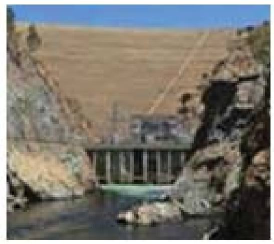
DON PEDRO HYDROELECTRIC PROJECT
FERC NO. 2299

FINAL LICENSE APPLICATION

EXHIBIT E – ENVIRONMENTAL REPORT



Prepared by:
Turlock Irrigation District
P.O. Box 949
Turlock, CA 95381

and

Modesto Irrigation District
P.O. Box 4060
Modesto, CA 95352

April 2014

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List of Acronyms

ac	acres
ACEC	Area of Critical Environmental Concern
ACHP	Advisory Council for Historic Preservation
ACOE	U.S. Army Corps of Engineers
ADA	Americans with Disabilities Act (ADA/ABAAG)
AF	acre-feet
AGS	Annual Grasslands
ALJ	Administrative Law Judge
APE	Area of Potential Effect
APEA	Applicant-Prepared Environmental Assessment
ARMR	Archaeological Resource Management Report
AWQC	Ambient Water Quality Criteria
BA	Biological Assessment
BDCP	Bay-Delta Conservation Plan
BLM	U.S. Department of the Interior, Bureau of Land Management
BLM-S	Bureau of Land Management – Sensitive Species
BMI	Benthic macroinvertebrates
BMP	Best Management Practices
BO	Biological Opinion
BOW	Blue Oak Woodland
ºC	celsius
CalCOFI	California Cooperative Oceanic Fisheries Investigations
CalEPPC	California Exotic Pest Plant Council
CalSPA	California Sportfishing Protection Alliance
CAS	California Academy of Sciences
CBDA	California Bay-Delta Authority
CCC	Criterion Continuous Concentrations
CCIC	Central California Information Center
CCSF	City and County of San Francisco
CD	Compact Disc
CDBW	California Department of Boating and Waterways

CDEC	California Data Exchange Center
CESA	California Endangered Species Act
CDFA	California Department of Food and Agriculture
CDFG	California Department of Fish and Game (as of January 2013, CDFW)
CDFW	California Department of Fish and Wildlife
CDMG	California Division of Mines and Geology
CDOF	California Department of Finance
CDPH	California Department of Public Health
CDPR	California Department of Parks and Recreation
CDSOD	California Division of Safety of Dams
CDWR	California Department of Water Resources
CE	California Endangered Species
CEC	California Energy Commission
CEII	Critical Energy Infrastructure Information
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CGS	California Geological Survey
cm	centimeters
CMAP	California Monitoring and Assessment Program
CMC	Criterion Maximum Concentrations
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CORP	California Outdoor Recreation Plan
CPUC	California Public Utilities Commission
CPUE	Catch Per Unit Effort
CRAM	California Rapid Assessment Method
CRC	Chamise-Redshank Chaparral
CRLF	California Red-Legged Frog
CRRF	California Rivers Restoration Fund
CSAS	Central Sierra Audubon Society
CSBP	California Stream Bioassessment Procedure

CSU	California State University
CT	California Threatened Species
CTR	California Toxics Rule
CTS	California Tiger Salamander
CVP	Central Valley Project
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
CWD	Chowchilla Water District
CWHR	California Wildlife Habitat Relationship
CZMA	Coastal Zone Management Act
DDT	dichlorodiphenyltrichloroethane
Districts	Turlock Irrigation District and Modesto Irrigation District
DLA	Draft License Application
DO	Dissolved Oxygen
DOI	Department of Interior
DPRA	Don Pedro Recreation Agency
DPS	Distinct Population Segment
DSE	Chief Dam Safety Engineer
EA	Environmental Assessment
EBMUD	East Bay Municipal Utilities District
EC	Electrical Conductivity
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
Elev or el	Elevation
ENSO	El Niño Southern Oscillation
EPA	U.S. Environmental Protection Agency
ESA	Federal Endangered Species Act
ESRCD	East Stanislaus Resource Conservation District
ESU	Evolutionary Significant Unit
EVC	Existing Visual Condition
EWUA	Effective Weighted Useable Area
°F	fahrenheit

FERC	Federal Energy Regulatory Commission
FFS	Foothills Fault System
FL	Fork length
FLA	Final License Application
FMP	Fishery Management Plan
FMU	Fire Management Unit
FOT	Friends of the Tuolumne
FPA	Federal Power Act
FPC	Federal Power Commission
FPPA	Federal Plant Protection Act
ft	feet
ft/mi	feet per mile
FWCA	Fish and Wildlife Coordination Act
FWUA	Friant Water Users Authority
FYLF	Foothill Yellow-Legged Frog
g	grams
GIS	Geographic Information System
GLO	General Land Office
GORP	Great Outdoor Recreation Pages
GPS	Global Positioning System
HCP	Habitat Conservation Plan
HSC	Habitat Suitability Criteria
HHWP	Hetch Hetchy Water and Power
HORB	Head of Old River Barrier
hp	horsepower
HPMP	Historic Properties Management Plan
IFIM	Instream Flow Incremental Methodology
ILP	Integrated Licensing Process
in	inches
ISR	Initial Study Report
ITA	Indian Trust Assets
IUCN	International Union for the Conservation of Nature
KOPs	Key Observation Points

kV	kilovolt
kVA	kilovolt-amperes
kW	kilowatt
LWD	large woody debris
m	meters
mm	millimeter
M&I	Municipal and Industrial
MCL	Maximum Contaminant Level
mg/kg	milligrams/kilogram
mg/L	milligrams per liter
mgd	million gallons per day
MGR	Migration of Aquatic Organisms
MHW	Montane Hardwood
mi	miles
mi^2	square miles
MID	Modesto Irrigation District
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MPN	Most Probable Number
MPR	market price referents
MSCS	Multi-Species Conservation Strategy
msl	mean sea level
MUN	municipal and domestic supply
MVA	Megavolt-ampere
MW	megawatt
MWh	megawatt hour
mya	million years ago
NAE	National Academy of Engineering
NAHC	Native American Heritage Commission
NAS	National Academy of Sciences
NAVD 88	North American Vertical Datum of 1988
NAWQA	National Water Quality Assessment
NCCP	Natural Community Conservation Plan

NGVD29	National Geodetic Vertical Datum of 1929
NEPA	National Environmental Policy Act
NERC	North American Electric Reliability Corporation
NGOs	Non-Governmental Organizations
NHI	Natural Heritage Institute
NHPA	National Historic Preservation Act
NISC	National Invasive Species Council
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPS	U.S. Department of the Interior, National Park Service
NRCS	National Resource Conservation Service
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory
NTU	Nephelometric Turbidity Unit
NWI	National Wetland Inventory
NWIS	National Water Information System
NWR	National Wildlife Refuge
O&M	operation and maintenance
OEHHA	Office of Environmental Health Hazard Assessment
OID	Oakdale Irrigation District
ORV	Outstanding Remarkable Value
OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
PAD	Pre-Application Document
PDAW	Project Demand of Applied Water
PDO	Pacific Decadal Oscillation
PEIR	Program Environmental Impact Report
PGA	Peak Ground Acceleration
PG&E	Pacific Gas and Electric
PHABSIM	Physical Habitat Simulation System
PHG	Public Health Goal
PM&E	Protection, Mitigation and Enhancement

PMF	Probable Maximum Flood
POAOR	Public Opinions and Attitudes in Outdoor Recreation
ppb	parts per billion
ppm	parts per million
PSP	Proposed Study Plan
PWA	Public Works Administration
QA	Quality Assurance
QC	Quality Control
RA	Recreation Area
RBP	Rapid Bioassessment Protocol
REC-1	water contact recreation
REC-2	water non-contact recreation
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RM	River Mile
RMP	Resource Management Plan
RP	Relicensing Participant
rpm	Rotations per minute
RPS	Renewable Portfolio Standard
RRMP	Recreation Resource Management Plan
RSP	Revised Study Plan
RST	Rotary Screw Trap
RWG	Resource Work Group
RWQCB	Regional Water Quality Control Board
SC	State candidate for listing under CESA
SCADA	Supervisory Control and Data Acquisition
SCD	State candidate for delisting under CESA
SCE	State candidate for listing as endangered under CESA
SCT	State candidate for listing as threatened under CESA
SD1	Scoping Document 1
SD2	Scoping Document 2
SE	State Endangered Species under the CESA
SEED	U.S. Bureau of Reclamation's Safety Evaluation of Existing Dams
SFP	State Fully Protected Species under CESA

SFPUC	San Francisco Public Utilities Commission
SHPO	State Historic Preservation Officer
SJRA	San Joaquin River Agreement
SJRGA	San Joaquin River Group Authority
SJTA	San Joaquin River Tributaries Authority
SM	Standard Method
SMUD	Sacramento Municipal Utility District
SPAWN	spawning, reproduction and/or early development
SPD	Study Plan Determination
SRA	State Recreation Area
SRMA	Special Recreation Management Area or Sierra Resource Management Area (as per use)
SRMP	Sierra Resource Management Plan
SRP	Special Run Pools
SSC	State species of special concern
ST	California Threatened Species under the CESA
STORET	Storage and Retrieval
SWAMP	Surface Water Ambient Monitoring Program
SWE	Snow-Water Equivalent
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
TAF	thousand acre-feet
TCP	Traditional Cultural Properties
TCWC	Tuolumne County Water Company
TDS	Total Dissolved Solids
TID	Turlock Irrigation District
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TRT	Tuolumne River Trust
TRTAC	Tuolumne River Technical Advisory Committee
UC	University of California
USBR	U.S. Bureau of Reclamation

USDA	U.S. Department of Agriculture
USDOC	U.S. Department of Commerce
USDOI	U.S. Department of the Interior
USFS	U.S. Department of Agriculture, Forest Service
USFWS	U.S. Department of the Interior, Fish and Wildlife Service
USGS	U.S. Department of the Interior, Geological Survey
USR	Updated Study Report
UTM	Universal Transverse Mercator
VAMP	Vernalis Adaptive Management Plan
VELB	Valley Elderberry Longhorn Beetle
VES	visual encounter surveys
VRM	Visual Resource Management
VRO	Visual Resource Objective
WBWG	Western Bat Working Group
WECC	Western Electricity Coordinating Council
WPA	Works Progress Administration
WPT	Western Pond Turtle
WQCP	Water Quality Control Plan
WSA	Wilderness Study Area
WSIP	Water System Improvement Program
WSNMB	Western Sierra Nevada Metamorphic Belt
WUA	weighted usable area
WWTP	Wastewater Treatment Plant
WY	water year
yd^3	cubic yard
yr	year
µS/cm	microSeimens per centimeter
µg/L	micrograms per liter
µmhos	micromhos

PREFACE

The Don Pedro Project provides water storage for irrigation and municipal and industrial (M&I) use, flood control, hydroelectric generation, recreation, and natural resource protection (hereinafter, the "Don Pedro Project"). The environmental analysis contained in this Exhibit E considers all the components, facilities, operations, and maintenance that make up the Don Pedro Project. The Don Pedro Project was originally conceived as a water supply project. The Don Pedro Project is operated for the following primary purposes: (1) to provide water supply for the co-licensees, Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts), for irrigation of over 200,000 acres of Central Valley farmland and M&I use, (2) to provide flood control benefits along the Tuolumne and San Joaquin rivers, and (3) to provide a water banking arrangement for the benefit of the City and County of San Francisco (CCSF) and its 2.6 million Bay Area water customers. The original license was issued in 1966. In 1995, the Districts entered into an agreement with a number of parties which resulted in greater flows to the lower Tuolumne River for the protection of aquatic resources.

Hydroelectric generation is a secondary purpose of the Don Pedro Project. Hereinafter, the hydroelectric generation facilities and operations will be referred to as the "Don Pedro Hydroelectric Project", or the "Project". With this license application to the Federal Energy Regulatory Commission (FERC), the Districts are seeking a new license to continue generating hydroelectric power. Based on the information contained in this application, and other sources of information on the record, FERC will consider whether, and under what conditions, to issue a new license for the continued generation of hydropower at the Districts' Don Pedro Project. The Districts are providing a complete description of the facilities and operation of the Don Pedro Project so the effects of the operation and maintenance of the hydroelectric facilities can be distinguished from the effects of the operation and maintenance activities of the overall Don Pedro Project's flood control and water supply/consumptive use purposes.

Being able to differentiate the effects of the hydropower operations from the effects of the flood control and consumptive use purposes and needs of the Don Pedro Project will aid in defining the scope and substance of reasonable protection, mitigation, and enhancement (PM&E) alternatives to be considered in relicensing. As FERC states in Scoping Document 2 in a discussion related to alternative project operation scenarios: "…alternatives that address the consumptive use of water in the Tuolumne River through construction of new structures or methods designed to alter or reduce consumptive use of water are…alternative mitigation strategies that could not replace the Don Pedro *hydroelectric* project [emphasis added]. As such, these recommended alternatives do not satisfy the National Environmental Policy Act (NEPA) purpose and need for the proposed action and are not reasonable alternatives for the NEPA analysis."

1.0 INTRODUCTION

The Districts file with FERC this application for a new license for the existing Don Pedro Hydroelectric Project (or Project). The Districts initiated relicensing in accordance with regulations governing the Integrated Licensing Process (ILP) promulgated by FERC at 18 Code of Federal Regulations (CFR) Part 5. This Exhibit E, the Environmental Report of the final license application (FLA), is prepared in the form of an Applicant-Prepared Environmental

Assessment (APEA) as provided for in 18 CFR §5.18. Exhibit E is supported by data and analysis from more than 30 resource studies conducted as part of the relicensing process and numerous prior studies conducted by the Districts in compliance with the terms and conditions of the current license.

The 168 megawatt (MW) Don Pedro Hydroelectric Project consists of a single dam and impoundment located on the Tuolumne River in Tuolumne County, California (Figure 1.0-1). The Project is jointly owned by the Districts: MID owns 31.54 percent and TID owns 68.46 percent. Approximately 13,568 acres (ac), or 74 percent, of lands within the Project Boundary are owned by the Districts. The remaining 26 percent of the Project lands, about 4,802 ac, are federal lands located within the Bureau of Land Management (BLM) Sierra Resource Management Area.

Exhibit E provides environmental analysis by resource area by first describing the existing environment and then evaluating the environmental effects of the Districts' proposal to continue operating the Don Pedro Hydroelectric Project. The Districts have developed the information on environmental resources contained in this license application in consultation with state and federal fish and wildlife agencies, local governments, Indian Tribes, non-governmental organizations (NGOs) and members of the public. Table 1.0-1 summarizes the studies conducted, and their status, in support of relicensing.

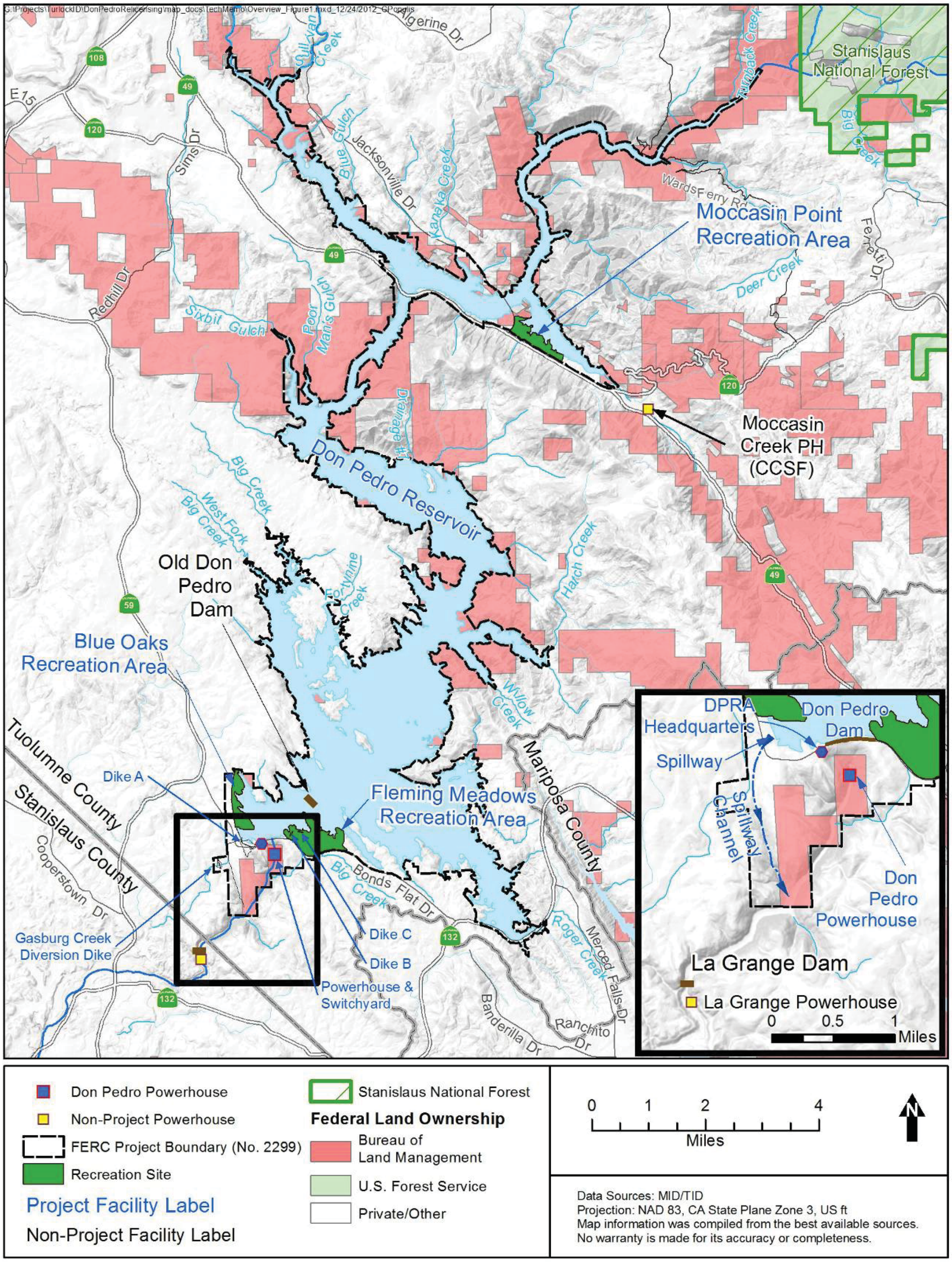

Figure 1.0-1. Don Pedro Project Boundary and major facilities.

Table 1.0-1. Study report status.

Study Number	Study Title	Study Status
Cultural Resources (CR)		
CR-01	Historic Properties Study	Draft report issued for review and comment[1]
CR-02	Native American Traditional Cultural Properties Study	Draft report issued for review and comment[1]
Recreation Resources (RR)		
RR-01	Recreation Facility Condition and Public Accessibility Assessment, and Recreation use Assessment	Complete
RR-02	Whitewater Boating Take Out Improvement Feasibility Study	Complete
RR-03	Lower Tuolumne River Lowest Boatable Flow Study	Complete
RR-04	Visual Quality Study	Complete
Terrestrial Resources (TR)		
TR-01	Special-Status Plants Study	Complete
TR-02	ESA- and CESA-Listed Plants Study	Complete
TR-03	Wetland Habitats Associated with Don Pedro Reservoir Study	Complete
TR-04	Noxious Weed Survey	Complete
TR-05	ESA-Listed Wildlife - Valley Elderberry Longhorn Beetle Study	Complete
TR-06	Special-Status Amphibians and Aquatic Reptiles Study	Complete
TR-07	ESA-Listed Amphibians - California Red-Legged Frog Study	Complete
TR-08	ESA-Listed Amphibians - California Tiger Salamander Study	Complete
TR-09	Special-Status Wildlife - Bats Study	Complete
TR-10	Bald Eagle Study	Complete
Water and Aquatic Resources (W&AR)		
W&AR-01	Water Quality Assessment	Complete
W&AR-02	Project Operations/Water Balance Model	Complete
W&AR-03	Don Pedro Reservoir Temperature Model	Complete
W&AR-04	Spawning Gravel in the Lower Tuolumne River Study	Complete
W&AR-05	Salmonid Population Information Integration and Synthesis Study	Complete
W&AR-06	Tuolumne River Chinook Salmon Population Model	Complete
W&AR-07	2012 Predation Study	Complete
W&AR-07	Mark-Recapture Predation Study[2]	Study report to be filed with FERC April 2016[3]
W&AR-08	Salmonid Redd Mapping Study	Complete
W&AR-10	*Oncorhynchus mykiss* Population Model	Complete
W&AR-11	Chinook Salmon Otolith Study	Ongoing; study report to be filed with FERC February 2015
W&AR-12	*Oncorhynchus mykiss* Habitat Survey	Complete
W&AR-13	Fish Assemblage and Population Between Don Pedro Dam and La Grange Dam Study	Complete
W&AR-14	Temperature Criteria Assessment (Chinook Salmon and *Oncorhynchus mykiss*)	Ongoing; study report to be filed with FERC February 2015

Study Number	Study Title	Study Status
W&AR-15	Socioeconomics Study	Complete
W&AR-16	Lower Tuolumne River Temperature Model	Complete
W&AR-17	Don Pedro Fish Population Survey	Complete
W&AR-18	Sturgeon Study	Complete
W&AR-19	Lower Tuolumne River Riparian Information and Synthesis Study	Complete
W&AR-20	*Oncorhynchus mykiss* Scale Collection and Age Determination Study	Complete
W&AR-21	Floodplain Hydraulic Analysis	Ongoing; study report to be filed with FERC February 2015
NMFS Information Request	Description of La Grange Facilities and Potentially Affected Environment of Anadromous Fish in the Vicinity of the La Grange Facilities	Complete
Lower Tuolumne River Instream Flow Study	Habitat Suitability Curves for Splittail and Lamprey	Complete
	Effective Weighted Usable Area Estimate for *O.mykiss*	Ongoing; supplement to be filed with FERC August 2014
	Evaluation of Non-Native Predatory Fish	Ongoing; supplement to be filed with FERC April 2016

[1] Draft study report is provided to the cultural resources workgroup under separate cover as it contains non-public, privileged information.
[2] Per FERC's May 21, 2013 Determination on Requests for Study Modifications and New Studies, the Districts are planning to complete an additional year of study.
[3] Per FERC's February 12, 2014 letter, the FERC-approved study plan was granted a one-year extension.

1.1 Purpose of Action and Need for Power

1.1.1 Purpose of Action

FERC is the federal agency authorized to issue licenses for the construction, operation and maintenance of the nation's non-federal hydroelectric facilities. In accordance with the Federal Power Act (FPA), as amended, FERC is able to issue such licenses for a period not less than 30 years, but no more than 50 years. Upon expiration of an existing license, FERC must decide whether, and under what terms, to issue a new license. Under the FPA, FERC issues licenses which are best adapted to a comprehensive plan for improving or developing a waterway, and, in so doing, must consider a suite of beneficial public uses including, among others, water supply, flood control, irrigation, recreation, and fish and wildlife. As the federal "action agency", FERC must also comply with the requirements of the NEPA. Under NEPA, FERC must clearly define the specific Proposed Action it is considering and state the purpose and need for the Proposed Action.

In the case of the Don Pedro Hydroelectric Project, the Proposed Action under review by FERC is the issuance of a new license to the Districts to authorize the continued generation of hydroelectric power at Don Pedro Dam and Reservoir. As such, and as generally described in FERC's Scoping Document 2 (SD2) issued on July 25, 2011, alternatives to mitigate Project's effects ("mitigation strategies") must be reasonably related to the purpose and need for the Proposed Action, which in this case is whether, and under what terms, to authorize the continuation of hydropower generation at Don Pedro.

1.1.2 Need for Power

Issuing a new license will allow the Districts to continue generating electricity at the Don Pedro Project for the term of the new license, producing low-cost electric power from an existing, non-polluting, renewable resource.

The California Energy Commission (CEC) issued an Updated California Energy Demand Forecast 2011–2022 in May 2011. The staff report presented an update to the 2009 California Energy Demand electricity forecast adopted for the 2009 Integrated Energy Policy Report in December 2009. The updated forecast was meant to provide the CEC's best estimate of the effect of economic conditions on energy demand since the 2009 forecast was published. The updated forecast presents low, mid, and high forecasts for the state. Average annual growth rates for consumption for 2010–2022 is 1.13 percent, 1.28 percent, and 1.53 percent, respectively (CEC 2011).

1.2 Statutory and Regulatory Requirements

1.2.1 Federal Power Act

The issuance of a new license for the Project is subject to numerous requirements under the FPA and other applicable statutes. The major statutes and regulatory requirements are summarized below in chronological order based on date of enactment of the applicable statute. Actions undertaken by the Districts or the agency with jurisdiction related to each requirement are described.

1.2.1.1 Section 18 Fishway Prescriptions

Section 18 of the FPA, 16 U.S.C. § 811, states that FERC shall require construction, maintenance and operation by a licensee of such fishways as the secretaries of the Department of Commerce and the Department of the Interior (DOI) may prescribe. The Districts have consulted with the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) during study plan development and implementation of the ILP. As stated in FERC's July 25, 2011 SD2, the Don Pedro Project does not block the upstream migration of anadromous fish because the upstream extent of anadromous fish in the Tuolumne River is currently limited to areas below La Grange Diversion Dam, located downstream of Don Pedro Dam.

1.2.1.2 Section 4(e) Conditions

The Don Pedro Project occupies approximately 4,802 ac of federal lands which are administered by the BLM. Section 4(e) of the FPA gives the Secretary of the land administering agency authority to prescribe conditions on licenses issued by FERC for hydropower projects located on "reservations" under the Secretary's supervision. See 16 U.S.C. §§ 796(2), 797(e). The Districts have consulted with the BLM during study plan development and implementation of the ILP.

1.2.1.3 Section 10(j) Recommendations

Under the provisions of Section 10(j) of the FPA, each hydroelectric license issued by FERC is required to include conditions based on recommendations of federal and state fish and wildlife agencies for the protection, mitigation, or enhancement of fish and wildlife resources affected by the Project, unless FERC determines they are inconsistent with the purposes and requirements of the FPA or other applicable law. During the relicensing, the Districts have consulted with NMFS, USFWS, and the California Department of Fish and Wildlife (CDFW).

1.2.1.4 Section 30(c) Fish and Wildlife Conditions

This section is applicable to projects that would impound or divert the water of a natural watercourse by means of a new dam or diversion. The Districts are not seeking a license to construct a new dam or diversion; therefore, this section of the FPA is not applicable to the relicensing of the Project.

