San Francisco County to Monterey County.	Nests in vertical bluffs or banks, usually adjacent to water, where the soil consists of sand or sandy loam.	None; outside of species' breeding range.
Yellow warbler *Dendroica petechia*	SJRRP PEIS/R	–/SSC	Summer resident; nests in most of California, except most of the Central Valley, high Sierras, and Mojave and Colorado deserts.	Open-canopy, deciduous riparian woodland close to water, along streams or wet meadows.	Low; suitable foraging habitat present, but outside of species' breeding range.

Table G-1.
Special-Status Terrestrial Wildlife Species Scoping List for the Study Area

Common Name ***Scientific Name***	**Query Source[1]**	**Status[2] (Federal/ State)**	**Distribution in California**	**Habitat Associations**	**Potential to Occur in Study Area**
Yellow-breasted chat *Icteria virens*	CWHR	–/SSC	Uncommon summer resident and migrant in coastal California and in foothills of the Sierra Nevada.	Early successional riparian habitats with a dense shrub layer and an open canopy.	Low; suitable habitat is present, but species is uncommon in region of study area.
Oregon vesper sparrow *Pooecetes gramineus affinis*	CWHR	–/SSC	Winter visitor in northern and eastern California.	Grasslands; open ground with little vegetation or short grass and low annuals, including stubble fields, meadows, and road edges.	None; habitat in study area not suitable because of excessive vegetation cover.
Grasshopper sparrow *Ammodramus savannarum*	CWHR	–/SSC	Summer resident; nests in Mendocino, Trinity, and Tehama counties south, west of the Cascade-Sierra Nevada axis and southeastern deserts, to San Diego County.	Typically found in moderately open grasslands with scattered shrubs.	None; habitat in study area not suitable because of excessive vegetation cover.
Tricolored blackbird *Agelaius tricolor*	CNDDB, CWHR	–/SSC	Permanent residents, but make extensive migrations both in breeding season and winter. Common locally throughout Central Valley and in coastal areas from Sonoma County south.	Feeds in grasslands and agriculture fields; nesting habitat components include open accessible water, a protected nesting substrate (including flooded or thorny vegetation), and a suitable nearby foraging space with adequate insect prey.	None; marsh habitat not sufficiently expansive.
Yellow-headed blackbird *Xanthocephalus xanthocephalus*	CNDDB, CWHR	–/SSC	Primarily a migrant and summer resident, though small numbers remain in winter; Central Valley, northeastern California, central and southern coasts, and southern deserts.	Breeds almost entirely in open marshes with relatively deep water and tall emergent vegetation, such as bulrush (*Schoenoplectus* spp.) or cattails (*Typha* spp.); nests are typically in moderately dense vegetation; forage within wetlands and surrounding grasslands and croplands.	None; marsh habitat not sufficiently expansive.

Table G-1.
Special-Status Terrestrial Wildlife Species Scoping List for the Study Area

Common Name *Scientific Name*	Query Source[1]	Status[2] (Federal/ State)	Distribution in California	Habitat Associations	Potential to Occur in Study Area
MAMMALS					
Pallid bat *Antrozous pallidus*	CWHR	–/SSC	Throughout California, except for the high Sierra Nevada and from Del Norte and western Siskiyou counties to northern Mendocino County.	Roosts in trees, caves, crevices, and buildings; feeds in a variety of open habitats.	Moderate; suitable day roost and foraging habitat present.
Spotted bat *Euderma maculatum*	SJRRP PEIS/R	–/SSC	Small number of localities identified in California; mostly found in the foothills, mountains, and desert regions of southern California.	Roosts in horizontal rock crevices of arid deserts, grasslands, and mixed coniferous forests; may occasionally use caves and buildings.	None; habitat in study area not suitable because of lack of rocky outcrops.
Western red bat *Lasiurus blossevillii*	CNDDB, CWHR	–/SSC	Near the Pacific Coast, Central Valley, and the Sierra Nevada.	Riparian forests, woodlands near streams, fields and orchards.	Moderate; suitable roosting and foraging habitat present.
Townsend's western big-eared bat *Corynorhinus townsendii*	CWHR	–/SSC	Throughout California, found in all but subalpine and alpine habitats; details of distribution not well-known.	Most abundant in mesic habitats; also found in oak woodlands, desert, vegetated drainages, caves; or cave-like structures (including mines, tunnels, and buildings).	None; habitat in study area not suitable because of lack of caves or mines.
Western mastiff bat *Eumops perotis californicus*	CNDDB	–/SSC	Found mostly in southern half of California.	Primarily a cliff-dwelling species though may be found in crevices in large boulders and buildings; open, semi-arid to arid habitats.	None; habitat in study area not suitable because of lack of rocky outcrops.
San Joaquin kit fox *Vulpes macrotis mutica*	CNDDB, USFWS, CWHR	FE/–	San Joaquin Valley floor and surrounding foothills of the coastal ranges, Sierra Nevada, and Tehachapi mountains.	Annual grasslands or open areas dominated by scattered brush, shrubs, and scrub.	Low; while denning habitat is not suitable, individuals may disperse through study area.

Table G-1.
Special-Status Terrestrial Wildlife Species Scoping List for the Study Area

Common Name *Scientific Name*	Query Source[1]	Status[2] (Federal/ State)	Distribution in California	Habitat Associations	Potential to Occur in Study Area
California ringtail *Bassariscus astutus raptor*	SJRRP PEIS/R	–/FP	Widely distributed, though greatest abundance in northern California and Sierra Nevada foothills.	Mixture of forest and shrub habitats in association with rocky areas or riparian habitats, low to middle elevations.	Low; unsuitable surrounding agricultural land uses and lack of sightings in the vicinity of the study area.
American badger *Taxidea taxus*	CNDDB, CWHR	–/SSC	Throughout the state except in the humid coastal forests of Del Norte County and northwest portion of Humboldt County.	Shrubland, open grasslands, fields, and alpine meadows with friable soils.	None; habitat in study area not suitable because of excessive vegetation cover.
Nelson's antelope squirrel *Ammospermophilus nelsoni*	CNDDB, CWHR	–/ST	San Joaquin Valley floor and adjacent foothills, elevations of 165 feet to around 3,609 feet.	Dry, sparsely vegetated, loam soils in arid grassland, shrubland, and alkali sink habitats.	None; habitat in study area not suitable because of excessive vegetation cover.
Giant kangaroo rat *Dipodomys ingens*	USFWS, CWHR	FE/–	Western Fresno and Eastern San Benito counties; Kettleman Hills in Kings County; San Juan Creek Valley in San Luis Obispo County; western Kern County; eastern San Luis Obispo County; and Cuyama Valley, in Santa Barbara and San Luis Obispo counties.	Fine sandy-loam soils supporting sparse annual grass and forb vegetation; occasionally found in low-density alkali desert scrub.	None; habitat in study area not suitable because of excessive vegetation cover.
Fresno kangaroo rat *Dipodomys nitratoides exilis*	CNDDB, USFWS, CWHR	FE/–	Historically occurred on the San Joaquin Valley floor. One individual captured twice in the Alkali Sink Ecological Reserve, west of Fresno.	Sands and saline sandy soils in flat chenopod scrub and annual grassland communities.	None; habitat in study area not suitable because of excessive vegetation cover, outside of species' range.

Table G-1.
Special-Status Terrestrial Wildlife Species Scoping List for the Study Area

Common Name *Scientific Name*	Query Source[1]	Status[2] (Federal/ State)	Distribution in California	Habitat Associations	Potential to Occur in Study Area
Riparian (San Joaquin Valley) woodrat *Neotoma fuscipes riparia*	SJRRP PEIS/R	FE/SSC	Single known extant population restricted to Stanislaus River in Caswell Memorial State Park.	In riparian areas with willows and dense oak, evergreen, and/or shrubby overstory.	None; outside of species' range.
Southern grasshopper mouse *Onychomys torridus ramona*	CWHR	–/SSC	Southward from Los Angeles County to the Mexican border, generally west of the desert.	Flat, sandy, valley floor habitats.	None; outside of species' range.
Riparian brush rabbit *Sylvilagus bachmani riparius*	SJRRP PEIS/R	FE/SE	Single, known extant population restricted to the Stanislaus River in Caswell Memorial State Park.	Brushy understory of valley riparian forests.	None; outside of species' range.

[1]Status: **Federal**
FE = listed as endangered under the ESA
FT = listed as threatened under the ESA
FC = federal candidate species
– = no status

State
SE = listed as endangered under the California ESA
ST = listed as threatened under the California ESA
SSC = Species of Special Concern
FP = Fully Protected
– = no status

[2]CNDDB = California Natural Diversity Database (California Department of Fish and Game [CDFG] 2010)
CWHR = California Wildlife Habitat Relationships (CDFG and California Interagency Wildlife Task Group 2008)
SJRRP PEIS/R = San Joaquin River Restoration Program Programmatic Environmental Impact Statement/Report (Bureau of Reclamation and California Department of Water Resources 2011)
USFWS = U.S. Fish and Wildlife Service (USFWS 2010)

Key:
ESA = Endangered Species Act

Special-Status Terrestrial Wildlife Species Accounts

The following are accounts are for special-status terrestrial wildlife species with low, medium, or high potential to occur within or near the study area. Accounts include listing status, distribution, habitat associations, and life history requirements. For species that are not discussed in the Environmental Consequences analysis of the EA/IS (Section 3.4.2), potential for occurrence within or near the study area is described here. For species that are discussed in the Environmental Consequences analysis of the EA/IS (Section 3.4.2), potential for occurrence within or near the study area is described in the Affected Environment section of the EA/IS (Section 3.4.1).

Western Spadefoot

Western spadefoot, a species of toad, is a California Species of Special Concern (SSC). This species is found in California from near Redding south throughout the Central Valley and nearby foothills and through the Coast Ranges south of Monterey Bay, from sea level to approximately 1,363 meters (4,460 feet) (Zeiner et al. 1988; Stebbins 2003). Western spadefoots prefer areas with sparse vegetation and/or short grasses in sandy or gravelly soils, primarily in washes, river floodplains, alluvial fans, playas, and alkali flats (Stebbins 2003). Spadefoots typically occur in grasslands, but they may also be found in valley-foothill hardwood woodlands, chaparral, or pine-oak woodlands (Zeiner et al. 1988; Stebbins 2003). During the spring rainy season, spadefoots breed primarily in ephemeral rain pools, though they may also breed in streams with fairly isolated pools that lack predators (e.g., fishes, bullfrogs, crayfish) (Jennings and Hayes 1994). Dormancy during the long dry season is spent in self-excavated burrows that individuals dig using the sharp-edged, spade-like projection on their rear foot (U.S. Fish and Wildlife Service [USFWS] 2005).

Western spadefoot occurrences have not been documented in the California Natural Diversity Database (CNDDB) records for the study area. This species has been observed approximately 25 miles to the northwest, in San Luis National Wildlife Refuge and Great Valley Grasslands State Park (McBain & Trush, Inc. 2002; California Department of Fish and Game [CDFG] 2010). No suitable ephemeral breeding pools were observed in the study area during spring and summer habitat assessments (Appendix E and Appendix F). Western spadefoots may breed outside of the study area if ephemeral rain pools form nearby in winter and spring. The study area has only marginally suitable dispersal habitat for spadefoot because there is excessive vegetative cover and most of the study area is within an active floodplain. Because of the lack of suitable habitat within the study area, this species is not considered further in the evaluation of effects.

Pacific Pond Turtle

Pacific pond turtle (formerly western pond turtle) is a California SSC. In California, it is found from the Oregon border along the Coast Ranges to the Mexican border, and west of the crest of the Cascades and Sierras. Pacific pond turtles inhabit fresh or brackish water characterized by areas of deep water, low flow velocities, moderate amounts of riparian vegetation, warm water and/or ample basking sites, and underwater cover elements, such as large woody debris and rocks (Jennings and Hayes 1994). Along major rivers, Pacific pond turtles are often concentrated in areas of optimal habitat, and those are often in side channel and backwater areas. Turtles may move to off-channel habitats, such as oxbows, during periods of high flows (Holland 1994). Although adults are habitat generalists, hatchlings and juveniles require specialized habitat for survival through their first few years. Hatchlings spend much of their time feeding in shallow water with dense submergent or short emergent vegetation (Jennings and Hayes 1994). Although an aquatic reptile, Pacific pond turtles spend time on land basking, overwintering, and nesting, up to 0.6 mile away from aquatic habitats (Holland 1994).

Potential for occurrence within or near the study area is described in the Affected Environment section of the EA/IS (Section 3.4.1).

Blunt-nosed Leopard Lizard

Blunt-nosed leopard lizard – a federally- and state-listed endangered species and California Fully Protected (FP) species – inhabits semiarid, expansive areas with scattered or sparse vegetation, including grassland and alkali-sink scrub communities with poorly drained, alkaline, and saline soils (USFWS 1998a). Blunt-nosed leopard lizards use small mammal burrows for cover and shelter, and retreat underground in burrow systems in the winter, during the species' dormant period. They typically use abandoned ground squirrel (*Spermophilus beecheyi*) burrows and abandoned or occupied kangaroo rat (*Dipodomys* spp.) burrows. Blunt-nosed leopard lizards prefer flat areas with open space for running, and avoid densely vegetated habitats. They are absent from areas with thick vegetation, steep slopes, or areas subject to seasonal flooding (USFWS 1998a). This species cannot survive on cultivated lands.

Potential for occurrence within or near the study area is described in the Affected Environment section of the EA/IS (Section 3.4.1).

Coast Horned Lizard

Coast horned lizard, a California SSC, is endemic to California. The coast horned lizard has a patchy distribution from Shasta County south along the edges of the Sacramento Valley into the South Coast Ranges, San Joaquin Valley, and Sierra Nevada foothills to Los Angeles, Santa Barbara, and Ventura counties (Jennings and Hayes 1994). This species is found from sea level to almost 8,000 feet in elevation (Stebbins 2003). Habitat types used by coast horned lizards include riparian woodlands, chamise chaparral, annual

grassland, alkali flats, sandy washes, and, occasionally, agricultural areas with sandy soil. Coast horned lizard habitat is typically composed of unvegetated areas near scattered shrubs with a gravelly-sandy or sandy loam substrate. Coast horned lizards shelter in burrows that they excavate themselves or that are excavated by small mammals (Jennings and Hayes 1994). The active period for coast horned lizards is generally from April through October. This species mainly eats harvester ants, but also feeds on beetles and other insects.

Likelihood for occurrence of coast horned lizard in the study area is low. There are no documented CNDDB occurrence records for coast horned lizards within a 10-mile radius of the study area (CDFG 2010). Although there are some sandy patches with low stature vegetation, most of the study area has excessive vegetation cover and soils that are too compact for burrowing. Because of the lack of suitable habitat in the study area, this species is not considered further in the evaluation of effects.

California Legless Lizard

California legless lizard is a California SSC. The range of the California legless lizard extends from the south shore of the San Joaquin River in Contra Costa County south along the coast, the interior Coast Ranges, and portions of the San Joaquin Valley to northern Baja California (Stebbins 2003). Because it constructs its own burrows, the California legless lizard is restricted to sandy or loamy soils. Vegetation types associated with the California legless lizard include dunes near beaches, chaparral, pine-oak woodland, sycamores, cottonwoods, or oaks (Jennings and Hayes 1994). This species is not found in rocky soils or soils disturbed by mining, agriculture, or other human uses (Jennings and Hayes 1994).

Likelihood for occurrence of California legless lizard in the study area is low. There are no documented CNDDB occurrence records for California legless lizards within a 10-mile radius of the study area (CDFG 2010). Although there are some sandy patches with low-stature vegetation, most of the study area has excessive vegetation cover and soils that are too compact for burrowing. Because of the lack of suitable habitat in the study area, this species is not considered further in the evaluation of effects.

Giant Garter Snake

Giant garter snake is both a federal- and state-listed threatened species. The giant garter snake is found from Butte Creek, near Gridley (12 miles south of Chico) in Butte County, south to the Mendota Wildlife Area (10 miles west of Fresno) (Fisher et al. 1994). Currently, the USFWS recognizes 13 separate populations of giant garter snakes spanning the following 11 counties: Butte, Colusa, Glenn, Sutter, Yolo, Solano, Sacramento, San Joaquin, Stanislaus, Merced, and Fresno (USFWS 1999). This species inhabits marshes; sloughs; ponds; low-gradient streams; agricultural wetlands (predominantly rice fields) and associated waterways, including irrigation and drainage canals and ditches; and adjacent uplands. The three main habitat components required by giant garter snakes are (1) adequate water and emergent, herbaceous wetland vegetation –

such as bulrush or cattails – during the active season, for foraging and escape cover; (2) grassy banks and openings in waterside vegetation for basking; and (3) higher-elevation uplands with terrestrial burrows or crevices for cover, hibernation, and refugia from seasonal floods (USFWS 1999; Fisher et al. 1994). Giant garter snakes are active mostly during the daytime, requiring low-lying vegetation or open areas adjacent to water to bask. The active season for the giant garter snake is generally early April through late October, while the inactive period lasts from about late October to mid- or late March (USFWS 1999).

Although giant garter snake occurrences have not been documented in the CNDDB within 5 miles of the study area, six occurrences of this species have been documented in the CNDDB within 10 miles (CDFG 2010). The study area is near the southern extent of this species' range. Parts of the study area with a dense tree canopy are unsuitable for giant garter snake because they do not provide basking opportunities. Moderately suitable giant garter snake habitat is present near, but outside of, the study area, where there is a concentration of bulrush and cattails along the right bank of the San Joaquin River, upstream of Sack Dam. Suitable habitat is also present in nearby irrigation canals; the ditch between the northern Arroyo Canal levee road and the adjacent agricultural field appears to support at least some water year-round (primarily as a result of irrigation return flow) and contains tules and cattails that could provide cover and foraging habitat for giant garter snake. However, these suitable areas will be avoided during study activities. Because of the lack of suitable habitat within the study area, this species is not considered further in the evaluation of effects.

Redhead

Redhead, a diving duck and summer resident of California, is a California SSC. Redheads have been documented breeding in the northeast, Central Valley, southern coasts, and southern desert. This duck species prefers freshwater emergent wetlands with dense stands of cattails and bulrush interspersed with areas of deep (greater than 3 feet), open bodies of water (Beedy and Deuel 2008). Redheads nest in permanent or semi-permanent wetlands of at least 0.4 hectare, with vegetation up to around 1 meter tall and approximately 75 percent open water (Beedy and Deuel 2008).

The open water of the San Joaquin River provides moderately suitable foraging and loafing habitat for redheads. Moderately suitable breeding habitat is present near, but outside of, the study area, where there is a concentration of bulrush and cattails along the right bank of the San Joaquin River upstream of Sack Dam. There are an estimated 1.2 acres of *Typha* spp. (cattail and bulrush) habitat available upstream of the study area, which is close to the minimum acreage typically needed for this species to nest. However, because of the lack of suitable breeding habitat within the study area, this species is not considered further in the evaluation of effects.

White-tailed Kite

White-tailed kite is a CDFG FP species. White-tailed kite is a resident (breeding and wintering) species throughout central and coastal California, up to the western edge of the foothills of the Sierra Nevada; California constitutes the stronghold of the North American breeding range (Zeiner et al. 1990a; Dunk 1995). They are not migratory, but may make slight seasonal range shifts in coastal areas during winter (Zeiner et al. 1990a). White-tailed kites breed in lowland grasslands, oak woodlands or savannah, and wetlands with open areas. Riparian corridors represent a preferred landscape characteristic for kites in both the breeding and non-breeding season (Erichsen 1995). Groves of trees are required for perching and nesting, though kites do not seem to associate with particular tree species (Dunk 1995). Preferred foraging sites include open and ungrazed grasslands, agricultural fields, wetlands, and meadows that support large populations of small mammals. The white-tailed kite's year-round diet consists of more than 95 percent small mammals (Dunk 1995; Erichsen 1995), but can also include birds, insects, and reptiles. White-tailed kites breed from February through October, although peak breeding occurs from May through August (Zeiner et al. 1990a).

Potential for occurrence within or near the study area is described in the Affected Environment section of the EA/IS (Section 3.4.1).

Northern Harrier

Northern harrier is a California SSC. It is a fairly common winter visitor, and small numbers remain in California to breed. The breeding population now appears to be restricted to north coastal lowlands, the central coast, the northern Central Valley, Klamath Basin, and Great Basin (MacWhirter and Bildstein 1996; Davis and Niemela 2008). Meadows, marshes, and wetlands are optimal habitat types; other suitable habitats include grasslands, ungrazed or lightly grazed pastures, and grain fields (Davis and Niemela 2008). Northern harriers nest on the ground in shrubby vegetation, usually along the edge of marshes. Nests are constructed of larger plants (e.g., willows, cattails) at the base with grasses and sedges lining the interior. Northern harriers feed primarily on voles or other small mammals; birds, frogs, reptiles, and invertebrates make up the rest of their diet (MacWhirter and Bildstein 1996). This highly territorial species breeds from April through September, with peak breeding during June and July (Zeiner et al. 1990a).

Potential for occurrence within or near the study area is described in the Affected Environment section of the EA/IS (Section 3.4.1).

Swainson's Hawk

Swainson's hawk, a migratory raptor that is a spring and summer resident in California's Central Valley, is a state-listed threatened species. Throughout its range, the Swainson's hawk nests almost exclusively in only a few species of trees, such as oaks, cottonwoods,

sycamores, or willows (Schlorff and Bloom 1983; CDFG 1994) near large, sparsely vegetated flatlands characterized by valleys, plateaus, broad flood plains, and large open expanses (Bloom 1980). Although Swainson's hawk is not an obligate riparian species, the availability of nesting trees is closely tied to riparian areas, usually associated with main river channels (Bloom 1980; Estep 1989). Nesting sites tend to be adjacent or close to suitable foraging grounds, which may include recently harvested hay, wheat, or alfalfa crops; low-growing crops, such as beets or tomatoes; open pasture; non-flooded rice fields; or post-harvest cereal grain crops (Bloom 1980; CDFG 1992, 1994). Swainson's hawks forage in open areas with reduced vegetative cover that provides good visibility of prey, such as voles, ground squirrels, pocket gophers, and deer mice; they cannot forage in tall crops that grow much higher than native grasses, which makes prey more difficult to find (CDFG 1994).