1.2.2 Clean Water Act

Under Section 401(a)(1) of the Clean Water Act (CWA) of 1970, as amended, 33 USC § 1329(a)(1), a license applicant must obtain certification from the appropriate state pollution control agency verifying compliance with the CWA 33 USC § 1251 *et seq*. In the State of California, the State Water Resources Control Board (SWRCB) is designated to carry out certification requirements prescribed by Section 401. The SWRCB and the State's nine Regional Water Quality Control Boards (RWQCBs) work in a coordinated effort to implement and enforce the CWA, as provided for in the State's Porter-Cologne Water Quality Act. The Project falls within the jurisdiction of the Central Valley RWQCB.

Within 60 days following FERC's Notice of Acceptance and Ready for Environmental Analysis, the Districts will file the appropriate application to request a Section 401 Water Quality Certificate from the SWRCB.

1.2.3 Endangered Species Act

Section 7 of the Endangered Species Act (ESA) 16 U.S.C. § 1536(a)(2) requires federal agencies to ensure that their actions are "not likely to jeopardize the continued existence of endangered and threatened species or to cause the destruction or adverse modification of the critical habitat of such species..."

FERC is the lead federal agency for relicensing of the Project, and therefore must consult with the USFWS and NMFS to determine whether its actions and authorizations would jeopardize the continued existence of any endangered or threatened species or adversely affect any designated critical habitat. Jeopardy exists when an action would "…appreciably reduce the likelihood of both the survival and recovery of a listed species…" (50 CFR § 402.02). Consultation involves a request to the USFWS and NMFS for an inventory of endangered and threatened species, and species proposed by USFWS or NMFS for listing as endangered or threatened that may be present in the Project Boundary. FERC then prepares a biological assessment (BA) to determine whether these listed species or critical habitat for them is likely to be adversely affected by the federal action, and therefore requires formal consultation. At the end of the consultation process, the USFWS or NMFS issues a biological opinion (BO) that specifies whether or not the action will place an endangered or threatened species or critical habitat in 'jeopardy'. If a jeopardy opinion is issued, the USFWS or NMFS must include reasonable and prudent alternatives to the action. A non-jeopardy opinion may be accompanied by an 'incidental take statement' that specifies impacts of the taking, mitigation measures, and terms and conditions for implementation of the mitigation measures.

On April 8, 2011, FERC initiated informal consultation with the USFWS and the NMFS under Section 7 of the ESA and the joint agency regulations thereunder at 50 CFR, Part 402, and designated the Districts as FERC's non-federal representatives for carrying out informal consultation. The Districts consulted with USFWS and NMFS in developing the aquatic and terrestrial study plans for threatened and endangered species, and implementation of the studies. One federally-listed fish species, *Oncorhynchus mykiss*,[1] occurs below the Project Boundary. Two federally-listed plant species, Layne's ragwort (*Packera layneae*) and California vervain (*Verbena californica*), are known to occur within the Project Boundary. Habitat for the federally-listed Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*, VELB) is known to occur within the Project Boundary.

A draft BA for federally listed terrestrial species that may occur in the Project Boundary (including Layne's ragwort, California vervain, and VELB) is included in this final license application as Appendix E-5. A draft BA for *O. mykiss* will be filed in November 2016 upon the completion of all aquatic resource-related studies and development of the Districts' proposed resource protection, mitigation, and enhancement measures for resources of the lower Tuolumne River.

1.2.4 Coastal Zone Management Act

Under § 307(c)(3)(A) of the Coastal Zone Management Act of 1972, as amended, (CZMA), (16 U.S.C. § 1456(3)(A)), the Commission cannot issue a license for a project within or affecting a state's coastal zone unless the state CZMA agency concurs with the license applicant's certification of consistency with the state's CZMA program, or the agency's concurrence is conclusively presumed by its failure to act within 180 days or its receipt of the applicant's certification.

The Project is not located within California's coastal zone boundary, which extends from a few city blocks to five miles inland from the sea[2], and therefore, would not affect resources located within the boundary of a coastal zone. The Project is not subject to California coastal zone program review and no consistency certification is required.

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[1] The term '*O. mykiss*' is used to represent both resident and anadromous life history forms of *Oncorhynchus mykiss*. In circumstances when the discussion is specifically limited to one or the other life history form, the terms 'rainbow trout' or 'resident' will be used to identify resident *O. mykiss*, whereas the terms 'steelhead' or 'anadromous' will be used to denote the anadromous form of *O. mykiss*. However, only steelhead are protected under the ESA.

[2] www.coastal.ca.gov

1.2.5 National Historic Preservation Act

FERC licenses may permit activities that may "…cause changes in the character or use of historic properties, if any such historic properties exist…" (36 CFR § 800.16[d]). FERC must therefore comply with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, (16 U.S. Code § 470 et seq.) and its implementing regulations at 36 CFR Part 800 that require any federal department or independent agency having authority to license any undertaking to take into account the effects of the undertaking on historic properties.

As defined under 36 CFR 800.16(l), historic properties are prehistoric or historic sites, buildings, structures, objects, districts, *or locations of traditional use or beliefs* that are included in, or eligible for inclusion in, the National Register of Historic Places (NRHP). Historic properties are identified through a process of evaluation against specific criteria found at 36 CFR 60.4. FERC is required to make a good faith effort to identify historic properties that may be affected by the proposed federal undertaking (i.e., the relicensing) (36 CFR § 800).

On April 8, 2011, FERC designated the Districts as its non-federal representatives for purposes of consultation during the relicensing under Section 106 of the NHPA and associated regulations found at 36 CFR § 800.2(c)(4). As FERC's non-federal representatives, the Districts have consulted throughout the relicensing effort with BLM, potentially affected tribes, and the State Historic Preservation Officer (SHPO), including obtaining the SHPO's concurrence on the Area of Potential Effects (APE). SHPO concurred with the APE in a letter dated January 9, 2012. Consultation efforts further included six meetings among the Districts, the tribes, BLM, and the SHPO that focused on the collaborative development of study plans and preliminary study results. Representatives from five tribes, BLM, the National Park Service (NPS), the SHPO and FERC routinely participated in these meetings.

To assist FERC in identifying historic properties that may be affected by the Project, as required under Section 106, a comprehensive and intensive field survey of the APE was completed between January 2012 and September 2012 in accordance with the Secretary of Interior's Standards and Guidelines for Identification (USDOI 1983) and BLM's Class III/intensive standards, per BLM's 8100 manual series. Tribal monitors from the Tuolumne Band of Me-Wuk Indians and the Southern Sierra Miwuk accompanied the field crew during the field survey. In addition, a study was undertaken to identify traditional cultural properties (TCPs) within the APE.

The Districts have provided a Draft HPMP with this license application as Appendix E-4 (which is being filed with FERC as Privileged) and will continue consultation with Tribes, BLM, and SHPO to develop the final HPMP for FERC's consideration.

1.2.6 Wilderness Act/Wild and Scenic Rivers Act

1.2.6.1 Wild and Scenic Rivers Act

Congress formally designated portions of the upper Tuolumne River, upstream of the Don Pedro Project Boundary, as Wild and Scenic by PL98-425 on September 28, 1984. In May 1988, the US Forest Service (USFS) issued the Tuolumne Wild and Scenic River Management Plan. Among other things, in Chapter 8 of that plan, the USFS identified what it proposed to be the resource management corridor associated with the wild and scenic reach designated by Congress. The management plan generally identified the corridor as encompassing lands within one-quarter mile of the wild and scenic river segements. Chapter 8 also identifies specific parcels of land proposed to be within the corridor and provided five maps showing the corridor boundary. The lands within the USFS wild and scenic management plan (USFS 1988) overlap the 1966 licensed FERC Project Boundary. Specifically, the USFS identifies in the management plan that the lands and waters of T1N R16E, Section 31: S1/2N1/2, N1/2S1/2 are classified as “wild”. However, a portion of the area designated as “wild” is within the previously licensed Don Pedro Project Boundary. The more proper designation of the wild and scenic corridor in this area would be Section 31: SE1/4N1/2, NE1/4S1/2.

Congress was clear in PL98-425 that prior authorized uses were not to be affected in any way by the wild and scenic designation. In relevant part, PL98-425 states: *“Nothing in this section is intended or shall be construed to affect any rights, obligations, privileges, or benefits granted under any prior authority of law including chapter 4 of December 19, 1913, commonly referred to as the Raker Act and including any agreement or administrative ruling entered into or made effective* ***before the enactment of this paragraph****.”* (emphasis added)

Portions of the Tuolumne River designated as Wild and Scenic include stretches of the river extending 83 miles upstream of the Don Pedro Project Boundary. Of that, a total of 54 miles of the Tuolumne River within Yosemite National Park have been designated as Wild and Scenic. These segments, which are administered by the National Park Service, include the Dana Fork and Lyell Fork at the headwaters of the river; a scenic segment through Tuolumne Meadows; a wild segment from the Grand Canyon of the Tuolumne River to the inlet of Hetch Hetchy Reservoir; a scenic segment from one mile west of O’Shaughnessy Dam; and the remaining five-mile wild segment through Poopenaut Valley to the park boundary. Approximately 13 river miles of the Hetch Hetchy Reservoir were not included in the 1984 Wild and Scenic River designation and thus are not included within the Tuolumne Wild and Scenic River corridor. The remaining segments of the Wild and Scenic Tuolumne River are under the administration of the U.S. Forest Service (USFS) and the BLM.

The Nationwide Rivers Inventory (NRI) is a listing of more than 3,400 river segments in the U.S. that are believed to possess one or more “outstandingly remarkable” natural or cultural values (ORV) judged to be of more than local or regional significance (NPS 1982). The NRI is a source of information for statewide river assessments and federal agencies involved with stream-related projects. Within the Project vicinity, Cherry Creek above Cherry Reservoir and the Clavey River are included in the NRI. Cherry Creek above Cherry Reservoir has potential classification as a wild river and possesses scenery values and geology values. Clavey River has potential classification as wild and scenic river and possesses six ORVs: cultural values, fish values, scenery values, recreation values, wildlife values, and other values, which may include hydrology, paleontology, and/or botany resources.

1.2.6.2 Wilderness Act

There are no Wilderness Areas located within the Project Boundary. The two closest Wilderness Areas to the Project Boundary, Yosemite Wilderness and Emigrant Wilderness, are each located approximately 21 miles away. Within 50 miles of the Project Boundary, there are a total of six Wilderness Areas: Yosemite Wilderness, Emigrant Wilderness, Carson-Iceberg Wilderness, Hoover Wilderness, Mokelumne Wilderness, and Ansel Adams Wilderness.

1.2.7 Magnuson-Stevens Fishery Conservation and Management Act

The purpose of the Magnuson-Stevens Fishery Conservation and Management Act is to conserve and manage, among other resources, anadromous fishery resources of the United States. The Act establishes eight Regional Fisheries Management Councils to prepare, monitor, and revise fishery management plans that will achieve and maintain the optimum yield from each fishery. In California, the Pacific Fisheries Management Council is responsible for achieving the objectives of the statute. The Secretary of Commerce has oversight authority.

The Act was amended in 1996 to establish a new requirement to describe and identify "essential fish habitat" (EFH) in each fishery management plan. EFH is defined as "…those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." EFH has been established by NMFS for waters in California supporting anadromous fish. The Act requires that all federal agencies, including FERC, consult with NMFS on all actions, or proposed actions, permitted, funded, or undertaken by the agency, that may adversely affect EFH. Adversely affect means any impact that reduces the quality and/or quantity of EFH. Comments from NMFS following consultation are advisory only; however, a written explanation must be submitted to NMFS if the implementing federal agency does not agree with NMFS' recommendations.

The Districts are developing an applicant-prepared EFH Assessment (to be provided with the amended FLA in November 2016) for relevant fisheries managed under the Pacific Salmon Fishery Management Plan (FMP). The FMP identifies freshwater EFH for one species: fall-run Chinook salmon. The EFH Action Area includes the stream reaches below the Project Boundary that are designated as EFH for Chinook salmon. Descriptions of fall-run Chinook abundance, distribution, available habitat, and habitat use are provided in section 3.5 of this Exhibit.

1.3 Public Review and Consultation

1.3.1 Notice of Intent and Pre-Application Document

Prior to filing the Notice of Intent (NOI) and Pre-Application Document (PAD) in February 2011, the Districts commenced relicensing discussions with a series of meetings with resource agencies and the public. The Districts met with the NMFS on August 30, 2010, USFWS on August 31, 2010, and CDFW on October 19, 2010. In September 2010, the Districts conducted three public information meetings to seek out additional sources of existing information, familiarize interested parties with the Don Pedro Project facilities, features, and operations, and review the Districts' relicensing plans and the overall relicensing schedule.

The Districts exercised due diligence in acquiring information to be included in the PAD. The Districts contacted governmental agencies, Indian Tribes, and other parties potentially having relevant information, conducted extensive searches of publicly available databases and their own records, and broadly distributed a request for information designed specifically to identify existing, relevant, and available information related to the Don Pedro Project and any potential effects on resources within the Project Boundary.

Pursuant to 18 C.F.R. §5.6, the Districts prepared a NOI and PAD and filed the documents with FERC on February 11, 2011. The Districts also distributed the PAD to federal and state resource agencies, NGOs, local governments, Indian Tribes, and other relicensing participants. The PAD included information the Districts had gathered to date as well as 10 proposed study plans, which addressed water quality, terrestrial, wildlife, historic properties, and cultural resources.

1.3.2 Scoping and Study Plan Development

Following the Districts' submittal of the PAD, FERC conducted issue scoping to determine what issues and alternatives should be addressed during the relicensing process. The purpose of scoping was to identify the significant environmental issues to be evaluated in the FERC Environmental Impact Statement (EIS). The purposes of the scoping process are as follows:

- invite participation of federal, state, and local resource agencies, Indian Tribes, NGOs, and the public (collectively, relicensing participants) to identify significant environmental and socioeconomic issues related to the proposed Project;
- determine the depth of analysis and significance of issues to be addressed in the environmental document;
- identify how the Project would or would not contribute to cumulative effects in the Project area;
- identify reasonable alternatives to the Proposed Action that should be evaluated in the environmental document;
- solicit available information on the resources at issue, including existing information and study needs; and
- determine the resource areas and potential issues that do not require detailed analysis during review of the Project.

Some resource areas did not require further detailed investigation owing to the fact that extensive studies had been completed as part of ongoing license compliance activities. The Don Pedro Project and its potential environmental effects have undergone continuous study and evaluation since the initial FERC license was issued. The Districts, in cooperation with state and federal resource agencies and environmental groups, have conducted over 150 individual resource investigations since the Project began commercial operation in 1971. The first 20 years of study led in 1995 to the development of a FERC-mediated Settlement Agreement with resource agencies, interested parties, and NGOs whereby the Districts agreed to modify their operations to increase the flows released to the lower Tuolumne River for the benefit of fisheries, especially fall-run Chinook salmon.

The Don Pedro Project has also benefited from the involvement of the Tuolumne River Technical Advisory Committee (TAC), the role of which was formalized in the 1995 Settlement Agreement. Since the early 1990s to the present time, the TAC has been actively engaged in developing, reviewing, and participating in activities to improve and protect the fisheries of the lower Tuolumne River downstream of the Don Pedro Project. In addition to the Districts, the TAC consists of state and federal resource agencies, CCSF, and NGOs. On an annual basis, the Districts file with FERC and share with the TAC results of on-going monitoring below the Project Boundary. The up-to-date record created by the continuous process of environmental investigation and resource monitoring has built a detailed record for the relicensing of the Don Pedro Project. Major studies conducted by the Districts since the 1995 Settlement Agreement are summarized in Table 1.3-1.

Table 1.3-1. Studies conducted by the Districts under the current license.

Study No.	Study Name
Salmon Population Models	
1992 Appendix 1	Population Model Documentation
1992 Appendix 26	Export Mortality Fraction Submodel
1992 Appendix 2	Stock Recruitment Analysis of the Population Dynamics of San Joaquin River System Chinook salmon
Report 1996-5	Stock-Recruitment Analysis Report
Salmon Spawning Surveys	
1992 Appendix 3	Tuolumne River Salmon Spawning Surveys 1971-88
Report 1996-1	Spawning Survey Summary Report
Report 1996-1.1	1986 Spawning Survey Report
Report 1996-1.2	1987 Spawning Survey Report
Report 1996-1.3	1988 Spawning Survey Report
Report 1996-1.4	1989 Spawning Survey Report
Report 1996-1.5	1990 Spawning Survey Report
Report 1996-1.6	1991 Spawning Survey Report
Report 1996-1.7	1992 Spawning Survey Report
Report 1996-1.8	1993 Spawning Survey Report
Report 1996-1.9	1994 Spawning Survey Report
Report 1996-1.10	1995 Spawning Survey Report
Report 1996-1.11	1996 Spawning Survey Report
Report 1996-1.12	Population Estimation Methods
Report 1997-1	1997 Spawning Survey Report and Summary Update
Report 1998-1	Spawning Survey Summary Update
Report 1999-1	1998 Spawning Survey Report
Report 2000-1	1999 and 2000 Spawning Survey Reports
Report 2000-2	Spawning Survey Summary Update
Report 2001-1	2001 Spawning Survey Report
Report 2001-2	Spawning Survey Summary Update
Report 2002-1	2002 Spawning Survey Report
Report 2002-2	Spawning Survey Summary Update
Report 2003-1	Spawning Survey Summary Update
Report 2004-1	2003 and 2004 Spawning Survey Reports
Report 2004-2	Spawning Survey Summary Update
Report 2006-1	2005 and 2006 Spawning Survey Reports

Study No.	Study Name
Report 2006-2	Spawning Survey Summary Update
Report 2007-1	2007 Spawning Survey Report
Report 2007-2	Spawning Survey Summary Update
Report 2008-2	Spawning Survey Summary Update
Report 2009-1	2008 and 2009 Spawning Survey Reports
Report 2009-2	Spawning Survey Summary Update
Report 2009-8	2009 Counting Weir Report
Report 2010-1	2010 Spawning Survey Reports
Report 2010-2	Spawning Survey Summary Update
Report 2010-8	2010 Counting Weir Report
Report 2011-2	Spawning Survey Summary Update
Report 2011-8	2011 Tuolumne River Weir Report
Report 2012-2	Spawning Survey Summary Update
Report 2012-6	2012 Tuolumne River Weir Report
Seine, Snorkel, Fyke Reports and Various Juvenile Salmon Studies	
1992 Appendix 10	1987 Juvenile Chinook Salmon Mark-Recapture Study
1992 Appendix 12	Data Reports: Seining of Juvenile Chinook salmon in the Tuolumne, San Joaquin, and Stanislaus Rivers, 1986-89
1992 Appendix 13	Report on Sampling of Chinook Salmon Fry and Smolts by Fyke Net and Seine in the Lower Tuolumne River, 1973-86
1992 Appendix 20	Juvenile Salmon Pilot Temperature Observation Experiments
Report 1996-2	Juvenile Salmon Summary Report
Report 1996-2.1	1986 Snorkel Survey Report
Report 1996-2.2	1988-89 Pulse Flow Reports
Report 1996-2.3	1990 Juvenile Salmon Report
Report 1996-2.4	1991 Juvenile Salmon Report
Report 1996-2.5	1992 Juvenile Salmon Report
Report 1996-2.6	1993 Juvenile Salmon Report
Report 1996-2.7	1994 Juvenile Salmon Report
Report 1996-2.8	1995 Juvenile Salmon Report
Report 1996-2.9	1996 Juvenile Salmon Report
Report 1996-9	Aquatic Invertebrate Report
Report 1997-2	1997 Juvenile Salmon Report and Summary Update
Report 1998-2	1998 Juvenile Salmon Report and Summary Update
Report 1999-4	1999 Juvenile Salmon Report and Summary Update
Report 2000-3	2000 Seine/Snorkel Report and Summary Update
Report 2001-3	2001 Seine/Snorkel Report and Summary Update
Report 2002-3	2002 Seine/Snorkel Report and Summary Update
Report 2003-2	2003 Seine/Snorkel Report and Summary Update
Report 2004-3	2004 Seine/Snorkel Report and Summary Update
Report 2005-3	2005 Seine/Snorkel Report and Summary Update
Report 2006-3	2006 Seine/Snorkel Report and Summary Update
Report 2007-3	2007 Seine/Snorkel Report and Summary Update
Report 2008-3	2008 Seine Report and Summary Update
Report 2008-5	2008 Snorkel Report and Summary Update
Report 2009-3	2009 Seine Report and Summary Update
Report 2009-5	2009 Snorkel Report and Summary Update
Report 2010-3	2010 Seine Report and Summary Update
Report 2010-5	2010 Snorkel Report and Summary Update
Report 2011-3	2011 Seine Report and Summary Update
Report 2011-5	2011 Snorkel Report and Summary Update
Report 2012-3	2012 Seine Report and Summary Update

Study No.	Study Name
Report 2012-5	2012 Snorkel Report and Summary Update
Screw Trap Monitoring	
Report 1996-12	Screw Trap Monitoring Report: 1995-96
Report 1997-3	1997 Screw Trap and Smolt Monitoring Report
Report 1998-3	1998 Tuolumne River Outmigrant Trapping Report
Report 1999-5	1999 Tuolumne River Upper Rotary Screw Trap Report
Report 2000-4	2000 Tuolumne River Smolt Survival and Upper Screw Traps Report
Report 2000-5	1999-2000 Grayson Screw Trap Report
Report 2001-4	2001 Grayson Screw Trap Report
Report 2004-4	1998, 2002, and 2003 Grayson Screw Trap Reports
Report 2004-5	2004 Grayson Screw Trap Report
Report 2005-4	2005 Grayson Screw Trap Report
Report 2005-5	Rotary Screw Trap Summary Update
Report 2006-4	2006 Rotary Screw Trap Report
Report 2006-5	Rotary Screw Trap Summary Update
Report 2007-4	2007 Rotary Screw Trap Report
Report 2008-4	2008 Rotary Screw Trap Report
Report 2009-4	2009 Rotary Screw Trap Report
Report 2010-4	2010 Rotary Screw Trap Report
Report 2011-4	2011 Rotary Screw Trap Report
Report 2012-4	2012 Rotary Screw Trap Report
Fluctuation Assessments	
1992 Appendix 14	Fluctuation Flow Study Report
1992 Appendix 15	Fluctuation Flow Study Plan: Draft
Report 2000-6	Tuolumne River Chinook Salmon Fry and Juvenile Stranding Report
2005 Ten-Year Summary Report Appendix E	Stranding Survey Data (1996-2002)
Predation Evaluations	
1992 Appendix 22	Lower Tuolumne River Predation Study Report
1992 Appendix 23	Effects of Turbidity on Bass Predation Efficiency
Report 2006-9	Lower Tuolumne River Predation Assessment Final Report
Smolt Monitoring and Survival Evaluations	
1992 Appendix 21	Possible Effects of High Water Temperature on Migrating Salmon Smolts in the San Joaquin River
Report 1996-13	Coded-wire Tag Summary Report
Report 1998-4	1998 Smolt Survival Peer Review Report
Report 1998-5	CWT Summary Update
Report 1999-7	Coded-wire Tag Summary Update
Report 2000-4	2000 Tuolumne River Smolt Survival and Upper Screw Traps Report
Report 2000-8	Coded-wire Tag Summary Update
Report 2001-5	Large CWT Smolt Survival Analysis
Report 2001-6	Coded-wire Tag Summary Update
Report 2002-4	Large CWT Smolt Survival Analysis
Report 2002-5	Coded-wire Tag Summary Update
Report 2003-3	Coded-wire Tag Summary Update
Report 2004-7	Large CWT Smolt Survival Analysis Update
Report 2004-8	Coded-wire Tag Summary Update
Report 2005-6	Coded-wire Tag Summary Update
Report 2006-6	Coded-wire Tag Summary Update
Report 2007-5	Coded-wire Tag Summary Update
Fish Community Assessments	
1992 Appendix 24	Effects of Introduced Species of Fish in the San Joaquin River System

Study No.	Study Name
1992 Appendix 27	Summer Flow Study Report 1988-90
Report 1996-3	Summer Flow Fish Study Annual Reports: 1991-94
Report 1996-3.1	1991 Report
Report 1996-3.2	1992 Report
Report 1996-3.3	1993 Report
Report 1996-3.4	1994 Report
Report 2001-8	Distribution and Abundance of Fishes Publication
Report 2002-9	Publication on the Effects of Flow on Fish Communities
Report 2007-7	2007 Rainbow Trout Data Summary Report
Report 2008-6	2008 July *Oncorhynchus mykiss* Population Estimate Report
Report 2010	Tuolumne River *Oncorhynchus mykiss* Monitoring Report (submitted January 15)
Attachment 5	March and July 2009 Population Estimates of *Oncorhynchus mykiss* Report
Report 2011	Tuolumne River *Oncorhynchus mykiss* Monitoring Summary Report (submitted January 15)
Report 2010-6	2010 *Oncorhynchus mykiss* Population Estimate Report
Report 2010-7	2010 *Oncorhynchus mykiss* Acoustic Tracking Report
Report 2011-6	2011 *Oncorhynchus mykiss* Population Estimate Report
Report 2011-7	2011 *Oncorhynchus mykiss* Acoustic Tracking Report
Invertebrate Reports	
1992 Appendix 16	Aquatic Invertebrate Studies Report
1992 Appendix 28	Summer Flow Invertebrate Study
Report 1996-4	Summer Flow Aquatic Invertebrate Annual Reports: 1989-93
Report 1996-4.1	1989 Report
Report 1996-4.2	1990 Report
Report 1996-4.3	1991 Report
Report 1996-4.4	1992 Report
Report 1996-4.5	1993 Report
Report 1996-9	Aquatic Invertebrate Report
Report 2002-8	Aquatic Invertebrate Report
Report 2004-9	Aquatic Invertebrate Monitoring Report (2003-2004)
Report 2008-7	Aquatic Invertebrate Monitoring (2005, 2007, 2008) and Summary Update
Report 2009-7	2009 Aquatic Invertebrate Monitoring and Summary Update
Delta Salmon Salvage	
Report 1999-6	1993-99 Delta Salmon Salvage Report
Gravel, Incubation, and Redd Distribution Studies	
1992 Appendix 6	Spawning Gravel Availability and Superimposition Report (incl. map)
1992 Appendix 7	Salmon Redd Excavation Report
1992 Appendix 8	Spawning Gravel Studies Report
1992 Appendix 9	Spawning Gravel Cleaning Methodologies
1992 Appendix 11	An Evaluation of the Effect of Gravel Ripping on Redd Distribution
Report 1996-6	Redd Superimposition Report
Report 1996-7	Redd Excavation Report
Report 1996-8	Gravel Studies Report: 1987-89
Report 1996-10	Gravel Cleaning Report: 1991-93
Report 2000-7	Tuolumne River Substrate Permeability Assessment and Monitoring Program Report
Report 2006-7	Survival to Emergence Study Report
Report 2008-9	Monitoring of Winter 2008 Runoff Impacts from Peaslee Creek
Water Temperature and Water Quality	
1992 Appendix 17	Preliminary Tuolumne River Water Temperature Report
1992 Appendix 18	Instream Temperature Model Documentation: Description and Calibration

Study No.	Study Name
1992 Appendix 19	Modeled Effects of La Grange Releases on Instream Temperatures in the Lower Tuolumne River
Report 1996-11	Intragravel Temperature Report: 1991
Report 1997-5	1987-97 Water Temperature Monitoring Data Report
Report 2002-7	1998-2002 Temperature and Conductivity Data Report
Report 2004-10	2004 Water Quality Report
Report 2007-6	Flow, Delta Export, Weather, and Water Quality Data Report: 2003-2007
IFIM Assessment	
1992Appendix 4	Instream Flow Data Processing, Tuolumne River
1992 Appendix 5	Analysis of 1981 Lower Tuolumne River IFIM Data
	1995 USFWS Report on the Relationship between Instream Flow and Physical Habitat Availability (submitted by Districts to FERC in May 2004)
Flow and Delta Exports	
Report 1997-4	Streamflow and Delta Water Export Data Report
Report 2002-6	1998-2002 Streamflow and Delta Water Export Data Report
Report 2003-4	Review of 2003 Summer Flow Operation
Report 2007-6	Flow, Delta Export, Weather, and Water Quality Data Report: 2003-2007
Report 2008-8	Review of 2008 Summer Flow Operation
Report 2009-6	Review of 2009 Summer Flow Operation
Restoration, Project Monitoring, and Mapping	
Report 1996-14	Tuolumne River GIS Database Report and Map
Report 1999-8	A Summary of the Habitat Restoration Plan for the Lower Tuolumne River Corridor
Report 1999-9	Habitat Restoration Plan for the Lower Tuolumne River Corridor
Report 1999-10	1998 Restoration Project Monitoring Report
Report 1999-11	1999 Restoration Project Monitoring Report
Report 2001-7	Adaptive Management Forum Report
Report 2004-12	Coarse Sediment Management Plan
Report 2004-13	Tuolumne River Floodway Restoration (Design Manual)
2005 Ten-Year Summary Report Appendix D	Salmonid Habitat Maps
2005 Ten-Year Summary Report Appendix F	GIS Mapping Products
Report 2005-7	Bobcat Flat/River Mile 43: Phase 1 Project Completion Report
Report 2006-8	Special Run Pool 9 and 7/11 Reach: Post-Project Monitoring Synthesis Report
Report 2006-10	Tuolumne River La Grange Gravel Addition, Phase II Annual Report
Report 2006-11	Tuolumne River La Grange Gravel Addition, Phase II Geomorphic Monitoring Report
General Monitoring Information	
Report	1992 Fisheries Studies Report
Report 2002-10	2001-2002 Annual CDFW Sportfish Restoration Report
Report	2005 Ten-Year Summary Report

FERC issued a Scoping Document 1 (SD1) and NOI on April 8, 2011, to solicit comments on the scope of environmental studies in the relicensing process, and to encourage participation in the relicensing process. The SD1 was noticed in the Federal Register on April 14, 2011. FERC staff conducted a public site visit of the Don Pedro Project on May 10, 2011, which included an overview of the Don Pedro Project and its operations and a tour of the Don Pedro Reservoir and adjacent recreation facilities and wildlife areas. On May 11, 2011, FERC staff conducted a daytime public scoping meeting in the city of Turlock, California and an evening public scoping meeting in the city of Modesto, California. Attendees included representatives from federal, state and local agencies, elected officials, business leaders, and community members.

After filing the PAD, the Districts held a series of resource work group (RWG) meetings to solicit input on the relicensing study plans. On July 25, 2011, the Districts filed their Proposed Study Plan (PSP) document with FERC. The PSP presented 30 draft study plans that the Districts proposed in response to study requests received from relicensing participants. On that same day, FERC filed its SD2, incorporating relicensing participant comments received on the SD1, the PAD, and study requests. FERC issued a minor clarification to its SD2 on July 29, 2011.

Between filing the PSP on July 25, 2011 and the October 24, 2011 deadline for filing comments on the PSP, the Districts hosted 13 additional RWG meetings to resolve differences regarding the proposed studies. Through these meetings, all 30 of the Districts' draft study proposals were discussed and two new study plans were formulated. On October 13, 2011, the Districts filed an Updated Study Plan with FERC to provide the most up-to-date version of the PSP. Based on the RWG meetings and comments received on the PSP, the Districts revised many of the original study plans and added five additional studies, bringing the total number of studies to be conducted to 35. On November 22, 2011, the Districts filed a Revised Study Plan containing the 35 study plans.

On December 22, 2011, FERC issued its Study Plan Determination (SPD) for the Don Pedro Project, approving or approving with modifications 33 studies proposed in the RSP, adding one study recommended by the BLM (Bald Eagle Study), and recommending that two studies not be undertaken (the Chinook Salmon Fry Movement Study and the Temperature Criteria Study). As required by the SPD, and after further consultation with the resource agencies and other relicensing participants, the Districts filed three revised study plans with more detailed methodologies on February 28, 2012 and one modified study plan on April 6, 2012. FERC approved or approved with modifications these studies on July 25, 2012. In addition, the Districts chose to conduct the Temperature Criteria Study (W&AR-14), which is to be filed with FERC in February 2015.

Following FERC's issuance of the SPD, a total of seven studies (and associated study elements) that were either not adopted in the SPD or were adopted with modifications, formed the basis of Study Dispute proceedings. On April 17, 2012, in response to study disputes, FERC convened a Dispute Resolution Panel technical conference in Sacramento, California. The Panel issued its findings on May 4, 2012. On May 24, 2012, FERC issued its Formal Study Dispute Determination, with additional clarifications related to the Formal Study Dispute Determination issued on August 17, 2012. The Study Dispute Determination resulted in two modifications to the SPD and six clarifications. Studies were implemented consistent with this determination.

In addition to studies required under the relicensing proceedings, the Districts' instream flow incremental methodology (IFIM) study provides information in support of this license application. On July 16, 2009, FERC directed the Districts to develop and implement an IFIM study to determine instream flows necessary to maximize Chinook salmon and *O. mykiss* production and survival in the Tuolumne River. The lower Tuolumne River Instream Flow

Studies – Final Study Plan (Stillwater Sciences 2009) was filed on October 14, 2009 and approved by FERC on May 12, 2010.

In order to examine the broad flow ranges identified in FERC's July 2009 Order, the study plan separated the study into two separate investigations: (1) A conventional 1-D Physical Habitat Simulation (PHABSIM) model (Lower Tuolumne Instream Flow Study), which examines in-channel habitat conditions at flows from approximately 100–1,000 cfs, and (2) a 2-D hydraulic model of overbank areas, as well as adjacent in-channel locations, for flows of 1,000–5,000 cfs, developed as part of the Pulse Flow Study. Following approval of the original Study Plan, in its December 22, 2011 SPD, FERC required the scope of the Lower Tuolumne River Instream Flow Study be expanded to include Pacific lamprey (*Entosphenus tridentatus*) and Sacramento splittail (*Pogonichthys macrolepidotus*), if existing habitat suitability criteria (HSC) were available. In its April 8, 2013 comments on the Draft Lower Tuolumne Instream Flow Study Report, the USFWS provided references to existing criteria, developed for the Lower Merced River. More recently, FERC's May 21, 2013 Determination on Requests for Study Modifications and New Studies required the scope of the Lower Tuolumne Instream Flow Study be expanded to assess habitat for non-native predatory fish, including smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*), and striped bass (*Morone saxatilis*) using existing HSC data, where available.

The Lower Tuolumne River Instream Flow Study–Final Report was filed with the Commission on April 26, 2013 (Stillwater Sciences 2013) and the Pulse Flow Study Report was filed on June 18, 2012 (Stillwater Sciences 2012).

An additional component of the Lower Tuolumne River Instream Flow Studies 1-D PHABSIM investigation is the effective habitat analysis for *O. mykiss*, which will be filed with FERC in August 2014. Both the effective habitat analysis and the additional HSC will be provided as addendums to the Lower Tuolumne River Instream Flow Study Report (Stillwater Sciences 2013).

1.3.3 Consultation Workshop Process

As part of the following studies, the Districts proposed, with FERC concurrence, a series of workshops associated with the studies listed below to share and discuss relevant data with relicensing participants:

- W&AR-02: Project Operations/Water Balance Model,
- W&AR-03: Reservoir Temperature Model,
- W&AR-05: Salmonid Population Information Integration and Synthesis Study,
- W&AR-06: Chinook Population Model,
- W&AR-10: *O. mykiss* Population Model,
- W&AR-16: Lower Tuolumne River Temperature Model, and
- W&AR-21: Lower Tuolumne River Floodplain Hydraulic Assessment.

The purpose of the workshops was to provide an opportunity for relicensing participants and the Districts to discuss relevant data sources, methods of data use and development, and modeling parameters at specific points in these study plans. The goal of the workshop process was for relicensing participants and the Districts to reach agreement where possible after thorough discussion of data and methods. In the December 2011 SPD, FERC directed the Districts to formalize the workshop process. The Districts submitted for review and comment a draft Workshop Consultation Process to relicensing participants in March 2012, and filed the final Workshop Consultation Process with FERC on May 18, 2013.

Throughout 2012, 2013, and 2014, the Districts conducted a total of 17 workshops. In addition, the Districts conducted model training sessions for several of the studies that involved the development of quantitative models. For each workshop, an agenda and materials were provided prior to the meeting date, draft meeting notes were provided for 30-day comment by relicensing participants, and final workshop notes and responses to comments received were filed with FERC to maintain a record of interim study plan decisions. A summary of all consultation documentation related to these Workshops was included as an Attachment to the Draft License Application (DLA).

1.3.4 Initial and Updated Study Reports

On January 17, 2013, the Districts filed their Initial Study Report (ISR); included in the ISR was the Districts' NOI to file a DLA rather than a Preliminary Licensing Proposal under the ILP. The Districts held the ISR meeting on January 30 and 31, 2013, in Modesto, California. On February 8, 2013, the Districts filed an ISR meeting summary.

Following the ISR meeting, relicensing participants filed requests for new studies and study modifications. The Districts responded to these comments on April 9, 2013, and agreed to a new model and three new studies. On May 21, 2013, FERC issued its Determination on Requests for Study Modifications and New Studies. The determination approved five study modifications and five new studies or study elements. The Districts filed an Updated Study Report (USR) for the Don Pedro Project on January 6, 2014, held a USR Meeting on January 16, 2014, and filed a summary of the meeting on January 27, 2014. On March 28, 2014, the Districts filed a response to USR comments received from relicensing participants.

1.3.5 Draft License Application

The DLA was filed on November 26, 2013, which was followed by a 90-day public comment period. Comments on the DLA were received from FERC, American Whitewater, USFWS, Conservation Groups, NMFS, Restore Hetch Hetchy, Tuolumne County Water Agency, Stanislaus National Forest, ARTA, SWRCB, BLM, CDFW, and OARS Rafting. The Districts' responses to these comments are provided as Attachment A to this license application.

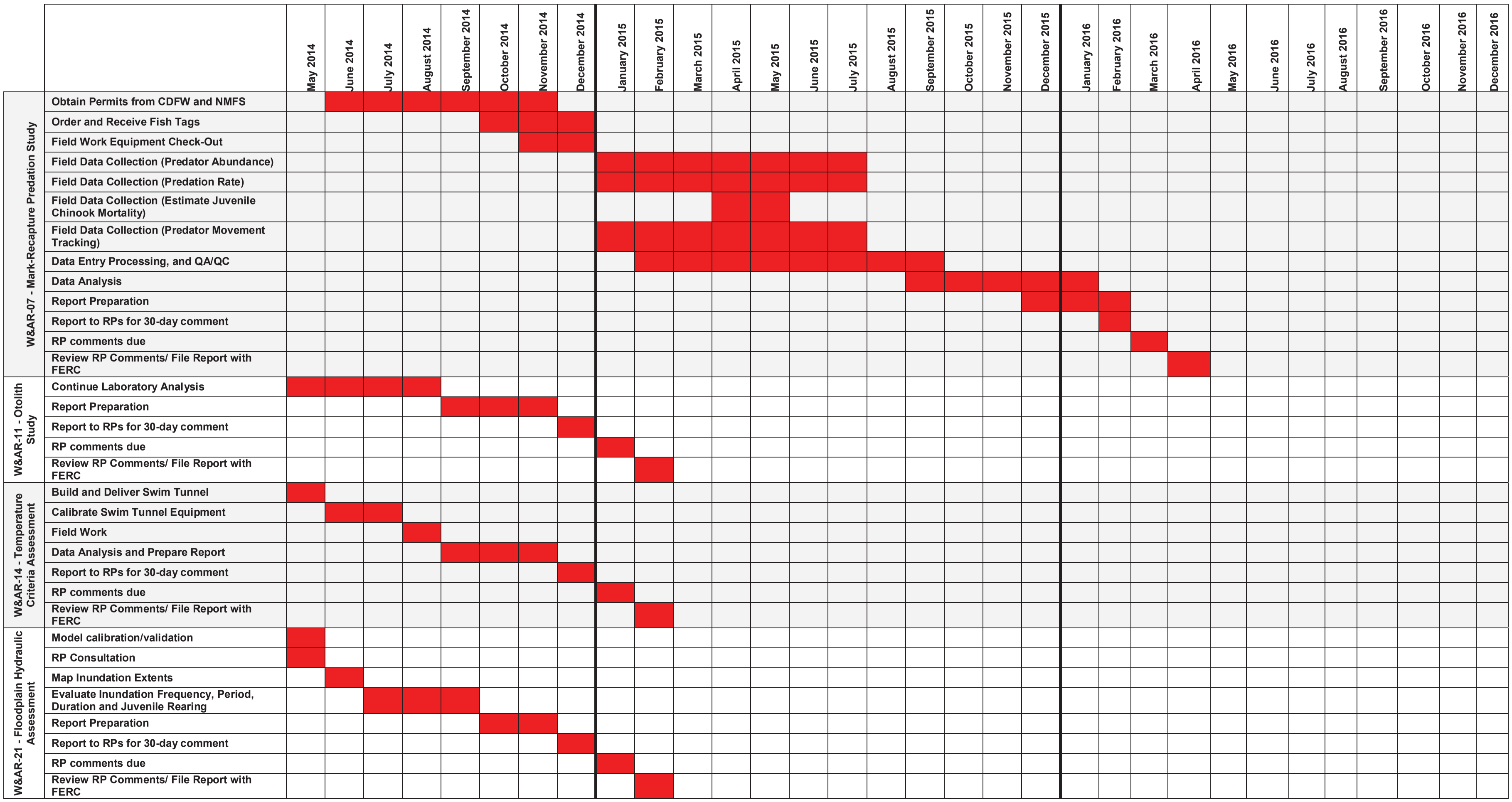
1.3.6 Post-Filing Consultation and Alternatives Analysis

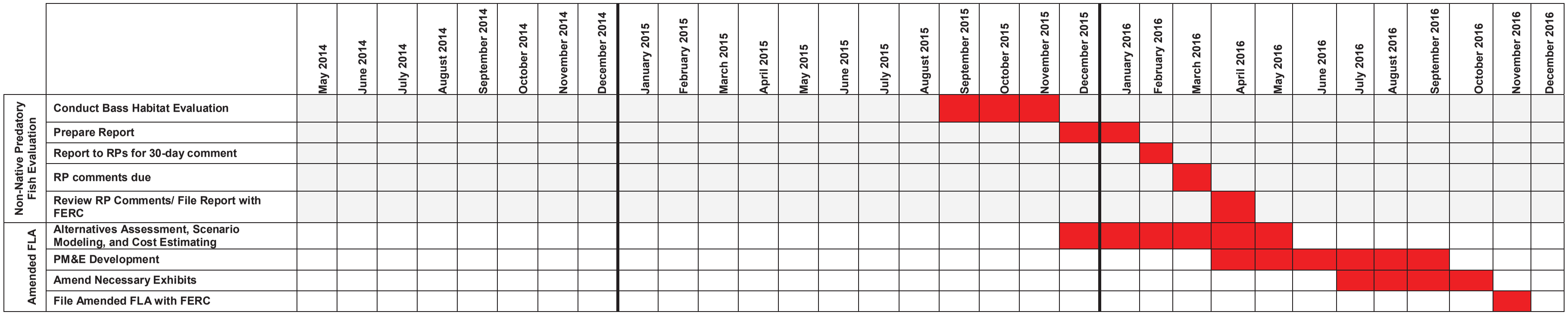
Consistent with study schedules approved by FERC through the ILP's study plan determinations, several important studies involving the resources of the lower Tuolumne River have yet to be completed. Until these studies are completed, the Districts are unable to assess in a comprehensive manner the direct and cumulative effects to these resources, or complete their assessment of the costs and benefits of potential PM&E measures to protect and enhance the resources of the lower Tuolumne River. The specific studies yet to be completed and their currently scheduled FERC-filing dates are:

- Lower Tuolumne River Predation Study using a mark-recapture approach -- April 2016
- Fall-run Chinook Salmon Otolith Study – February 2015
- Lower Tuolumne River Floodplain Hydraulic Assessment – February 2015
- Non-Native Predator IFIM Assessment -- April 2016
- *O. mykiss* Swim Tunnel and Temperature Criteria Study -- February 2015

Once these studies are completed, the Districts will evaluate all data, reports, and models then available for the purpose of identifying appropriate PM&E measures to address the direct, indirect, and cumulative effects of Project operations and maintenance. This assessment may potentially involve the assessment of a number of flow and non-flow measures, and may consider changes to the current operations and maintenance practices of the Districts. The costs of potential measures, their benefit to resources, and their potential impacts to the water supplies of the Districts and the City and County of San Francisco will be determined. Once these assessments are completed, the Districts will prepare any needed amendments to this license application to incorporate the results of the completed studies, the evaluations conducted, and any proposed PM&E measures. The Districts have projected a date of filing of any required amendments to this license application of November 2016. A detailed schedule for completion of studies and filing any amendments to this license application is provided in Figure 1.3-1.

Figure 1.3-1. **Schedule for completion of studies and amendments to license application.**




May 2014
June 2014
July 2014
August 2014
September 2014
October 2014
November 2014
December 2014
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September 2015
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December 2015
January 2016
February 2016
March 2016
April 2016
May 2016
June 2016
July 2016
August 2016
September 2016
October 2016
November 2016
December 2016
Non-Native Predatory Fish Evaluation
Conduct Bass Habitat Evaluation
Prepare Report
Report to RPs for 30-day comment
RP comments due
Review RP Comments/ File Report with FERC
Amended FLA
Alternatives Assessment, Scenario Modeling, and Cost Estimating
PM&E Development
Amend Necessary Exhibits
File Amended FLA with FERC

2.0 PROPOSED ACTION AND ALTERNATIVES

This section describes the Districts' licensing proposal for continuing to operate the Don Pedro Hydroelectric Project under a new license. This section also describes the no-action alternative and other alternatives considered but eliminated from detailed study.

The Don Pedro Project provides water storage for irrigation and municipal and industrial (M&I) use, flood control, hydroelectric generation, recreation, and natural resource protection (hereinafter, the "Don Pedro Project"). The environmental analysis contained in this Exhibit E considers all the components, facilities, operations, and maintenance that make up the Don Pedro Project. The Don Pedro Project was originally conceived as a water supply project. The Don Pedro Project was constructed for the following primary purposes: (1) to provide water supply for the co-licensees, Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts), for irrigation of over 200,000 acres (ac) of Central Valley farmland and for M&I use, (2) to provide flood control benefits along the Tuolumne and San Joaquin rivers, and (3) to provide a water banking arrangement for the benefit of the City and County of San Francisco (CCSF) and its 2.6 million Bay Area water customers. The original license was issued in 1966. In 1995, the Districts entered into an agreement with a number of parties which resulted in greater flows to the lower Tuolumne River for the protection of aquatic resources.

Hydroelectric generation is a secondary purpose of the Don Pedro Project. Hereinafter, the hydroelectric generation facilities and operations will be referred to as the "Don Pedro Hydroelectric Project", or the "Project". With this license application to FERC, the Districts are seeking a new license to continue generating hydroelectric power. Based on the information contained in this application, and other sources of information on the record, FERC will consider whether, and under what conditions, to issue a new license for the continued generation of hydropower at the Districts' Don Pedro Project. The Districts are providing a complete description of the facilities and operation of the Don Pedro Project so the effects of the operation and maintenance of the Don Pedro hydroelectric facilities can be distinguished from the effects of the operation and maintenance activities of the overall Don Pedro Project's flood control and water supply/consumptive use purposes.

Being able to differentiate the effects of the hydropower operations from the effects of the flood control and consumptive use purposes and needs of the Don Pedro Project will aid in defining the scope and substance of reasonable protection, mitigation, and enhancement (PM&E) alternatives to be considered in relicensing. As FERC states in Scoping Document 2 in a discussion related to alternative project operation scenarios: "…alternatives that address the consumptive use of water in the Tuolumne River through construction of new structures or methods designed to alter or reduce consumptive use of water are…alternative mitigation strategies that could not replace the Don Pedro *hydroelectric* project [emphasis added]. As such, these recommended alternatives do not satisfy the NEPA purpose and need for the proposed action and are not reasonable alternatives for the NEPA analysis."

2.1 No-action Alternative

Under the no-action alternative, the Don Pedro Hydroelectric Project would continue to operate in the future under the terms of the current license (i.e., there would be no change to the existing environment). No new environmental PM&E measures would be implemented under the new license under the no-action alternative. Any ongoing effects of the Project not addressed by current measures would continue. This alternative is used to establish baseline environmental conditions for comparison with other alternatives.

2.1.1 Existing Don Pedro Project Facilities

The primary Don Pedro Project facilities include (1) Don Pedro Dam and Reservoir, (2) gated and uncontrolled spillways on the right (west) abutment of the main dam, (3) low-level outlet works located in the diversion tunnel in the left (east) abutment of the main dam, (4) the power intake and tunnel, also in the left abutment, (5) the Don Pedro powerhouse, (6) the Project switchyard located at the powerhouse, and (7) four dikes—the Gasburg Creek Dike and Dikes A, B, and C. Facility specifications are provided below. The Don Pedro Project also includes three developed recreation areas and other small recreation facilities (restrooms and buoys) outside of the developed areas. Detailed descriptions of facilities and features are in Exhibit A of this FLA.

The Project Boundary encompasses all Don Pedro Project facilities and features as well as all lands needed for operation and maintenance. Approximately 74 percent of all lands within the Project Boundary, or 13,568 acres, are owned by the Districts. The remaining lands, about 4,802 acres, are public lands located within BLM's Sierra Resource Management Area.

2.1.2 Existing Settlements and Agreements

2.1.2.1 1995 Settlement Agreement

In 1995, the Districts entered into a settlement agreement with CDFW, USFWS, CCSF, California Sportfishing Protection Alliance, Friends of the Tuolumne, Tuolumne River Expeditions, and the Tuolumne River Preservation Trust. Pursuant to this agreement, the Districts agreed, among other things, to increase flows to the lower Tuolumne River for the purpose of enhancing and protecting the fall-run Chinook salmon population. This flow regime remains in effect today. The agreement also formalized the role of the Tuolumne River TAC, provided for multi-party partnership to undertake a series of river restoration projects along the lower Tuolumne River, and defined responsibilities for additional fishery monitoring studies.

2.1.2.2 Fourth Agreement Between the Districts and the City and County of San Francisco

CCSF contributed financially to the construction of the Don Pedro Project to meet its flood control obligations and to obtain water banking privileges in the new Don Pedro Reservoir. This innovative water banking arrangement allows CCSF to pre-release flows from its upstream facilities into the Don Pedro Reservoir where the flows are credited against CCSF's obligation to meet the Districts' water entitlements so that at other times CCSF can divert water that otherwise would have to be released to satisfy the Districts' senior water rights. Both the transfer of flood management and the creation of the water bank provide CCSF and its wholesale customers in the Bay Area with improved reliability of water supply and greater flexibility with its water and power operations. Under certain circumstances, the Districts and CCSF share responsibility for meeting FERC license requirements in the lower Tuolumne River downstream of the Don Pedro Project (see Exhibit B, Appendix B-1, Article 8). Therefore, changes in downstream flow requirements may affect both the Districts' and CCSF's ability to meet the water supply needs of their customers in the Central Valley and the Bay Area, respectively.

2.1.3 Don Pedro Project Safety

The Don Pedro Project has been operating for more than 40 years under the existing license and during this time, FERC staff has conducted operational inspections to evaluate the condition of the structures, the occurrence of any unauthorized modifications, the efficiency and safety of operations, compliance with the terms of the license, and proper maintenance. In addition, the Don Pedro Project has been inspected and evaluated every five years by an independent consultant, and the consultants' safety reports have been submitted for FERC's review. The most recent dam safety report was filed with FERC in January 2013.

As part of the relicensing process, FERC staff evaluates the continued adequacy of the proposed Don Pedro Project facilities under a new license. Special articles would be included in any license issued, as appropriate. FERC staff will continue to inspect the Don Pedro Project during the new license term to ensure continued adherence to the FERC-approved plans and specifications, special license articles related to operation and maintenance, and accepted engineering practices and procedures.

2.1.4 Current Don Pedro Project Operation

The Don Pedro Project operates on an annual cycle consistent with managing for and providing a reliable water supply for consumptive use purposes, providing flood flow management, and ensuring delivery of downstream flows to protect aquatic resources. By October 6 of each year, the Don Pedro Reservoir must be lowered to at least elevation 801.9 ft above mean sea level (National Geodetic Vertical Datum (NGVD) 29)[3] to provide the 340,000 AF of flood control benefits acquired by the U.S. Army Corps of Engineers (ACOE) through its financial contribution to the development of the Don Pedro Project. Beginning on October 1 of each year, flows provided by the Don Pedro Project to the lower Tuolumne River, as measured at the USGS streamflow gage at La Grange, are adjusted to meet license requirements to benefit upmigrating adult Chinook salmon. This includes in certain years providing a pulse flow, the amount of which varies depending on the water year type.