Migrating Swainson's hawks first arrive in the Central Valley in mid-March through May and migrate south in September and October (Zeiner et al. 1990a). Breeding occurs from late March to late August, with peak activity from late May through July (Zeiner et al. 1990a). Most clutches are completed by mid-April, with fledging occurring from July to mid-August (Estep 1989). Incubation is approximately 34 to 35 days, with first flight typically occurring when young are 38 to 46 days old (Bechard et al. 2010). Reproductive success is influenced by distance between the nest site and foraging grounds. The farther a hawk travels to forage, the less food it can bring back to the nest and, consequently, the fewer young the pair can support (Estep 1989).

Potential for occurrence within or near the study area is described in the Affected Environment section of the EA/IS (Section 3.4.1).

Western Burrowing Owl

The western burrowing owl, a California SSC, is a year-round resident through much of the state. Western burrowing owl is widely distributed in suitable habitats throughout the lowlands of California, including in the Central Valley and southeast deserts, and is rare along the coast north of Marin County and east of the Sierra Nevada crest (Small 1994, Gervais et al. 2008). Local distributions of western burrowing owl have changed considerably because of urbanization and agriculture (Gervais et al. 2008).

The burrowing owl is found primarily in sparse, open grasslands or shrublands characterized by low-growing vegetation, but may be found in areas highly altered by human activity, including airports, golf courses, and cemeteries (Haug et al. 2011). Burrows are the essential component of western burrowing owl habitat, and are used for nesting and roosting. Individuals primarily use burrows made by ground squirrels (*Spermophilus beecheyi*), but may also use those excavated by other fossorial (ground-denning) mammals, including badger (*Taxidea taxus*) and coyote (*Canis latrans*) (Gervais et al. 2008). Western burrowing owls may also excavate their own burrows (Haug et al. 1993; Gervais et al. 2008). Western burrowing owls may be found occupying human-made structures, such as levees, culverts, pipes, or debris piles (California Burrowing Owl Consortium 1993, Gervais et al. 2008), and have been found

on the edges of drains and canals that border agriculture fields (Rosenburg and Haley 2004).

Burrowing owls are monogamous and breed from March through August, with peak activity occurring in April and May, but breeding can begin as early as February and end as late as December (Zeiner et al. 1990a; Rosenberg and Haley 2004).

Potential for occurrence within or near the study area is described in the Affected Environment section of the EA/IS (Section 3.4.1).

Short-eared Owl

Short-eared owl, a California SSC, is a year-round resident throughout much of the state. The breeding range for this species includes northern coastal areas, the northeastern plateau, the San Francisco Bay Delta, the San Joaquin valley, and the east side of the Sierra Nevada from Lake Tahoe to Inyo County (Zeiner et al. 1990a). However, recent breeding from coastal central California and the San Joaquin Valley has been episodic (Roberson 2008).

Preferred habitats include open, treeless areas with abundant voles and small mammals (Zeiner et al. 1990a; Roberson 2008) and enough vegetation to conceal nesting females (Wiggins et al. 2006). Examples of suitable habitat include saltwater and freshwater marshes; irrigated alfalfa or grain fields; and level, open, dry, ungrazed grasslands and old pastures (Roberson 2008; Ivey et al. 2003). Short-eared owls nest on dry ground in dense herbaceous cover; in wetlands, nest sites are in dry microsites (Howard 1994).

Short-eared owl occurrences have not been documented in the CNDDB within a 10-mile radius of the study area. Short-eared owls have been documented approximately 25 miles to the northwest, in San Luis National Wildlife Refuge (McBain & Trush, Inc. 2002; CDFG 2010). Although there may be moderately suitable nesting habitat for short-eared owls in the study area, the vegetation is likely too dense and extensive to support foraging. Likelihood of presence is low because of the combined marginal suitability of habitat and rarity of the species in this area; consequently, this species is not considered further in the evaluation of effects.

Loggerhead Shrike

Loggerhead shrike, a California SSC, is distributed throughout much of California, except for the forested coastal slope and the high elevations of the Sierra Nevada, southern Cascades, and Transverse Ranges (Humple 2008). Habitats include open areas with scattered trees or shrubs, with short vegetation and and/or bare ground for hunting. Loggerhead shrikes need tall perches, such as trees, tall shrubs, fences, posts, or power lines for hunting, territorial advertisement, and pair maintenance (Zeiner et al. 1990a; Humple 2008). A unique feeding strategy is for the shrike to impale invertebrate or vertebrate prey on sharp objects, including barbed wire, twigs, or thorns, to feed or to

cache. Nest sites are typically in isolated trees or large shrubs with dense foliage (Yosef 1996).

Potential for occurrence within or near the study area is described in the Affected Environment section of the EA/IS (Section 3.4.1).

Least Bell's Vireo

Least Bell's vireo is a federal- and state-listed endangered species. When the subspecies was listed in 1986, the breeding range of least Bell's vireo was limited primarily from Santa Barbara County south to San Diego County. Since its listing, least Bell's vireo populations have been returning to their historical range (Kus 2002). Breeding has been documented near Gilroy (Santa Clara County) and along the Santa Clara River (Ventura County), Mojave River (San Bernadino County) and San Joaquin River (San Joaquin County) (Kus 2002; River Partners 2005). Critical habitat for this species has been designated in Santa Barbara, Ventura, Los Angeles, San Bernardino, Riverside, and San Diego counties (USFWS 1992).

Least Bell's vireos primarily occupy riparian habitats along open water or dry parts of intermittent streams, generally below 1,500 feet in elevation (Kus 2002). They are generally associated with the following vegetation types: southern willow scrub, cottonwood forest, mulefat scrub, sycamore alluvial woodland, coast live oak riparian forest, arroyo willow riparian forest, wild blackberry, and mesquite in desert localities (Kus 2002). Most vireo territories contain both dense vegetative cover within 1 to 2 meters of the ground, the preferred habitat for nesting, and a dense, stratified overstory canopy, the preferred habitat for foraging (Goldwasser 1981; USFWS 1998b). Least Bell's vireos have been observed to maintain territories that include upland habitats adjacent to riparian areas, such as coastal sage scrub (USFWS 1998b). Upland habitats have also been documented for foraging, and for nesting when early spring floods inundate riparian areas (Kus and Miner 1989; USFWS 1998b).

Least Bell's vireos generally arrive in California from mid- to late March for a breeding season that typically ends in late September (Kus 2002). During this period, they are known to breed almost exclusively within riparian habitats (USFWS 1998b). Least Bell's vireos have been documented to return to the same breeding site year after year (Greaves 1989).

Although least Bell's vireo has been reported to have been extirpated from the San Joaquin Valley, the species is reportedly returning to its historical range and has recently been documented as breeding in the San Joaquin National Wildlife Refuge in Stanislaus County (Bureau of Reclamation and California Department of Water Resources 2011). Riparian areas in the study area are marginally suitable for nesting and foraging least Bell's vireos. Likelihood of presence is low because of the combined marginal suitability of habitat and rarity of the species in this area; consequently, this species is not considered further in the evaluation of effects.

Yellow Warbler

Yellow warbler, a California SSC, is a summer resident that breeds throughout much of California, except the Central Valley, southern Californian deserts, and high Sierra Nevada (Zeiner et al. 1990a, Heath 1998, Heath 2008). The largest concentrations of breeding pairs occur in northeastern California, in Modoc National Forest and Shasta County, as well as in the Cascade Range and Sierra Nevada (Heath 2008). The preferred habitat of yellow warblers includes open-canopy, deciduous riparian vegetation close to water, often along streams or wet meadows (Heath 2008). Frequently nesting in small willows and alders, yellow warblers are also associated with cottonwoods, Oregon ash, and other riparian shrubs and trees, depending upon the geographic region (Zeiner et al. 1990a; Heath 2008). This species also occasionally nests in montane chaparral in open coniferous forests (Heath 2008). Breeding occurs from mid-April through early August, with peak activity in June (Zeiner et al. 1990a). Yellow warblers nest 2 feet to 16 feet above ground, at the bases of branches (branch forks) in small deciduous trees and shrubs, often in willow thickets (Zeiner et al. 1990a; Lowther et al. 1999). Birds forage for insects within the shrub and tree canopy, occasionally feeding on the wing or eating fruit (Zeiner et al. 1990a; Lowther et al. 1999).

Riparian areas in the study area may provide foraging habitat for yellow warblers; however, the study area is outside of the species' breeding range. Therefore, this species is not considered further in the evaluation of effects.

Yellow-breasted Chat

Yellow-breasted chat, a migrant and summer resident distributed across much of California, is a California SSC. This species breeds mainly in northwestern California and the low- and mid-elevation Sierra Nevada, with sporadic occurrences documented in northeastern California (e.g., Lassen, Modoc, and Mono counties), the northern portion of the Central Valley, the San Francisco Bay-Delta region, central coast, and portions of southern California and southern deserts (Eckerle and Thompson 2001; Comrack 2008). Suitable elevations range up to 6,500 feet; the higher-elevation occurrences are on the eastern side of the Sierra Nevada. Yellow-breasted chats can be found in dense thickets of willows or other brushy areas of riparian woodlands (Zeiner et al. 1990a; Ricketts and Kus 2000). This species prefers areas with an open-canopy and proximity to water along streams or wet meadows; however, the preferred understory for nesting sites is thick and often includes a tangle of blackberry and wild grape (Zeiner et al. 1990a; Comrack 2008). Yellow-breasted chats form pairs and begin nesting in early May (Zeiner et al. 1990a). A few taller trees are necessary to use as perches for singing (Comrack 2008). This species forages in low, dense, riparian shrubland on a variety of spiders, insects, and berries gleaned from vegetation (Zeiner et al. 1990a; Ricketts and Kus 2000).

The likelihood for occurrence within the survey area and in the vicinity of the study is low. Although some foraging and nesting habitat is present in riparian vegetation in the study area, yellow-breasted chats are uncommon in this region of California. Therefore, this species is not considered further in the evaluation of effects.

Pallid Bat

Pallid bat, a California SSC, is fairly widespread in California. Pallid bats occupy a variety of habitats, from arid deserts to grasslands to conifer forests and riparian areas. Roosts (including day, night, and maternity roosts) are typically located in rock crevices and cliffs; day roosts can also be found in tree hollows and caves (Hermanson and O'Shea 1983; Lewis 1994; Pierson et al. 1996; Pierson et al. 2001). In more urban settings, roosts are frequently associated with human structures, such as abandoned buildings, abandoned mines, and bridges (Pierson et al. 1996; Pierson et al. 2001). Overwintering roosts require relatively cool and stable temperatures out of direct sunlight. Pallid bats typically glean prey from the ground, and may forage 1 to 3 miles from their day roost (Zeiner et al. 1990b).

The pallid bat is a colonial species, with a typical maternal colony size of 50 to 300 (Hermanson and O'Shea 1983; Lewis 1994; Pierson et al. 1996). Breeding occurs from late October to February. With the average litter size of two, the young are born between April and July and are typically weaned in August (Sherwin and Rambaldini 2005).

Pallid bats may day-roost in the study area within the riparian forest, and may forage over the study site and nearby fields. Pallid bats do not likely use trees near the study area as maternity roosts because they typically uses rock crevices for reproduction and rearing young. Because there is no potential maternity roosting habitat or hibernacula within the study area, this species is not considered further in the evaluation of effects.

Western Red Bat

Western red bat is a California SSC. In California, western red bats have been observed near the Pacific Coast, Central Valley, and the Sierra Nevada. Usually found at lower elevations, recent acoustic surveys in California have documented that western red bats, although relatively rare, are broadly distributed up to 8,200 feet in the Sierra Nevada (Pierson et al. 2000, 2001; Pierson and Rainey 2003). Western red bat roosts have often been observed in edge habitats – near streams, fields, orchards, or urban areas (Zeiner et al. 1990b). This species roosts non-colonially in dense canopies and within tree foliage, beneath overhanging leaves (Constantine 1959; Shump and Shump 1982), from 2 feet to 40 feet above ground level (Zeiner et al. 1990b). Studies in the Central Valley found that summering populations of western red bats are substantially more abundant in remnant riparian stands of cottonwood or sycamore greater than 164 feet wide than in younger, less-extensive stands (Pierson et al. 2000). Western red bats may forage up to 0.3 to 0.6 mile from their day roost (Zeiner et al. 1990b), both at canopy height and low over the ground (Shump and Shump 1982). This species feeds primarily on small moths, but its diet may include a variety of other insects, such as crickets, beetles, and cicadas (Zeiner et al. 1990b).

Western red bats mate in August and September. Breeding females are found in association with the same cover requirements as for roost sites, and with cottonwood/ sycamore riparian habitat along large river drainages in the Central Valley (Ziener et al.

1990b; Pierson and Rainey 2003). Fertilization is delayed until March or April. After an 80- to 90-day gestation period, pups are born from late May through early July.

Potential for occurrence within or near the study area is described in the Affected Environment section of the EA/IS (Section 3.4.1).

San Joaquin Kit Fox

San Joaquin kit fox is a federal-listed endangered and state-listed threatened species. Although a comprehensive survey of the range of kit fox has not been conducted, kit foxes are known to inhabit the San Joaquin Valley floor and the foothills of the coast range, Sierra Nevada, and Tehachapi mountains; from southern Kern County northwest to Contra Costa County and east to Madera County (USFWS 1998a). The largest extant populations of kit foxes are in western Kern County and in the Carrizo Plain in San Luis Obispo County (USFWS 1998a). There are three recognized larger "core" populations and a number of smaller "satellite" kit fox populations within their range (USFWS 1998a). The most favorable habitats for San Joaquin kit foxes include saltbush scrub, arid grasslands, alkali sink, and heavily grazed mesic grasslands (Cypher et al. 2007). Agricultural, industrial, and urban development are deemed to be the primary factors responsible for impacts on kit fox habitat in the San Joaquin Valley, because of associated habitat fragmentation and anthropogenic disturbance (USFWS 1998a; Cypher et al. 2005). Agricultural lands are typically unsuitable kit fox habitat because they are subject to intense ground disturbance and lack suitable prey (Cypher et al. 2007).

One San Joaquin kit fox occurrence has been documented in the CNDDB within 5 miles of the study area (CDFG 2010). Although the study area provides no denning opportunities, San Joaquin kit fox may occasionally disperse through the study area. However, because there is no denning habitat in or near the study area, this species is not considered further in the evaluation of effects.

California Ringtail

California ringtail, a nocturnal carnivore in the raccoon family, is a California FP species. Ringtails are active year-round and widely distributed throughout California as a non-migratory resident, ranging over the entire state, except for the extreme northeast corner and the southern portions of the San Joaquin Valley (Orloff 1988). Little is known about the specific habitat requirements of California ringtails; they are found in a variety of environments, including riparian, shrub, and forest, in close association with rocky areas or riparian habitats (Jameson and Peeters 2004), and are usually not found more than 0.6 mile from permanent water. Dens may be located in rock crevices, tree cavities, logs, snags, abandoned burrows, or woodrat nests (Zeiner et al. 1990b). The mating season occurs from February to May, and young are born around May and June (Zeiner et al. 1990b). Ringtails mainly eat rodents (woodrats and mice) and rabbits, although they also forage on fruits, berries, nuts, birds, reptiles, and invertebrates (Zeiner et al. 1990b; Jameson and Peeters 2004).

Information on the distribution of California ringtail was collected by Sue Orloff (1980) from sighting records, museum specimens, and literature. No records of ringtail within the San Joaquin River Restoration Program area or immediate vicinity were mentioned in Orloff's summary report. Ringtail occurrences were scarce in the highly developed agricultural portions San Joaquin Valley (Orloff 1980). Although habitats in the study area may be somewhat suitable for California ringtails, the likelihood of occurrence is low because of surrounding agricultural land uses that are unsuitable and the lack of sightings in the vicinity of the study area. This species is not considered further in the evaluation of effects.

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Appendix H – Special-Status Plant Species Queried in the Study Area

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Appendix H.
Special-status Plant Species Queried in the Study Area

Common Name **Scientific Name**	**Status[1] (Federal/ State/CNPSR)**	**Distribution in California**	**Habitat Associations**	**Elevation (meters)**	**Blooming Period**	**Potential to Occur in Study Area**
Heartscale *Atriplex cordulata*	--/--/1B	West edge of the Central Valley	Chenopod scrub, meadows and seeps, valley and foothill grassland (sandy)/saline or alkaline	1–375	Apr–Oct	Documented in Project quadrangles; **unlikely** to occur as suitable habitat does not occur in the study area; not detected during rare plant surveys.
Lesser saltscale *Atriplex minuscula*	--/--/1B	Southern San Joaquin Valley	Chenopod scrub, playas, valley and foothill grassland/alkaline, sandy soil	15–200	May–Oct	Documented in Project quadrangles; **unlikely** to occur as suitable habitat does not occur in the study area; not detected during rare plant surveys.
Subtle orache *Atriplex subtilis*	--/--/1B	Known from fewer than 20 occurrences including locations in Fresno, King, Madera, and Merced counties	Valley and foothill grassland	40–100	Jun–Aug	Documented in adjacent quadrangles; **unlikely** to occur as grasslands in study area are not suitable habitat; not detected during rare plant surveys.
Lost Hills crownscale *Atriplex vallicola*	--/--/1B	Lost Hills, vicinity of McKittrick in Kern County, scattered locations in Fresno and Merced counties	Alkali sink, alkaline vernal pool, saltbush scrub	50–635	Apr–Aug	Documented in adjacent quadrangles; **unlikely** to occur as suitable habitat does not occur in the study area; not detected during rare plant surveys.
Hispid bird's-beak *Cordylanthus mollis* ssp. *hispidus*	--/--/1B	Scattered locations in San Joaquin Valley from Solano County to Kern County	Meadows, grasslands, and playas on alkaline soils	1–155	Jun–Sep	Documented in adjacent quadrangles; **unlikely** to occur as suitable habitat does not occur in the study area; not detected during rare plant surveys.
Palmate-bracted bird's-beak *Cordylanthus palmatus*	FE/SE/1B	Glenn, Colusa, Yolo, Alameda, Madera, and Fresno counties	Chenopod scrub, alkaline grasslands	5–155	May–Oct	Documented in Project quadrangles; **unlikely** to occur as suitable habitat does not occur in the study area; not detected during rare plant surveys.

Appendix H.
Special-status Plant Species Queried in the Study Area

Common Name **Scientific Name**	**Status[1] (Federal/ State/CNPSR)**	**Distribution in California**	**Habitat Associations**	**Elevation (meters)**	**Blooming Period**	**Potential to Occur in Study Area**
Hoover's cryptantha *Cryptantha hooveri*	--/--/1A	Assumed extinct in California; previously in Madera and Stanislaus counties	Inland dunes, valley and foothill grassland	9–150	Apr–May	Documented in external quadrangles; **unlikely** to occur as suitable habitat does not occur in study area; not detected during rare plant surveys.
Recurved larkspur *Delphinium recurvatum*	--/--/1B	San Joaquin Valley and central valley of the South Coast Ranges, Contra Costa County to Kern County	Subalkaline soils in annual grassland, saltbush scrub, cismontane woodland, and vernal pools	3–750	Mar–Jun	Documented in adjacent quadrangles; **unlikely** to occur as grasslands in study area are not suitable habitat; not detected during rare plant surveys.
Four-angled spikerush *Eleocharis quadrangulata*	--/--/2	Central Valley	Freshwater marshes, lake and pond margins	<457	Jul–Sep	Documented in SJRRP study area; **unlikely** to occur as streambanks in study area are not suitable habitat; not detected during rare plant surveys.
Delta button-celery *Eryngium racemosum*	--/SE/1B	San Joaquin River delta and floodplains	Seasonally-inundated depressions along floodplains	5–23	Jul–Oct	Documented in external quadrangles; **unlikely** to occur as suitable habitat does not occur in study area; not detected during rare plant surveys.
Munz's tidy-tips *Layia munzii*	--/--/1B	Western San Joaquin Valley and interior foothills valleys from Fresno County to San Luis Obispo County	Chenopod scrub, grasslands, flats and hillsides in alkaline clay soils	150–700	Mar–Apr	Documented in adjacent quadrangles; **unlikely** to occur as suitable habitat does not occur in study area; not detected during rare plant surveys.
Slender-leaved pondweed *Potamogeton filiformis*	--/--/2	Central Sierra Nevada, San Joaquin Valley, San Francisco Bay Area, and Modoc Plateau	Shallow freshwater marshes	300–2,150	May–Jul	Documented in SJRRP study area; **unlikely** to occur as suitable habitat does not occur in study area; not detected during rare plant surveys.