FERC-required flows to the lower Tuolumne River are adjusted on October 16, the rate of flow dependent on water year type, and these flows are maintained through May 31 of the following year to protect egg incubation, emergence, fry and juvenile development, and smolt outmigration of fall Chinook salmon. A spring pulse flow is provided each year to aid smolt outmigration, the amount again depending upon water year type. Irrigation deliveries normally begin in early March, but can begin as early as February to provide early growing season soil moisture in dry

[3] All elevations are NGVD 29.

winters. Irrigation deliveries ramp up considerably by April and normally reach their peak in July and August. Minimum flows to the lower Tuolumne River are adjusted on June 1 and these flows extend through September 30. Irrigation deliveries normally end in late October/early November. Municipal and industrial water supplies are delivered year-round.

Throughout the winter months, Don Pedro Project operators maintain a constant assessment of snow conditions in the upper Tuolumne River watershed and, during years with heavy snow accumulation, may reduce reservoir levels to balance forecasted inflows, outflows, and reservoir storage. The goal of operations is to fill the reservoir by early June; however, greater snowpack volumes can extend this filling into early July if needed for maintenance of the required ACOE flood control space. ACOE flood control guidelines also provide for maintenance of downstream flows on the lower Tuolumne River to less than 9,000 cfs as measured at the USGS gage at Modesto (River Mile (RM) 16), located downstream of Dry Creek almost 40 miles below the Don Pedro Project.

2.1.5 Current Don Pedro Project Maintenance

2.1.5.1 Facilities and Road Maintenance

The Districts maintain developed facilities and Don Pedro Project roads using a combination of mechanical mowing and periodic use of pre-emergent herbicides by licensed applicators to manage vegetation growth. Areas maintained by the Districts are typically managed in proportion to their use. Developed facilities (e.g., housing areas near Don Pedro Dam) and associated roads are managed with pre-emergent herbicides annually after the first fall rain (usually in November). Similarly, the perimeters of wastewater treatment facilities are sprayed annually, using herbicides labeled for aquatic use, when appropriate to manage aquatic weeds and algae. Mechanical removal of aquatic weeds is also employed on occasion. Main access road shoulders are mechanically mowed. No formal management is conducted for unpaved roads leading to Don Pedro Dam from the main road. Additionally, some roads may be treated for specific uses. For example, a small access road leading toward La Grange Diversion Dam is typically unmanaged but was mowed in 2012 to allow access for water quality monitoring efforts.

2.1.5.2 Recreation Area Maintenance

The Districts' three developed recreation areas are managed to minimize the spread of unwanted vegetation and the risk of fire. High-use sections of each recreation area are subject to mechanical mowing and trimming on a frequent basis, and pads, road edges, firebreaks, and the immediate area around restrooms and Don Pedro Recreation Agency (DPRA) facilities are sprayed with pre-emergent and/or post-emergent herbicides annually after the first rains.

Additionally, the Districts may engage in ground squirrel control via two methods:

(1) Burrow blasting: This poison-free management approach uses near pure oxygen and a small amount of propane that is injected into the squirrel burrow. Once a correct amount of

oxygen and gas is injected, it is shut off and then ignited. This method was utilized in the 2012–2013 season.

(2) Targeted use of pelleted rodent bait in developed recreation areas. The last such application was during the 2009–2010 season. The Districts will notify the USFWS of any rodenticide use and locations.

The Districts also have a Prescribed Burn Program that allows the use of prescribed burns for vegetation management. The Prescribed Burn Program specifies limitations on timing, weather conditions, and frequency so as to minimize fire risk and the potential for damage to adjacent habitats. The Districts use prescribed burns as a management tool infrequently; the last burn under the Program was in 2009. The Districts will continue to use prescribed burns as conditions permit.

2.1.5.3 Woody Debris Management

Article 52 of the existing FERC license requires the implementation of the Districts' Log and Debris Removal Plan. Under the Plan, the Districts collect and remove floating debris at Don Pedro Dam, in the upper Tuolumne River portion of the reservoir, and in other dispersed areas of the reservoir as needed. Debris is collected in boom rafts, anchored along the reservoir edge, and burned during fall and winter under low reservoir levels.

2.1.6 Existing Resource Measures

The following measures represent ongoing obligations of the Districts as licensees which affect the quality of the environment and/or Don Pedro Project operations. Under the no-action alternative, these obligations would continue during the term of any new license.

2.1.6.1 Public Safety Plan

Last updated in 2007, the Don Pedro Project's Public Safety Plan describes safety devices associated with Don Pedro Project activities, such as signage, buoys, fencing, and floating booms, as well as the locations of these devices. The DPRA Recreation Area Public Safety Plan is a section of the Public Safety Plan.

2.1.6.2 Don Pedro Emergency Action Plan

The Don Pedro Emergency Action Plan identifies potential emergency conditions at Don Pedro dam and specifies actions to be followed to minimize property damage and loss of life. The Districts update the Emergency Action Plan each year.

2.1.6.3 Recreation Facilities

Authorized under Article 45 of the existing license, the Districts built and maintain three developed recreation areas, and primitive and semi-primitive lakeshore campsites on Don Pedro Reservoir. The recreation facilities include both floating and shoreline restrooms in addition to those at the developed recreation areas. Facilities also include hazard marking, regulatory buoy lines, and other open water-based features including houseboat marinas and a marked water ski slalom course. A full list of recreation facilities is provided in Exhibit A.

2.1.6.4 DPRA Rules and Regulations

DPRA Rules and Regulations (Exhibit H, Appendix H-4) govern the use of lands and waters within the Project Boundary. In accordance with these rules and regulations, the Districts' land use policy prohibits any placement of improvements along the Don Pedro Reservoir shoreline (e.g., dredging, docks, moorings, piers) and prohibits all vehicular use of undeveloped lands. DPRA Rules and Regulations also govern visitor use related to prohibiting, restricting, controlling, and managing as appropriate camping, fires, noise, group size, and other aspects of visitor use that have the potential to impact natural resources and public enjoyment of the recreation facilities.

2.1.6.5 Non-Don Pedro Project Uses of Don Pedro Project Lands

All of the lands within the Project Boundary are owned by the Districts with the exception of approximately 4,802 acres of federal lands located within the BLM Sierra Resource Management Area. The lands within the Project Boundary are largely undeveloped, with the exception of the recreation areas discussed above. As such, there are very limited number of non-Don Pedro Project uses of Don Pedro Project lands. The Districts currently permit limited grazing and apiary uses.

2.1.6.5.1 Apiaries

The Districts have issued five permits for apiaries within the Project Boundary, totaling 1760 hives. The permits specifically prohibit any use of the permitted area for the purposes of accessing Don Pedro Reservoir. The apiary permits were issued on September 1, 2010, and are active through August 31, 2015.

2.1.6.5.2 Livestock Grazing

The Districts have issued four permits for livestock grazing within the Project Boundary, covering a total of 559 acres of upland habitats and allowing up to a total of 240 animals to graze. The permits require that no grazing is to occur below the normal maximum water surface elevation for Don Pedro Reservoir. The grazing permits were issued on November 1, 2010, and are active through October 31, 2015.

2.2 Districts' Proposed Future Don Pedro Hydroelectric Project Operations

The Districts are proposing several changes to the operation and maintenance of the Don Pedro Hydroelectric Project as part of this FLA. These changes primarily consist of the adoption of certain resource management plans intended to protect and enhance environmental attributes found within the FERC Project Boundary. The Districts are also proposing to upgrade the Units 1, 2, and 3 turbine-generators from a maximum output of 203 MW to approximately 244 MW.

Related to flood management operations, the Districts are proposing to modify the initial date when the full flood storage space must be available from October 7 to November 7 of each year.

At the time of the filing of the FLA, there are several important studies involving lower Tuolumne River resources that are yet to be completed. A schedule for the completion of these studies is provided in Exhibit E, Section 1.0 of the FLA. After completion of all studies, the Districts will perform a comprehensive assessment of potential protection, mitigation, and enhancement measures to address resource issues of the lower Tuolumne River. All measures evaluated, and any proposed for adoption by the Districts, will be provided to relicensing participants and filed with FERC as part an amendment to the FLA.

2.2.1 Proposed New Capital Projects

The Districts are proposing to design and construct certain improvements to the existing whitewater boating take-out at the Ward's Ferry Bridge to improve public safety and efficiency of river egress at this site. A description of proposed improvements is provided in Exhibit B of this application and in the draft Recreation Resource Management Plan. The Districts are also proposing to upgrade the Units 1, 2, and 3 turbine-generators to increase efficiency and capacity, as described in Exhibit B.

2.2.2 Proposed Don Pedro Project Operations

The Districts are not proposing any changes to Don Pedro Project operations affecting the lower Tuolumne River at this time as several studies related to resources of the lower river have yet to be completed. A schedule for the completion of these studies is provided in Exhibit E, Section 1.0 of this FLA. The Districts will consider alternative operating scenarios and potential flow and non-flow measures following completion of all studies, and may file an amended final license application at that time.

The Districts have initiated discussions with the ACOE on the possibility of amending a part of the 1972 Flood Control Manual. Specifically, the Districts are asking the ACOE to consider modifying the date when full flood control space is to be available from the current date of October 7 to November 7. Initial research conducted by the Districts indicate no increased risk of flood damage resulting from this change. The drawdown to elevation 801.9 ft by October 6 appears to have been driven primarily by preparation for a potential early season warm rain on snow event. The Districts believe that improved weather tracking, snow measurement by satellite, and computer-based runoff risk assessment allow extending this date to later in the calendar year. The date of November 7 fits better with possible release of stored water to benefit upmigrating adult fall-run Chinook salmon. Therefore, releases of stored water to reach elevation 801.9 ft could be used as pulse flow water if drawdown to 801.9 ft can be delayed to November 7. The Districts plan to research this potential change further in close coordination with ACOE, and if acceptable to the ACOE, would formally request ACOE approval following the appropriate research and analyses.

2.2.3 Proposed Resource Measures

This FLA contains a number of specific proposals for new resource PM&Es. The resource-related programs proposed for future implementation under the new license consist of the following measures:

- Historic Properties Management Plan (HPMP), including the development of certain cultural resource education exhibits. A draft HPMP (Appendix E-4; being filed with this license application as PRIVILEGED) and general description of education exhibits are included in Exhibit E of this application.
- Bald Eagle Management Plan, as described in a draft plan contained in Exhibit E of this application (Appendix E-2).
- Vegetation Management Plan, as described in a draft plan contained in Exhibit E of this application, including protection measures for the host plant of the VELB (Appendix E-1).
- Recreation Resource Management Plan (RRMP), including the design and construction of improvements at the Ward's Ferry Bridge site. A draft RRMP and description of the proposed improvements to the Ward's Ferry whitewater boating take-out are included in Exhibit E of this application (Appendix E-3).

As explained in the Executive Summary of this application, until all resource-related studies have been completed, including all FERC-approved studies, and the associated reports have been reviewed and commented upon by relicensing participants, it is premature to propose other specific resource protection measures beyond those enumerated above. A draft BA evaluating potential Project effects, and potential effects of any proposed PM&E measures, on ESA-listed Central Valley steelhead will be provided as part of amendments to this FLA.

2.3 Alternative Measures and Operations Proposed by Others

There have been no specific alternative measures or operations related to aesthetic, terrestrial, or cultural resources proposed by others at this time. However, the BLM recommended the adoption of a number of resource management plans which the Districts have largely incorporated within the proposed management plans identified above and included in this FLA. A number of requests for improved river-egress facilities at the Ward's Ferry Bridge were included in comments to the DLA. These were considered by the Districts and resulted in modifications to the original concepts evaluated in the feasibility study. The Lower Tuolumne Farmers recommended certain changes in water management, which the Districts have evaluated and discuss further in Exhibit E, Section 5.0 of the FLA. Several comments were received about providing additional boating flows in the lower Tuolumne River, but because any such modifications would also deal with flows affecting aquatic resources of the lower Tuolumne River, the Districts are not proposing any changes to lower Tuolumne River flows at this time.

2.4 Alternatives Considered but Eliminated from Detailed Study

2.4.1 Federal Government Takeover of the Project

FERC's SD2 noted that no governmental agency has suggested a willingness or ability to take over the Project. Therefore, this alternative has not been considered. Also, as the Districts are public entities, the Project is not subject to federal takeover.

2.4.2 Issuing a Non-Power License

A non-power license is a temporary license FERC would terminate whenever it determines that another governmental agency is authorized and willing to assume regulatory authority and supervision over the lands and facilities covered by the non-power license. The Districts are public entities authorized to own and operate dams in the State of California. At this time, no other governmental agency has suggested a willingness or ability to take over the Project. No party has sought a non-power license for the Don Pedro Project. Therefore, a non-power license has not yet been considered.

2.4.3 Retiring the Don Pedro Hydroelectric Project

Decommissioning of the Don Pedro Hydroelectric Project could be accomplished without removal of Project facilities. This alternative could potentially occur if FERC denied issuance of a new license to continue hydropower generation or if the Districts were not to accept the new license issued by FERC. Under the decommissioning alternative, the Project would no longer be authorized to generate power; however, the primary purposes and needs for the Don Pedro Project of water supply and flood control would continue. No entity has recommended retirement of the Project.

3.0 ENVIRONMENTAL ANALYSIS

The Don Pedro Project provides water storage for irrigation and municipal and industrial (M&I) use, flood control, hydroelectric generation, recreation, and natural resource protection (hereinafter, the "Don Pedro Project"). The environmental analysis contained in this Exhibit E considers all the components, facilities, operations, and maintenance that make up the Don Pedro Project. The Don Pedro Project was originally conceived as a water supply project. The Don Pedro Project is operated for the following primary purposes: (1) to provide water supply for the co-licensees, Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts), for irrigation of over 200,000 acres of Central Valley farmland and M&I use, (2) to provide flood control benefits along the Tuolumne and San Joaquin rivers, and (3) to provide a water banking arrangement for the benefit of the City and County of San Francisco (CCSF) and its 2.6 million Bay Area water customers. The original license was issued in 1966. In 1995, the Districts entered into an agreement with a number of parties which resulted in greater flows to the lower Tuolumne River for the protection of aquatic resources.

Hydroelectric generation is a secondary purpose of the Don Pedro Project. Hereinafter, the hydroelectric generation facilities and operations will be referred to as the "Don Pedro Hydroelectric Project", or the "Project". In this license application to FERC, the Districts are seeking a new license to continue generating hydroelectric power. Based on the information contained in this application, and other sources of information on the record, FERC will consider whether, and under what conditions, to issue a new license for the continued generation of hydropower at the Districts' Don Pedro Project. The Districts are providing a complete description of the facilities and operation of the Don Pedro Project so the effects of the operation and maintenance of the hydroelectric facilities can be distinguished from the effects of the operation and maintenance activities of the overall Don Pedro Project's flood control and water supply/consumptive use purposes.

Being able to differentiate the effects of the hydropower operations from the effects of the flood control and consumptive use purposes and needs of the Don Pedro Project will aid in defining the scope and substance of reasonable protection, mitigation, and enhancement (PM&E) alternatives to be considered in relicensing. As FERC states in Scoping Document 2 in a discussion related to alternative project operation scenarios: "…alternatives that address the consumptive use of water in the Tuolumne River through construction of new structures or methods designed to alter or reduce consumptive use of water are…alternative mitigation strategies that could not replace the Don Pedro *hydroelectric* project [emphasis added]. As such, these recommended alternatives do not satisfy the NEPA purpose and need for the Proposed Action and are not reasonable alternatives for the NEPA analysis."

3.1 General Description of the Tuolumne River Basin and Don Pedro Project

The 150-mile-long Tuolumne River originates in the Sierra Nevada in Yosemite National Park. At Tuolumne Meadows, streams flowing down the slopes of Mount Lyell and Mount Dana join to form the river's headwaters. After nearly 8,600 ft of elevation drop, the Tuolumne River converges with the San Joaquin River. Don Pedro Dam is located at RM 54.8 of the Tuolumne

River. The upstream extent of the Project Boundary is at RM 80.8 and the downstream extent of the Project Boundary is at RM 53.2.

There are 23 tributaries to the Tuolumne River (Table 3.1-1 and Figure 3.1-1), primarily located upstream of the Project Boundary. Only Twin Gulch and Dry Creek converge with the Tuolumne River below the Project Boundary. The hydrologic characteristics of the tributaries vary significantly. East of Don Pedro Reservoir, especially in areas above approximately 5,000 ft where snow accumulation is significant, the upper Tuolumne River and its tributaries are snowmelt-dominated. Runoff from tributaries in the lower elevations is primarily rain-driven.

Table 3.1-1. Primary tributaries to the Tuolumne River.

Major Tributary (listed upstream to downstream)
Above the Project Boundary
Lyell Fork
Dana Fork
Cathedral Creek
Falls Creek
Return Creek
South Fork Tuolumne
Eleanor Creek
Cherry Creek
Jawbone Creek
Clavey River
Indian Springs Creek
Big Creek
North Fork
Turnback Creek
Project Boundary
Hatch Creek
Moccasin Creek
Grizzly Creek
Rough and Ready Creek
Sullivan Creek
Woods Creek
Big Creek
West Fork Creek
Below the Project Boundary
Twin Gulch
Dry Creek

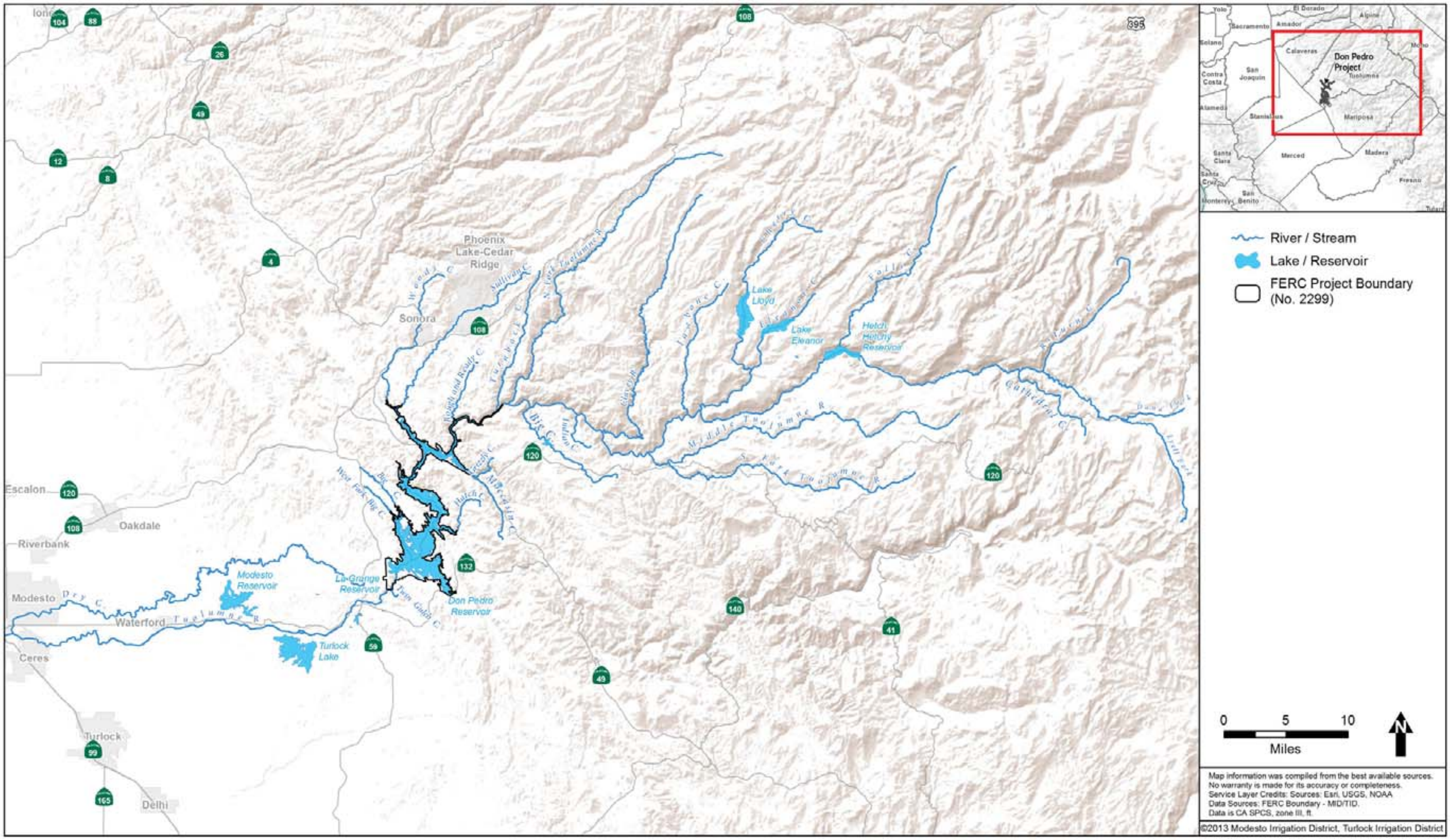

Figure 3.1-1. Location of tributaries to the Tuolumne River.

There are three major water diversions from the Tuolumne River. First, upstream of the Don Pedro Project at RM 118, O'Shaughnessy Dam impounds Hetch Hetchy Reservoir and diverts water to the Bay Area through the Canyon, Mountain, and Foothill tunnels, and San Joaquin Pipelines. Owned and operated by CCSF, the 360,400 AF Hetch Hetchy Reservoir is an integral component of CCSF's Hetch Hetchy Water and Power System, which provides approximately 85 percent of CCSF's Bay Area municipal and industrial ("M&I") water supply and generates on average 1,700,000 megawatt-hours (MWh) of electricity each year. Second, CCSF owns and operates Early Intake Diversion Dam, located at RM 105. This facility is used to divert water supplied by CCSF's Cherry Creek facilities through the Mountain and Foothill tunnels to its San Joaquin Pipelines during emergency and extreme drought conditions. Third, located below the Project Boundary at RM 52.2, La Grange Diversion Dam, owned by the Districts, diverts flows from the Tuolumne River for irrigation and M&I water supply purposes.

The mainstem Tuolumne River forms at an elevation just above 8,600 ft in the high alpine Tuolumne Meadows located in Yosemite National Park. At this point, the eight mile-long Dana Fork and the 13-mile-long Lyell Fork converge (NPS 2010), draining the south-facing slopes of the mountains near Tioga Pass and the north-facing slopes of the Cathedral Range. From Tuolumne Meadows, the Tuolumne River winds and plunges generally westward through a number of waterfalls, including Tuolumne, California, Le Conte, and Waterwheel falls (DeLorme 2003), before entering the steep-sided and rocky Grand Canyon of the Tuolumne.

The river continues down the canyon and into Don Pedro Reservoir, at which point the canyon transitions into the low Sierra foothills and wider Tuolumne River valley. Downstream of the reservoir, the rolling hills of the eastern Central Valley gradually flatten to become a terraced floodplain. From here, the river flows to its confluence with the San Joaquin River.

The Tuolumne River watershed covers 1,960 mi^2 and encompasses a wide range of climates and hydrologic conditions. Annual precipitation within the watershed ranges from over 60 inches in the high mountain areas to 12 inches in the Central Valley (Western Regional Climate Center 2010). Within the Project Boundary, annual precipitation ranges from 25 to 40 inches (ACOE 1972). At its headwaters in the Sierra Nevada, the Tuolumne River area experiences significant snow accumulation from December to April. Downstream in the Sierra Nevada foothills where the Don Pedro Project is located, the climate is often described as Mediterranean. Winters are wet and cool, with most precipitation occurring in the form of rain. The summers are hot and dry.

Runoff in the Tuolumne River watershed is produced by rainfall and snowmelt. Runoff from the upper basin occurs from April to July, when snowpack from the winter melts (ACOE 1972). In the Sierra foothills and valley floor, runoff occurs from December to March, coinciding with the rainy season. The long-term mean annual natural runoff of the Tuolumne River at Don Pedro Dam is approximately 1.9 million AF. The observed mean annual runoff into the reservoir (based on the period 1975 to 2009) is 1.6 million AF, with the bulk of the difference being the out-of-basin diversions by CCSF for its M&I water customers. However, the annual runoff of the Tuolumne River is subject to considerable variability. For example, during that same time period, the annual unimpaired runoff of the Tuolumne River has varied from 382,000 AF (WY 1977) to 4.6 million AF (WY 1983).

Lands within the Tuolumne basin have a number of uses and a variety of ownership types. Above the Don Pedro Project area, lands in the Tuolumne River watershed are primarily federally owned, with NPS managing Yosemite National Park and the USFS managing the Stanislaus National Forest. Developed land in this stretch of the subbasin is largely limited to small communities, such as Groveland and Smith Station, as well as dispersed individual residences and small tracts of non-irrigated farmland. Much of the land immediately upstream of the Project Boundary is managed by the BLM, including lands adjacent to the Tuolumne River.

Surrounding the Project, lands are a mix of publicly owned lands administered by the BLM and private property. All of the lands within the Project Boundary are either owned by the Districts or are federal lands managed by BLM.

Downstream of the Project Boundary, in the Central Valley area of the Tuolumne River watershed, land is primarily privately owned and used for agriculture, grazing, rural residential purposes, and denser residential purposes, such as in the communities of Waterford and Modesto (Stanislaus County 2006). A small portion of land downstream of the Project is under state ownership; Turlock Lake State Recreation Area (SRA) is a small state park spanning from the southern bank of the Tuolumne River to the north shore of Turlock Lake.

Tuolumne County, where the Don Pedro Project is located, has a diverse economic base. From 2007 to 2011, the four largest employment sectors were (1) Educational services, and health care and social assistance; (2) Arts, entertainment, and recreation, and accommodation and food services; (3) Retail Trade; and (4) Construction (U.S. Department of Commerce (USDOC) 2013). During this time period, agriculture, forestry, fishing and hunting, and mining was the eleventh largest employment sector in Tuolumne County. Major employers in the county include the Corrections Department, Sonora Regional Convalescent Home, and Sonora Regional Hospital (State of California 2013). A more thorough discussion of the economic activity in the vicinity of the Don Pedro Project is included in Section 3.12.