Appendix H.
Special-status Plant Species Queried in the Study Area

Common Name **Scientific Name**	**Status[1] (Federal/ State/CNPSR)**	**Distribution in California**	**Habitat Associations**	**Elevation (meters)**	**Blooming Period**	**Potential to Occur in Study Area**
Hartweg's golden sunburst *Pseudobahia bahiifolia*	FE/SE/1B	Eastern side of Sacramento and San Joaquin Valleys and adjacent foothills; historically as far north as Yuba County	Predominantly on northern slopes of rocky, bare or grassy areas along rolling hills, and adjacent to vernal pools and streams	15–150	Mar–Apr	Documented in SJRRP study area; **unlikely** to occur as no suitable habitat occurs in study area blooming rare plant survey; not detected during rare plant surveys.
Sanford's arrowhead *Sagittaria sanfordii*	--/--/1B	Scattered locations in Central Valley and Coast Range	Freshwater marshes, sloughs, canals, and other slow-moving water habitats	n/a	May–Aug	Documented in SJRRP study area; **unlikely** to occur as suitable habitat does not occur in study area; not detected during rare plant surveys.
Chaparral ragwort *Senecio aphanactis*	--/--/2	Fresno and Merced counties	Chaparral, cismontane woodland, coastal scrub/sometimes alkaline	15–800	Jan-Apr	Documented in external quadrangles; **unlikely** to occur as suitable habitat does not occur in study area; not detected during rare plant surveys.
Wright's trichocoronis *Trichocoronis wrightii* var. *wrightii*	--/--/2	Central Valley and south coast	Alkaline meadows, marshes and swamps, riparian forests, and vernal pools	n/a	May–Sept	Documented in SJRRP study area; **unlikely** to occur as suitable habitat does not occur in study area; not detected during rare plant surveys.

[1]Status:

Federal
FE = listed as endangered under the Federal ESA
-- = no status

State
SE = listed as endangered under the California ESA
-- =no status

California Native Plant Society Rank (CNPSR)
1B = rare, threatened, or endangered in California and elsewhere
2 = rare, threatened, or endangered in California, but more common elsewhere

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Appendix I – Henry Miller Reclamation District #2131 – Arroyo Canal Fish Screen and Sack Dam Fish Passage Project: San Joaquin River (Reach 3) Channel Capacity Water Surface Elevations

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Arroyo Canal Fish Screen and Sack Dam Fish Passage Project – San Joaquin River (Reach 3) Channel Capacity Water Surface Elevations, Henry Miller Reclamation District 2131

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DATE: January 25, 2012

Introduction

This technical memorandum documents the development of a one-dimensional hydraulic model, Hydrologic Engineering Center River Analysis System (HEC-RAS), used to compare the effects of the proposed project on the existing Reach 3 water surface elevations at the reported channel capacity. Water surface elevations were compared from approximately 400 feet upstream to 100 feet downstream of the existing Sack Dam.

The San Joaquin River channel capacity for Reach 3 is reported at 4,500 cfs, according to the California Department of Water Resources map titled *Sacramento Valley and Delta and San Joaquin Valley Flood Control System* (see Attachment 1).

The highest recorded flood flow at the South Dos Palos (SDP) gaging station was 5,990 cfs in February 1983. The current SDP gaging station rating curve does not cover this historical flood flow. For this analysis, a flood flow of 4,500 cfs will be used to evaluate the effects of the proposed project.

Model Setup

The channel geometry data for the HEC-RAS model was developed from survey data collected in March and October 2011, as described in the 30 percent Design Development Report (DDR). Elevation data are based on the Central California Irrigation District (CCID) vertical datum. The survey data were used to develop a digital terrain model (DTM) meeting National Map Accuracy Standard specifications for 1-foot contour interval mapping.

Cross sections were generated using the DTM and imported to the HEC-RAS model using the GIS/CADD systems interfacing tool. Cross section stations are from 9900.0 to 10399.2. The structural geometry of Sack Dam was obtained from an as-built drawing (see Attachment 2) and survey data collected in March 2011.

The locations of the HEC-RAS cross sections are shown on Figure 1. Figure 2 shows the inline structure used in the HEC-RAS model for the existing Sack Dam structure. Entrapment of debris at the piers was modeled by reducing the orifice coefficient from 0.8 to 0.7.

Boundaries

The downstream boundary for the HEC-RAS model is at cross section station 9900.0 (approximately 100 feet downstream of the existing Sack Dam). The SDP gaging station rating curve was shifted to the downstream boundary location using the slope of the hydraulic grade line from Reclamation's Reach 4A HEC-RAS model. Information regarding the SDP gaging station rating curve, Reclamation's Reach 4A HEC-RAS model, and the shifted rating curve is provided in the 30 percent DDR.

The downstream boundary condition at the reported Reach 3 channel capacity (4,500 cfs) is elevation 125.5 feet (CCID vertical datum, the vertical reference for all elevations provided herein). For reference, the crest of the levees at cross section station 9900.0 are elevation 131.4 feet (left levee, facing downstream) and 132.4 feet (right levee, facing downstream) yielding a freeboard of approximately 5.9 feet during the channel capacity flow event. However, the minimum freeboard in the reach studied is approximately 3.9 feet during the channel capacity flow event (which occurs at cross section station 10399.2).

Diversions to the Arroyo Canal were excluded from all model simulations. The entrance to the Arroyo Canal was designated as an ineffective flow area to simulate the no-flow condition in the canal.

Calibration

Field water surface measurements were taken by Henry Miller Reclamation District 2131 (HMRD) upstream and downstream of the existing Sack Dam (approximate cross section stations 10199.3 and 9900.0, respectively) during flood flows in spring 2011 (see Table 1). These field measurements were used to calibrate the roughness coefficients assigned to the channel and overbanks. The roughness values assigned to the channel and overbanks were set at 0.045 and 0.060, respectively. All simulations used the same channel and overbank roughness values.

TABLE 1
Field Water Surface Measurements
Arroyo Canal Fish Screen and Sack Dam Fish Passage Project

Date	Cross Section Station 9900.0 WS EL[a] (ft)	Cross Section Station 10199.3 WS EL[a] (ft)	Flow[b] (cfs)
4/1/2011	124.2	124.6	3,129
4/2/2011	124.7	125.2	3,699
4/4/2011	125.0	125.4	3,873
4/14/2011	124.1	124.6	3,192
4/18/2011	124.1	124.6	3,262

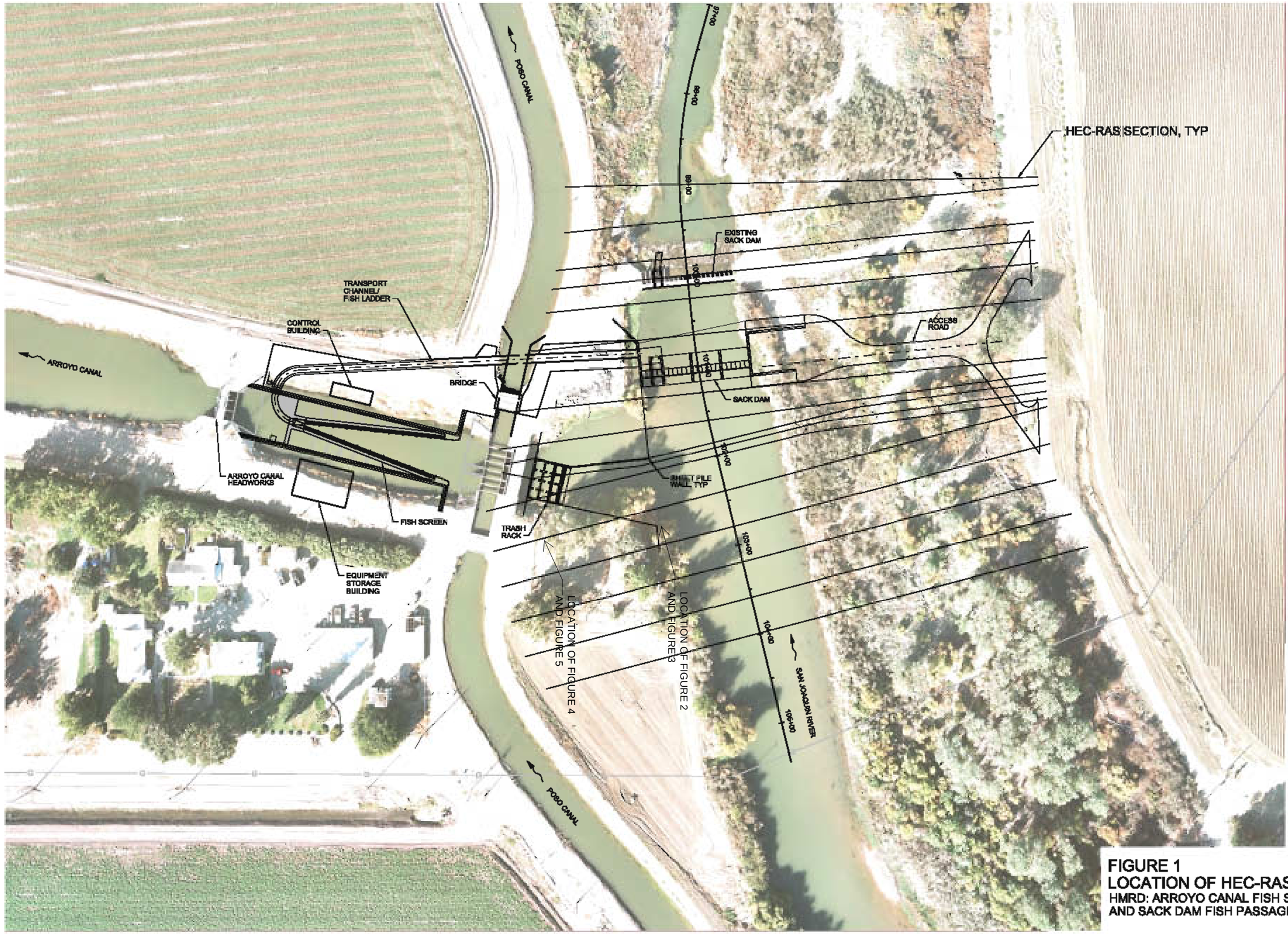
[a]CCID vertical datum.
[b]Flow based on the SDP gaging station water surface elevation and associated rating curve.

Validation of the HEC-RAS model calibration is shown in Table 2. The calibration simulations used the field water surface measurements at cross section 9900.0 (shown in Table 1) as the downstream boundary condition and the reported flow at the SDP gaging station. As shown in Table 2, the largest difference between the field measurements and HEC-RAS model simulations was 0.3 feet.

TABLE 2
Validation of the HEC-RAS Model Calibration
Arroyo Canal Fish Screen and Sack Dam Fish Passage Project

	Cross Section Station 10199.3		
Flow[a] (cfs)	Field Measurement WS EL[b] (ft)	HEC-RAS Model WS EL[b] (ft)	Difference (ft)
3,129	124.6	124.4	0.2
3,699	125.2	124.9	0.3
3,873	125.4	125.2	0.2
3,192	124.6	124.3	0.3
3,262	124.6	124.4	0.2

[a]Flow based on the SDP gaging station water surface elevation and associated rating curve.
[b]CCID vertical datum.



Date of Aerial Photography
October 17, 2011

N

0 50 100 150
SCALE IN FEET

FIGURE 1
LOCATION OF HEC-RAS CROSS SECTIONS
HMRD: ARROYO CANAL FISH SCREEN
AND SACK DAM FISH PASSAGE PROJECT

CH2MHILL.

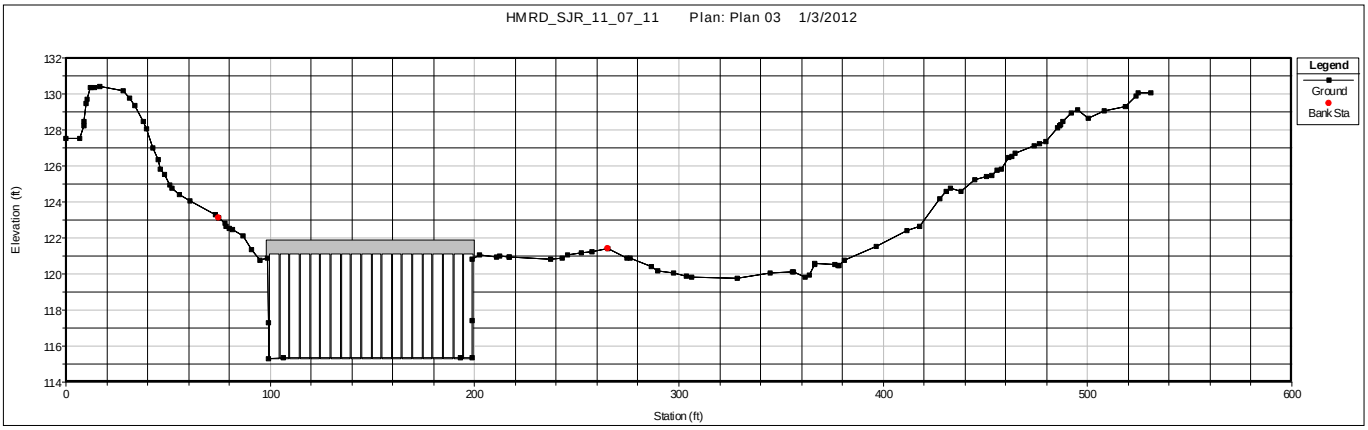


FIGURE 2
Existing Sack Dam Structure

During calibration, the existing Sack Dam structure was modeled as a bridge and an inline structure to verify that the two different modeling approaches yielded similar results. The results were found to be identical for the two modeling approaches. The inline structure was chosen as the preferred modeling approach to allow for design-phase modeling of gate operation, which is outside the purview of this analysis.

The HEC-RAS model results for existing conditions at the Reach 3 channel capacity (4,500 cfs) are shown in Table 3.

TABLE 3
Existing Conditions – Channel Capacity (4,500 cfs) Water Surface Elevations
Arroyo Canal Fish Screen and Sack Dam Fish Passage Project

Cross Section Station	WS EL[a] (ft)
9900.0	125.5
9940.0	125.5
9980.0	125.5
10000.0	125.5
10020.0	125.6
10025.0	125.6
10065.0	125.6
10075.0	125.6
10129.0	125.7
10160.0	125.7
10184.9	125.7
10190.9	125.7
10199.3	125.7
10239.1	125.7
10279.1	125.7
10319.1	125.7
10359.2	125.8
10399.2	125.8

[a]CCID vertical datum.

Project Conditions

Once calibration was completed, the model geometry was modified to account for the Project improvements (see Figure 1). Common model geometry modifications to the cross sections (namely station 10120.0, 10160.0, and 10184.9) include the improvements to the area west of the left abutment. Other geometry modifications are described in the following sections.

Two alternatives were evaluated regarding the hydraulic control utilized for the new Sack Dam. The hydraulic control alternatives considered include the following:

- 118-foot-wide gated structure (see Attachment 3).
- 158-foot-wide partially gated and fixed-crest structure (see Attachment 4).

Both hydraulic control alternatives considered for the new Sack Dam were modeled as inline structures with a weir coefficient of 2.9. In addition, both hydraulic control alternatives incorporated improvements to the embankment adjacent to the right abutment (east floodplain). The embankment was modeled as part of the inline structure with a weir coefficient of 2.9.

Both hydraulic control alternatives considered for the new Sack Dam include the concrete sill appended to the existing Sack Dam (see Attachment 5). The improvements to the existing Sack Dam were modeled as an inline structure with a weir coefficient of 2.9. Figure 3 shows the inline structure used in the HEC-RAS model.

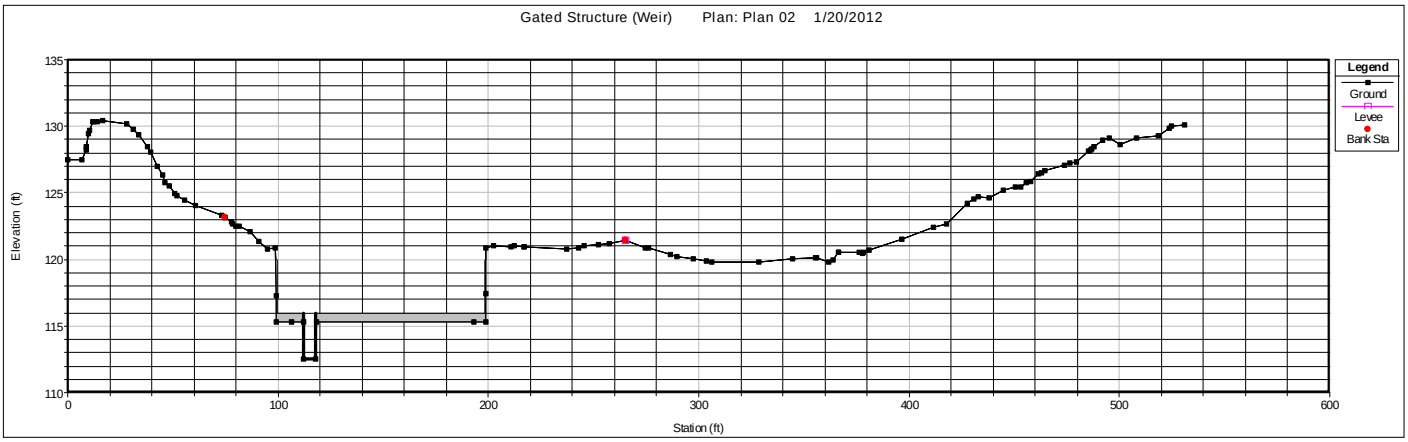


FIGURE 3
Inline Structure – Existing Sack Dam Improvements

Sack Dam "Gated Structure"

Information regarding the gated structure alternative is provided in the 30 percent design documents.

The gated structure includes two 10-foot and three 30-foot-wide gate bays. The full depth slot in Bay 2 was accounted for by reducing the 10-foot bay width to 6 feet. The cross sections immediately upstream and downstream of the gated structure (station 10129.0 and 10075.0, respectively) were modified to reflect the proposed improvements. Figure 4 shows the inline structures used in the HEC-RAS model.

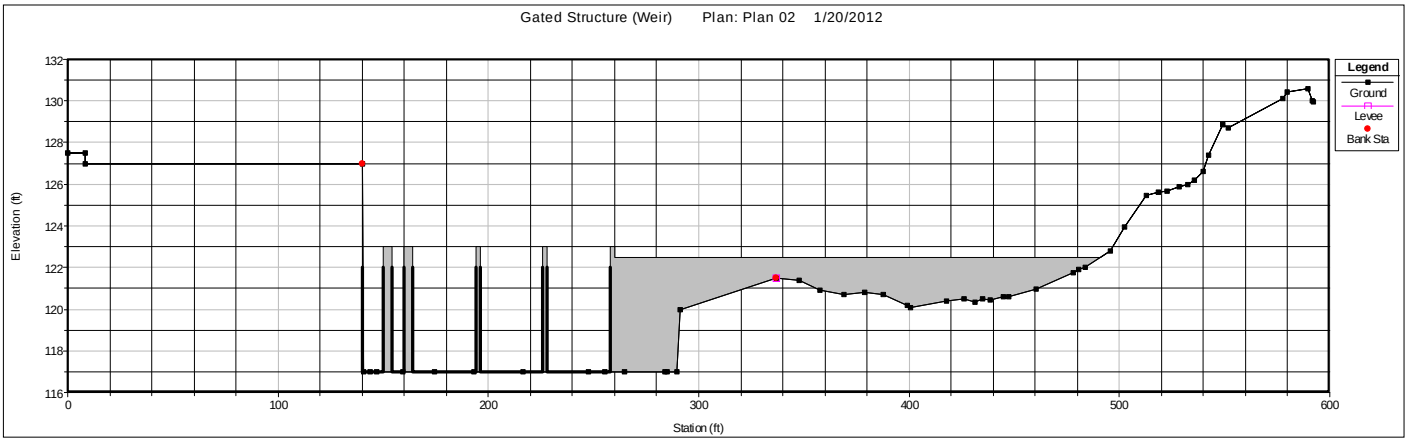


FIGURE 4
Inline Structure – Sack Dam "Gated Structure"

Sack Dam "Fixed-crest Structure"

Information regarding the fixed-crest structure alternative can be found in the 30 percent design documents.

This alternative consists of a 110-foot-long, fixed-crest centered between two 10-foot-wide gate bays adjacent to the left and right abutments. The full depth slot in Bay 2 was accounted for by reducing the 10-foot bay width to 6 feet. The cross sections immediately upstream and two downstream of the fixed-crest structure (station 10129.0, 10075.0, and 10065.0, respectively) were modified to reflect the proposed improvements. Figure 5 shows the inline structure used in the HECRAS model.

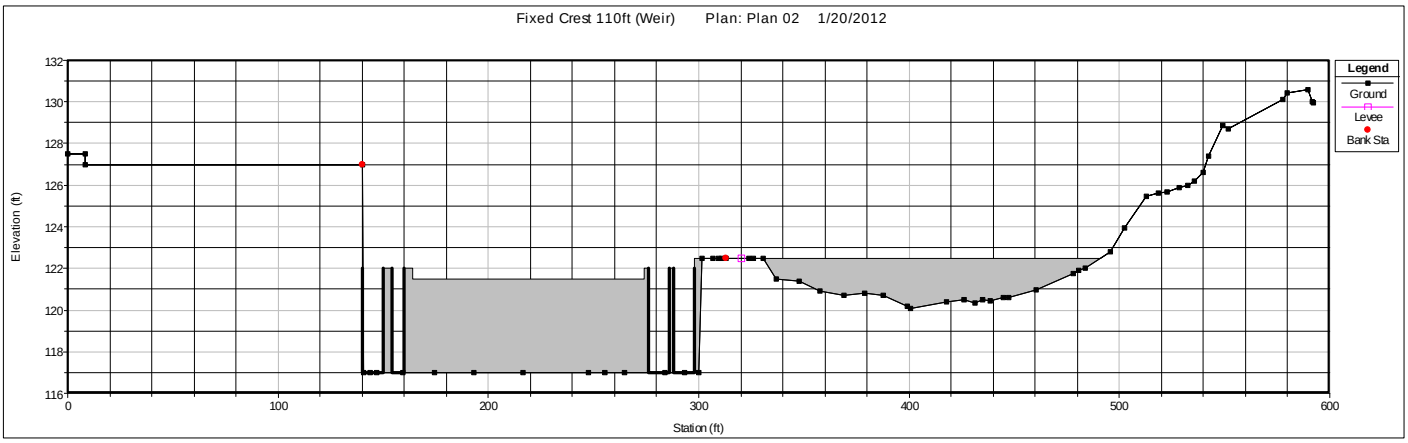


FIGURE 5
Inline Structure – Sack Dam "Fixed-crest Structure"

Results

HEC-RAS water surface elevations in the vicinity of Sack Dam were compared at the Reach 3 channel capacity (4,500 cfs) with and without project improvements. Tables 4 and 5 compare the gated structure and fixed crest structure, respectively. The model results show no significant increase in water surface elevation. The model did show nominal changes in the water surface elevations in localized areas around the structure, but these fluctuations did not exceed 0.1 foot of rise at any of the modeled cross sections. The HEC-RAS model results show no notable increase in water surface elevation at the most upstream cross section (station 10399.2).

TABLE 4
Gated Structure – Water Surface Elevation Difference at Reach 3 Channel Capacity (4,500 cfs)
Arroyo Canal Fish Screen and Sack Dam Fish Passage Project

Cross Section Station	Existing Conditions WS EL[a] (ft)	Project Improvements WS EL[a] (ft)	Difference (ft)
9900.0	125.5	125.5	0.0
9940.0	125.5	125.5	0.0
9980.0	125.5	125.5	0.0
10000.0	125.5	125.5	0.0
10020.0	125.6	125.6	0.0
10025.0	125.6	125.6	0.0
10065.0	125.6	125.6	0.0
10075.0	125.6	125.7	0.0
10129.0	125.7	125.7	0.0
10160.0	125.7	125.7	0.0
10184.9	125.7	125.7	0.0
10190.9	125.7	125.7	0.0
10199.3	125.7	125.8	0.0
10239.1	125.7	125.7	0.0
10279.1	125.7	125.7	0.0
10319.1	125.7	125.7	0.0
10359.2	125.8	125.8	0.0
10399.2	125.8	125.8	0.0

[a]CCID vertical datum.

TABLE 5
Fixed Crest Structure – Water Surface Elevation Difference at Reach 3 Channel Capacity (4,500 cfs)
Arroyo Canal Fish Screen and Sack Dam Fish Passage Project

Cross Section Station	Existing Conditions WS EL[a] (ft)	Project Improvements WS EL[a] (ft)	Difference (ft)
9900.0	125.5	125.5	0.0
9940.0	125.5	125.5	0.0
9980.0	125.5	125.5	0.0
10000.0	125.5	125.5	0.0
10020.0	125.6	125.6	0.0
10025.0	125.6	125.6	0.0
10065.0	125.6	125.6	0.0
10075.0	125.6	125.7	0.0
10129.0	125.7	125.7	0.0
10160.0	125.7	125.7	0.0
10184.9	125.7	125.7	0.0
10190.9	125.7	125.7	0.0
10199.3	125.7	125.8	0.0
10239.1	125.7	125.7	0.0
10279.1	125.7	125.8	0.1
10319.1	125.7	125.8	0.1
10359.2	125.8	125.8	0.0
10399.2	125.8	125.8	0.0

[a]CCID vertical datum.

In the reach studied, the existing freeboard is no less than 3.9 feet (which occurs at cross section station 10399.2) for any of the model simulations at 4,500 cfs. At the highest recorded flood flow (5,990 cfs), it is estimated that the freeboard is no less than 3.0 feet. The water surface profiles for both the Reach 3 channel capacity (4,500 cfs) and the highest recorded flood flow (5,990 cfs) are shown on Figure 6.

The HEC-RAS model results demonstrate no measurable increase in the water surface elevation at the Reach 3 channel capacity (4,500 cfs) and the highest recorded flood flow (5,900 cfs) as a result of project improvements. To ensure that project structures do not increase the localized flood water surface elevation, it is critical to undertake proper operation and maintenance of the structures. The proposed crest control gates must be in the fully open position during high flow events, and maintenance bulkheads shall be completely out of the flow path.

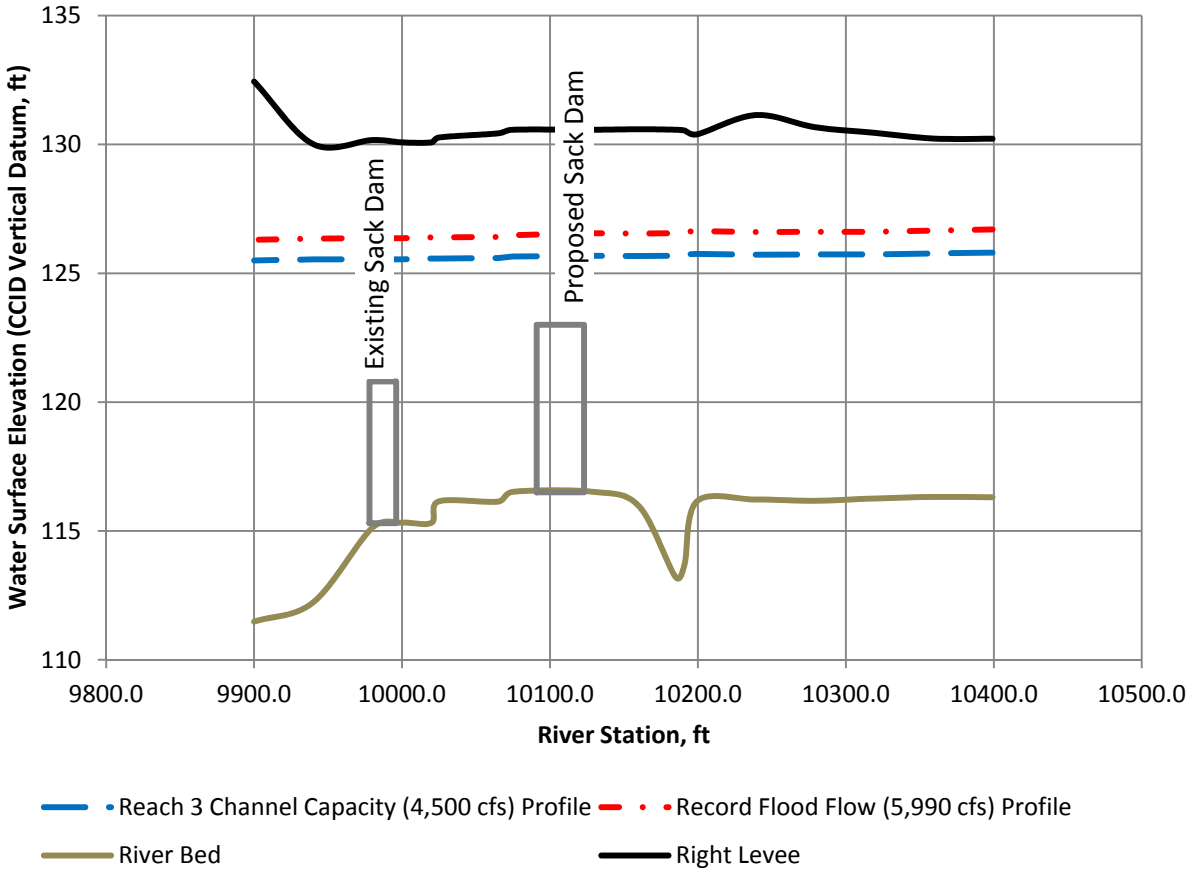
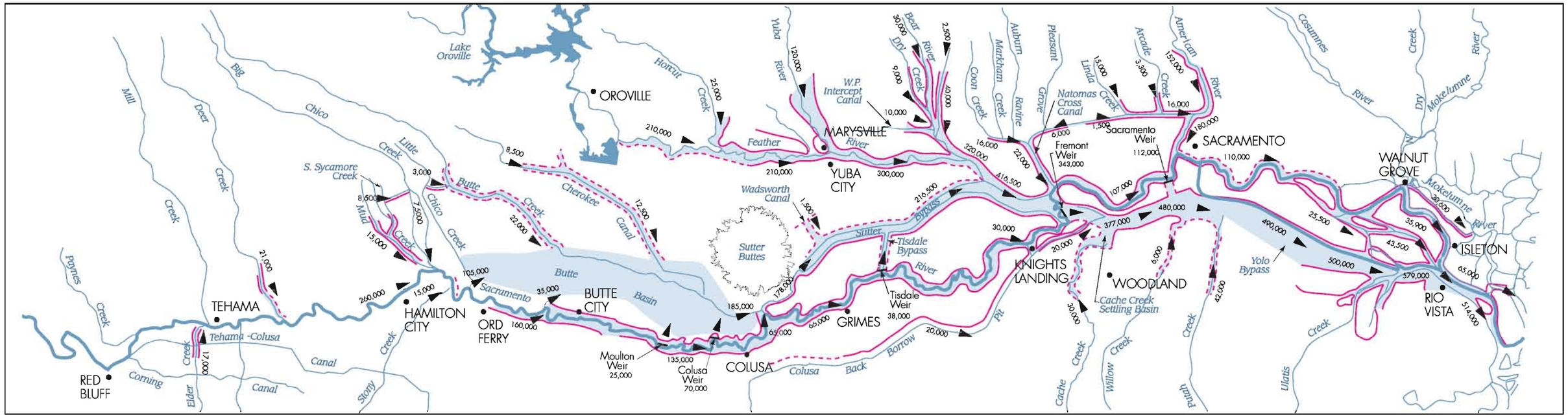


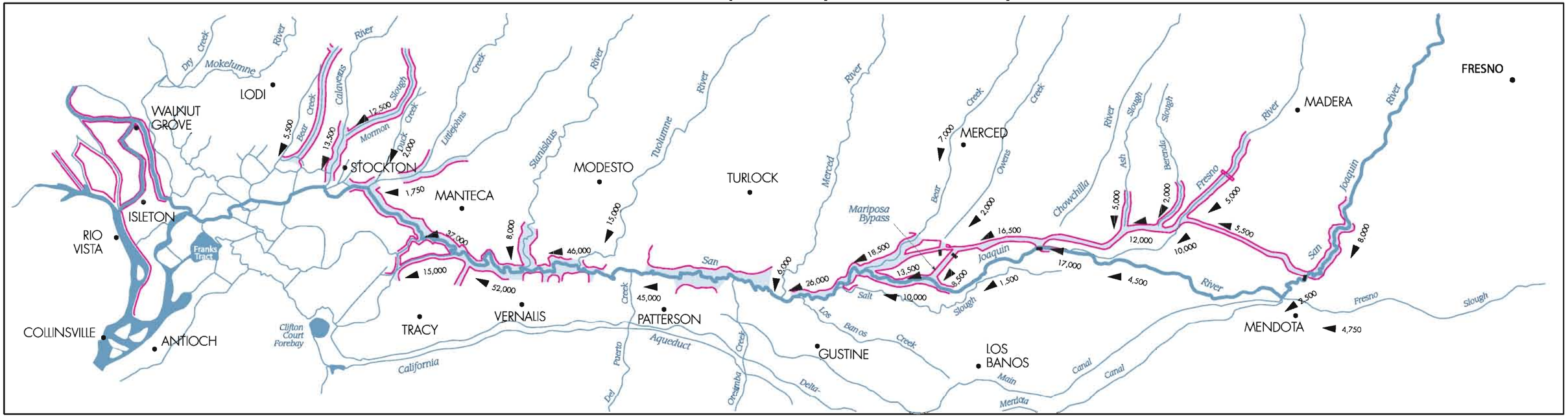
FIGURE 6
Water Surface Profiles

Attachment 1
Sacramento Valley and Delta and San Joaquin Valley Flood Control System

Sacramento Valley Flood Control System



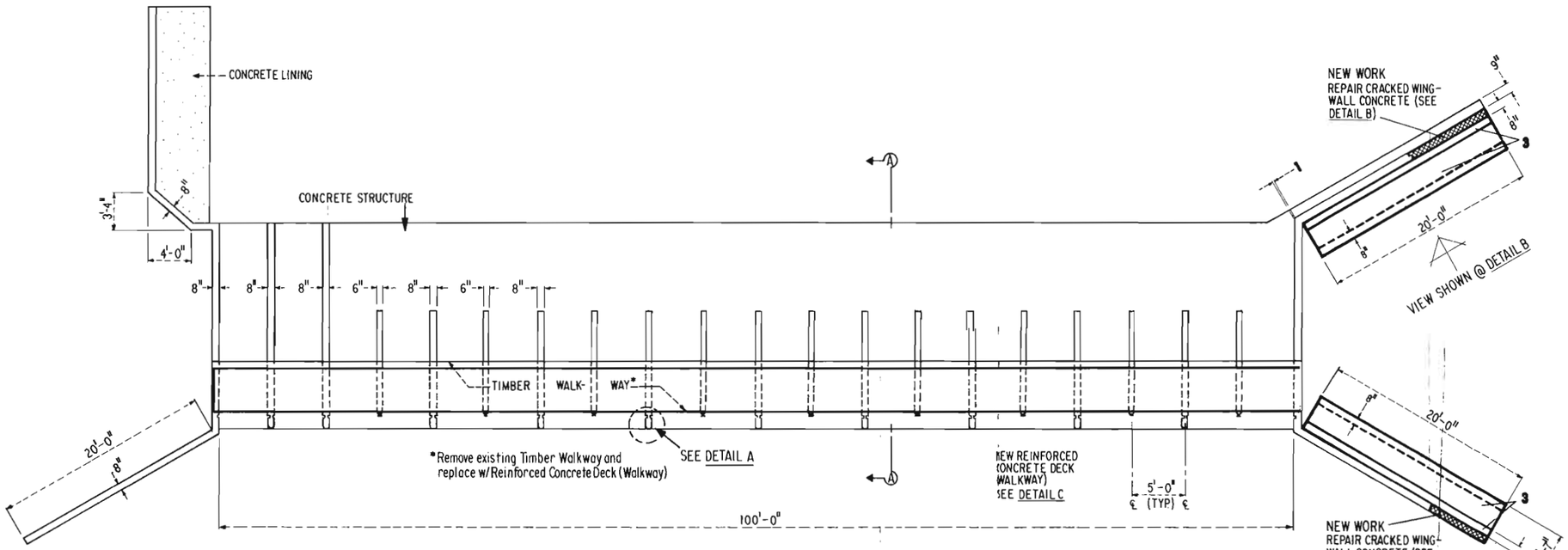
Delta and San Joaquin Valley Flood Control System



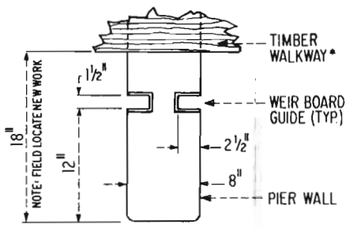
Project Levees Maintained by Reclamation, Levee, and Drainage Districts and Municipalities

45,000 Estimated Channel Capacity (in cubic feet per second)

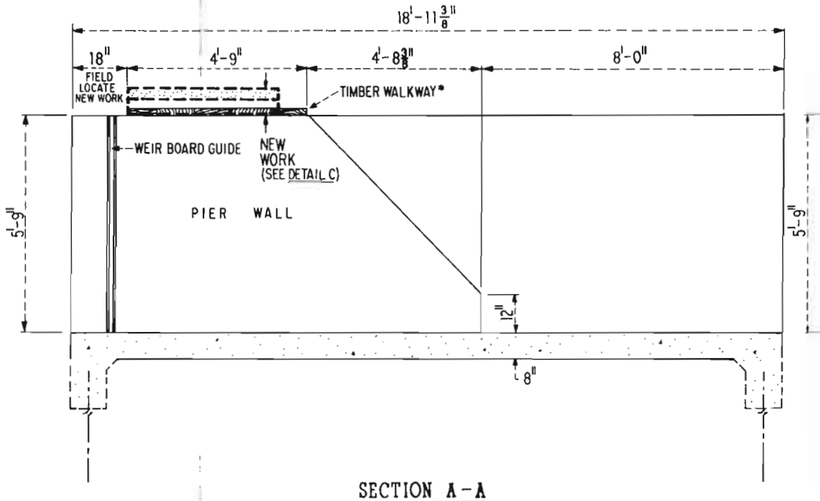
Attachment 2
Existing Sack Dam



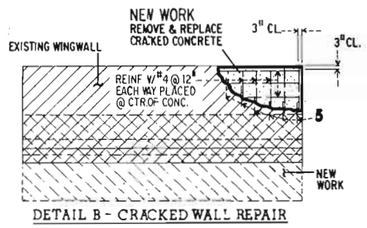
PLAN



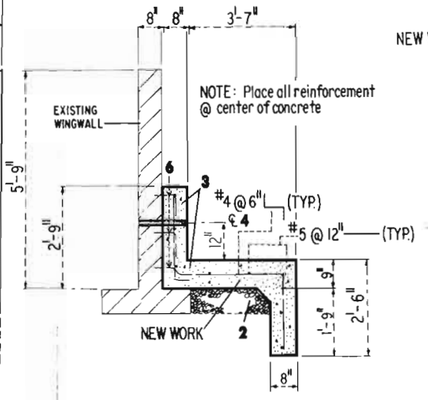
DETAIL A



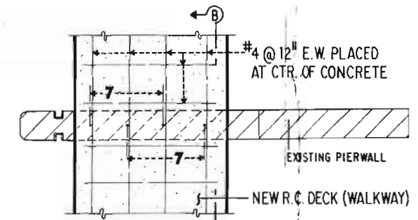
SECTION A-A



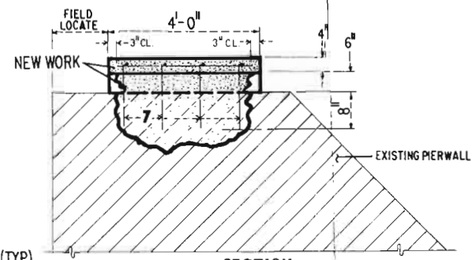
DETAIL B - CRACKED WALL REPAIR



TYPICAL WINGWALL FOOTING CROSS SECTION

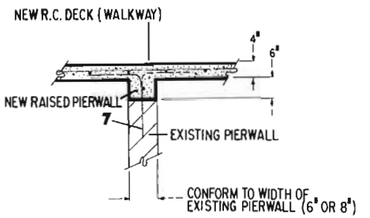


PLAN



SECTION

DETAIL C - CONCRETE DECK (WALKWAY)



SECTION B-B

GENERAL NOTES

- 1. ALL REINFORCING BAR BENDS SHALL HAVE A MINIMUM RADIUS OF SIX BAR DIAMETERS.
- 2. ALL REINFORCING BAR SPLICES SHALL BE LAPPED THIRTY BAR DIAMETERS, IF NOT WELDED.
- 3. CHAMFER ALL EXPOSED CORNERS OF CONCRETE 1" ±; HAUNCH ALL INTERIOR CORNERS OF CONCRETE 1" ±.
- 4. REINFORCING STEEL SHALL CONFORM TO ASTM DESIGNATION A-15 FOR BILLET STEEL BARS FOR CONCRETE REINFORCEMENT, INTERMEDIATE GRADE, AND SHALL CONFORM TO ASTM DESIGNATION A-305.
- 5. REINFORCED CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 3,000 P.S.I.. CEMENT SHALL BE TYPE II IN ACCORDANCE WITH ASTM C-150. A MINIMUM OF 5½ SACKS OF CEMENT TO EACH CUBIC YARD OF CONCRETE SHALL BE USED.
- 6. THE STRUCTURE SHALL BE BACKFILLED IN 6 INCH LAYERS TO 90% MAXIMUM DRY DENSITY IN ACCORDANCE WITH ASTM D-1557. BACKFILL SHALL NOT BE PLACED UNTIL CONCRETE COMPRESSIVE STRENGTH MEETS OR EXCEEDS 3,000 P.S.I.
- 7. WINGWALLS SHALL INCLUDE 1¼" DIAMETER WEEP VALVES, SPACED AT 5' CENTERS, 1' FROM TOP OF FOOTING, WHERE WALL FACE IS OPEN TO STREAM.

ESTIMATED QUANTITIES

REINFORCED CONCRETE:	
WINGWALL FOOTING	8.5 C.Y.
CONCRETE DECK	6.0 C.Y.
3/4" CRUSHED ROCK	5.3 C.Y.