3.2 Scope of Cumulative Effects Analysis

As described in FERC's SD2 (FERC 2011), the scope of FERC's environmental assessment for the Don Pedro Hydroelectric Project relicensing must include an analysis of how the Proposed Action would or would not contribute to cumulative effects. According to the Council on Environmental Quality's regulations for implementing NEPA (50 CFR. §1508.7), cumulative effects on a resource are the result of the combined influence of past, present, and reasonably foreseeable future actions within a specified geographical range (FERC 2008), regardless of which agency (federal or non-federal) or entity undertakes such actions. Related specifically to the Tuolumne River basin, cumulative effects can result from individually minor but collectively significant actions taking place over a prolonged period of time, including hydropower operations, diversions for irrigation and drinking water supply, past gravel and gold mining activities, other land and water development activities, and the introduction of non-native species to the watershed.

Based on FERC's scoping meetings, comments received during scoping, and information in the PAD, FERC identified the following resources as having the potential to be cumulatively affected by the continued operation and maintenance (O&M) of the Don Pedro Hydroelectric Project: water; geomorphology; fish and aquatic, including anadromous fish and their habitat; and socioeconomic resources.

Section 4 of this Exhibit E describes each of the aforementioned resources and identifies relevant actions inside and outside[1] the Tuolumne River basin that influence the environmental baseline for the Proposed Action, in accordance with guidance issued by FERC in its SD2 for the Project. Government and private actions are addressed, as appropriate, in this assessment. Actions undertaken by the government and/or other private entities which have occurred, or may occur, independently of the Districts' Proposed Action, are neither direct nor indirect effects of Don Pedro Project operations. Following the description of relevant actions potentially affecting a given resource (i.e., water, geomorphology, fish and aquatic, and socioeconomic), Section 4 of Exhibit E includes an assessment of cumulative effects on that resource.

The effects of the Don Pedro Project are attenuated with increasing distance downstream in the Tuolumne River and into the San Joaquin River basin, Sacramento-San Joaquin River Delta, and the San Francisco Bay. With increased distance downstream of the Don Pedro Project, the number and complexity of co-occurring past, current, and future actions make it exceedingly difficult, if not impossible, to meaningfully isolate specific effects of the numerous individual actions on the resources of concern.

3.3 Geology and Soils

This discussion of geology and soils considers the geologic setting of the Don Pedro Project, in addition to seismicity, physiography, soils, and erosion information. Existing, relevant, and reasonably available information regarding each of these is also presented in the PAD (TID/MID 2011) and summarized here. Consultation with agencies and relicensing participants did not result in the identification of any potential effects to resources due to erosion except as related to cultural resources within the Don Pedro Reservoir, nor were any studies requested or required related directly to geology and soils.

3.3.1 Existing Environment

3.3.1.1 Geologic Setting and Site Specific Geology

The Don Pedro Project is located in the Western Sierra Nevada Metamorphic Belt (WSNMB), which is contained within the Sierra Nevada Block, a tilted fault block approximately 400 miles long that trends north-northwest, is 40 to 80 miles wide, and includes a broad region of foothills along the western slope of the Sierra Nevada Range (Harden 2004). The eastern face of the tilted Sierra Nevada Block is high and rugged, consisting of multiple fault scarps (Eastern Sierra Nevada Frontal Shear Zone) separating it from the Basin and Range Province. This contrasts with the gentle western slope that disappears under sediments of the Great Valley. The Sierra Nevada block continues under the Great Valley and is bounded on the west by an active fold and thrust belt that marks the eastern boundary of the Coast Range Province (Wentworth and Zoback

[1] For geomorphology, out-of-basin actions are not considered relevant in the context of cumulative effects (see Geographic Scope).

1989). The northern boundary of the tilted fault block is marked by the disappearance of typical Sierra bedrock under the volcanic cover of the Cascade Range. The southern boundary of the fault block is along the Garlock Fault located in the Tehachapi Mountains 210 miles southeast of the Project Boundary where characteristic rocks of the Sierra Nevada are abruptly truncated by this east-west fault system. The Don Pedro Project is located a few miles east of the surficial boundary with the Great Valley geomorphic province (Figure 3.3-1).

The WSNMB is divided into three lithotectonic subunits, designated the Western, Central, and Eastern belts (Day et al. 1985). The Project Boundary is situated within the Central Belt. The Western and Central belts are composed of Paleozoic and Mesozoic serpentinized peridotite (ultramafic rock) and metamorphosed volcanic and sedimentary sequences. Both belts represent oceanic terranes (Schweickert and Cowan 1975; Bogen 1985; Tobisch et al. 1987). The Eastern Belt is composed of Paleozoic and Mesozoic sedimentary and volcanic rocks and is generally accepted to have formed in near-continental to continental arc environments (Hannah and Moores 1986; Harwood 1988).

The Central Belt consists of a Paleozoic ophiolite complex (a sequence of former sea floor to upper mantle strata, here known as the Tuolumne Ultramafic Complex), middle Triassic to early Jurassic volcanic rocks (Jasper Point and Peñon Blanco formations) and sedimentary rocks (Mariposa Formation) intruded by lower Jurassic plutons (Clark 1964; Morgan 1977; Bogen 1985). The lowest stratigraphic unit at the site is the above-mentioned Tuolumne Ultramafic Complex of late Paleozoic (about 300 million years ago (mya)) age (Saleeby et al. 1982). It is overlain structurally and stratigraphically by the metavolcanic rocks of the Peñon Blanco Formation of middle Triassic to early Jurassic age. Overlying all the above rock units in places are several types of surficial deposits, primarily colluvial soils and local alluvium in drainage courses.

3.3.1.2 Faulting and Seismicity

The Project Boundary is located near the western margin of the Sierra Nevada range, where the Foothills Fault System is a dominant structural feature. This fault system, developed during the Nevadan orogeny (mountain building) episode approximately 123 to 160 mya, is a braided complex of north-northwest-striking fault structures with mineralized zones (Clark 1960). Nearby fault segments were reactivated during the Cenozoic Era (less than 65 mya), and some were reactivated as recently as during the Quaternary Period (1.8 mya to present day). The Cleveland Hills Fault, located about 134 miles northwest of the Project Boundary, was active during the Lake Oroville earthquake on August 1, 1975.

The Foothills Fault System contains two major fault zones, the Bear Mountains Fault Zone and the Melones Fault Zone, that cross the Tuolumne River. The California Division of Mines and Geology (CDMG) Open-File Report 84-52 (USGS 1984) states that the Bear Mountains and Melones Fault zones did not warrant zoning as active faults because they “either are poorly defined at the surface or lack evidence of Holocene (recent) displacement” (Hart et al. 1984). The Bowie Flat Fault is a relatively minor fault within the Foothills Fault System and is also located in the vicinity of the Don Pedro Project.

A seismicity and ground motion study performed for Don Pedro Dam in November 1992 showed that earthquakes from faults less than six miles from the dam control the maximum ground motion observed, rather than more distant (greater than 50 miles from the dam) active regional faults such as the San Andreas and Sierra Nevada Frontal faults (Bechtel Corporation 1992). A subsequent review of the 1992 study agreed with that assessment, but recommended that a maximum earthquake of magnitude 6.5 (compared to magnitude 6.25 in the 1992 Bechtel Corporation report) be assigned to the fault traces in the Foothills Fault System. The report classified all the faults in the system as "conditionally active" (HDR Engineering and Geomatrix Consultants 2000). Earthquake ground motions were estimated assuming a maximum earthquake of Magnitude 6.5. Median bedrock peak ground accelerations (PGA) were estimated using two available ground motion attenuation models (Sadigh et al. 1997; Abrahamson and Silva 1997). Using those models, the reported PGA for the Don Pedro Project ranges from 0.50g to 0.60g.

3.3.1.3 Recent Seismic Activity

Figure 3.3-2 illustrates seismic events in the vicinity of the Don Pedro Project from 1769 through the 2013. The source of information on historical seismic events (magnitude and epicentral location) prior to the year 2000 were obtained from the CGS (2013). For events from the year 2000 to 2013, the source of information was the USGS (USGS 2013). There have been no earthquakes within approximately 60 miles of the Project Boundary in recorded history.

3.3.1.4 Mineral Resources

Tuolumne County and lands within the Project Boundary include considerable mineral resources, chiefly gold, and have been subject to extensive mining activity (Figure 3.3-3). The placers of Columbia and Springfield northwest of the Don Pedro Project produced approximately $55,000,000 in gold prior to 1899. The pocket mines of Sonora, Bald Mountain, and vicinity have also been highly productive and exceptionally long-lived. Marble and limestone products have been next to gold in value. The Columbia marble beds northwest of the Project Boundary had a long history of production prior to 1941, and two plants are presently processing the stone from these deposits. Tuolumne County also contains deposits of copper, soapstone, scheelite (an ore of tungsten), limestone, marble, platinum, silver, sulphur, decorative stone, slate, sand, and gravel (TID/MID 2011).

California leads the nation in aggregate production, virtually all of which is removed from alluvial deposits (Kondolf 1995). As of 1994 sand and gravel mining exceeded the economic importance of gold mining in the state. Large-scale in-channel aggregate mining began in the Tuolumne River corridor in the 1940s, when aggregate mines extracted sand and gravel directly from large pits located within the active river channel. Off-channel aggregate mining along the Tuolumne River has also been extensive. For example, the Gravel Mining Reach of the lower Tuolumne (RM 34.2 to 40.3) is currently the focus of development by commercial aggregate producers.

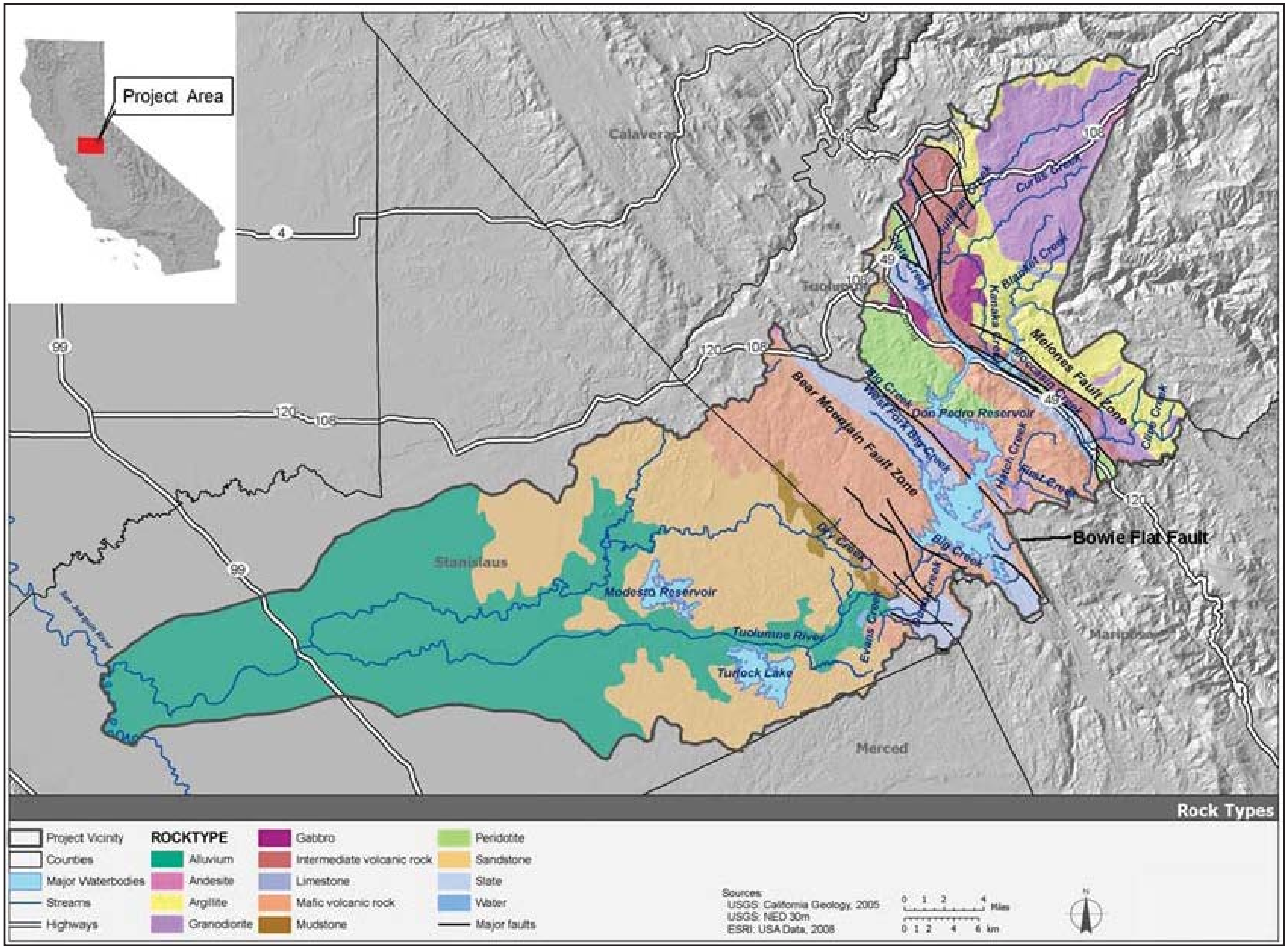

Figure 3.3-1. Rock types in the Don Pedro Project vicinity.

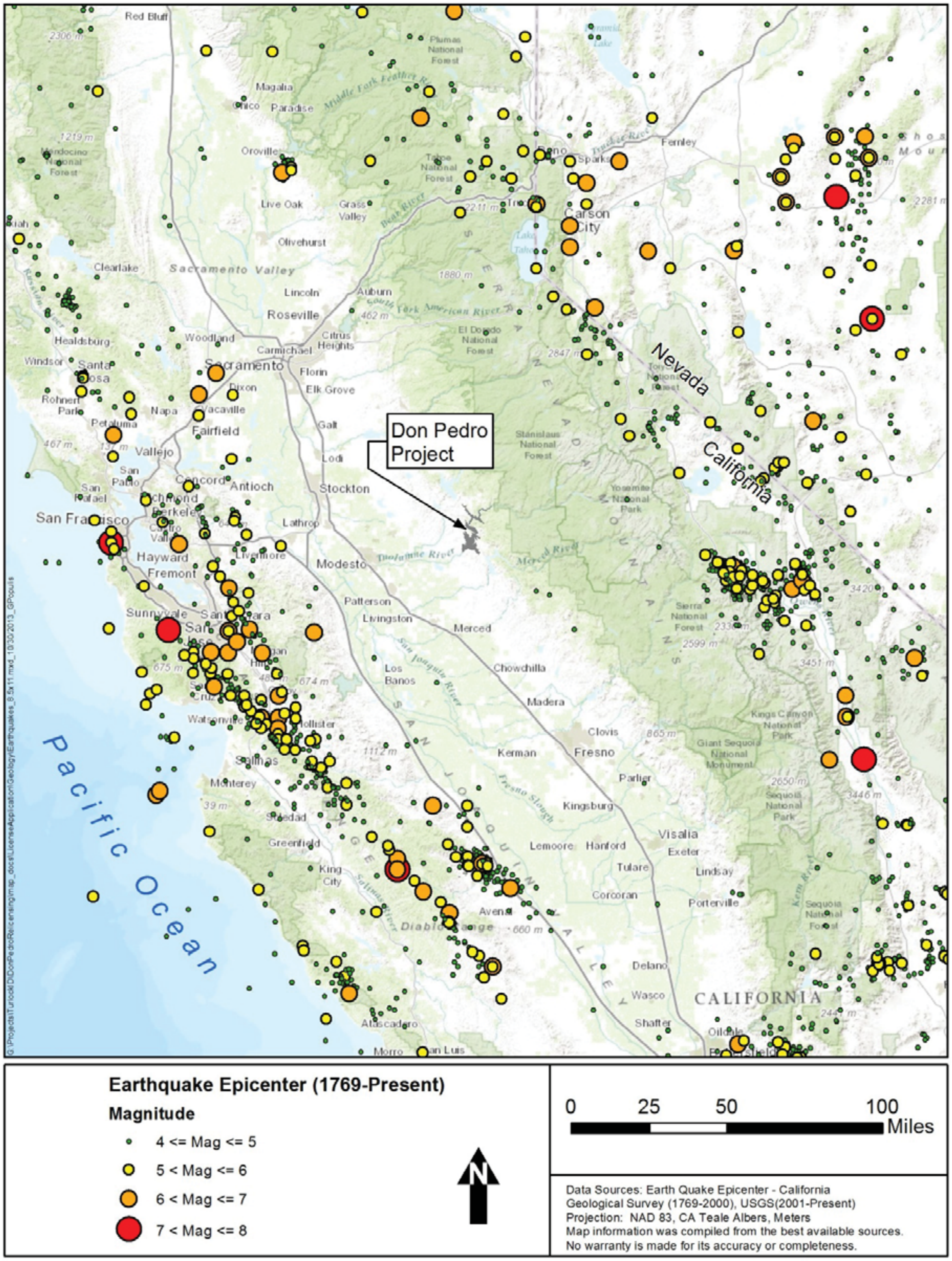

Figure 3.3-2. Historical Seismicity 1769 to 2013.

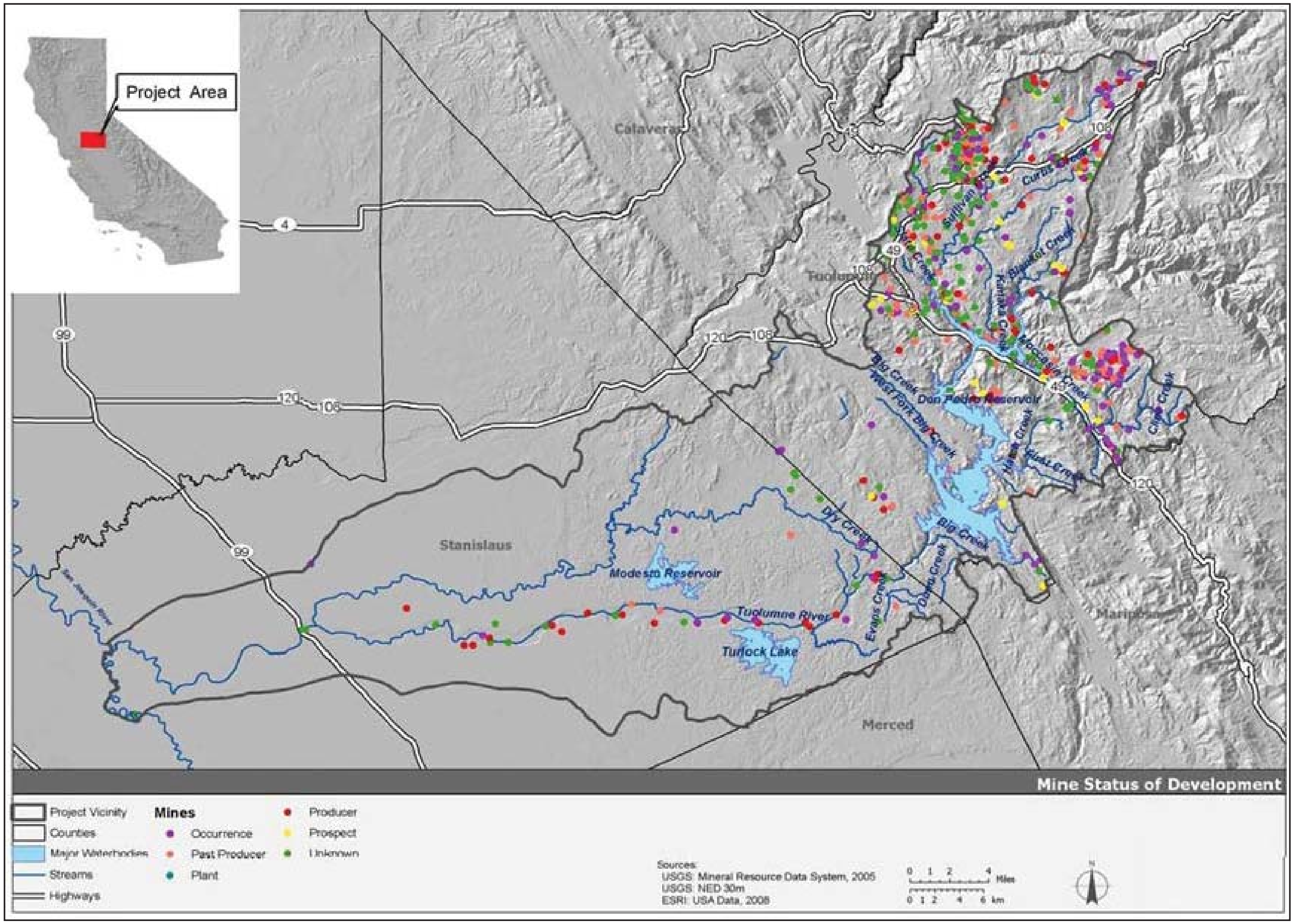

Figure 3.3-3. Past and present mines in the general vicinity of the Project Boundary.

3.3.1.5 Soil Resources

3.3.1.5.1 Soil Associations

Two soil associations cover nearly 90 percent of the Project Boundary, Whiterock-rock outcrop-Auburn covers 70.6 percent and rock outcrop-Henneke-Delpiedra covers 18.2 percent (Table 3.3-1). The areas to the southwest and northeast of Don Pedro Reservoir are dominated by soils of the Whiterock-rock outcrop-Auburn association, with bands of the rock outcrop-Henneke-Delpiedra and Sierra-Rock outcrop-Auberry-Ahwahnee associations bisecting the lake in a northwest to southeast direction. The area to the south of the Tuolumne River in the upper few river miles of the Project Boundary is rock outcrop-Friant-Coarsegold association, and there are very small areas of Sites-rock outcrop-Mariposa-Diamond Springs and Maymen-Mariposa associations in the uppermost Project Boundary (TID/MID 2011).

Table 3.3-1. Soil associations within the Don Pedro Project Boundary.

Soil No.	Soil Association	Acres	% of Total
s818	Whiterock-Rock outcrop-Auburn	4,556.9	70.6
s838	Rock outcrop-Henneke-Delpiedra	664.2	18.2
s841	Sierra-Rock outcrop-Auberry-Ahwahnee	488.6	7.8
s751	Rock outcrop-Friant-Coarsegold	281.1	3.2
s757	Maymen-Mariposa	13.7	Trace
s846	Sites-Rock outcrop-Mariposa-Diamond Springs	5.5	Trace
	Total	**6,009.9**	**100**

The Whiterock-rock outcrop-Auburn association is one of the more extensive associations in the foothills of the Sierra Nevada, and it typically develops in tilted slate, amphibolite schist, and partially metamorphosed sandstone formations. Whiterock soils tend to be shallower and less weathered than those of the Auburn series. The Bear Mountains Fault Zone, which runs northwest to southeast, has serpentinized ultramafic rock in many areas along the zone. The areas underlain by these ultramafic rocks are reflected by the presence of the Henneke and Delpiedra series, which are often shallow and poorly developed as shown by the large amount of "rock outcrop" in the association.

3.3.1.5.2 Shoreline and Reservoir Conditions

Much of the Don Pedro Reservoir shoreline is intact rock or rock/rubble/boulder not prone to erosion (Figure 3.3-4). Slopes less than eight percent are generally soil (Figure 3.3-5). There have been no large movements or mass movements of soil along the reservoir shoreline since the Don Pedro Project commenced operation. Within the reservoir, the 1997 flood resulted in substantial accumulation of sediment (approximately 30 ft deep) near Ward's Ferry Bridge; this material is slowly moving downstream and has recently accumulated near Rough and Ready Creek.

Sediment resulting from eroded material is contained within Don Pedro Reservoir, as Don Pedro Dam traps coarse sediment and much of the fine sediment. An assessment of bathymetry data collected in 2011 determined the reservoir to have a total current storage capacity of 2,014,306 AF at elevation 830 ft. The original elevation-storage curve for Don Pedro Reservoir at the time of its construction indicated a total storage capacity of 2,030,000 AF, a difference of less than one percent (TID/MID 2013).

Figure 3.3-4. Photograph of the Three Springs Gulch shows steep, vertical, rocky slopes typical of the Railroad Canyon area. Photograph taken on June 11, 2012.

Figure 3.3-5. Typical shoreline condition along the Don Pedro Reservoir. Photograph shows the east side of the South Bay on May 4, 2011.

Observations of soil and reservoir conditions were components of the extensive relicensing studies conducted within the Project Boundary during 2012. In particular, 11 terrestrial and cultural resource studies conducted field surveys and reconnaissance efforts that included the entirety of the Don Pedro Reservoir shoreline, Don Pedro Project facilities, and surrounding areas (Table 3.3-2). Each study included observation of potential disturbances to targeted resources, as well as general habitat conditions within the study areas. Study leads reported that no substantial erosion was observed. Erosion was observed in the larger drainages entering the reservoir where seasonal flows would result in bank erosion of soils along the stream (e.g., Hatch Creek and Big Creek). Steep soil slopes in excess of 30 degrees also showed some signs of erosion, likely due to overland flow. In no case was erosion above the normal maximum water surface elevation observed to affect non-geologic resources, including special-status species or cultural resource sites.

DPRA personnel are tasked with constant observation of soil and reservoir conditions, and reporting major instances of erosion and soil movement. DPRA personnel patrol Don Pedro Reservoir daily during the recreation season, and all areas of the reservoir at weekly intervals during the off-season. Any observations potentially affecting sensitive resources or Don Pedro Project uses are designated for monitoring and/or management. However, no instances of substantial erosion or large/mass movement of soil are currently reported within the Project Boundary, and none have been observed in recent years (Russell 2013).

Table 3.3-2. Relicensing studies observing shoreline habitats.

Study	Study Name	Study Scope and Area[1]
CR-01	Historic Properties	Field survey. All lands within the Project Boundary that are (1) within 100 ft beyond the normal maximum water surface elevation (830 ft), (2) within designated facilities and formal recreation use areas, (3) within informal recreation use areas identified by the DPRA, (4) within the Red Hills ACEC, or (5) along the reservoir edge.
TR-01	Special-Status Plants	Field survey. Lands within the Project Boundary that are subject to O&M or recreation activities, including high-use shoreline areas, the Red Hills ACEC, and all facilities.
TR-02	ESA and CESA-listed Plants	Field survey. Lands within the Project Boundary that are subject to O&M or recreation activities, including high-use shoreline areas, the Red Hills ACEC, and all facilities.
TR-03	Wetlands	Field survey. Wetland and riparian habitats within ten drainages to Don Pedro Reservoir.
TR-04	Noxious Weeds	Field survey. Lands within the Project Boundary that are subject to O&M or recreation activities, including high-use shoreline areas, the Red Hills ACEC, and all facilities.
TR-05	ESA-listed Wildlife - VELB	Field survey. Lands within the Project Boundary that are subject to O&M or recreation activities, including high-use shoreline areas, the Red Hills ACEC, and all facilities, as well as wetland and riparian habitats within ten tributaries to Don Pedro Reservoir.
TR-06	Special-Status Amphibians and Reptiles	Field reconnaissance. Suitable aquatic habitats within the Project Boundary within 0.5 mi from the normal maximum water surface elevation of Don Pedro Reservoir, including accessible sections of the Tuolumne River, and tributaries up to 1.0 mi upstream of the reservoir.
TR-07	California Red-Legged Frog	Field reconnaissance. Suitable habitats within the Project Boundary and 1-mile surrounding radius.
TR-08	California Tiger Salamander	Field reconnaissance. Suitable habitats within the Project Boundary and 1.24-mile surrounding radius.
TR-09	Special-Status Bats	Field reconnaissance. All facilities and recreation areas.
TR-10	Bald Eagle	Project Boundary and 1000 ft buffer surrounding.