DO NOT SCALE FROM DRAWINGS ON THIS SHEET

EXPLANATION OF SYMBOLS

1. EXPANSION JOINT REPAIR - FILL W/POLYSULFIDE LIQUID POLYMER (ONE COMPONENT) THIOKOL HORNFLEX, OR APPROVED EQUAL
2. 3/4" CRUSHED ROCK, 12" THICK
3. NEW WINGWALL FOOTING (SEE TYPICAL WINGWALL FOOTING CROSS SECTION)
4. WEEP VALVE (SEE GENERAL NOTE NO.7)
5. #4 BAR DOWELS, EPOXY 8" INTO EXISTING WINGWALL 8" 8"
6. #4 BAR DOWELS @ 12" CTRS. EACH WAY
7. #4 BAR DOWELS @ 12" CTRS. ALTERNATE RT. & LT., EMBED 8" INTO EXISTING PIERWALL

REGISTERED PROFESSIONAL ENGINEER JOSEPH C. McGOWAN NO. 26307 Exp. 3-31-96 CIVIL STATE OF CALIFORNIA

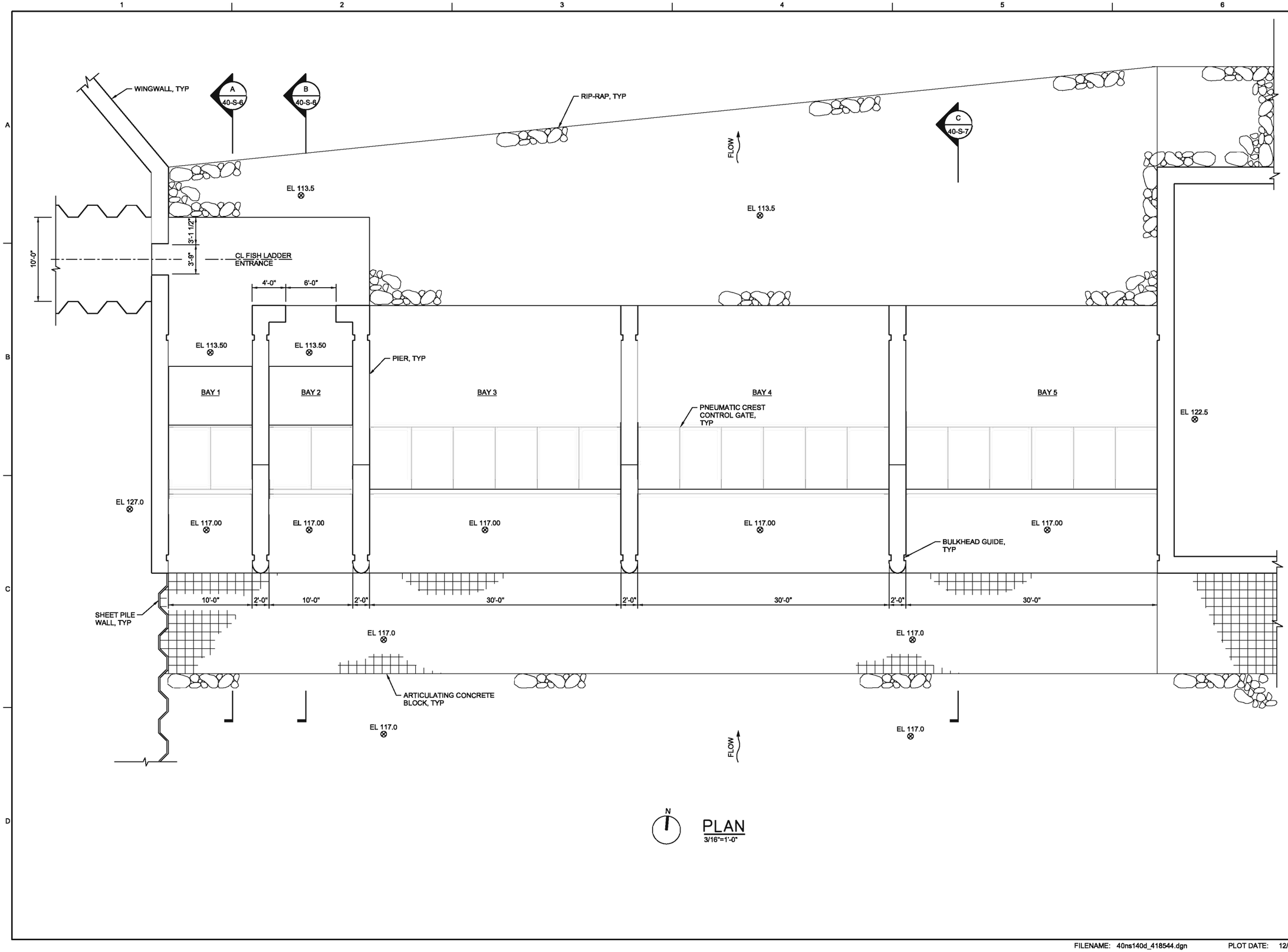
SAN LUIS CANAL COMPANY
LOS BANOS CALIFORNIA

SACK DAM
EAST WINGWALL REPAIR

SUMMERS ENGINEERING, INC.
HANFORD CONSULTING ENGINEERS CALIFORNIA

DATE DEC. 1995 | APPROVED
DRAWN CRI-D | DRAWING NO. SD-1
CHKD DAM | SHEET 1 1

Attachment 3
Sack Dam – Gated Structure



PLAN
3/16"=1'-0"

2525 AIRPARK DR
REDDING, CA. 96001
(530)-243-5831

CH2MHILL

HMRD No. 2131
ARROYO CANAL FISH SCREEN
AND SACK DAM FISH PASSAGE
PROJECT

STRUCTURAL
SACK DAM
PNEUMATIC CREST CONTROL GATE
OVERALL TOP PLAN

NO.	DATE	REVISION	BY	APVD
DSGN	B MEMEO / C LOW	DR	D CAVE	CHK

CHECKED-BY APVD
APPROVED-BY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	DECEMBER 2011
PROJ	418544
DWG	40-S-2
SHEET	75

PRELIMINARY - NOT FOR CONSTRUCTION

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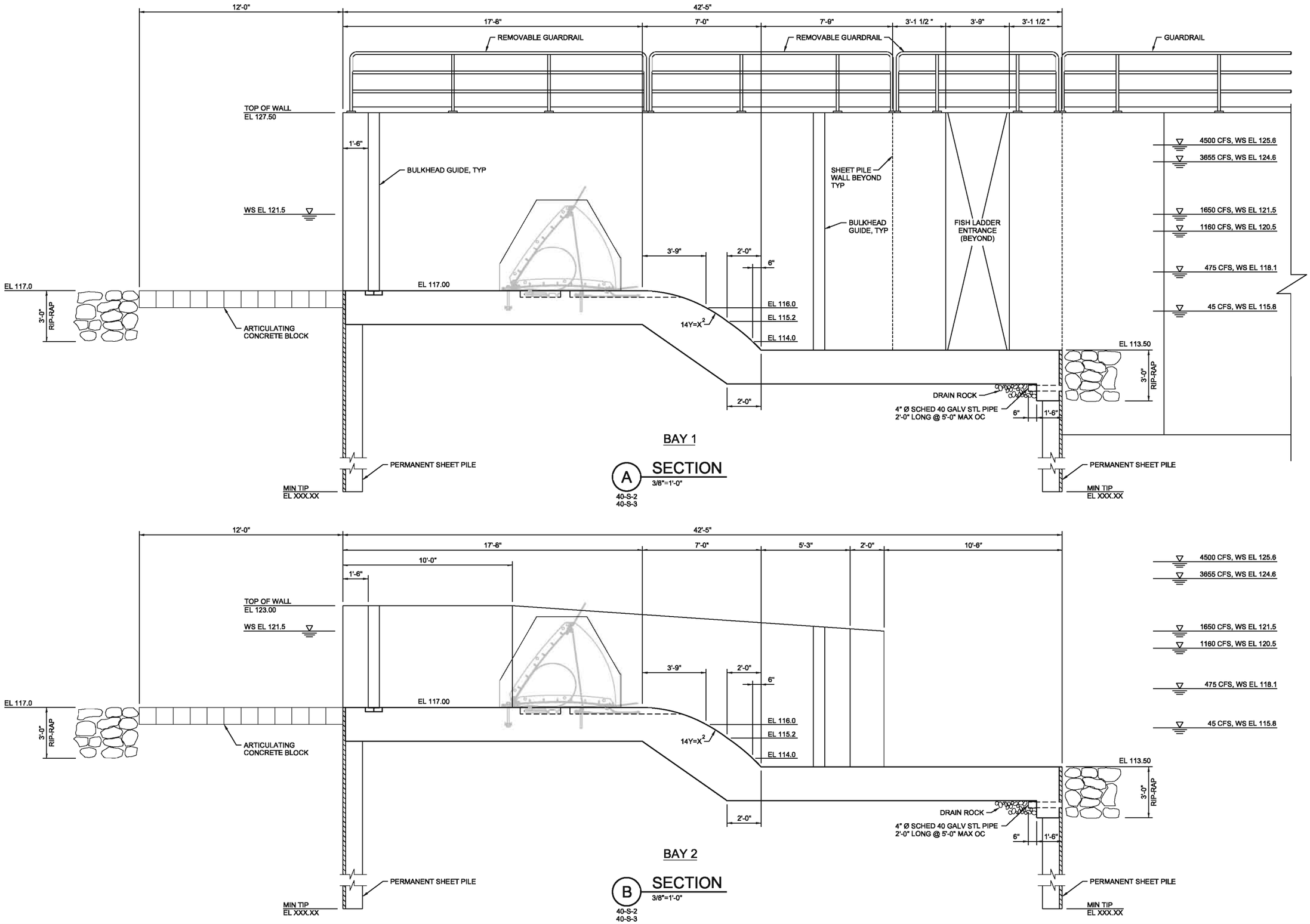

NO.	DATE	REVISION	BY	APVD
DSGN		DR	CHK	APVD
B MEMEO / C LOW		D CAVE	CHECKED-BY	APPROVED-BY

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AND SACK DAM FISH PASSAGE
PROJECT

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STRUCTURAL

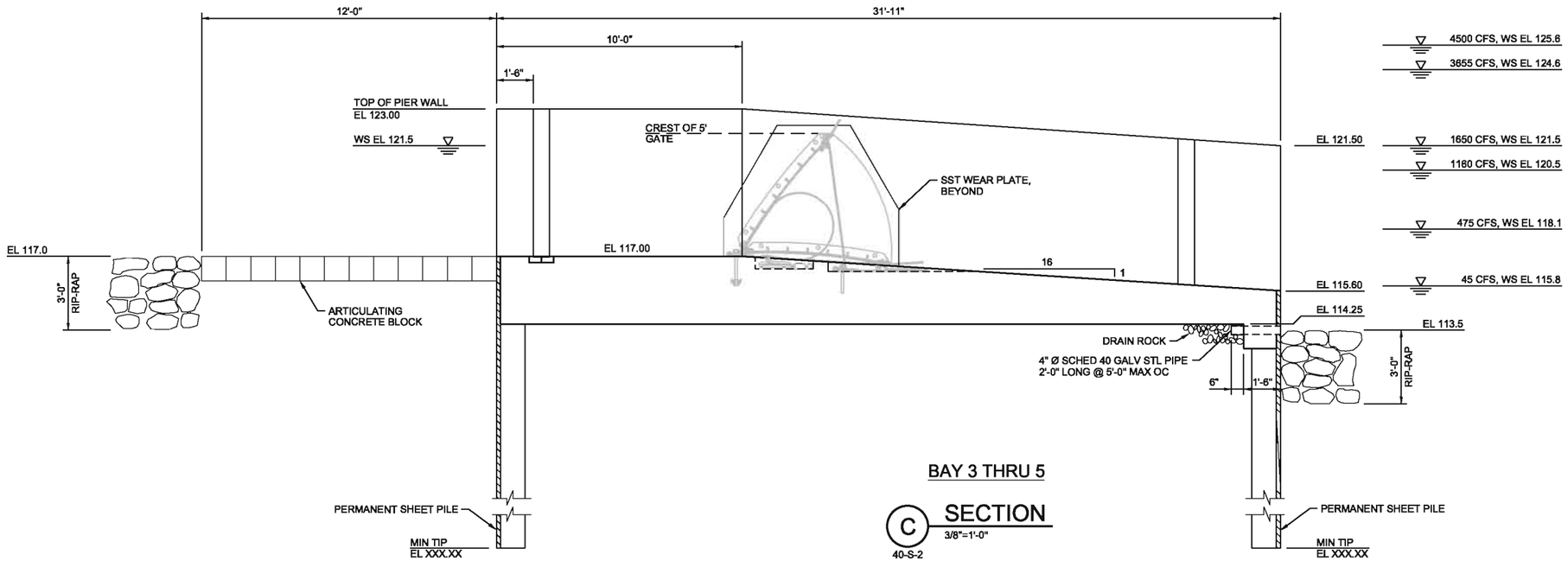
SACK DAM SECTIONS

PRELIMINARY - NOT FOR CONSTRUCTION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	DECEMBER 2011
PROJ	418544
DWG	40-S-6
SHEET	79

FILENAME: 40ns300d_418544.dgn PLOT DATE: 12/22/2011 PLOT TIME: 12:36:35 PM

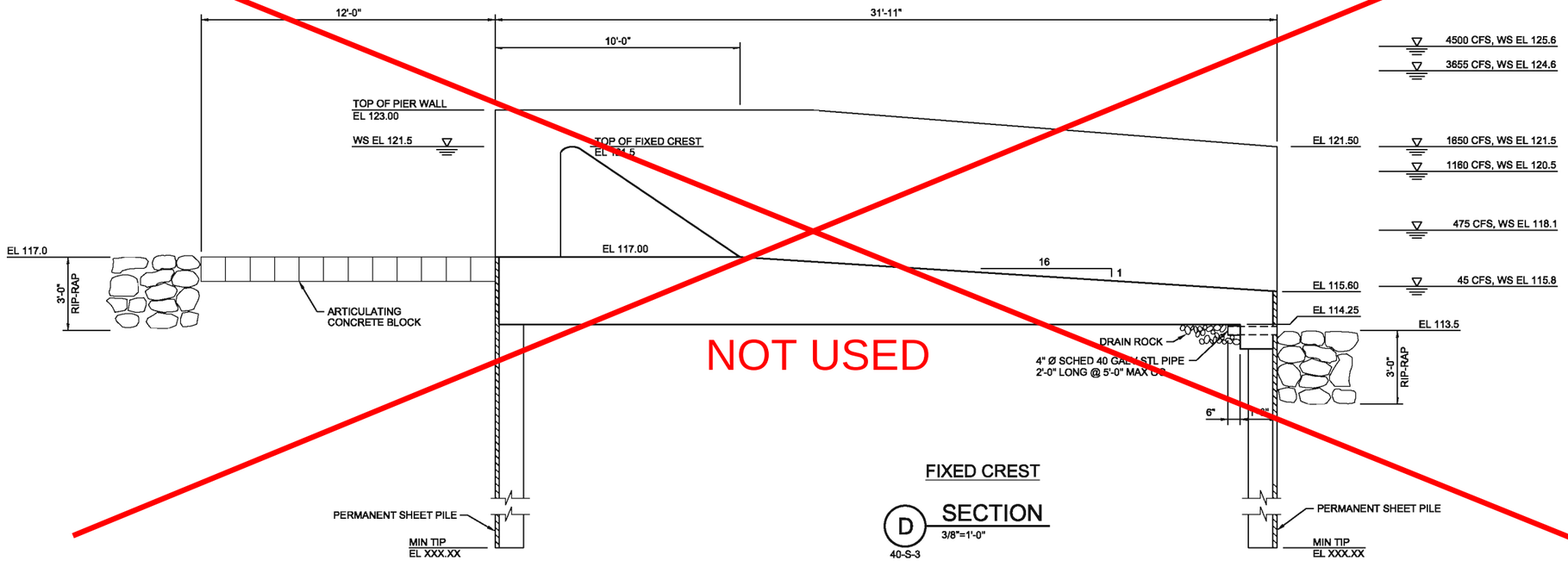


BAY 3 THRU 5

C SECTION

3/8"=1'-0"

40-S-2
40-S-3



NOT USED

FIXED CREST

D SECTION

3/8"=1'-0"

40-S-3

NO.	DATE	DSGN	REVISION	CHK	APVD	BY	APVD
B	MEMEO / C LOW	DR	D CAVE	CHECKED-BY	APVD	APPROVED-BY	

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AND SACK DAM FISH PASSAGE
PROJECT

STRUCTURAL

SACK DAM SECTIONS

REUSE OF DOCUMENTS: THIS DOCUMENT, AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE USED.

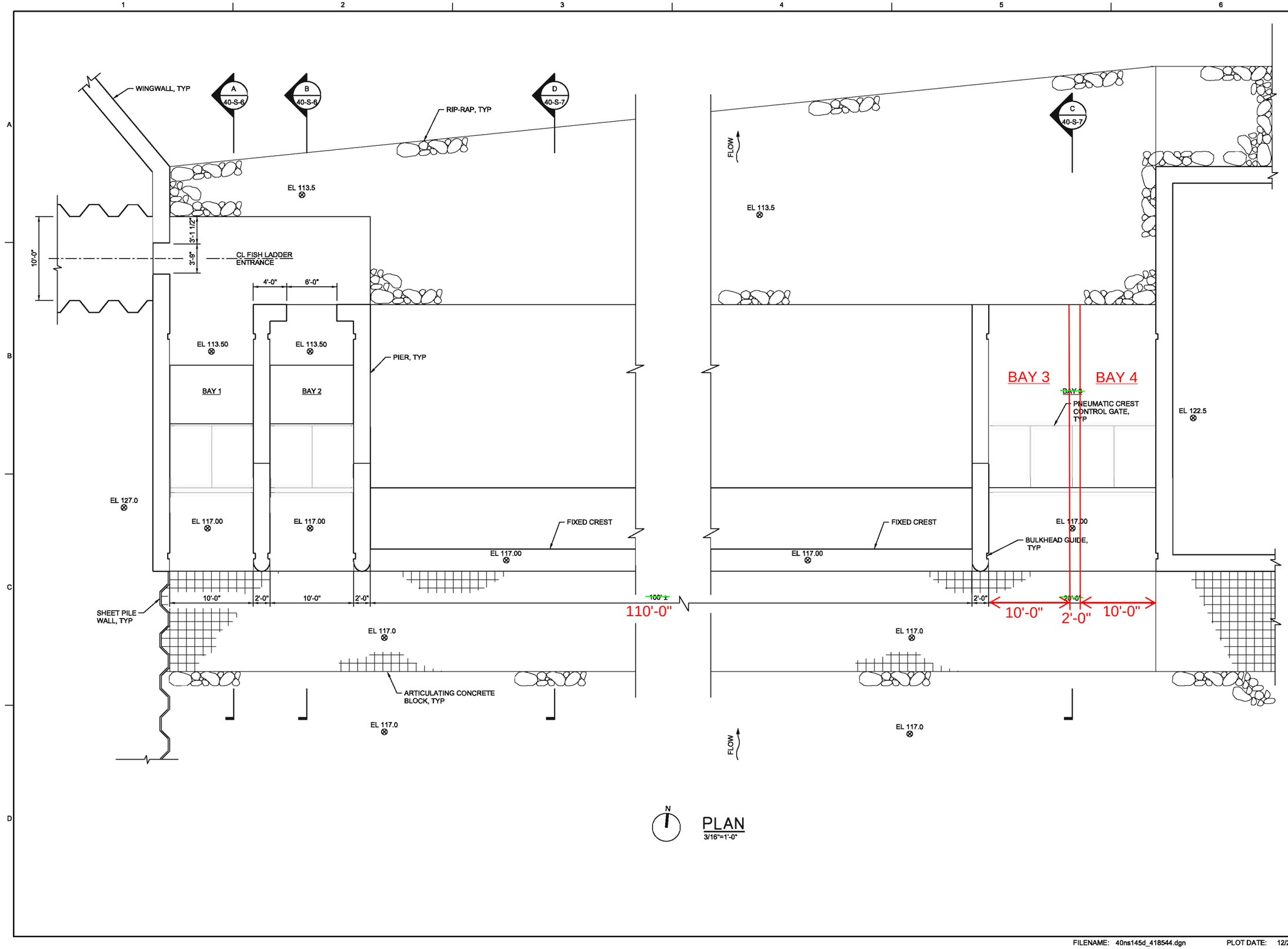
PRELIMINARY - NOT FOR CONSTRUCTION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	DECEMBER 2011
PROJ	418544
DWG	40-S-7
SHEET	80

FILENAME: 40ns301d_418544.dgn PLOT DATE: 12/22/2011 PLOT TIME: 12:36:48 PM

Attachment 4
Sack Dam – Fixed Crest Structure



PLAN
3/16"=1'-0"

NO.	DATE	DSGN	DR	CHK	APVD
B	MEMEO / C LOW	D CAVE		APVD	

REVISION BY APVD

CHECKED-BY APVD

APPROVED-BY

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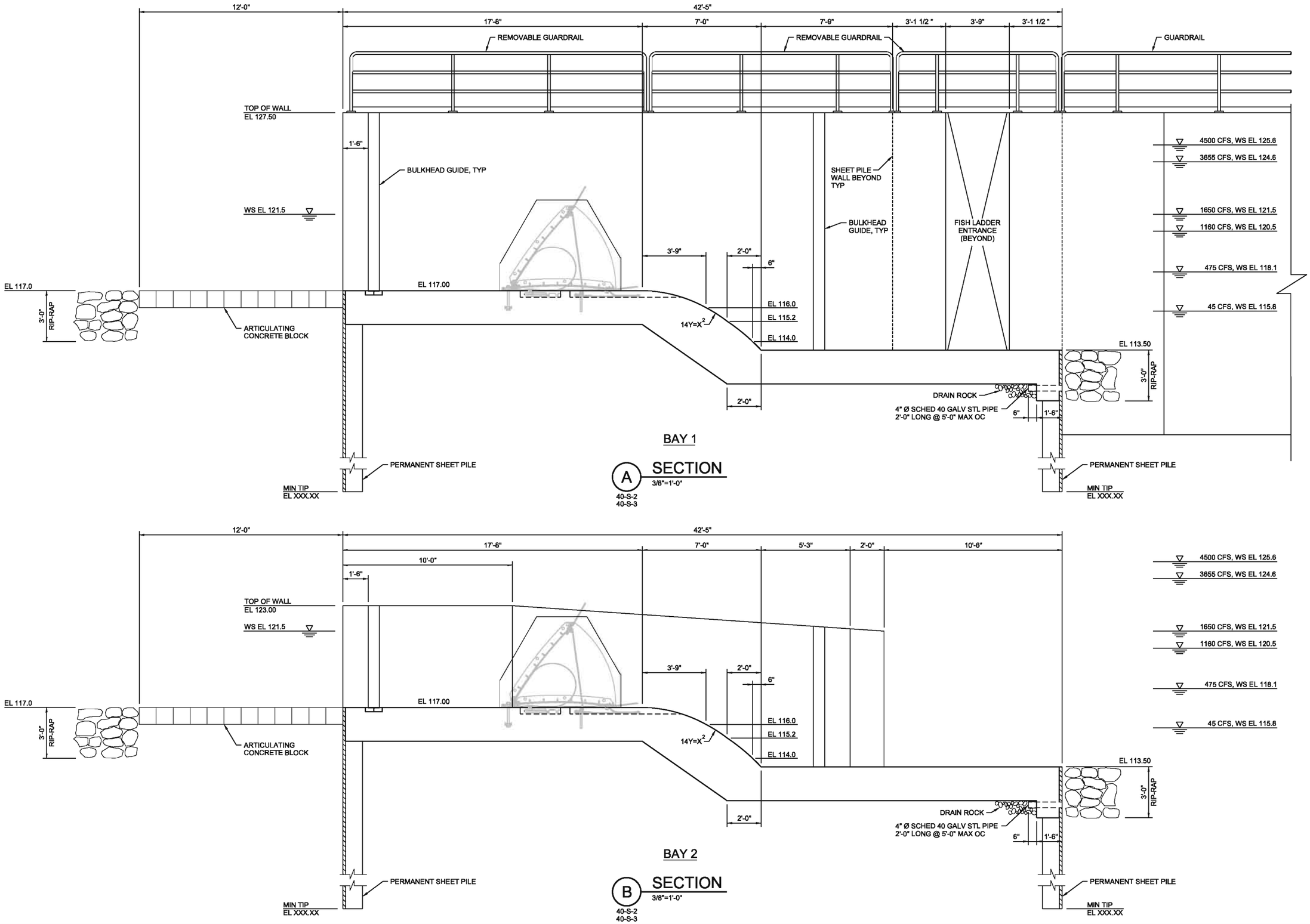
HMRD No. 2131
ARROYO CANAL FISH SCREEN AND SACK DAM FISH PASSAGE PROJECT