[1] Field surveys covered all lands within the study area using pedestrian survey methods. Reconnaissance surveys sampled the study area, targeting individual habitats.

3.3.2 Resource Effects

Page 35 of FERC's SD2 specifically identifies the following potential issues associated with geologic and soils resources:

- *Effects of project operation and maintenance on soil erosion and shoreline erosion at the project reservoir and stream reaches*
- *Potential effects of any project-related changes in streamflow and sediment delivery to project stream reaches on stream geomorphic processes or reservoir bathymetry*
- *Potential effects of runoff from project roads and other hard surface runoff on erosion and sediment transport*
- *Potential effects of the use of project spillways and dam outlet facilities on soil erosion*

- *Potential effects of project operations on large woody debris distribution and recruitment*
- *Effects of project-related recreation to soil compaction or erosion*

Don Pedro Project operations have the potential to directly affect resources within the Project Boundary; those effects related to geology and soils are discussed below. Additionally, the Don Pedro Project is one among many influences affecting resources of the lower Tuolumne River downstream of the Project Boundary. These potential cumulative effects, including those related to streamflow, sediment delivery, and woody debris, are addressed in Section 4 of this Exhibit E.

3.3.2.1 Shoreline Erosion, Spillway, and Outlet Works

The Proposed Action has no measureable impact on erosion or shoreline resources. Water storage level changes over the water year can exceed 1 million AF, although they are normally less than about 700,000 AF from the normal low level which occurs in the October/November time frame to the normal high which occurs in the May/June time frame. The effect of hydropower operations on reservoir water levels is limited to the daily shaping of flows. At the median reservoir level of 780 ft, a change in reservoir level of 0.15 ft, or 1.8 inches would occur over a 16 hour summer day operating period, when compared to the off-peak flow occurring all day, and assuming no inflow to the reservoir.

The effects of the Don Pedro Project to erosion and shoreline resources are minor, limited in scope and degree, and do not affect other resource areas. Based on observations by DPRA staff and extensive relicensing studies covering the entirety of the reservoir shoreline, indicators of active shoreline erosion above the normal maximum water line are few within the Project Boundary, including at the three developed recreation sites. During completion of relicensing studies, no substantial erosion was observed above the normal maximum water line. Erosion was observed in the larger drainages entering the reservoir where seasonal flows would result in bank erosion of soils along the stream (e.g., Hatch Creek and Big Creek). Steep soil slopes in excess of 30 degrees also showed some signs of erosion likely due to overland flow. In no case was erosion observed to be affecting any non-geologic resources, including special-status species or cultural resource sites, above the normal maximum water surface elevation.

Additionally, the bulk of the lands within the Project Boundary are undeveloped, and geographically removed from any O&M activity. The reservoir shoreline is either federal land administered by the BLM or lands owned in fee and managed by the Districts; no development is permitted within the Project Boundary except at the three developed recreation areas. DPRA strictly regulates shoreline uses, and prohibits shoreline disturbances such as dredging, ORV use, and camping outside designated areas (DPRA 2001).

During daily operations, erosion related to the use of the spillway and dam outlet facilities is minimal, and not likely to result in any environmental effects. The spillway, founded on rock, discharges directly to a bedrock-confined channel, and the outlet works tunnel discharges into a bedrock-lined channel approximately 400 ft downstream of the powerhouse. The gulch downstream of the spillway channel is dry, except occasionally during seasonal rainy periods. Since the Don Pedro Project went into service, there has been one spill event, which occurred during the January 1997 flood. Outflows at the spillway exceeded 50,000 cfs. This initial and only use of the spillway resulted in considerable scour and erosion in Twin Gulch, the eventual receiving channel of flows released at the spillway. This event eroded approximately 500,000 yd^3 of sediment from the Twin Gulch channel below the spillway chute (McBain & Trush 2004). The effects of this event to resources is unknown, but are believed to have been minor, as there were no known occurrences of special-status species in the vicinity of Twin Gulch Channel. Current terrestrial habitat assessments indicate poor habitat in the Twin Gulch channel and near the dam outlet works facilities.

3.3.2.2 Effects of Local Runoff and Recreation

Based on observations by DPRA staff and extensive relicensing studies covering the entirety of the reservoir shoreline, runoff related to road use and hard surfaces is minimal and not likely to result in any environmental effects. During completion of relicensing studies, no observations were made of detrimental effects of runoff to any resource study area. Additionally, the bulk of the roads within the Project Boundary are county roads not managed by the Districts. Roads and hard surfaces related to facilities and recreation sites are removed from streams and waterways, and no observations of runoff-related damage or erosion have been reported or were noted during relicensing consultations.

The Don Pedro Project includes three developed recreation areas that receive substantial use during much of the year. The recreation areas are largely unpaved, and soils in each are subject to compaction and related effects. Additionally, DPRA maintains a trail system in parts of the Project Boundary; these trails are compacted but serve to focus recreational use on already-compacted lands. Outside these areas, Don Pedro Project lands receive little foot traffic and the majority of dispersed recreational uses are boat-based.

3.3.3 Proposed Resource Measures

No environmental measures are proposed in this license application related directly to geology and soil resources as there is no evidence of Project effects to sensitive resources due to erosion or soil/rock movement.

3.3.4 Unavoidable Adverse Impacts

Use of the spillway during flood conditions is an unavoidable effect that has occurred only once since construction, but could occur in the future. Erosion in Twin Gulch downstream of the spillway channel is an unavoidable effect of the primary purposes of the Don Pedro Project, with little to no adverse impact due to the limited occurrences during extreme high water events and the lack of sensitive resources in Twin Gulch.

3.4 Water Resources

3.4.1 Existing Environment

The Tuolumne River originates in Tuolumne Meadows in Yosemite National Park from the confluence of headwater streams running off the slopes of Mount Lyell and Mount Dana, both over 13,000 ft in elevation. From there it flows roughly 140 miles–and loses about 8,000 ft in elevation–to its confluence with the San Joaquin River. Like other rivers of the Sierra Nevada that flow west to the Central Valley, the Tuolumne River has a long history of development and use, dating back to the mid-1800s. Many small dams were built on the river as early as the 1850s, such as those built by the Jacksonville Damming Company formed in 1850 "[t]o change the present course of the Tuolumne River, above and below Wood's Creek"[2] to facilitate in-channel gold mining operations. The first major dam constructed on the Tuolumne River–Wheaton Dam–was completed in 1871 near the location of the current La Grange Diversion Dam. Wheaton Dam was used to divert flow for irrigation and domestic use (see Section 4.0 of this FLA for a detailed account of the history of water management in the Tuolumne River basin).

Community interest in developing the water resources of the Tuolumne River extends back to 1887, when TID and MID became the first two entities in California to organize as irrigation districts under the 1887 Wright Act. Three years later, in 1890, the Districts agreed to build a jointly-owned diversion dam, La Grange Diversion Dam, which was put into service in 1893. The Districts completed construction of the original Don Pedro Dam in 1923 at a location approximately 1.5 miles upstream of the present Don Pedro Dam.

The City of San Francisco's interests in using the waters of the Tuolumne River date back to 1901 when the city first announced plans to build a dam in Hetch Hetchy Valley, culminating in the construction of O'Shaughnessy Dam in 1923. Major water resource projects continued to be built in the watershed through the 1970s (e.g., Cherry Dam in 1955; Kirkwood powerhouse in 1967; new Don Pedro Dam in 1971). TID, MID, and CCSF have been involved in managing the waters of the Tuolumne River for over 100 years.

The Don Pedro Project Boundary extends from RM 53.2 to RM 80.8. Don Pedro Reservoir extends upstream from Don Pedro Dam (located at RM 54.8) for approximately 24 miles at the normal maximum water surface elevation of 830 ft. The surface area of the reservoir at this elevation is approximately 12,960 ac, and the reservoir shoreline, including the numerous islands within the lake, is approximately 160 miles long. The watershed upstream of Don Pedro Dam is approximately 1,533 mi^2.

[2] A History of Tuolumne County, 1882, p. 51.

3.4.1.1 Water Resources Studies Conducted During Relicensing

3.4.1.1.1 Water Quality Study

The goals of the Water Quality study (TID/MID 2013a) were to (1) characterize existing water quality conditions within Don Pedro Reservoir, downstream of Don Pedro Dam at the point of the Don Pedro Project discharge, and just downstream of La Grange Diversion Dam, and (2) evaluate the consistency of existing water quality conditions with the CVRWQCB's Basin Plan Objectives (CVRWQCB 1998).

3.4.1.1.2 Don Pedro Project Operations Water Balance Model

The Tuolumne River Operations Model (Operations Model) (TID/MID 2013b) was developed to simulate (1) Don Pedro Project operations and Hetch Hetchy water supply operations for a period of analysis that covers a range of historical hydrologic conditions and (2) alternative operating scenarios and their effects on hydropower generation, downstream flows, and water supplies to the Districts and CCSF's Bay Area customers. The Operations Model is able to simulate basic decisions made which affect Don Pedro flood management, water supply, lower river releases, reservoir levels, and hydropower generation. More specifically, objectives for the Operations Model include, (1) adequate reproduction of observed Don Pedro reservoir levels, reservoir releases, and hydropower generation, within acceptable calibration standards over a range of hydrologic conditions, (2) providing output to inform other studies, analyses, and models, and (3) evaluating alternative operations scenarios to estimate effects on reservoir levels, reservoir releases, and hydropower generation.

The geographic scope of the Operations Model on the Tuolumne River extends from CCSF's Hetch Hetchy system through the Districts' Don Pedro Reservoir, and then from Don Pedro Dam to the Tuolumne River's confluence with the San Joaquin River. Hydrologic records of Tuolumne River flows at La Grange have been recorded by the Districts and CCSF dating back to the early 1900s to implement and monitor the provisions of the Raker Act and 4th Agreement between the Districts and CCSF regarding the allocation of Tuolumne River flows.

Within this scope, the Operations Model also depicts the water supply operations of the Hetch Hetchy system including reservoir levels, outflows, and flows in the San Joaquin Pipeline providing water to the Bay Area. Under certain circumstances, the Districts and CCSF share responsibility for meeting FERC license requirements in the lower Tuolumne River downstream of the Don Pedro Project. The model can depict changes in water supply at the Don Pedro Project and the Hetch Hetchy system with and without shared responsibility.

3.4.1.1.3 Reservoir Temperature Model

The goal of the Reservoir Temperature Model study (TID/MID 2013c) is to develop a model that simulates and characterizes the seasonal water temperature dynamics experienced in Don Pedro Reservoir under current and alternative future conditions. The model (1) reproduces observed reservoir temperatures, within acceptable calibration standards, over a range of hydrologic conditions, (2) provides output that can inform other studies, analyses, and models, and (3) predicts potential changes in reservoir thermal conditions under alternative operating scenarios. The study area for the reservoir temperature model consists of Don Pedro Reservoir, extending from about elevation 300 ft to about elevation 850 ft, or from the tailwater of Don Pedro powerhouse to about 20 ft above the Don Pedro Reservoir normal maximum reservoir elevation of 830 ft. The complex physical geometry and setting of the reservoir, including the continued existence of the old Don Pedro Dam, required the use of a three-dimensional representation of the reservoir and its behavior over a full range of conditions.

3.4.1.1.4 Lower Tuolumne River Temperature Model

The Lower Tuolumne River Temperature Model (TID/MID 2013d) simulates existing water temperature conditions in the lower Tuolumne River from below Don Pedro Dam (RM 54.8) to the confluence with the San Joaquin River (RM 0). The model is also able to estimate river temperature conditions under alternative Don Pedro Project operations scenarios. The model simulates the temperature regime of the lower river for the 1971-2012 period, consistent with the period of record of the Tuolumne River Operations Model. The lower river temperature model was developed to address the following specific objectives: (1) reproduce observed river water temperatures, within reasonable calibration standards, over the range of hydrologic conditions, (2) evaluate sensitivity of water temperatures to Tuolumne River-specific flow and meteorological conditions, (3) provide output to inform other studies, analyses, and models, and (4) predict potential changes in river temperature under alternative operating scenarios. The study area includes the Tuolumne River from the outlet of the Don Pedro Project at an elevation of approximately 300 ft to the Tuolumne River's confluence with the San Joaquin River at elevation 35 ft. The total drainage area and reach length of the study area are approximately 430 mi^2 and 54 river miles, respectively. There is one major tributary in this reach, Dry Creek, which joins the lower Tuolumne River at RM 16. Dry Creek has a drainage area of approximately 204 mi^2, accounting for nearly half of the total drainage area encompassed by the model.

In 2013, the Districts supplemented the already-extensive water temperature data collection activities with additional temperature data collection. This study, entitled *In-River Diurnal Temperature Variation Study,* was conducted to investigate the occurrence of large changes in diurnal temperature variation which were observed to occur over very short distances at certain locations along the lower Tuolumne River. The study involved establishment of a high-density network of thermologgers at specific locations along the river, and monitoring river temperatures from July 1 through at least September 30, 2013. The report on this study is being issued with this license application.

3.4.1.1.5 Tuolumne River Flow and Water Temperature Model: Without Dams Assessment (Jayasundara et al. 2014)

The purpose of the Tuolumne River Flow and Water Temperature Model: Without Dams Assessment study (Jayasundara et al. 2014) is to develop a flow and water temperature model to simulate water temperatures in the Tuolumne River without the existing Hetch Hetchy (including Cherry and Eleanor reservoirs), Don Pedro, and La Grange projects in place. The model was developed to complement detailed models developed for Don Pedro and La Grange reservoirs (TID/MID 2013c) and the lower Tuolumne River (TID/MID 2013d). Supporting data included the development of long-term flow and meteorological conditions to assess flow and water temperatures over a multi-decade period, i.e., 1970 to 2012. In its December 2011 Study Plan Determination, FERC indicated that EPA (2003) temperature guidelines would apply to the lower Tuolumne River, unless other empirical information could be developed specific to the Tuolumne River to inform potential alternative water temperature considerations. The "without dams" model developed by this study provides such information.

3.4.1.1.6 Model Integration

The Tuolumne River Operations Model, Don Pedro Reservoir Temperature Model, and Lower Tuolumne River Temperature Model form an integrated system of river- and reservoir-specific models for developing "base case" conditions (i.e., existing baseline as defined by FERC) and evaluating alternative Don Pedro Project operation scenarios. The Operations Model establishes reservoir inflows, outflows, and water levels. Output from the Operations Model acts as input to the reservoir temperature model, which in turn provides reservoir outflow temperatures as an input to the river temperature model. The operations model and the river temperature model also provide input to the Tuolumne River Chinook (TID/MID 2013e) and *Oncorhynchus mykiss* (TID/MID 2014) population models. The population models are described in detail in Section 3.5 of this Exhibit E.

3.4.1.2 Water Quantity

3.4.1.2.1 Drainage Area

The Tuolumne River can be divided into three subbasins: the upper Tuolumne River, the Project Boundary, and the lower Tuolumne River. Table 3.4-1 provides the approximate drainage areas and lengths of reaches in these subbasins.

Table 3.4-1. Drainage areas and lengths of Tuolumne River subbasins.

Subbasin	Length of Reach (miles)	Drainage Area (mi^2)	Total Upstream Drainage Area (mi^2)
Upper Tuolumne River	60	1,300	1,300
Project Boundary	28	230	1,530
Lower Tuolumne River	53	430	1,960
Total	141	1,960	NA

The upper Tuolumne River includes the Hetch Hetchy Reservoir watershed (459 mi^2) and the Cherry Lake/Lake Eleanor Reservoir (Cherry/Eleanor) watershed (193 mi^2). Hetch Hetchy Reservoir has a normal pool elevation of about 3,800 ft, Cherry Lake has a normal pool elevation of 4,700 ft, and Lake Eleanor has a normal pool elevation of 4,657 ft. The Don Pedro Project Boundary is at elevation 845 ft.

3.4.1.2.2 Climate

The climate and hydrology of the Tuolumne River basin varies considerably over the river's length. Annual precipitation in the high elevations of the watershed, above 10,000 ft, exceeds 60 inches per year, occurring mostly as snow, while less than 100 miles away in the Central Valley, the annual precipitation is less than 12 inches. In addition to the geographic variation in precipitation, the seasonal and annual variations are also extreme. In the lower reaches of the river, the average precipitation from May through September, inclusive, is less than 1 inch. Year-to-year variation is also dramatic. During the period of WY 1971–2012, the lowest estimated unimpaired flow at the La Grange gage was 382,000 AF (WY 1977) compared to a high of 4.6 million AF (WY 1983), i.e., an inter-annual range that varies by a factor of 12. Another characteristic of the basin's hydrology is that dry and wet years often come in multi-year, back-to-back periods. The third driest year in the WY 1971–2012 period was WY 1976 (672,000 AF), the year before the driest year of WY 1977, and the third wettest year was WY 1982 (3.8 million AF), the year before the wettest year of WY 1983.

Temperature and precipitation statistics for the Tuolumne River basin are provided in Table 3.4-2, and evapotranspiration rates along the lower Tuolumne River are shown in Figure 3.4-1. About 88 percent of the annual precipitation occurs from November through April. Precipitation usually occurs as rain at elevations below 4,000 ft and as snow at higher elevations. Snow cover below 5,000 ft is generally transient and may accumulate and melt several times during a winter season. Normally snow accumulates at higher elevations until about April 1, when the melt rate begins to exceed snowfall. The statistics in Table 3.4-2 also demonstrate why agriculture in the Central Valley is dependent upon irrigation. Average precipitation during the hot summer months of May through September is less than one inch.

Table 3.4-2. Monthly climatological data for the Tuolumne River watershed.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Downstream of Don Pedro Project ***MODESTO, CALIFORNIA (WRCC Station No. 045738)*** ***Period of Record : 1/ 1/1931 to 12/31/2005, Approx. Elevation: 90 ft***												
Avg. High (°F)	54°	61°	67°	73°	81°	88°	94°	92°	88°	78°	64°	54°
Avg. Low (°F)	38°	41°	44°	47°	52°	56°	60°	59°	56°	50°	42°	38°
Mean (°F)	46°	51°	55°	60°	66°	72°	77°	75°	72°	64°	53°	46°
Avg. Rainfall (in)	2.4	2.1	2.0	1.1	0.5	0.1	0	0	0.2	0.6	1.3	2.1
Avg. snowfall (in)	0	0	0	0	0	0	0	0	0	0	0	0
Near Don Pedro Project Boundary ***SONORA Ranger Station, CALIFORNIA (WRCC Station No. 048353)*** ***Period of Record : 1/11/1931 to 12/31/2005, Approx. Elevation: 1,750 ft***												
Avg. High (°F)	55°	58°	62°	68°	77°	87°	95°	94°	88°	77°	64°	56°
Avg. Low (°F)	33°	35°	38°	41°	47°	52°	58°	57°	53°	45°	37°	33°
Mean (°F)	44°	47°	50°	55°	62°	69°	77°	75°	70°	61°	51°	45°
Avg. Precip. (in)	6.1	5.7	4.8	2.7	1.2	0.3	0.1	0.1	0.5	1.7	3.6	5.5
Avg. Snowfall (in)	1.6	0.8	0.4	0.2	0	0	0	0	0	0	0	0.5
Upper Tuolumne River Basin ***HETCH HETCHY, CALIFORNIA (WRCC Station No. 043939)*** ***Period of Record : 1/ 7/1931 to 12/31/2005, Approx. Elevation: 3,780 ft***												
Avg. High (°F)	48°	52°	57°	63°	70°	78°	86°	86°	81°	71°	58°	49°
Avg. Low (°F)	29°	30°	33°	37°	43°	50°	56°	55°	51°	42°	34°	30°
Mean (°F)	38°	41°	45°	50°	57°	64°	71°	71°	66°	57°	46°	39°
Avg. Precip. (in)	6.0	5.7	5.2	3.3	1.9	0.8	0.2	0.2	0.7	2.0	4.2	5.9
Avg. Snowfall (in)	15.2	12.9	14.7	6.3	0.3	0	0	0	0	0.1	2.7	11.7

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High-Sierra Nevada Climate (north of Tuolumne River watershed) ***TWIN LAKES, CALIFORNIA (WRCC Station No. 049105)*** ***Period of Record : 7/ 1/1948 to 8/31/2000, Approx. Elevation: 8,000 feet***												
Avg. High (°F)	38°	40°	41°	47°	54°	63°	71°	70°	65°	56°	45°	39°
Avg. Low (°F)	16°	16°	18°	22°	29°	36°	43°	42°	39°	31°	23°	18°
Mean (°F)	27°	28°	30°	34°	42°	49°	57°	56°	52°	44°	34°	29°
Avg. Precip. (in)	9.0	7.3	6.7	3.9	2.5	1.1	0.7	0.7	1.2	2.6	6.1	7.8
Avg. Snowfall (in)	79.5	73.3	75.9	36.6	14.5	2.3	0	0.2	1.1	10.3	40.9	66.4

Source: Western Regional Climate Center 2006 - http://www.wrcc.dri.edu/summary/climsmnca.html.

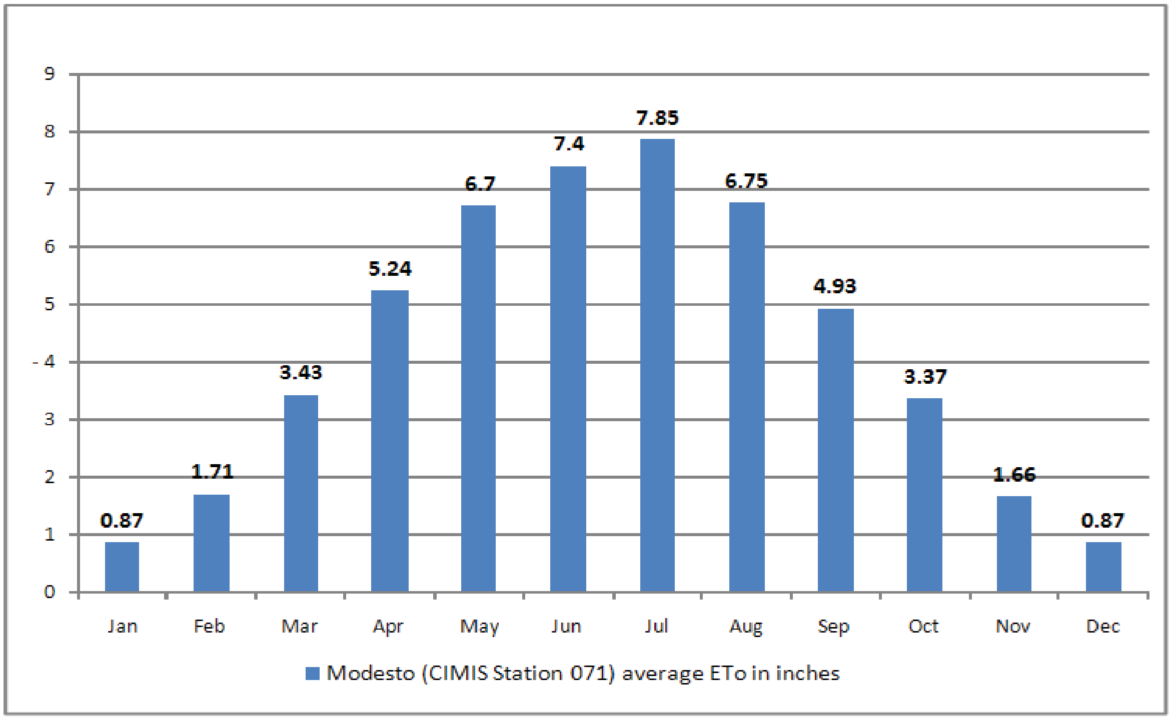

Figure 3.4-1. Modesto monthly average evapotranspiration rates (ETo in inches), June 1987 to present.

Source: California Department of Water Resources (CDWR) 2013

3.4.1.2.3 General Description of Basin Hydrology

The hydrologic characteristics of the Tuolumne River and its tributaries vary significantly from its headwaters to its terminus at the San Joaquin River. Above about 5,000 ft, the Tuolumne River and its tributaries are snowmelt-dominated. Smaller streams in this area may have extremely low summer flows, although groundwater and interflow may continue to provide small amounts of late summer flows. Approximately 75 percent of the runoff in these areas occurs between April and July, with 20 percent or less occurring from December through March, and as little as 5 percent occurring from August through November (ACOE 1972).

In the middle elevations, more precipitation occurs as rainfall, and there can be multiple rain-on-snow periods each year. Several reservoirs are located in this middle-elevation band upstream of the Don Pedro Project, from 3,000 to 5,000 ft elevation (Hetch Hetchy Water and Power [HHWP] 2006 [San Francisco Public Utilities Commission (SFPUC), HHWP, MAH 010721, BJM Rev 070626, undated]). Much of the runoff in these elevations occurs from December through March during winter rains, with much of the remaining runoff occurring from April through July (ACOE 1972).

The Tuolumne River derives much of its flow from snowmelt. Using estimates of natural flow, Don Pedro Reservoir would normally receive about 88 percent of its inflow from January through July. However, because of upstream regulation, the pattern of inflow does not reflect a typical snow-melt driven hydrograph. Some low-elevation, unregulated, rain-driven tributaries flow directly into Don Pedro Reservoir, but these streams provide only a small fraction of the annual flow to the reservoir. The average annual flow of the Tuolumne River at Don Pedro Reservoir is approximately 1.7 million AF. Flood flows in the Don Pedro Project area can be the result of heavy rains, rain-on-snow (mainly in winter and early spring), and/or snowmelt-floods (mostly in spring through early summer). Consequently, the ACOE Flood Control Manual for the Don Pedro Project requires the maintenance of a flood envelope of 340,000 AF from October 7 through April 27 and conditional flood space thereafter depending on the anticipated snowmelt runoff during April, May, and June (ACOE 1972). Details on flood control operations are provided in Exhibit B of this FLA.