STRUCTURAL
SACK DAM
FIXED CREST
OVERALL TOP PLAN

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	DECEMBER 2011
PROJ	418544
DWG	40-S-3
SHEET	76

FILENAME: 40ns145d_418544.dgn PLOT DATE: 12/22/2011 PLOT TIME: 3:33:03 PM



NO.	DATE	REVISION	BY	APVD
DSGN		DR	CHK	APVD
B MEMEO / C LOW		D CAVE	CHECKED-BY	APPROVED-BY

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AND SACK DAM FISH PASSAGE
PROJECT

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STRUCTURAL

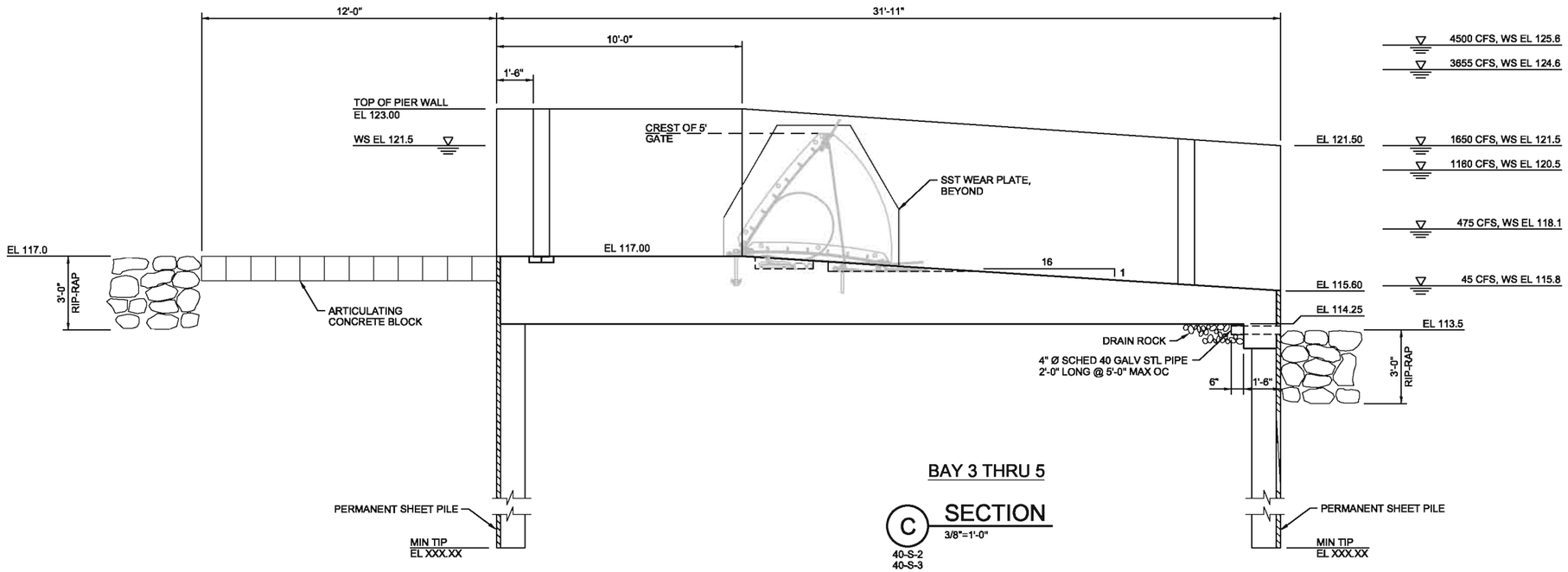
SACK DAM SECTIONS

PRELIMINARY - NOT FOR CONSTRUCTION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

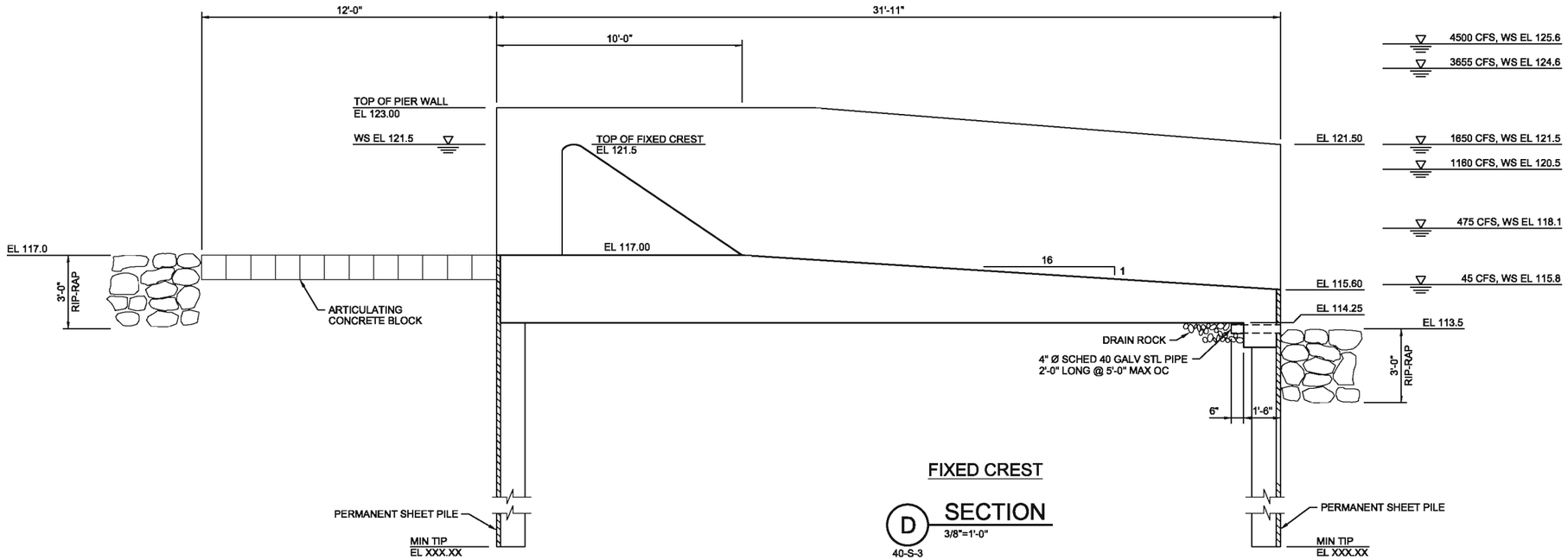
DATE	DECEMBER 2011
PROJ	418544
DWG	40-S-6
SHEET	79

FILENAME: 40ns300d_418544.dgn PLOT DATE: 12/22/2011 PLOT TIME: 12:36:35 PM



BAY 3 THRU 5

C SECTION
3/8"=1'-0"
40-S-2
40-S-3



FIXED CREST

D SECTION
3/8"=1'-0"
40-S-3

NO.	DATE	REVISION	BY	APVD
DSGN	B MEMEO / C LOW	DR	D CAVE	CHK

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ARROYO CANAL FISH SCREEN
AND SACK DAM FISH PASSAGE
PROJECT

STRUCTURAL

SACK DAM
SECTIONS

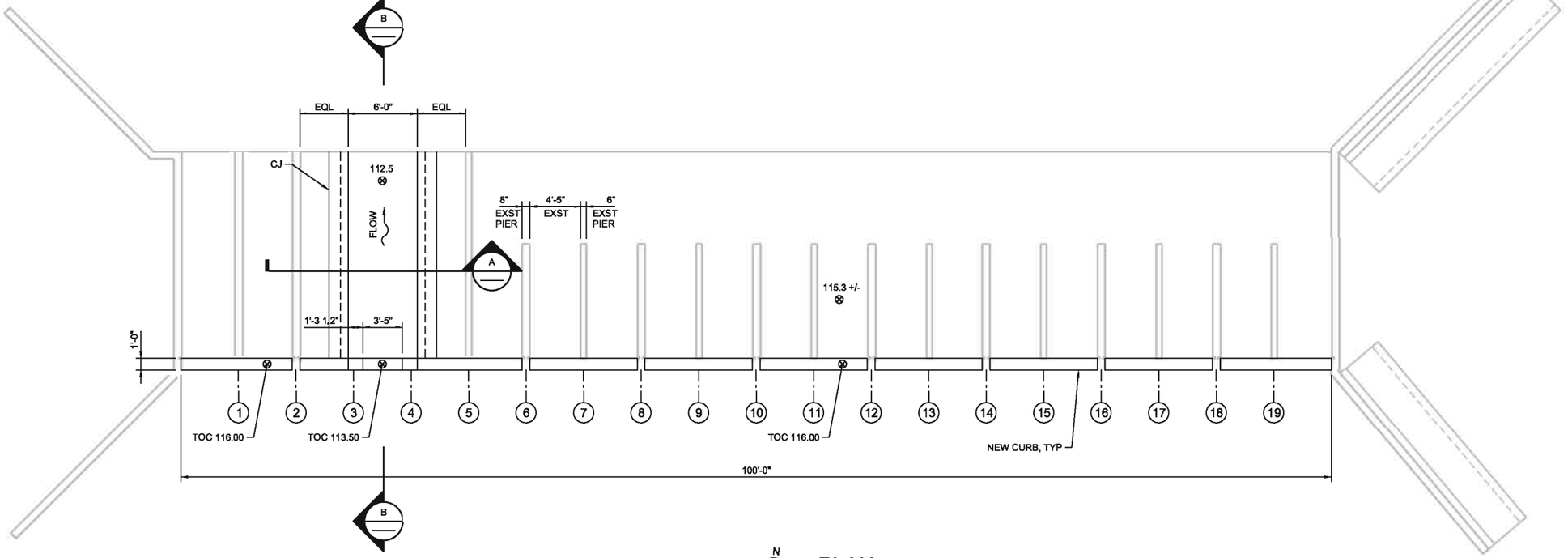
PRELIMINARY - NOT FOR CONSTRUCTION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"

DATE	DECEMBER 2011
PROJ	418544
DWG	40-S-7
SHEET	80

FILENAME: 40ns301d_418544.dgn PLOT DATE: 12/22/2011 PLOT TIME: 12:36:48 PM

Attachment 5
Existing Sack Dam Improvements



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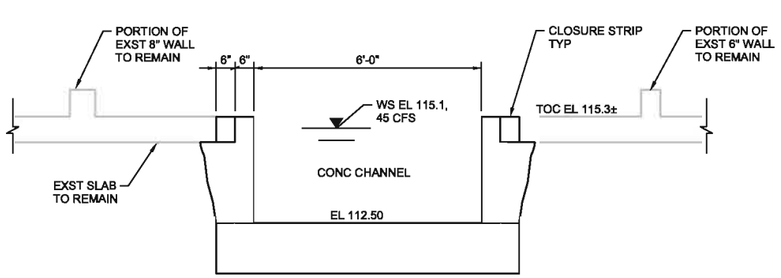
PLAN
3/16"=1'-0"



A SECTION
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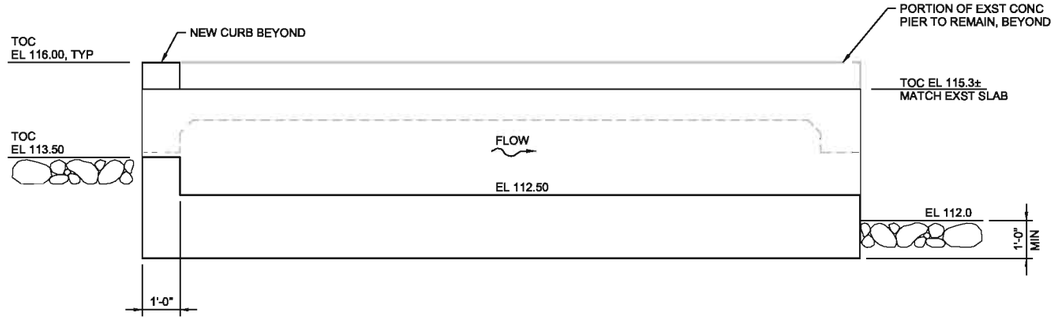

B SECTION
1/2"=1'-0"

NO.	DATE	REVISION	BY	APVD
DSGN	DR	CHK	CHECKED-BY	APVD
B MEMEO / C LOW		D CAVE		APPROVED-BY

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ARROYO CANAL FISH SCREEN
AND SACK DAM FISH PASSAGE
PROJECT

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STRUCTURAL

EXSITING SACK DAM IMPROVEMENTS PLAN AND SECTIONS

PRELIMINARY - NOT FOR CONSTRUCTION

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	DECEMBER 2011
PROJ	418544
DWG	50-S-1
SHEET	83

FILENAME: 50ns140d_418544.dgn PLOT DATE: 12/22/2011 PLOT TIME: 12:37:03 PM

Appendix J – U.S. Fish and Wildlife Service – Fish and Wildlife Coordination Act Report

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In Reply Refer To:
SJRRP Arroyo Canal Fish Screen and Sack Dam Fish Passage Project

MAY 14 2012

Memorandum

To: Regional Director, Bureau of Reclamation, Mid-Pacific Region, Sacramento, California (Attn: Alicia Forsythe)

From: Assistant Field Supervisor, Sacramento Fish and Wildlife Office, Sacramento, California

Subject: Draft Fish and Wildlife Coordination Act Report for the U.S. Bureau of Reclamation's Arroyo Canal Fish Screen and Sack Dam Fish Passage Project

In accordance with 48 Stat. 401, as amended; 16 U.S.C. 661 et seq., this document constitutes the U. S. Fish and Wildlife Service's (Service) Draft Fish and Wildlife Coordination Act (FWCA) report to the U. S. Bureau of Reclamation (Reclamation) for the Arroyo Canal Fish Screen and Sack Dam Fish Passage Project (Project). The FWCA requires Federal agencies proposing water resource development projects or involved in issuance of related permits or licenses to consult with the Service and provide equal consideration to the conservation, rehabilitation, and enhancement of fish and wildlife resources with other project purposes. The findings of this report are based on information provided in the April 2012 Arroyo Canal Fish Screen and Sack Dam Fish Passage Project, Administrative Draft Environmental Assessment (Reclamation 2012), the San Joaquin River Restoration Program (SJRRP) Draft Programmatic Environmental Impact Statement/Environmental Impact Report (PEIS/R)(Reclamation 2011) and review of available scientific literature. Our report addresses the proposed Project-related beneficial and adverse effects on fish and wildlife resources and provides recommendations for Project implementation. Details of the project's effects on federally listed species, pursuant to section 7 of the Endangered Species Act of 1973 (ESA), as amended, are being addressed separately.

Background

In 1942, Reclamation constructed Friant Dam on the San Joaquin River (SJR) as part of the Central Valley Project (CVP). The dam serves many purposes, including the diversion of water to service the CVP Friant Division long-term contractors.

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit challenging the renewal of long-term water service contracts between the United States and the CVP Friant Division contractors. After more than 18 years of litigation of this lawsuit, known as *NRDC et al. v. Kirk Rodgers et al.*, a Stipulation of Settlement (Settlement) was reached. On September 13, 2006, the Settling Parties, including NRDC, Friant Water Users Authority, and the U.S. Departments of the Interior and Commerce, agreed on the terms and conditions of the Settlement, which was subsequently approved by the U.S. Eastern District Court of California on October 23, 2006. The San Joaquin River Restoration Settlement Act (Public Law 111-11) authorizes and directs the Secretary of the Interior to implement the Settlement.

The SJRRP was established in late 2006, to implement the Settlement. The "Implementing Agencies" responsible for management of the SJRRP include the U.S. Department of the Interior through Reclamation and the Service, the U.S. Department of Commerce through the National Marine Fisheries Service (NMFS), the State of California (State) Natural Resources Agency through the California Department of Water Resources (DWR), and California Department of Fish and Game (CDFG). The Settlement also stipulates the appointment of a Restoration Administrator, in consultation with a Technical Advisory Committee, to make recommendations to the Secretary of the Interior to help meet the Restoration Goal.

The two primary goals established by the Settlement are as follows:

- **Restoration Goal** – To restore and maintain fish populations in "good condition" in the main stem SJR below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish.

- **Water Management Goal** – To reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement.

Barriers to migration for anadromous and other fish in the SJR encompass a wide range of both adult and juvenile passage impediments. Fish passage in the river has been essentially blocked since the 1940s, and upstream diversions have resulted in the river being dewatered in several portions of the river under dry to normal conditions, with the exception of return flows from agricultural operations and uncontrolled flow releases in wet years. The Settlement requires the restoration of flows to the SJR, improvements in fish passage at a number of structures, and actions to prevent fish entrainment at certain structures and sloughs.

Settlement-required improvements at the Arroyo Canal and Sack Dam facilities are proposed to be designed, built, and operated in accordance with Public Law 111-11 and the Memorandum of Understanding between Reclamation and Henry Miller Reclamation District #2131 (District).

The District is located in the San Joaquin Valley of California, about 7 miles southeast of Dos Palos (see Figure 1), and supplies irrigation water to about 47,000 acres within the San Luis

Canal Company (SLCC) service area. The District serves as the operating agency for the SLCC in that it owns or has easements on the majority of the water delivery facilities within the SLCC boundary. The District delivers water to SLCC landowners as well as the San Luis National Wildlife Refuge Complex, the Los Banos State Wildlife Area, and refuge lands within Grasslands Water District. The water supply is surface diversions from the SJR via releases from Mendota Pool at the downstream end of the Delta-Mendota Canal. SLCC's contractual diversion is off of the SJR at Sack Dam, about 22 miles downstream of the Mendota Dam. This diversion includes the District's unscreened Arroyo Canal Headworks and the existing Sack Dam.

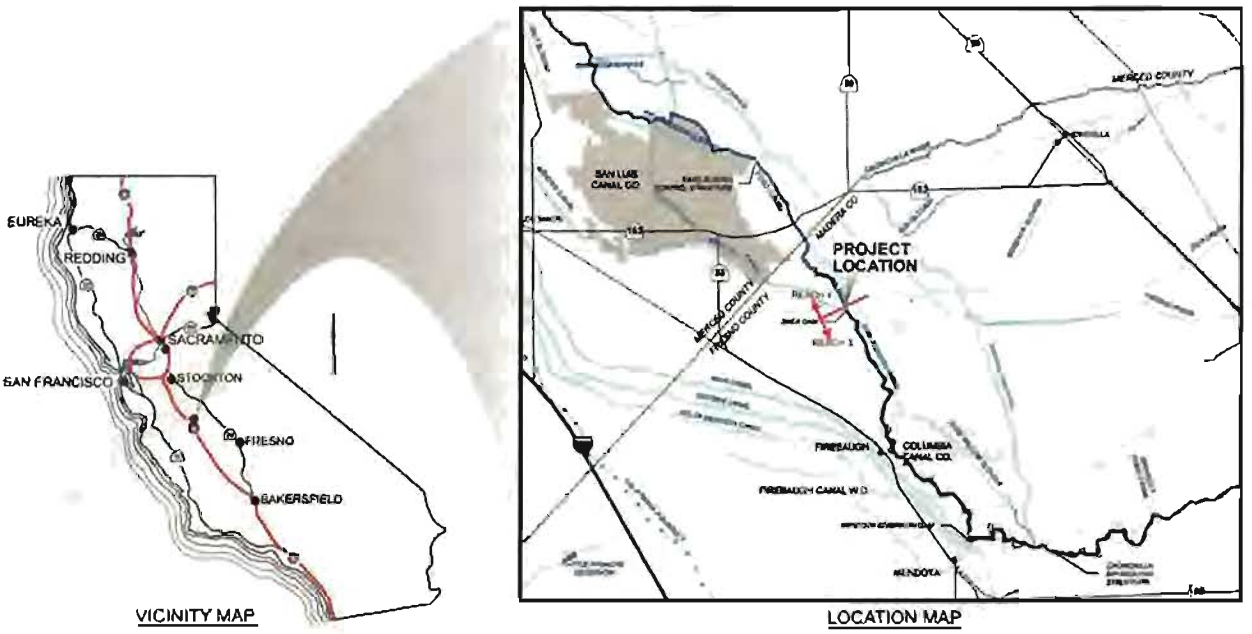

Figure 1

Project Area

The Proposed Project is located on or adjacent to the SJR about 7 miles southeast of Dos Palos, California. Sack Dam is on the SJR in the western region of the San Joaquin Valley, just north of Arroyo Canal. The facilities are owned and operated by the District. Structural components and related facilities of the proposed project occur within Fresno and Madera counties (Figure 1).

PROJECT DESCRIPTION

No Action Alternative

The No-Action Alternative assumes the continued operation of the existing Sack Dam and Arroyo Canal without the installation of a new fish ladder or fish screen. The District would operate the dam using the recently installed Lopac gates (interim gates) to assist in passing up to 500 cubic feet per second (cfs) of the Restoration Flows. Sack Dam becomes inundated at flows greater than 1,000 cfs; therefore, the District would remove the interim gates for any flows above

this level (including long-term Restoration Flows) to prevent damage to the gates and the supervisory control and data acquisition system. It is also likely that the District would need to repair the east side of the river channel after high-flow events, which would likely require the use of heavy equipment for 2 to 3 days per occurrence. Fish passage across Sack Dam would be limited to those periods when river flows are greater than 1,000 cfs. Periodic sediment dredging around Sack Dam and the approach channel is anticipated for the No-Action Alternative.

Proposed Action

The Proposed Action includes removing the existing dam and constructing a new dam about 100 feet upstream, near the Arroyo Canal divergence to enable fish passage at Sack Dam, improve operational control, and provide a suitable and reliable structure under the scheduled Restoration Flow regime (Reach 4 Restoration Flows between 475 cfs and 1,225 cfs). Relocating Sack Dam immediately downstream of the Arroyo Canal divergence would enhance the ability of the dam to influence and ultimately manage sediment within the Arroyo Canal approach channel. Relocating Sack Dam would also allow the transport channel/fish ladder to be aligned in a manner that would minimize impacts on the adjacent agricultural field (see Figure 2).

The new dam would consist of an automated pneumatic crest control gate system. The dam would include two smaller gate bays (about 10 feet wide) adjacent to the west abutment, and three to four larger gate bays (about 20 feet wide to 30 feet wide) between the former gate bays and the east abutment. The first smaller gate bay (closest to the west abutment) would serve to "shadow" the fish ladder entrance (located downstream of the dam in the west abutment) and to periodically manage sediment that may accumulate at the fish ladder entrance. The second smaller gate bay would include a removable baffle, composed of a 4-foot-wide slot, and positioned at the downstream end of the bay to provide an alternative fish passage mechanism during transitional flow periods.

All gate bays would be lowered during high Restoration Flows and flood flows (Reach 4 flows in excess of about 1,550 cfs) to preserve the flood profile and allow volitional fish passage across Sack Dam.

Environmental Commitments

The following environmental commitments have been incorporated by Reclamation into the Proposed Action and the Vertical Slot Fish Ladder and Fish Bypass System Alternative to avoid and minimize potential effects on fish species. Additionally, Conservation Measures as listed in Table 2-7 of the SJRRP Draft PEIS/R (Reclamation 2011) has been incorporated where appropriate:

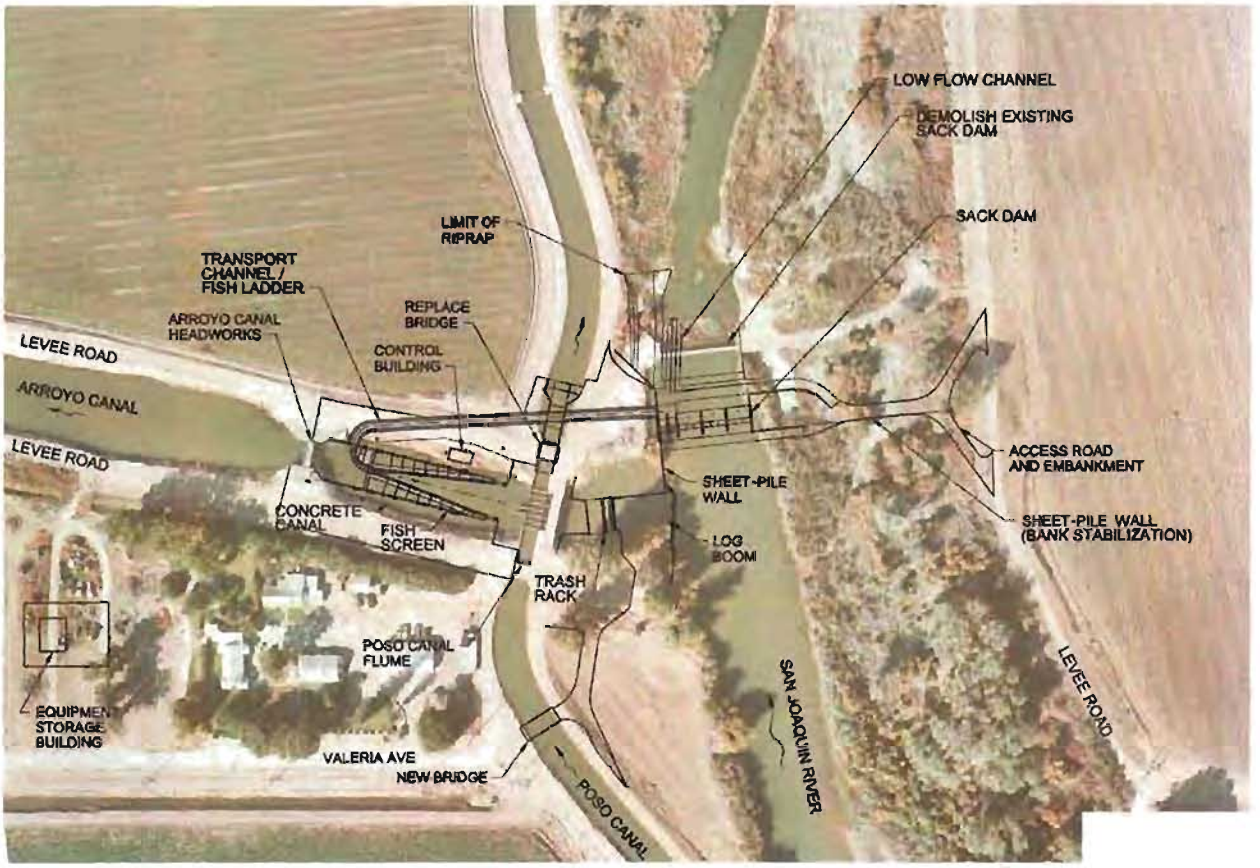

Figure 2

- A qualified biologist who possesses a valid recovery permit for species handling will conduct preconstruction and construction monitoring activities throughout project implementation, inclusive of all construction phases, and as needed during all facets of the project construction. The biological monitor would also conduct worker awareness training as necessary prior to and during project construction.

- Riparian vegetation removed or damaged would be replaced or allowed an opportunity for natural recruitment, coordinated with the Service, NMFS, or CDFG, as appropriate, within the immediate area of the disturbance to maintain habitat quality. Additionally, work within areas of riparian habitats would comply with the following measures as identified in Table 2-7 of the SJRRP Draft PEIS/R (Reclamation 2011):

    - Biological surveys would be conducted to identify, map, and quantify riparian and other sensitive habitats in potential construction areas.

- If effects occur on riparian habitat, emergent wetland, or other sensitive natural communities, as associated with streams, the State lead agency would comply with Section 1602 of the California Fish and Game Code.

- Prior to implementation of the project, the District/Reclamation would conduct an education program for all site workers relative to protected species that may be encountered within the project area, and required practices for their avoidance and protection, as included in Conservation Measure CVS-1 in Table 2-7 of the SJRRP Draft PEIS/R(Reclamation 2011).

- Stockpiling of materials, including portable equipment, and vehicles and supplies, including chemicals, would be restricted to the designated construction staging areas, exclusive of any riparian and wetland areas outside the construction area.

- Sedimentation and turbidity would be avoided and minimized by implementing construction BMPs and preparing a Stormwater Pollution and Prevention Plan acceptable to the Regional Water Quality Control Board.

- If individuals of listed species are observed present within a project area, then the NMFS, Service, or CDFG, as appropriate, would be notified. The NMFS, Service, or CDFG personnel would have access to construction sites during construction and following completion to evaluate species presence and condition and habitat conditions, as included in Conservation Measure CVS-2 in Table 2-7 of the SJRRP Draft PEIS/R (Reclamation 2011).

- Potential injury and mortality associated within water pile driving would be avoided or minimized by implementing the following noise-reduction measures:

    - A cofferdam would be installed around the in-channel construction area, which would be dewatered before additional pile-driving and construction activities. Fish would not have access to the construction site, and underwater sounds produced by pile driving would be attenuated. The number and size of piles would be limited to the minimum necessary to meet the engineering and design requirements of the Proposed Action.

    - A Fish Rescue Plan would be prepared and implemented during any dewatering activities that may entrain fish. The plan would include using a qualified biologist(s) to capture, remove, and relocate fish using areas to be dewatered. The plan would be provided to the NMFS for approval prior to the onset of construction activities.

    - Vibratory hammers would be used whenever feasible, with the exception of impact testing for H-piles.

- The number and size of piles would be limited to the minimum necessary to meet the engineering and design requirements of the Proposed Action.

- The performance of the newly constructed fish screen would be evaluated to make sure that the fish screen is operated and maintained in accordance with acceptable fish screen performance criteria established during consultation with the Service, NMFS, and CDFG. A hydraulic monitoring plan would be submitted to the NMFS before completion of the Proposed Action.

- As described in Conservation Measure WPT-1 in Table 2-7 of the SJRRP Draft PEIS/R (Reclamation 2011): to avoid and/or minimize effects on Pacific pond turtle, a qualified biologist would conduct surveys in aquatic habitats to be dewatered prior to dewatering and/or filling during project construction. Surveys would be conducted immediately after dewatering and before fill of aquatic habitat suitable for Pacific pond turtles. If pond turtles are found, the biologist would capture them and move them to nearby agency-approved areas of suitable habitat that would not be disturbed by project construction, as included in Conservation Measure WPT-1.

- Conservation Measure SWH-1 in Table 2-7 of the SJRRP Draft PEIS/R (Reclamation 2011) is incorporated to avoid and minimize impacts on Swainson's hawk:

    - Project mobilization and construction would commence prior to the Swainson's hawk nesting season (March 1 through September 15).

    - Given construction activities would occur during the Swainson's hawk nesting season (from March 1 through September 15), a qualified biologist would conduct preconstruction surveys in and around all potential nest trees within a 0.5-mile radius of the project footprint, including haul routes. At least one survey would be conducted no more than 2 weeks prior to the initiation of construction activities. Surveys for Swainson's hawk and other special-status raptors would be conducted in accordance with the *Swainson's Hawk Technical Advisory Committee's Recommended Timing and Methodology for SWHA Nesting Surveys* (CDFG 2000).

    - Trees containing known raptor nests would not be removed and would be visibly marked for protection. Nests would not be disturbed, removed, and otherwise tampered with.

    - If determined necessary, the District would obtain an incidental take permit from the CDFG under Section 2081, and would comply with the terms of the permit.

- Conservation Measures BRO-1 and BRO-2 in Table 2-7 of the SJRRP Draft PEIS/R (Reclamation 2011) are incorporated to avoid and minimize impacts on western burrowing owl:

    - Preconstruction surveys for burrowing owls would be conducted in areas supporting potentially suitable habitat within 30 days prior to the start of project construction. Areas with potentially suitable burrowing owl habitat have been identified as the concrete debris piles adjacent to the southern Arroyo Canal levee road, just west of the intersection with Poso Canal, and at the upper margins of the ditch adjacent to Arroyo Canal (near where borrow material may be excavated). If ground-disturbing activities are delayed or suspended for more than 30 days after the survey, the site would be resurveyed.

    - Occupied burrows would not be disturbed during the breeding season (February 1 through August 31) or a method developed in coordination with the CDFG to minimize disturbance would be implemented. A 160-foot buffer would be incorporated around occupied burrows during the non-breeding season (September 1 through January 31), and a 250-foot buffer would be incorporated around occupied burrows during the breeding season. Ground-disturbing activities would not occur within the buffers.

    - If occupied burrows are documented and the recommended buffer distances cannot be adequately incorporated, passive owl relocation techniques (for example, installing one-way doors in burrow entrances to temporarily or permanently evict burrowing owls and prevent burrow re-occupation) would be implemented in coordination with the CDFG.

- Conservation Measure MBTA-1 in Table 2-7 of the SJRRP Draft PEIS/R (Reclamation 2011) is incorporated as appropriate into this analysis, which includes the measures to avoid and minimize impacts on other migratory nesting birds. Such measures would also minimize impacts on white-tailed kite, a non-migratory, California fully protected species. To avoid and/or minimize effects on other migratory nesting birds (including northern harrier and loggerhead shrike):

    - Tree and vegetation removal is scheduled to occur prior to the nesting season. Clearing and grubbing activities are anticipated to remove most or all potential nesting areas prior to the nesting season with the exception of trees containing known raptor nests. Tree or vegetation removal activities would be avoided to the extent practicable during the nesting season for migratory birds (from February 1 to September 1).

    - If tree or vegetation removal is to occur during the nesting season, a qualified biologist would conduct a preconstruction survey within the construction area to determine the presence and absence of nesting birds. At least one survey

would be conducted no more than 2 weeks prior to the onset of any construction activity. If no active nests are located, no further mitigation is necessary.

- If active nests (nests containing eggs or young) are identified within the survey area, a no-disturbance buffer zone would be established around the nest site. The width of the buffer zone would be determined by a qualified biologist in coordination with the Service and CDFG. For white-tailed kite, the width of the buffer zone would be 0.5 mile. No construction activities would occur within the buffer zone. The buffer zone would be maintained until the young have fledged (as determined by a qualified biologist). The buffer zone would be delineated with exclusionary fencing and flagging and/or signage as appropriate.

- To avoid and/or minimize effects on western red bat:

  - If feasible, large riparian trees on the east side of the SJR would not be removed during the western red bat maternity season (May 1 through August 31).

  - If large riparian trees on the east side of the SJR are to be removed during the western red bat maternity season (May 1 through August 31), a roost assessment and/or surveys for roosting western red bats on the project site would be conducted by a qualified bat biologist prior to tree removal. The type of survey would depend on the condition of the potential roosting habitat, and may include the use of acoustic detectors. If no bat roosts are found, then no further study is required.

  - If evidence of western red bat use is observed, the number of bats using the roost would be determined. If active western red bat maternity roosts are determined to be present, the trees occupied by the roost would be avoided (not removed), if feasible.

  - If active maternity roosts are determined to be present and the trees occupied by the roost must be removed, the tree removal would be timed to avoid the maternity season (May 1 through August 31). A mitigation program addressing compensation and roost removal procedures would be developed in consultation with the CDFG prior to implementation.

EXISTING BIOLOGICAL RESOURCES

Annual Grassland Habitat

Annual grassland habitats are open grasslands composed predominantly of annual plant species (CDFG 2005). Perennial grass species once dominated native grasslands, but introduced annual

species have largely displaced native perennial and annual grasses (CDFG 2005). Typical annual grass species are foxtail fescue, ripgut brome, red brome, wild oats, wild barley, soft chess, and Italian ryegrass; native perennial grasses include needle grasses, California onion grass, and Idaho fescue (CDFG 2005).

Annual grassland habitat in the project study area may support several species of nesting birds. Western meadowlark, savannah sparrow, white-crowned sparrow, horned lark, grasshopper sparrow, short-eared owl, and ring-necked pheasant conceal their nests in the vegetation, and burrowing owls may use abandoned ground squirrel holes as nest sites. Some waterfowl, such as mallard and cinnamon teal, nest in grassy areas, particularly where this interfaces with open water areas. Grassland areas provide foraging habitat for migratory shorebirds and geese. The annual grassland habitat in the project study area may provide suitable nesting and foraging habitat for predatory birds such as, northern harrier, Swainson's hawk, white-tailed kite, red-tailed hawk, Cooper's hawk, American kestrel, and short-eared owl (USFWS 1995).

Reptiles typically found in annual grasslands include the western fence lizard, common garter snake, and western rattlesnake. Mammals found in this habitat include the black-tailed jackrabbit, California ground squirrel, western harvest mouse, California vole, badger, and coyote.

Ruderal Herbaceous Habitat

Herbaceous cover may range from sparse to dense, with plant heights ranging up to 6 feet depending on soil and moisture conditions. Species composition varies with availability of moisture, disturbance, and maintenance work (mowing, burning, herbicide spraying). Common plant species include natives and exotics such as mustard, wild radish, blackberry, fennel, poison hemlock, milk thistle, nut grass, and scouring rush (USFWS 1995).

Ruderal herbaceous habitat provides food and cover for a variety of wildlife species. Some of these include the California vole, Botta's pocket gopher, western harvest mouse, house mouse, western fence lizard, common garter snake, lesser goldfinch, white-crowned sparrow, and red-winged blackbird.

Riparian Habitat

Historically, riparian habitat associated with the lower reaches of the SJR has been removed or degraded due to farming and/or grazing practices. Mature riparian habitat on the site is restricted to a narrow linear band along the river consisting of cottonwoods, willow, and associated understory shrubs.

Riparian areas provide food, water, and shade for resident species of wildlife as well as other species associated with adjacent habitats. The multiple layers of riparian vegetation in association with edges of adjacent plant communities create a diverse physical structure that provides cover for a diversity of amphibians, reptiles, birds, and mammals, including the Pacific chorus frog, aquatic garter snake, northwestern pond turtle, and black phoebe. Riparian habitats

provide important habitat for several species of neotropical migrant birds, such as belted kingfisher, Wilson's warbler, and yellow-breasted chat. Riparian communities also function as important dispersal and migration corridors for many wildlife species.

Barren/Riprap Habitat

Barren/riprap habitat includes disturbed areas such as roads, equipment storage areas, graveled levee tops, bare soil, and riprap. These areas provide extremely low habitat value and receive minimal use by native wildlife species. Barren/riprap habitat is found in the staging areas and access roads within the project area.

Riverine

The SJR at this location has been identified by the U.S. Army Corps of Engineers as a Navigable Water of the Unites States subject to section 10 of the Rivers and Harbors Act and the Clean Water Act.

Immediately upstream of Sack Dam, the SJR is confined by local dikes and canals on both banks. The sandy channel meanders through a predominantly agricultural area, except where the City of Firebaugh borders the river's west bank. The river at this location has a low stage, but is perennial and supports a narrow riparian corridor along the edge of the river channel.

Immediately downstream of Sack Dam, the river is sand-bedded and usually dewatered, with the exception of flood flows in wet years. The upstream portion starting at Sack Dam is bounded by canals and local dikes down to the Sand Slough control structure near Merced National Wildlife Refuge. The floodplain in this reach is broad, with levees set back from the active channel. The river immediately downstream of Sack Dam is sparsely vegetated, with a thin and discontinuous band of vegetation along the channel margin.

Barren/Riprap Habitat

Barren/riprap habitat includes disturbed areas such as roads, equipment storage areas, graveled levee tops, bare soil, and riprap. These areas provide extremely low habitat value and receive minimal use by native wildlife species. Barren/riprap habitat is found in the staging areas and access roads within the project area.

Special Status Species

The project site is within the range of four federally listed species including the blunt-nosed leopard lizard (*Gambelia sila*), giant garter snake (*Thamnophis gigas)*, San Joaquin kit fox (*Vulpes macrotis mutica*) and valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*). Due to existing site conditions, none of these species are expected to occur within the project boundary.

Four State or Federal special status species have been documented to occur within the project site: Pacific pond turtle, Swainson's hawk, northern harrier, and loggerhead shrike. Other potential species which may occur on the project site include: white-tailed kite, western burrowing owl, and western red bat.

Pacific Pond Turtle. There is suitable aquatic and upland basking habitat in the study area. In dry years when no flooding occurs, the floodplain provides suitable nesting habitat.

Swainson's Hawk. A nesting pair of Swainson's hawks was observed in the study area in April 2011. A nest has been observed in a cottonwood tree on the right bank of the SJR, just upstream of Sack Dam. The cottonwoods and other mature riparian trees on the east side of the SJR may provide additional nesting sites for Swainson's hawks.

Western Burrowing Owl. Potential habitat for burrowing owl occurs in several concrete debris piles adjacent to the southern Arroyo Canal levee, just west of the intersection with Poso Canal, and at the upper margins of the ditch adjacent to Arroyo Canal, where numerous suitable burrows were observed.

Loggerhead Shrike. A loggerhead shrike was observed during Swainson's hawk surveys conducted in April 2011. Although suitable nesting habitat for loggerhead shrike in tall trees in the study area is present, most of the study area does not contain highly suitable foraging habitat.

Western Red Bat. Western red bats may use the cottonwoods or other riparian trees along the SFR.

FUTURE CONDITIONS WITHOUT PROJECT

If the Project is not initiated, the District would operate the existing Sack Dam using the recently installed Lopac interim gates to assist in passing up to 500 cfs of the Restoration Flows. Sack Dam becomes inundated at flows greater than 1,000 cfs; therefore, the District would remove the interim gates for any flows above this level (including long-term Restoration Flows) to prevent damage to the gates and supervisory control and data acquisition system. Fish passage across Sack Dam would be limited to those periods when river flows are greater than 1,000 cfs. Periodic repairs to the east side of the channel, and sediment dredging around Sack Dam and the approach channel after high flow events is anticipated for the No-Action Alternative.

FUTURE CONDITIONS WITH PROJECT

The Project would retain an upstream water elevation about 8 inches higher than the existing structure's capability to enable the design diversion rate of 700 cfs. The increase in headwater elevation is a function of the hydraulic losses imposed by the proposed trash rack and fish screen facility. The proposed in-canal fish screen is an off-river, vertical flat-plate screen in a single vee configuration. The in-canal vee screen would minimize the fish exposure time to the screen and associated bypass requirements, and minimize streambank impacts.

The transport channel/fish ladder would accommodate both upstream and downstream migrating fish past Sack Dam. The design flow for the transport channel/fish ladder is coincident with the minimum Reach 4 Restoration Flow of 45 cfs. The transport channel/fish ladder would consist of the bypass entrance at the downstream end of the fish screen, a transport channel, and a fish ladder.