Downstream of the Don Pedro Project, water flows from the Don Pedro powerhouse or outlet works tunnel into the Tuolumne River and then into the impoundment formed by La Grange Diversion Dam, a non-project diversion dam owned by the Districts[3]. Downstream of La Grange Diversion Dam, the Tuolumne River becomes a meandering stream, with an average gradient of about 2 ft/mile, in contrast to the upper Tuolumne where gradients can exceed 100 ft/mile. In the lower Tuolumne River valley, around 75 percent of the annual runoff occurs during rainstorms between December and March (ACOE 1972). Some flow in this area is derived from groundwater, but the groundwater contribution has not been well quantified. Based on accretion flow measurements taken during the relicensing process, the lower Tuolumne River is considered to be generally a gaining stream (TID/MID 2013b, Attachment A, Appendix B).

Hydrology Upstream of Don Pedro Reservoir

There are a number of streamflow gages on the upper Tuolumne River, either presently maintained or historical that account for much of the data about the contributing watershed to the Don Pedro Reservoir (Table 3.4-3). In particular, there are four locations of streamflow measurement below the last points of regulation on the mainstem Tuolumne or its larger tributaries upstream of the Project Boundary. The sum of these four gages constitutes the flow from the majority of the Tuolumne River watershed. Approximately 875 mi^2 of the 1,300 mi^2 of the watershed upstream of Don Pedro Reservoir is accounted for by these four gages: Tuolumne River Below Early Intake Near Mather, Cherry Creek Below Dion R Holm PH, South Fork

[3] In its SD2, FERC states that "The Districts' powerhouse, pipeline, canals and other facilities associated with La Grange dam are not part of the existing license for the Don Pedro Project nor are they included within the project boundary of the existing license." And, "…the Don Pedro Project is a complete unit of development, separate and distinct from La Grange Dam. Since the Districts have all the rights necessary or appropriate for the operation and maintenance of the project, there is no basis for requiring that La Grange Dam be included in the new license for the Don Pedro Project." On December 19, 2012, FERC staff issued an order finding licensing required for the unlicensed La Grange Hydroelectric Project (141 FERC 62,211 (2012)).

Tuolumne River Near Oakland Recreation Camp, and Middle Tuolumne River At Oakland Recreation Camp. Some regulation by smaller reservoirs occurs on Sullivan Creek and Big Creek (USGS 2008), but the regulation of Cherry and Eleanor creeks and the upper mainstem Tuolumne River constitutes the majority of regulation on the upper Tuolumne River.

Table 3.4-3. Flow and storage gages in the Tuolumne River watershed.[1]

Gage Number	Gage Name	Period of Record[2]	Notes
Relevant Streamflow Gages Upstream of Don Pedro Reservoir			
11276500	Tuolumne River Near Hetch Hetchy CA	10/1/1910-present	Located downstream of CCSF's Hetch Hetchy Reservoir. Period of record spans period of construction of O'Shaughnessy Dam
11276900	Tuolumne River Below Early Intake Near Mather CA	10/1/1966-present	Downstream of Hetch Hetchy and Kirkwood Powerhouse
11278400	Cherry Creek Below Dion R Holm PH, Near Mather CA	4/1/1963-present	--
11281000	South Fork Tuolumne River Near Oakland Recreation Camp CA	4/1/1923-9/30/2002; 1/27/2009-present	Gage re-installed in 2006 by CCSF HHWP, but data after 2002 are not reported on USGS. Recent data available through CDEC
11282000	Middle Tuolumne River At Oakland Recreation Camp CA	10/1/1916-9/30/2002; 1/28/2009-present	Gage re-installed in 2009 by CCSF HHWP, but data after 2002 are not reported on USGS. Recent data available through CDEC
Don Pedro Reservoir Gage			
11287500	Don Pedro Reservoir Near La Grange CA	1923-present	The period 1923-1970 reflects original Don Pedro Reservoir storage (max. 290,400 AF)
Relevant Streamflow Gages Downstream of Don Pedro Reservoir			
11289650	Tuolumne River Below La Grange Diversion Dam Near La Grange CA	12/1/1970-present	Flow and temperature (from 11/10/1970)
11289000	Modesto Canal Near La Grange CA	12/1/1970-present	--
11289500	Turlock Canal Near La Grange CA	12/1/1970-present	--
11289651	Combined Flow Tuolumne River, Modesto Canal + Turlock Canal CA	10/1/1970-present	--
11290000	Tuolumne River At Modesto CA	present	Location of 9,000 cfs restriction

1 All gage information is taken from the USGS National Water Information System (NWIS), and data from these locations is available to the public at: http://waterdata.usgs.gov.

2 Note that some gages, particularly those with long-term records, may have missing data.

Relevant data from US Geological Survey (USGS) are presented below for the Tuolumne River below CCSF's Early Intake and Kirkwood powerhouse; Cherry Creek below CCSF's Cherry Lake, Lake Eleanor, and Holm Powerhouse; and the South Fork and Middle Fork Tuolumne rivers near their confluences with the mainstem Tuolumne River.

Tuolumne River Below Early Intake, Near Mather, California (USGS Gage No. 11276900)

This location represents the flow in the mainstem Tuolumne River below Hetch Hetchy Reservoir plus discharges from Robert C. Kirkwood Powerhouse that is not diverted to CCSF's Mountain Tunnel (Table 3.4-4).

Table 3.4-4. Mean monthly flows for the 1975-2012 period for Tuolumne River below Early Intake (RM 105.5).

Month	Mean Monthly Flow (cfs)	Lowest Mean Monthly Flow (cfs)	Highest Mean Monthly Flow (cfs)
Jan	264	31	2917
Feb	314	35	1039
Mar	436	38	1145
Apr	597	34	1694
May	1619	52	4028
Jun	2077	37	6260
Jul	1006	30	5530
Aug	227	31	1726
Sep	114	29	370
Oct	77	30	247
Nov	95	35	313
Dec	168	29	1169

Source: USGS 11276900.

Cherry Creek below Dion R. Holm Powerhouse, Near Mather, California (USGS Gage No. 11278400)

This gage is located immediately downstream of the Dion R. Holm powerhouse about 600 ft upstream of the confluence of Cherry Creek with the Tuolumne River and represents nearly the full regulated flow of Cherry Creek (Table 3.4-5). Cherry Creek and its tributary, Eleanor Creek, both have regulating reservoirs upstream of this point. Cherry Creek enters the Tuolumne River at RM 104.

Table 3.4-5. Mean monthly flows for the 1975-2012 period for Cherry Creek below Dion R. Holm powerhouse.

Month	Mean Monthly Flow (cfs)	Lowest Mean Monthly Flow (cfs)	Highest Mean Monthly Flow (cfs)
Jan	610	4	3266
Feb	703	4	1528
Mar	834	4	1497
Apr	1008	3	2199
May	1321	3	3768
Jun	1257	4	3728
Jul	746	11	2643
Aug	467	26	1161
Sep	380	20	898
Oct	341	13	962
Nov	365	15	1445
Dec	473	6	1394

Source: USGS 11278400.

South Fork Tuolumne River near Oakland Recreation Camp, CA (USGS Gage No. 11281000)

Historical data are available at this USGS gage for the period of 1923–2002 (Table 3.4-6). Measurement at this gage was discontinued at the end of September 2002, but the gage was reinstalled by CCSF in 2006. Data are now reported on the California Data Exchange Center (CDEC) website. There are no known diversions in this watershed. The South Fork enters the Tuolumne River at RM 97.5.

Table 3.4-6. Mean monthly flows for the 1975-2012 period for South Fork Tuolumne River near Oakland Recreation Camp.

Month	Mean Monthly Flow (cfs)	Lowest Mean Monthly Flow (cfs)	Highest Mean Monthly Flow (cfs)
Jan	98	8	429
Feb	164	9	725
Mar	207	11	750
Apr	222	16	730
May	246	26	654
Jun	143	13	656
Jul	44	3	242
Aug	14	0	58
Sep	11	1	39
Oct	14	2	51
Nov	32	6	211
Dec	52	6	416

Source: USGS 11281000; CCSF HHWP.

Middle Fork Tuolumne River at Oakland Recreation Camp, CA (USGS Gage No. 11282000)

Historical data are available at this USGS gage for the period of 1923–2002 (Table 3.4-7). Measurement at this gage was discontinued at the end of September 2002, but the gage was reinstalled by CCSF in 2006. Data are now reported on the CDEC website. There are no known diversions on this stream.

Table 3.4-7. Mean monthly flows for the 1975-2012 period for Middle Fork Tuolumne River at Oakland Recreation Camp.

Month	Mean Monthly Flow (cfs)	Lowest Mean Monthly Flow (cfs)	Highest Mean Monthly Flow (cfs)
Jan	51	2	218
Feb	87	4	345
Mar	115	5	354
Apr	170	17	476
May	285	24	598
Jun	205	11	875
Jul	57	1	361
Aug	10	0	61
Sep	6	0	27
Oct	7	0	37

Month	Mean Monthly Flow (cfs)	Lowest Mean Monthly Flow (cfs)	Highest Mean Monthly Flow (cfs)
Nov	18	2	138
Dec	27	2	234

Source: USGS 11282000; CCSF HHWP.

Hydrology within the Project Boundary

Inflows to Don Pedro Reservoir are affected by upstream water management, particularly that associated with CCSF's Hetch Hetchy development. Outflows from Don Pedro Dam reflect real-time operations by the Districts to manage flows in accordance with storage requirements, ACOE flood control guidelines, and diversions for irrigation and M&I uses (i.e., the primary Don Pedro Project purposes, as described in Exhibit B of this FLA). Water releases are also provided to benefit fish and aquatic resources in the lower Tuolumne River, as contained in the current FERC license. Table 3.4-8 shows Don Pedro outflows since the first full calendar year following the 1996 FERC order incorporating terms of the 1995 Settlement Agreement.

Hydrology of the Lower Tuolumne River

Flows in the lower Tuolumne River above La Grange Diversion Dam are reported at three USGS gages: nos. 11289650, 11289000, and 11289500 (Table 3.4-8). The data are combined to estimate total flow releases from the Don Pedro Project (Table 3.4-9). Records for these locations are available from the USGS NWIS website for October 1, 1970 to September 30, 2012. Flow data continue to be reported by USGS and are updated at least annually. The mean annual flow at this location since completion of reservoir filling is 2,300 cfs (WY 1975-2012).

Table 3.4-8. Don Pedro Project mean monthly outflows (cfs) 1997-2012.

Month	Monthly mean flow (cfs)[1]																Mean monthly flow (cfs)	Highest mean monthly flow (cfs)	Lowest mean monthly flow (cfs)
	1997[2]	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012			
USGS 11289650 - Tuolumne River Below La Grange Diversion Dam Near La Grange, CA (cfs)																			
Jan	13,070	2,114	1,247	324	325	177	184	223	187	4,456	353	171	165	232	4,096	342	1,729	13,070***	165
Feb	8,116	6,168	4,903	2,284	1,273	172	185	220	1,823	2,373	358	173	168	225	3,176	340	1,997	8,116***	168
Mar	2,443	5,407	3,285	4,602	615	165	182	1,098	3,875	4,234	357	172	169	284	5,142	323	2,022	5,407	165
Apr	1,457	5,392	2,034	1,548	558	665	685	1,010	4,524	7,436	487	533	372	1,342	7,400	271	2,232	7,436	271
May	953	3,621	1,697	1,164	706	419	477	412	4,868	7,847	385	680	687	2,706	3,396	798	1,926	7,847	385
Jun	269	4,433	284	340	54	97	234	127	3,809	4,657	127	95	149	2,555	5,027	134	1,399	5,027	54
Jul	290	2,845	287	421	89	88	243	108	1,913	834	114	93	107	813	2,132	107	655	2,845	88
Aug	287	1,019	259	603	110	86	236	106	773	584	110	99	102	316	2,498	104	467	2,498	86
Sep	285	1,423	294	473	112	68	250	110	328	412	89	97	106	308	1,197	102	365	1,423	68
Oct	465	628	424	412	189	202	297	209	464	449	141	174	385	491	491		367	628	141
Nov	380	316	338	347	184	191	231	186	369	379	174	161	255	399	366	In WY	292	399	161
Dec	330	1,321	336	334	177	187	226	178	1,285	352	169	164	256	4,152	366	2013	904	4,625	164
USGS 11289000 - Modesto Canal Near La Grange, CA (cfs)																			
Jan	6	117	66	237	72	40	76	87	83	143	9	27	31	16	34	358	88	358	6
Feb	168	56	47	72	142	67	58	44	204	135	113	45	29	11	93	69	84	204	11
Mar	642	121	301	231	213	434	328	355	260	142	348	346	219	253	96	340	289	642	96
Apr	601	250	630	586	607	720	325	720	450	249	483	575	474	337	453	275	483	720	249
May	872	310	697	659	773	724	605	653	665	716	682	656	573	533	674	736	658	872	310
Jun	701	655	769	733	802	791	801	751	695	802	763	646	716	769	708	767	742	802	646
Jul	962	787	781	915	905	891	894	825	1,043	846	803	748	791	704	761	869	845	1,043	704
Aug	813	869	927	878	767	707	825	704	827	824	781	793	721	754	858	764	801	927	704
Sep	550	482	566	474	567	583	525	461	604	594	411	506	474	482	589	453	520	604	411
Oct	347	344	334	293	387	358	380	270	299	304	321	301	266	271	233		314	387	233
Nov	78	73	195	44	36	105	172	84	141	173	162	100	112	184	169	In WY	122	195	36
Dec	26	86	72	75	72	58	13	43	126	8	9	18	2	0	0	2013	40	126	0
USGS 11289500 - Turlock Canal Near La Grange, CA (cfs)																			
Jan	387	69	506	0	91	27	6	25	316	299	164	4	82	108	301	581	185	581	0
Feb	599	326	313	0	8	6	323	302	339	529	257	101	151	180	190	202	239	599	0
Mar	1,457	454	623	603	595	1,023	637	1,035	872	644	1,113	1,132	601	601	581	477	778	1,457	454
Apr	1,222	699	1,304	1,135	1,110	1,249	771	1,272	1,184	529	1,082	866	1,013	712	1,070	623	990	1,304	529
May	1,710	800	1,321	1,246	1,455	1,121	1,073	1,336	1,256	1,339	1,166	1,136	1,021	1,171	1,145	1,248	1,222	1,710	800
Jun	1,445	1,243	1,525	1,725	1,664	1,483	1,639	1,552	1,504	1,624	1,599	1,310	1,525	1,569	1,398	1,425	1,514	1,725	1,243

Month	Monthly mean flow (cfs)[1]																Mean monthly flow (cfs)	Highest mean monthly flow (cfs)	Lowest mean monthly flow (cfs)
	1997[2]	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012			
Jul	2,081	1,817	1,938	1,898	1,805	1,817	1,883	1,840	1,917	2,000	1,816	1,572	1,899	1,846	1,845	1,788	1,860	2,081	1,572
Aug	1,587	1,681	1,796	1,784	1,526	1,489	1,516	1,510	1,706	1,674	1,494	1,314	1,482	1,656	1,718	1,510	1,597	1,796	1,314
Sep	812	977	952	1,063	825	736	714	617	991	936	631	571	793	1,097	1,069	953	847	1,097	571
Oct	505	613	566	527	445	358	742	577	259	379	305	129	180	430	533	In WY 2013	442	742	129
Nov	30	0	59	24	4	22	1	1	3	8	35	2	27	279	95		37	279	0
Dec	109	0	301	173	12	94	36	12	27	1	45	149	20	600	29		102	600	0
USGS 11289651 - Combined Flow Tuolumne River + Modesto Canal + Turlock Canal (~ total Don Pedro Project outflow)[3] (cfs)																			
Jan	13,630	2,301	1,818	561	489	244	266	335	585	4,897	525	203	278	355	4,430	1,282	2,012	13,630	203
Feb	8,885	6,551	5,262	2,355	1,424	245	565	566	2,365	3,038	728	320	348	415	3,458	611	2,321	8,885	245
Mar	4,544	5,983	4,210	5,435	1,423	1,622	1,146	2,487	5,005	5,020	1,818	1,651	989	1,139	5,818	1,142	3,090	5,983	989
Apr	3,280	6,341	3,968	3,269	2,276	2,634	1,781	3,001	6,158	8,211	2,052	1,973	1,860	2,392	8,922	1,168	3,705	8,922	1,168
May	3,535	4,732	3,714	3,067	2,935	2,263	2,155	2,402	6,790	9,902	2,234	2,472	2,280	4,408	5,216	2,783	3,806	9,902	2,155
Jun	2,415	6,332	2,579	2,796	2,519	2,371	2,672	2,430	6,009	7,083	2,488	2,049	2,391	4,894	7,134	2,328	3,656	7,134	2,049
Jul	3,333	5,448	3,006	3,234	2,798	2,795	3,021	2,772	4,872	3,678	2,732	2,414	2,798	3,363	4,738	2,766	3,361	5,448	2,414
Aug	2,687	3,569	2,982	3,264	2,403	2,281	2,578	2,319	3,305	3,082	2,385	2,205	2,304	2,725	5,074	2,377	2,846	5,074	2,205
Sep	1,647	2,882	1,812	2,009	1,504	1,386	1,489	1,188	1,922	1,942	1,130	1,175	1,371	1,888	2,855	1,509	1,732	2,882	1,130
Oct	1,318	1,584	1,324	1,231	1,021	917	1,419	1,055	1,021	1,133	766	604	832	1,193	1,258	In WY 2013	1,141	1,587	604
Nov	489	389	592	415	224	318	404	270	513	559	371	263	394	862	630		443	862	224
Dec	466	1,407	709	582	261	339	275	233	1,437	361	223	330	277	4,752	394		1,043	4,752	223

1 Values Calculated using USGS NWIS monthly statistics module: http://waterdata.usgs.gov/nwis/nwisman/?site_no=11289650&agency_cd=USGS, http://waterdata.usgs.gov/nwis/nwisman/?site_no=11289000&agency_cd=USGS, http://waterdata.usgs.gov/nwis/nwisman/?site_no=11289500&agency_cd=USGS, and http://waterdata.usgs.gov/nwis/nwisman/?site_no=11289651&agency_cd=USGS

2 The flood of record occurred in January, 1997, with high reservoir releases continuing on into February, 1997. These values skew the January and February mean monthly flow averages for the 1997 to 2012 period. Without 1997 values, the mean monthly flow in January is 973 cfs and February is 1,589, compared to 1,729 and 1,997 cfs, respectively.

3 Some values rounded by USGS - sum of individual gage monthly mean flows may not precisely equal combined gage monthly mean flows.

Table 3.4-9. Mean monthly flows for the 1975-2012 period for lower Tuolumne River above La Grange Diversion Dam

Month	Below La Grange Diversion Dam (cfs)	Modesto Canal near La Grange (cfs)	Turlock Canal near La Grange (cfs)	Don Pedro Project Release (cfs)
Jan	1491	74	140	1705
Feb	1812	66	183	2061
Mar	1952	267	604	2823
Apr	1962	543	1069	3574
May	1790	660	1211	3661
Jun	1034	786	1474	3294
Jul	537	878	1798	3213
Aug	327	782	1568	2677
Sep	481	513	786	1780
Oct	618	288	400	1306
Nov	348	174	196	718
Dec	881	122	208	1211

Source: USGS 11289650, USGS 11289000, USGS 11289500, and USGS 11289651.

Tuolumne River at 9th Street Bridge in Modesto, California (USGS Gage No. 11290000)

USGS also reports flows for a gage located farther downstream near the City of Modesto (Table 3.4-10). This gage has relevance to the operation of the Don Pedro Project through implementation of the ACOE 1972 Flood Control Manual. Flows measured at this gage can affect operations because the Flood Control Manual calls for maintaining Tuolumne River flows below 9,000 cfs at the 9th Street Bridge (below the Dry Creek confluence) to minimize significant property damage. This restriction has the greatest potential to affect operation during the wet winter and early spring snowmelt months when diversions for irrigation or M&I use may be relatively low and maintenance of flood control space in Don Pedro Reservoir is vital.

Unimpaired Flow

The unimpaired flow of the Tuolumne River is calculated on a daily basis by the California Department of Water Resources (CDWR) for the Tuolumne River at La Grange Diversion Dam (Station ID TLG.) The drainage area at this location, according to the CDWR's CDEC system, is approximately 1,548 mi^2. Historical computed flows are available from CDEC on a daily basis beginning in April 1986, and on a monthly basis from October 1900 through the present. Because these data are computed on a daily basis using a number of different gages for an arithmetic water-balance (including changes in storage at Don Pedro Reservoir), CDWR's estimate of unimpaired flows for the Tuolumne River can vary considerably from day to day and occasionally show negative flows. These flows over time, however, are a reasonable representation of the total amount of natural runoff in the Tuolumne River. Table 3.4-11 presents a summary of average monthly unimpaired flow for 1975–2012.

Annual unimpaired flow of the Tuolumne River above Don Pedro Reservoir has averaged about 1.97 million AF since 1975, or about 1.8 cfs/mi^2. The maximum annual unimpaired runoff since 1975 occurred in WY 1983, at 4.6 million AF (4.1 cfs/mi^2), and the minimum occurred in WY 1977, at 0.38 million AF (0.34 cfs/mi^2), or just 19 percent of the mean flow.

Table 3.4-10. Mean monthly flows for the 1975-2012 period for Tuolumne River at Modesto, below Dry Creek.

Month	Mean Monthly Flow (cfs)	Lowest Mean Monthly Flow (cfs)	Highest Mean Monthly Flow (cfs)
Jan	1837	154	15500
Feb	2138	166	8782
Mar	2293	239	7658
Apr	2192	169	9268
May	1992	138	10420
Jun	1216	95	5683
Jul	716	79	4244
Aug	501	68	2415
Sep	680	73	4041
Oct	848	78	4760
Nov	647	93	2089
Dec	1129	110	5431

Source: USGS 11290000.

Table 3.4-11. Tuolumne River at La Grange Diversion Dam mean monthly unimpaired flow, 1975-2012.

Month	Unimpaired Flow Monthly Average (AF)
January	146,465
February	156,184
March	227,960
April	279,811
May	449,940
June	354,796
July	143,172
August	33,145
September	16,926
October	24,289
November	46,374
December	83,581
Total	**1,946,116**

Source: TID/MID 2013a.

Flood Hydrology

The ACOE participated financially in the construction of the Don Pedro Project to acquire 340,000 AF of flood storage space in the Don Pedro Reservoir. This storage is to be provided each year from October 7 to at least April 27. Depending on runoff forecasts, the flood storage space can be reduced to zero as early as the first week in June. Under current operations, the flood storage volume of 340,000 AF lies between elevations 801.9 ft and 830 ft. The flood storage space may be encroached upon during the annual flood management period as long as such encroachment is subsequently reduced. Details on the seasonal and inter-annual variability of operations and flood control can be found in Exhibit B of this FLA.

Since completion of the new Don Pedro Dam in 1971, the flood of record occurred in January 1997 (the “1997 New Year’s Flood”). The peak inflow was estimated to be 120,935 cfs and peak outflow was 59,462 cfs, as measured at the La Grange gage. This is the only time water has been discharged at the Don Pedro spillway since Don Pedro Project completion.

Prior to 1971, the unregulated historical flood of record occurred in January 1862, with an estimated discharge of 130,000 cfs. A more recent flood (post-original Don Pedro Dam construction) occurred in December 1950, with an estimated discharge of 61,000 cfs.

The design flood for the Don Pedro Project is the Probable Maximum Flood (PMF), which was recomputed in 2006 during the Don Pedro Project's Potential Failure Mode Analysis. Peak inflow and outflow were estimated to be 706,900 cfs and 525,600 cfs, respectively. The PMF would be passed at the reservoir elevation 852 ft, or 3 ft below top of dam.

Drought Hydrology

As noted above, the minimum annual unimpaired flow of the Tuolumne River above Don Pedro Reservoir occurred in WY 1977, at 0.38 million AF (0.34 cfs/mi^2), or just 19 percent of the mean flow. The current normal year Tuolumne River water demand exceeds 1.4 million AF, consisting of 900,000 AF for the Districts irrigation and M&I use, 300,000 AF for protection of aquatic resources in the lower Tuolumne River, and 250,000 AF of M&I water for CCSF's Bay Area customers. Annual unimpaired flow since 1975 at Don Pedro Dam has been less than 1.4 million AF in more than 40 percent of the years.

Successive dry years are challenging for water supply management. Drought planning is based on supplying adequate amounts of water to meet demands through a sequence of dry years. Since 1971, several drought periods have occurred: WYs 1976–1977, 1987–1992, 2001–2004, and 2012–2013 were all periods of drought. During the 1976–1977 drought, the combined two-year unimpaired flow was 1 million AF or only 26 percent of the two-year mean of 3.9 million AF. These two years are the driest two consecutive years in recorded history. The longest drought occurred during the WYs 1987–1992. The unimpaired flow over these six years averaged 0.9 million AF, or just 48 percent of the mean. In the entire WY 1987–1992 period, not a single year exceeded 70 percent of the long-term mean annual flow. The successive four-year low-flow period from WY 2001–2004 had a mean unimpaired flow of 1.35 million AF, or 69 percent of the mean, without a single-year's flow being above the mean. The present drought has now extended through WY 2014, and, if remaining 2014 precipitation is normal, the WY 2012-2014 period will be the driest three consecutive years on record at approximately 2.7 million AF.

Demand for irrigation water during drought years is greater than during normal or wet years due to reduced winter moisture. Use of groundwater during drought periods can offer only temporary relief from droughts. The majority of groundwater recharge in both the Turlock and Modesto groundwater basins comes from applied irrigation water during wet years. Recent studies indicate that groundwater storage has been reduced and may no longer be in a state of equilibrium as had existed in the 1990s (TID 2008).

3.4.1.2.4 Development of Hydrology for the Tuolumne River Operations Model

As noted above, the Districts have developed a detailed river-specific computer model (TID/MID 2013b) to simulate the operations of the Don Pedro Project and the water supply operations of CCSF's Hetch Hetchy water system. The geographic scope of the model extends from Hetch Hetchy Reservoir, Cherry Lake, and Eleanor Lake in the upper watershed to the USGS La Grange and Modesto streamflow gages in the lower Tuolumne River, and on to the confluence of the Tuolumne and San Joaquin rivers. The model Version 3.0 provides a simulation of the "base case" for the Don Pedro Project, reflecting existing conditions, including the influence of the Don Pedro Project's primary purposes (i.e., irrigation and M&I uses and flood control) on hydrology. The model may also be used to simulate alternative operations scenarios and can be used to compare the effects of alternative scenarios with the base case.