The proposed entrance to the transport channel would use an inclined ramp to control flow through the transport channel/fish ladder. The entrance would transition from 2.5-foot-wide to a 6-foot-wide transport channel extending from the centerline of the fish screen to the fish ladder. The fish ladder would be composed of a roughened invert (for example, loose cobbles) and a series of full-depth-vertical-slot fabricated metal weirs. The fish ladder would terminate at the west abutment of Sack Dam.

The fish ladder would cross under the Poso Canal, which is owned and operated by the Central California Irrigation District. The transport channel/fish ladder is intended to allow passage to native fish species, including Chinook salmon and green or white sturgeon.

The new dam would include revetment protection on the riverbed and banks upstream and downstream of the dam to resist channel degradation and bank erosion

Terrestrial and Wildlife Resources

Since construction activities and the hauling of equipment and supplies will be limited to the access roads, the terrestrial habitat conditions are not expected to change significantly, but surface erosion and dust may occur with road activity, which may affect plants and grasses near the project area. Ruderal and agricultural habitats are present near the staging areas and may be impacted, but these habitat types are common and re-establish after rapidly once construction activities cease. However, wildlife such as birds, small mammals and reptiles, may be present in these areas and near the borrow sites. Impacts to shrub/scrub and ruderal habitats are expected to be about 2.4 acres.

Aquatic Resources

The aquatic habitat conditions immediately upstream of Sack Dam are not expected to change significantly. Water elevations are expected to remain about the same as in the without project situation. The river at this location has a low stage, but is perennial and would continue to support a narrow riparian corridor along the edge of the river channel.

Immediately downstream of Sack Dam, the river is expected to receive more water as a result of the larger SJRRP. The new Sack Dam, fish screen and fish ladder combined with greater flows would encourage a more robust aquatic insect population and would support a greater variety of both native and non-native fish species. Post construction upstream and downstream reaches should look similar to each other. Both reaches would remain a low gradient, sand-bedded, meandering river. Impacts to riverine habitats are expected to be about 0.63 acre. With

additional flows downstream of the dam additional riparian vegetation would likely be establish along the edge of the river channel.

SERVICE MITIGATION POLICY

The recommendations provided herein for the protection of fish and wildlife resources are in accordance with the Service's Mitigation Policy as published in the Federal Register (46:15; January 23, 1981).

The Mitigation Policy provides Service personnel with guidance in making recommendations to protect or conserve fish and wildlife resources. The policy helps ensure consistent and effective Service recommendations, while allowing agencies and developers to anticipate Service recommendations and plan early for mitigation needs. The intent of the policy is to ensure protection and conservation of the most important and valuable fish and wildlife resources, while allowing reasonable and balanced use of the Nation's natural resources.

Under the Mitigation Policy, resources are assigned to one of four distinct Resource Categories, each having a mitigation planning goal which is consistent with the fish and wildlife values involved. The Resource Categories cover a range of habitat values from those considered to be unique and irreplaceable to those believed to be much more common and of relatively lesser value to fish and wildlife. The Mitigation Policy does not apply to threatened and endangered species, Service recommendations for completed Federal projects or projects permitted or licensed prior to enactment of Service authorities, or Service recommendations related to the enhancement of fish and wildlife resources.

In applying the Mitigation Policy during an impact assessment, the Service first identifies each specific habitat or cover-type that may be impacted by the project. Evaluation species which utilize each habitat or cover-type are then selected for Resource Category analysis. Selection of evaluation species can be based on several rationales, as follows: (1) species known to be sensitive to specific land- and water-use actions; (2) species that play a key role in nutrient cycling or energy flow; (3) species that utilize a common environmental resource; or (4) species that are associated with Important Resource Problems, such as anadromous fish and migratory birds, as designated by the Director or Regional Directors of the Service. (Note: Evaluation species used for Resource Category determinations may or may not be the same evaluation species used in a Habitat Evaluation Procedures application, if one is conducted). Based on the relative importance of each specific habitat to its selected evaluation species, and the habitat's relative abundance, the appropriate Resource Category and associated mitigation planning goal are determined.

Mitigation planning goals range from "no loss of existing habitat value" (Resource Category 1) to "minimize loss of habitat value" (Resource Category 4) (Table 1). The planning goal of Resource Category 2 is "no net loss of in-kind habitat value;" to achieve this goal, any unavoidable losses would need to be replaced in-kind. "In-kind replacement" means providing or managing substitute resources to replace the habitat value of the resources lost, where such substitute resources are physically and biologically the same or closely approximate those lost.

Table 1. Summary of Resource Categories, Designation Criteria and Mitigation Planning Goals under the Service Mitigation Policy

Resource Category	Designation Criteria	Mitigation Planning Goal
1	High value for evaluation species and unique and irreplaceable	No loss of existing habitat
2	High value for evaluation species and scarce or becoming scarce	No net loss of in-kind habitat value
3	High to medium value for evaluation species and abundant	No net loss of habitat value while minimizing loss of in-kind habitat value
4	Medium to low value for evaluation species	Minimize loss of habitat value

In addition to mitigation planning goals based on habitat values, Region 8 of the Service, which includes California, has a mitigation planning goal of no net loss of acreage and value for wetland habitat. This goal is applied in all impact analyses.

In recommending mitigation for adverse impacts to any of these habitats, the Service uses the same sequential mitigation steps recommended in the Council on Environmental Quality's regulations. These mitigation steps (in order of preference) are: avoidance, minimization, rectification, reduction or elimination of impacts over time, and compensation.

Five fish and/or wildlife habitats were identified in the project study area which had potential for impacts from the Project. These habitats, and their corresponding evaluation species, designated Resource Categories and associated mitigation planning goals are discussed below, and summarized in Table 2.

Table 2. Resource Categories, Evaluation Species, and Mitigation Planning Goal for the Habitats Impacted by the Arroyo Canal Fish Screen and Sack Dam Fish Passage Project

Resource Category	Cover-Type	Evaluation Species	Mitigation Goal
4	Annual grassland	Burrowing owl, Swainson's hawk, California vole	Minimize loss of habitat value.
4	Ruderal herbaceous	Red-winged blackbird	Minimize loss of habitat value.
2	Riparian/Riparian Shrub-Scrub	Belted king-fisher, Yellow breasted chat	No net loss of in-kind habitat value.
2	Riverine	Pacific pond turtle	No net loss of in-kind habitat value.
4	Barren/Riprap	Burrowing owl	Minimize loss of habitat value.

Annual Grassland Habitat

The evaluation species selected for annual grasslands in the project study area are the burrowing owl, Swainson's hawk, and the California vole. We chose the burrowing owl and Swainson's hawk as evaluation species because: (1) raptors, as predators, play a key role in community ecology of the study area; (2) they have important human non-consumptive benefits (e.g. bird watching); and (3) the Service's responsibilities for these species protection and management under the Migratory Bird Treaty Act (MBTA). We chose the California vole as an evaluation species because they are important prey species for a variety of wildlife species, including certain raptor species, predatory mammal species, and reptile species. Annual grasslands in the project study area have been designated Resource Category 4, based on the limited extent they occur on the project site, the high degree of nonnative plant species they contain and the marginal value they provide to the evaluation species at this location. Our associated mitigation planning goal for these areas is to minimize loss of habitat value.

Ruderal Herbaceous Habitat

The evaluation species selected for ruderal herbaceous habitat in the project study area is the red-winged blackbird. We chose the red-winged blackbird as an evaluation species because: (1) they have important human non-consumptive benefits (e.g. bird watching); (2) and the Service's responsibilities for these species protection and management under the MBTA. Ruderal herbaceous habitat in the project study area has been designated Resource Category 4, based on the marginal habitat value they provide to the evaluation species, and the high degree of nonnative plant species they contain. Our associated mitigation planning goal for these areas is to minimize loss of habitat value.

Riparian/Riparian Shrub-Scrub

The evaluation species selected for riparian/riparian shrub-scrub habitat in the project study area are the belted kingfisher and yellow-breasted chat. We chose the belted kingfisher and yellow-breasted chat as evaluation species because: (1) they have important human non-consumptive benefits (e.g. bird watching); (2) and the Service's responsibilities for these species protection and management under the MBTA. Due to the importance of riparian/riparian shrub-scrub habitat for the evaluation species and for many other native wildlife species in the area, the Service has designated this habitat as Resource Category 2. Our associated mitigation planning goal for these areas is no net loss of in-kind habitat value.

Riverine

The evaluation species selected for riverine habitat in the project study area is Chinook salmon. The Chinook salmon was selected as an evaluation species due to its (1) importance in riverine systems within the Central Valley of California; (2) they have important human non-consumptive and consumptive benefits (e.g. nature watching and recreational/commercial fishing); (3) and are a target restoration species of the Settlement and the SJRRP. Due to the importance of riverine habitat for Chinook salmon as well as its relationship to other habitats

(e.g. riparian), the Service has designated riverine habitat as Resource Category 2. Our associated mitigation planning goal for these areas is no net loss of in-kind habitat value.

Barren/Riprap Habitat

No evaluation species was selected for this habitat type due to the low value it provides to terrestrial species. In view of the extremely low habitat value for most wildlife species provided by these areas in the project footprint, the Service finds that any highly disturbed habitats meeting the barren/riprap habitat definition that would be impacted by the project should have a mitigation planning goal of "minimize loss of habitat value" (Resource Category 4).

DISCUSSION

The SJRRP is supported by several restoration and management plans developed by State and Federal resource agencies in order to meet the terms of the SJRRP Settlement. The Settlement specifically calls for the reintroduction of spring-run Chinook salmon and certain river restoration actions. The Arroyo Canal Fish Screen and Sack Dam Fish Passage Project tiers from the PEIS/R (Reclamation 2011), and incorporates numerous ecosystem-level actions that target ecosystem-level benefits.

The SJRRP is comprised of several Federal and State of California agencies responsible for implementing the Settlement. Implementing Agencies responsible for managing and implementing the SJRRP are: the Service, Reclamation, NMFS, DWR, CDFG, and California Environmental Protection Agency. As an active partner working toward meeting the terms of the settlement agreement the Service supports the goals of the Settlement and the SJRRP.

This project focuses on removing a barrier to adult and juvenile passage, improving flows downstream of Sack Dam, and reducing the effects of river diversions for agriculture on both native and non-native fish species. Expected ecological benefits are improved access to available upstream spawning habitat, facilitating passage for adults and juveniles past a major barrier on the SJR, and improving habitat stability and continuity.

The Service's draft FWCA report developed for the SJRRP recognized that increased instream flow from the larger restoration project is expected to benefit riparian vegetation. This assumes the present flow regime limits the area and/or quality of riparian habitat. The SJRRP will release flows into reaches of the SJR which have historically been dry, except during flood releases from Friant Dam. The higher flows provided by the SJRPP should enable establishment of more riparian vegetation in these formerly reaches and potentially increase groundwater levels along the SJR and area tributaries over time, which could lead to wider riparian corridors than at present.

The proposed project would impact about 2.4 acres of riparian/riparian shrub-scrub habitat. It is expected that riparian habitat that is re-established and/or enhanced, due to increased instream flows would have similar plant composition and be used by similar assemblages of animal species as the habitat lost, thereby meeting the Service' mitigation goal for this habitat type.

The construction of a fish ladder, fish screen and new dam would reduce both native and non-native fish losses due to agricultural diversions and largely resolve fish passage issues at this location. The proposed ladder would allow for the passage of salmon, sturgeon, and Pacific lamprey; other native fishes would also benefit should they become reestablished within this reach as a result of increased flows.

RECOMMENDATIONS

The proposed Arroyo Canal Fish Screen and Sack Dam Fish Passage Project could have impacts on fish and wildlife and their habitat. If Reclamation proceeds with the project as described, the Service recommends that:

- Minimize impacts to ruderal habitat that is temporarily disturbed during construction by reseeding with native grasses and forbs after the construction is complete;
- Implement measures to mitigate shrub-scrub and riparian habitats as described in the project description;
- Implement an Erosion Control Plan and Stormwater Prevention Plan that minimizes erosion and sedimentation during construction by using erosion control devices, such as straw waddles;
- Survey the construction sites for ground nesting birds (e.g. killdeer) and if nests with eggs are found, it is recommended that either: (1) construction is delayed until nesting season is completed, or (2) eggs are removed from the nest and placed in a facility for incubation;
- Work towards making the proposed project carbon neutral. Consistent with the Intergovernmental Panel on Climate change (IPCC) (2007) adaptation strategies/mitigation recommendations, compensation for the proposed project's carbon footprint could be achieved by purchasing carbon offsets. Alternatively, carbon offsets could be achieved through sequestering carbon (converting tilled agricultural fields near the project area to native grasslands);
- Implement a Hazardous Materials Control and Spill Prevention and Response Plan to avoid the release of hazardous materials to the environment;
- Consult with the Service under ESA for impacts to federally-listed species as needed;
- Contact CDFG regarding the projects impacts to State-listed species
- Implement the conservation measures listed in the Environmental Assessment for the Project, and;

- Maintain continuance of the collaborative approach to the planning and implementation of this Project with the Service.

If you have any questions regarding this report, please contact Mark Littlefield at (916) 414-6520.

REFERENCES

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Appendix K – Arroyo Canal Fish Screen and Sack Dam Fish Passage Project ITA Request and Concurrence

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From: Rivera, Patricia L
Sent: Tuesday, April 24, 2012 7:24 AM
To: Banonis, Michelle
Subject: RE: Arroyo Canal Fish Screen & Sack Dam Fish Passage Project ITA Request

Michelle,

I reviewed the proposed action key components which are the following:

- Replace Sack Dam to accommodate fish passage, improve operational control, and provide a stable and reliable structure under the scheduled Restoration Flow regime.
- Demolish the existing Sack Dam structure, and recontour the resulting disturbed channel.
- Provide stabilization improvements to the east side of the SJR channel between the east abutment of Sack Dam and the adjacent levee.
- Construct a new 700-cfs positive barrier fish screen structure within the Arroyo Canal in a single vee configuration with profile bar screens. The fish screen would be designed to meet the criteria and guidelines issued by DFG and NMFS, which are generally supported by USFWS.
- Construct a new trash-rack structure at the head of the Arroyo Canal, upstream of the new fish screen structure, with an automated raking mechanism. downstream end of the vee screen and terminating at the west abutment of Sack Dam. The transport channel/fish ladder would convey downstream migrating fish and accommodate upstream migrating fish past Sack Dam.
- Construct a defined work bench area adjacent to the west abutment of Sack Dam to facilitate operation and maintenance access to the dam and the Arroyo Canal approach channel.
- Construct a new control building to accommodate mechanical, electrical, and instrumentation and control equipment related to Proposed Action improvements.
- Construct a new equipment storage building to accommodate maintenance equipment related to Proposed Action improvements.
- Replace an existing bridge across the Poso Canal (located immediately north of the Arroyo Canal) to accommodate project operation and maintenance equipment access needs.
- Construct a new bridge across the Poso Canal to facilitate site access from Valeria Avenue during inclement weather conditions. This bridge would also be designed to accommodate project operation and maintenance equipment.

Sack Dam Replacement

The Proposed Action includes removing the existing dam and constructing a new dam approximately 100 feet upstream, near the Arroyo Canal divergence to enable fish passage at Sack Dam, improve operational control, and provide a suitable and reliable structure under the scheduled Restoration Flow regime. Relocating Sack Dam immediately downstream of the Arroyo Canal divergence would enhance the ability of the dam to influence and ultimately manage sediment within the Arroyo Canal approach channel. Relocating Sack Dam would also allow the transport channel/fish ladder to be aligned in a manner that would minimize impacts on the adjacent agricultural field.

The new dam would consist of an automated pneumatic crest control gate system. The dam would include two smaller gate bays (approximately 10 feet wide) adjacent to the west abutment, and three to four larger gate bays (approximately 20 feet wide to 30 feet wide) between the former gate bays and the east abutment. The first smaller gate bay (closest to the west abutment) would serve to "shadow" the fish ladder entrance (located downstream of the dam in the west abutment) and to periodically manage sediment that may accumulate at the fish ladder entrance. The second smaller gate bay would include a removable baffle, composed of a 4-foot-wide slot, and positioned at the downstream end of the bay to provide an alternative fish passage mechanism during transitional flow periods (Reach 4 Restoration Flows between 475 cfs and 1,225 cfs). All gate bays would be lowered during high Restoration Flows and flood flows (Reach 4 flows in excess of approximately 1,550 cfs) to preserve the flood profile and allow volitional fish passage across Sack Dam.

- The new dam would retain an upstream water elevation approximately 8 inches higher than the existing structure's capability to enable the design diversion.
- Construct a new transport channel/fish ladder, beginning at the rate of 700 cfs. The increase in headwater elevation is a function of the hydraulic losses imposed by the proposed trash rack and fish screen facility.

The new dam would include revetment protection (for example, stones or articulating concrete block) on the riverbed and banks upstream and downstream of the dam to resist channel degradation and bank erosion.

Demolition of the Existing Sack Dam

The existing dam would be demolished in its entirety up to 3 feet below the channel bed elevation. The channel bed and active channel banks, disturbed and/or depressed as a result of demolition activities would be backfilled with suitable onsite borrow material, compacted, and shaped to conform to the river channel upstream and downstream. All disturbed areas within the levees, including the disturbed area on the east side of the river, would be graded to drain to the active channel. Riprap would be placed along the left channel bank (facing downstream), between the new dam and the existing left abutment area to repair and minimize future erosion along the toe of the levee. The existing riprap immediately downstream of the existing dam would be reused elsewhere on the project site. The anticipated extent of channel recontouring upstream of the existing dam would be set by the location of the upstream cofferdam used to construct the new dam.

Stabilization Improvement

To provide a permanent fill for the east side of the Sack Dam embankment, an engineered embankment and sheet-pile cutoff wall would be constructed. Upstream and downstream of the embankment, revetment protection would be necessary to resist channel degradation and bank erosion. Preliminary estimates of revetment extents range from 25 feet to 50 feet upstream and downstream of the embankment. The embankment configuration would also provide vehicle and foot traffic access from SJR east levee to the east abutment of Sack Dam.

In-Canal Positive Barrier Fish Screen and Associated Facilities

The proposed in-canal fish screen is an off-river, vertical flat-plate screen in a single vee configuration. The in-canal vee screen was selected as the Proposed Action/Preferred Alternative to minimize the fish exposure time to the screen and associated bypass requirements, and to minimize streambank impacts. In addition, the current point of diversion at Sack Dam is limited to a water depth of about 4 feet, which precludes the effectiveness of an in-river diversion facility.

The in-canal fish screen would be placed in a rectangular canal extending from the Poso Canal flume (old headworks structure) to the Arroyo Canal Headworks. The fish screen structure would include a fish screen cleaning mechanism, sediment jetting system, and a transport channel/fish ladder to allow upstream and downstream fish passage past Sack Dam. The in-canal fish screen structure would consist of 20 fish screen

panels, configured to permit a peak diversion rate of 700 cfs and meet DFG and NMFS salmonid fish protection criteria.

A trash-rack structure would be located immediately upstream of the fish screen structure (upstream of the bridge/Poso Canal old headwords structure) to prevent large debris from damaging the screens. The trash-rack structure would include provisions for bulkheads to facilitate maintenance and repair of the fish screen facility in the dry. The trash-rack bar spacing would accommodate sturgeon and other migrating fish species.

Transport Channel/ Fish Ladder

The transport channel/fish ladder would accommodate both upstream and downstream migrating fish past Sack Dam. The design flow for the transport channel/fish ladder is coincident with the minimum Reach 4 Restoration Flow of 45 cfs. The transport channel/fish ladder would consist of the bypass entrance at the downstream end of the fish screen, a transport channel, and a fish ladder.

The proposed entrance to the transport channel would use an inclined ramp to control flow through the transport channel/fish ladder. The entrance would transition from 2.5-foot-wide to a 6-foot-wide transport channel extending from the centerline of the fish screen to the fish ladder. The fish ladder would be composed of a roughened invert (for example, loose cobbles) and a series of full-depth-vertical-slot fabricated metal weirs. The fish ladder would terminate at the west abutment of Sack Dam.

The fish ladder would cross under the Poso Canal, which is owned and operated by the Central California Irrigation District. The transport channel/fish ladder is intended to allow passage to native fish species, including Chinook salmon and green or white sturgeon.

Arroyo Canal Approach Channel and Work Bench

The approximate 100-foot-long section of canal beginning at SJR and extending to the proposed trash-rack structure is defined as the “approach channel.” Sediment would need to be removed from the approach channel to maintain the channel geometry and approach velocity hydraulics. To manage the approach channel effectively, a work bench would be constructed along the west bank of the river. The work bench would be defined by a sheet-pile wall aligned along the north bank of the approach channel that would intersect a sheet-pile wall along the west abutment of Sack Dam.

The work bench would be accessible by a long-reach excavator and hydraulic boom truck (and other operation and maintenance vehicles) during normal operating conditions to remove sediment and debris from the approach channel and to perform maintenance and repairs on the Sack Dam pneumatic crest control gates.

Control Building and Equipment Storage Building

A control building would be required to accommodate mechanical, electrical, and instrumentation and control equipment related to the Proposed Action improvements. The anticipated size of the control building is between 600 square feet and 1,000 square feet. Figure 2-1 shows the location for this building.

An equipment storage building would be required to accommodate the maintenance equipment required at the project site. The anticipated size of this building is approximately 1,500 square feet (not including the proposed 1,500-square-foot storage yard).

Bridge Crossing over Poso Canal

The existing north access bridge that spans the Poso Canal (located approximately 50 feet north of the old headworks structure) would be demolished and replaced with a new bridge that would accommodate equipment anticipated for future operation and maintenance. In addition, a new south access bridge would be constructed to span the Poso Canal (located approximately 200 feet south of the old headworks structure) to accommodate

equipment anticipated for future operation and maintenance, and to provide all-weather access to the project site.

The proposed action does not have a potential to affect Indian Trust Assets. The nearest ITA is a Public Domain Allotment approximately 45 miles NE of the project location.

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