The hydrology associated with the model's base case contains simulated inflows to Don Pedro Reservoir for the WY 1971–2012 period. Inflows consist of two basic components: (1) a fluctuating unregulated inflow to Don Pedro Reservoir from the portion of the watershed that contains no water regulation, and (2) the regulated releases from the CCSF system. The inflow reflects a daily fluctuating pattern mostly associated with the unregulated component of runoff, which amounts to approximately 40 percent of the total runoff in the basin upstream of the Don Pedro Project. The unregulated component of inflow to Don Pedro Reservoir remains the same among all operation simulations. The regulated inflow to Don Pedro is based on the simulated operations of the CCSF system, which may change among operation simulations due to changed flow requirements for CCSF system demands or user-controlled parameters.

The unimpaired hydrology of the final model was based on collaboration among the Districts and relicensing participants. The selected approach was to develop a flow record for the Tuolumne River using gage proration to develop daily flows, while conforming to the underlying monthly mass balances developed using existing, reliable reservoir level and outflow data. This approach allowed conservation of mass principles to be maintained over the monthly time steps. Gaged data from both the Tuolumne River and nearby drainages were included in the gage proration. To prorate the gaged data to a larger ungaged area, three physical variables were considered: elevation, drainage area, and average annual precipitation (precipitation). Each gaged basin, along with each application basin (Hetch Hetchy, Cherry/Eleanor, and Unregulated), was divided into 100-ft "elevation bands" for its entire drainage area. This was done using USGS National Elevation Dataset, 1/3 arc-second (USGS 2009), which equates to about a 30-ft pixel size. Each elevation band for each gage had attributes added for the drainage area within this band (e.g., the number of mi^2 of the Tuolumne River drainage that exists between elevation 500 and 600 ft) and precipitation (e.g., the average annual precipitation for the drainage area between elevation 500 and 600 ft).

The Oregon Climate Service's Probabilistic Symbolic Model Checker (PRISM) was employed to estimate average annual precipitation from 1971–2000 (PRISM 2006) for each of the elevation bands represented by the basins being evaluated (elevation 100–13,000 ft). PRISM uses the observed precipitation gage and radar data network, in conjunction with an orographic precipitation and atmospheric model, to develop an estimate of average annual precipitation for the contiguous United States at a pixel size resolution of 2,500 ft. Bi-linear interpolation was used to resample the PRISM values to the same pixel size as the elevation model.

Areas at low elevations and high elevations in each of the application basins, which were poorly represented or not represented at all by the reference gages, were added into the elevation distributions of the most representative gages to provide some amount of coverage for those elevation ranges. The proration calculation includes two main steps. First, the daily flow for a given gage is divided across the elevation range that the gage represents, in equal proportion to the drainage area represented within each 100-ft elevation band. Second, the sum of each of the individual "elevation band flows" for each gage is scaled up to the area of that elevation band in the application basin. Each of these steps includes a scaling factor for both area and precipitation.

This method and its results are explained in detail in Appendix B-2 of Exhibit B of this FLA and were described to relicensing participants in a March 27, 2013 Workshop and again in the Districts' April 9, 2013 submittal to FERC titled *Districts' Response to Relicensing Participants Comments on the Initial Study Report (Attachment 2).*

3.4.1.3 State Designated Beneficial Uses

Beneficial use designations for the Tuolumne River are established by the Central Valley Regional Water Quality Control Board (CVRWQCB) through the issuance of the Water Quality Control Plan (Basin Plan). The Don Pedro Project and the areas upstream and downstream of the Project Boundary fall within three Basin Plan units (HUs): (1) HU 536, which includes the Tuolumne River upstream of the Don Pedro Project; (2) HU 536.32, which includes Don Pedro Reservoir; and (3) HU 535, which includes the Tuolumne River from Don Pedro Dam to the San Joaquin River. Table 3.4-12 lists the designated beneficial uses for these units. As provided in the Basin Plan, existing beneficial uses of Don Pedro Reservoir water include (1) Industrial Service Supply (power generation), (2) Water Contact Recreation, (3) Non-Water Contact Recreation, (4) Warm Freshwater Habitat, (5) Cold Freshwater Habitat, and (6) Wildlife Habitat. Although Municipal and Domestic Supply is listed only as a potential use, in actuality Don Pedro Reservoir is currently the drinking water supply for the City of Modesto, as well as the DPRA campgrounds and facilities. The agricultural supply, municipal water supply, and fish habitat enhancement beneficial uses are elaborated on below.

Table 3.4-12 Designated beneficial uses of the Tuolumne River from the Basin Plan.

Designated Beneficial Use Description from Basin Plan, Section II		**Designated Beneficial Use by HU from Basin Plan Table II-1**			
		Use	**Source to Don Pedro Reservoir**	**Don Pedro Reservoir**	**Don Pedro Dam to San Joaquin River**
			HU 536	**HU 536.32**	**HU 535**
Municipal and Domestic Supply (MUN)	Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply.	MUNICIPAL AND DOMESTIC SUPPLY	Existing	Potential	Potential

Designated Beneficial Use Description from Basin Plan, Section II		Designated Beneficial Use by HU from Basin Plan Table II-1			
		Use	Source to Don Pedro Reservoir	Don Pedro Reservoir	Don Pedro Dam to San Joaquin River
			HU 536	HU 536.32	HU 535
Agricultural Supply (AGR)	Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation (including leaching of salts), stock watering, or support of vegetation for range grazing.	IRRIGATION	Existing	--	Existing
		STOCK WATERING	Existing	--	Existing
Industrial Process Supply (PRO)	Uses of water for industrial activities that depend primarily on water quality.	PROCESS	--	--	--
Industrial Service Supply (IND)	Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well repressuration.	SERVICE SUPPLY	--	--	--
		POWER	Existing	Existing	--
Water Contact Recreation (REC-1)	Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.	CONTACT	Existing	Existing	Existing
		CANOEING AND RAFTING[1]	Existing	--	Existing
Non-Contact Water Recreation (REC-2)	Uses of water for recreational activities involving proximity to water, but where there is generally no body contact with water, nor any likelihood of ingestion of water. These uses include, but are not limited to, picnicking, sunbathing, hiking, beach-combing, camping, boating, tide-pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.	OTHER NON-CONTACT	Existing	Existing	Existing
Warm Freshwater Habitat (WARM)	Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.	WARM[2]	Existing	Existing	Existing

Designated Beneficial Use Description from Basin Plan, Section II		Designated Beneficial Use by HU from Basin Plan Table II-1			
		Use	Source to Don Pedro Reservoir	Don Pedro Reservoir	Don Pedro Dam to San Joaquin River
			HU 536	HU 536.32	HU 535
Cold Freshwater Habitat (COLD)	Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.	COLD[2]	Existing	Existing	Existing
Migration of Aquatic Organisms (MGR)	Uses of water that supports habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.	WARM[3]	--	--	--
		COLD[4]	--	--	Existing
Spawning (SPWN)	Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.	WARM[3]	--	--	Existing
		COLD[4]	--	--	Existing
Wildlife Habitat (WILD)	Uses of water that support terrestrial or wetland ecosystems including, but not limited to, preservation or enhancement of terrestrial habitats or wetlands, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, or invertebrates), or wildlife water and food sources.	WILDLIFE HABITAT	Existing	Existing	Existing

1 Applies to streams and rivers only.
2 Resident does not include anadromous. Any hydrologic unit with both WARM and COLD beneficial use designations is considered a COLD water body by the SWRCB for the application of WQOs.
3 Warm water fish species include striped bass, sturgeon, and shad.
4 Cold water fish species include salmon and steelhead.
Source: CVRWQCB 1998 and amendments.

3.4.1.3.1 Irrigated Agriculture

Water for irrigated agriculture is a designated beneficial use of Tuolumne River waters. TID and MID use a combined average of 850,000 AF per year to serve over 200,000 ac of highly productive farmland north and south of the Tuolumne River. For annual crops (e.g., grains, pasture, and vegetables), initial decisions and financial commitments to the number of acres to plant must be made by late January or early February, at which time total water year precipitation levels and runoff are largely unknown. Many of these annual crops are grown to support the large regional dairy industry. Growing annual crops provides a source of feed for cows as well as a means by which to dispose of nutrients created by the herds. Other important irrigated crops in the Districts' service areas are nut and fruit orchards, which are permanent crops requiring significant initial and continuing investment. A reliable year-over-year water supply is necessary to sustain the yield and health of permanent crops.

3.4.1.3.2 Municipal and Industrial Water Supply

The Don Pedro Project serves two distinct purposes related to M&I water supply: (1) MID serves treated reservoir water to the City of Modesto's approximately 200,000 people and (2) CCSF uses the water bank, created through CCSF's financial participation in the construction of the Don Pedro Dam, to ensure the reliability of water supply to its 2.6 million customers in the Bay Area. CCSF's Hetch Hetchy water system provides 85 percent of the water supply to its Bay Area customers. The demand for M&I water is not substantially affected during successive dry years. This combined M&I demand for Tuolumne River water exceeds 300,000 AF per year.

3.4.1.3.3 Fish Habitat Enhancement Flows

Under the current FERC license, Don Pedro Reservoir provides up to 300,000 AF of water to the lower Tuolumne River to protect and enhance aquatic resources, including spawning, rearing and migration flows for Chinook salmon and *O. mykiss* (flow releases made for the benefit of fish and aquatic resources in the lower river are described in Section 4.1 of this FLA).

3.4.1.4 Water Quality

3.4.1.4.1 Water Quality Objectives

The CVRWQCB has adopted WQOs to protect the beneficial uses listed in Table 3.4-12. These WQOs are described in Table 3.4-13. The objectives are primarily narrative, incorporating California's numeric Title 22 drinking water standards by reference, although some (i.e., bacteria, dissolved oxygen [DO], pH, temperature, and turbidity), are numeric.

Table 3.4-13. Water quality objectives to support beneficial uses in the vicinity of the Don Pedro Project as designated by the Central Valley Regional Water Quality Control Board and listed in the Basin Plan.

Water Quality Objective	Description
Bacteria	In terms of fecal coliform. Less than a geometric average of 200/100 ml on five samples collected in any 30-day period and less than 400/100 ml on ten percent of all samples taken in a 30-day period.
Biostimulatory Substances	Water shall not contain biostimulatory substances that promote aquatic growth in concentrations that cause nuisance or adversely affect beneficial uses.
Chemical Constituents	Waters shall not contain chemical constituents in concentrations that adversely affect beneficial uses. Specific trace element levels are given for certain surface waters, none of which include the waters in the vicinity of the Don Pedro Project. Other limits for organic, inorganic and trace metals are provided for surface waters that are designated for domestic or municipal water supply. In addition, waters designated for municipal or domestic use must comply with portions of Title 22 of the California Code of Regulations. For protection of aquatic life, surface water in California must also comply with the California Toxics Rule (40 CFR Part 131).
Color	Water shall be free of discoloration that causes a nuisance or adversely affects beneficial uses.

Water Quality Objective	Description
Dissolved Oxygen (DO)	The DO concentrations shall not be reduced below the following minimum levels at any time. Waters designated WARM .... 5.0 mg/L Waters designated COLD ...... 7.0 mg/L Waters designated SPWN 7.0 mg/L The Tuolumne River also has a water body specific DO objective (Table III-2). DO concentrations shall not be reduced below 8.0 mg/L from October 15 – June 15 from Waterford to La Grange.
Floating Material	Water shall not contain floating material in amounts that cause a nuisance or adversely affect beneficial uses.
Oil & Grease	Water shall not contain oils, greases, waxes or other material in concentrations that cause a nuisance, result in visible film or coating on the surface of the water or on objects in the water, or otherwise adversely affect beneficial uses.
pH	The pH of surface waters will remain between 6.5 and 8.5, and cause changes of less than 0.5 in receiving water bodies.
Pesticides	Waters shall not contain pesticides or a combination of pesticides in concentrations that adversely affect beneficial uses. Other limits established as well.
Radioactivity	Radionuclides shall not be present in concentrations that are harmful to human, plant, animal or aquatic life nor that result in the accumulation of radionuclides in the food web to an extent that presents a hazard to human, plant, animal or aquatic life.
Sediment	The suspended sediment load and suspended-sediment discharge rate of surface waters shall not be altered in such a manner as to cause a nuisance or adversely affect beneficial uses.
Settleable Material	Waters shall not contain substances in concentrations that result in the deposition of material that causes a nuisance or adversely affects beneficial uses.
Suspended Material	Waters shall not contain suspended material in concentrations that cause a nuisance or adversely affect beneficial uses.
Tastes and Odor	Water shall not contain taste- or odor-producing substances in concentrations that impart undesirable tastes and odors to domestic or municipal water supplies or to fish flesh or other edible products of aquatic origin, or that cause nuisance, or otherwise adversely affect beneficial uses.
Temperature	The natural receiving water temperature of interstate waters shall not be altered unless it can be demonstrated to the satisfaction of the RWQCB that such alteration in temperature does not adversely affect beneficial uses. Increases in water temperatures must be less than 5 ºF above natural receiving-water temperature.
Toxicity	All waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. Compliance with this objective will be determined by analyses of indicator organisms, species diversity, population density, growth anomalies, and biotoxicity tests as specified by the RWQCB.
Turbidity	In terms of changes in turbidity (NTU) in the receiving water body: where natural turbidity is 0 to 5 NTUs, increases shall not exceed 1 NTU; where 5 to 50 NTUs, increases shall not exceed 20 percent; where 50 to 100 NTUs, increases shall not exceed 10 NTUs; and where natural turbidity is greater than 100 NTUs, increase shall not exceed 10 percent.

[1] Methylmercury objectives in the Basin Plan do not apply to the vicinity of the Don Pedro Project. The radioactivity and suspended material objectives do not apply to the Don Pedro Project; Don Pedro Project O&M does not contribute radioactive or suspended material into the Tuolumne River or its impoundments.

[2] There is no waterbody specific salinity objective that applies to the vicinity of the Don Pedro Project. Salinity is therefore addressed thorough the chemical constituents objective.
[3] Table 3.4-15 lists numeric standards, criteria, and benchmarks selected for interpreting water quality constituent concentrations that do not have numeric Basin Plan objectives.
[4] Tastes and Odors limits for drinking water are provided as secondary MCLs in Title 22 of the California Code of Regulations.
Source: CVRWQCB 1998 and amendments.

Two of the Basin Plan WQOs, temperature and turbidity, include, at least in part, a criterion limiting changes to receiving water. The temperature objective states that "natural receiving waters" should not be warmed by more than 5°F (approximately 2.8°C), and the turbidity objective provides restrictions for percentage increases in turbidity. The turbidity standard cannot be evaluated based on directly applicable information, because no information exists to characterize the natural receiving water turbidity levels.

However, simulation modeling can be used to estimate natural receiving water temperatures with reasonable certainty. With respect to the temperature regime of the natural receiving water of the Tuolumne River, the Districts have developed an estimate of the unimpaired flow and temperature regime of the Tuolumne River from above Hetch Hetchy Reservoir to its confluence with the San Joaquin River. The model and the comparison of with- and without-dams temperature conditions are discussed further below.

Application of the Basin Plan's temperature and DO WQO to reservoirs is also difficult due to seasonal reservoir stratification, especially in a physically complex reservoir such as Don Pedro. However, advancements in computer modeling have also made possible the simulation of temperature dynamics in reservoirs.

3.4.1.4.2 California List of Impaired Waters

Section 303(d) of the federal Clean Water Act (CWA) requires that every two years each state submit to the Environmental Protection Agency (EPA) a list of rivers, lakes, and reservoirs for which pollution control and/or requirements have failed to provide adequate water quality. The SWRCB and CVRWQCB work together to research and update the list for the State of California. Based on a review of this list and its associated Total Maximum Daily Load (TMDL) Priority Schedule, the surface water bodies identified by the SWRCB as CWA § 303(d) State Impaired in the vicinity of the Don Pedro Project are listed in Table 3.4-14 (SWRCB 2010). There are currently no approved TMDL plans for the Tuolumne River.

Table 3.4-14. 2010 CWA Section 303(d) list of water quality limited segments for the Don Pedro Project Boundary and upstream and downstream of the Project Boundary.

Waterbody Segment	Pollutant/Stressor	Potential Sources	Expected TMDL Completion Date
Upstream of the Project Boundary			
Tuolumne River	None	--	--
Sullivan Creek (Phoenix Reservoir to Don Pedro Reservoir)	Escherichia coli (E. coli)	unknown	2021
Woods Creek (north side of Don Pedro Reservoir)	Escherichia coli (E. coli)	unknown	2021

Waterbody Segment	Pollutant/Stressor	Potential Sources	Expected TMDL Completion Date
Project Boundary			
Don Pedro Reservoir	Mercury	Resource Extraction	2020
Downstream of the Project Boundary			
Lower Tuolumne River (Don Pedro Reservoir to San Joaquin River)	Chlorpyrifos	Agriculture	2021
	Diazinon	Agriculture	2010
	Group A Pesticides[1]	Agriculture	2011
	Mercury	Resource Extraction	2021
	Temperature	unknown	2021
	Unknown Toxicity	unknown	2021
Turlock Lake	Mercury	unknown	2021
Modesto Reservoir	Mercury	unknown	2012
Dry Creek (tributary to Tuolumne River at Modesto)	Chlorpyrifos	Agriculture	2021
	Diazinon	Agriculture	2021
	Escherichia coli (E. coli)	unknown	2021
	Unknown Toxicity	unknown	2021

[1] The Group A Pesticides consist of aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexanes (including lindane), endosulfan, and toxaphene.
Source: SWRCB 2010

3.4.1.4.3 Water Quality Information and Studies

In addition to water quality investigations performed as part of relicensing studies, existing water quality information for waters in the vicinity of the Don Pedro Project was documented in Section 5.2.1 of the PAD and included data collected from 1970 through 2009 from the following sources:

- EPA Storage and Retrieval (STORET) data and reports,
- USGS Water Resources Data Reports and data collected for the National Water Quality Assessment (NAWQA) Program,
- CVRWQCB reports prepared for the Surface Water Ambient Monitoring Program (SWAMP),
- Environmental Defense Fund’s Paradise Regained: Solutions for Restoring Yosemite's Hetch Hetchy Valley, Appendix B,
- NPS report on Yosemite National Park,
- CDWR data,
- Districts’ water quality monitoring data from Don Pedro Reservoir and the lower Tuolumne River, and
- Various CCSF reports.

When developing the PAD, the Districts found that water samples collected within the Don Pedro Project Boundary, while limited, indicated that surface waters are of low specific conductivity and hardness, prone to acidification, and had limited potential sources of local contamination. However, Don Pedro Reservoir's minor tributaries and recreation related infrastructure were identified as potential sources of water quality degradation.

The Districts conducted a study in summer of 2012 to characterize current water quality just upstream, within, and immediately downstream of Don Pedro Reservoir (TID/MID 2013a). Surface water samples were collected at five locations and analyzed for 55 physical and chemical characteristics. In-reservoir sites were sampled at two depths: within 1-2 meters of the reservoir's surface and within 1-2 meters of the bottom. During the 30 days surrounding and including the 2012 Independence Day holiday, surface water samples were collected five times adjacent to 12 reservoir recreation sites. These were analyzed for bacteria and hydrocarbons.

Data collected in 2012 indicate that water quality is good upstream, within, and downstream of the Don Pedro Project Boundary. Water is clear, DO is near saturation at riverine sites and in the epilimnion of the reservoir, alkalinity is low (<16 mg/L in all samples), and pH is near neutral. Fecal coliform bacteria are below or near detection limits near potential sources. Nitrogen and phosphorous occur at concentrations generally less than 1 mg/L, and algae blooms are not observed. Eilers et al. (1987) defined Don Pedro Reservoir as mesotrophic, which is consistent with the nutrient concentrations observed in 2012. Hardness (i.e., 6 to 15 mg/L), turbidity (i.e., 0 to 8 NTU[4]), and nutrient concentrations remain generally constant as water flows downstream through the Project Boundary (TID/MID 2013a).

Consistency with Basin Plan Water Quality Objectives

Water quality data were evaluated relative to 15 applicable (see following sections) Basin Plan WQOs[5,6] (see Table 3.4-13) (TID/MID 2013a). As prescribed by the FERC-approved study plan, for narrative WQOs (i.e., non-numeric objectives), data were compared to relevant guidelines and benchmarks, including EPA's (EPA 2000) California Toxics Rule (CTR) aquatic-life protective criteria (TID/MID 2013a). Numeric WQOs and the benchmarks used for evaluating the protection of designated beneficial uses of Don Pedro Project waters are provided in Table 3.4-15.

Table 3.4-15. Benchmark values used for evaluating the protection of designated beneficial uses of Don Pedro Project waters.[1]

Basin Plan Water Quality Objective (Potentially Affected Beneficial Uses)	Symbol or Abbreviation	Benchmark Values	Reference	Notes
Bacteria (MUN, REC-1)				
Total coliform	--	< 10,000 MPN per 100 mL < 240 MPN per 100 mL (geometric mean);	EPA 2003	Water contact recreation, single-day sample; Water contact recreation, 30-day geometric mean

[4] In 2012, the sample collected between Don Pedro Reservoir's upper and middle bay was 282 NTU. Review of temperature profiles indicated that this reading was near the metalimnion, a location where plankton can accumulate. All other samples exhibited turbidity between 8 NTU (most upstream sample) and 0 NTU (near dam and downstream samples).
[5] The radioactivity WQO does not apply to the Don Pedro Project.
[6] Temperature was evaluated separately and is discussed below, in Section 3.4.5.

Basin Plan Water Quality Objective (Potentially Affected Beneficial Uses)	Symbol or Abbreviation	Benchmark Values	Reference	Notes
Fecal coliform	--	< 200 MPN per 100 mL (geometric mean); < 10% of samples > 400 MPN per 100 mL	CVRWQCB 1998	Water contact recreation, 30-day geometric mean; with individual samples not > 400 MPN/100 mL
Escherichia coli	*E. coli*	<126 MPN per 100 mL (geometric mean) <235 MPN per 100 mL in any single sample	EPA 2003	Water contact recreation, 30-day geometric mean
Biostimulatory Substances (COLD, SPAWN)				
Total Kjeldahl Nitrogen	TKN	None	--	--
Total Phosphorous	TP	None	--	--
Chemical Constituents (AGR, COLD, MUN)				
Alkalinity	--	20 mg/L (minimum)	Marshack 2008	EPA AWQC; low alkalinity can affect water treatment
Arsenic	As	0.010 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Primary MCL[2]
Cadmium	Cd	5 µ/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Primary MCL[2]
Calcium	Ca	None	--	--
Chloride	Cl	250 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Chromium (total)	Cr (total)	50 µg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Primary MCL[2]
Copper	Cu	1 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Lead	Pb	15 µg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Primary MCL[2]
Mercury (inorganic)	Hg	0.002 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Primary MCL[2]
Nickel	Ni	0.1 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Primary MCL[2]
Nitrate	NO_3	45 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Primary MCL[2]
Nitrite	NO_2	1 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Primary MCL[2]
Nitrate + Nitrite	$NO_3 + NO_2$	10 mg/L (combined total)	CDPH 2010 cited in CVRWQCB 1998	Title 22 Primary MCL[2]
Potassium	K	None	--	--

Basin Plan Water Quality Objective (Potentially Affected Beneficial Uses)	Symbol or Abbreviation	Benchmark Values	Reference	Notes
Selenium	Se	0.05 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Primary MCL[2]
Sodium	Na	20 mg/L	Marshack 2008	Sodium Restricted Diet[3]
Specific conductance	--	150 µmhos	CVRWQCB 1998	Aquatic Life Protection
Zinc	Zn	5 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Dissolved Oxygen (COLD, SPAWN)				
Dissolved Oxygen	DO	7.0 mg/L (minimum)	CVRWQCB 1998	Aquatic life protection
Floating Material (REC-1, REC-2)				
Floating Material	--	Narrative Criteria	CVRWQCB 1998	Aesthetics - Absent by visual observation
Oil and Grease (REC-1, REC-2)				
Oil & Grease	--	Narrative Criteria	CVRWQCB 1998	Aesthetics - Absent by visual observation
Total Petroleum Hydrocarbons	TPH	None	--	--
pH (COLD, SPAWN, WILD)				
pH	--	6.5-8.5	CVRWQCB 1998	Aquatic life protection
Sediment and Settleable Solids (REC-2, SPAWN, WILD)				
Sediment	--	Narrative Criteria	CVRWQCB 1998	--
Tastes and Odors (MUN)				
Aluminum	Al	0.2 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Chloride	Cl	250 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Copper	Cu	1.3 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Iron	Fe	0.3 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Silver	Ag	0.1 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Specific Conductance	--	900 umhos	CDPH 2010 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Sulfate	SO_4	250 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Total Dissolved Solids	TDS	500 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Zinc	Zn	5 mg/L	CDPH 2010 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]

Basin Plan Water Quality Objective (Potentially Affected Beneficial Uses)	Symbol or Abbreviation	Benchmark Values	Reference	Notes
Toxicity (COLD, SPAWN, MUN) ***CTR values listed below generally assume Total Recoverable Concentrations (unfiltered)[4,5]***				
Ammonia as N (pH and Temp dependent)	NH_3-N	24.1 mg/L (CMC); 4.1-5.9 mg/L (CCC)	EPA 2000	CTR criteria over 0-20°C assuming pH 7.0
		5.6 mg/L (CMC); 1.7-2.4 mg/L (CCC)	EPA 2000	CTR criteria over 0-20°C assuming pH 8.0
		0.9 mg/L (CMC); 0.3-0.5 mg/L (CCC)	EPA 2000	CTR criteria over 0-20°C assuming pH 9.0
Arsenic	As	0.34 mg/L (CMC); 0.15 mg/L (CCC)	EPA 2000	CTR criteria
Cadmium (hardness dependent)	Cd	0.23 µg/L (CMC); 0.15 µg/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 5 mg/L as $CaCO_3$
		0.4 µg/L (CMC); 0.34 µg/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 10 mg/L as $CaCO_3$
		0.56 µg/L (CMC); 0.53 µg/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 15 mg/L as $CaCO_3$
		0.83 µg/L (CMC); 0.95 µg/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 25 mg/L as $CaCO_3$
Copper (hardness dependent)	Cu	0.83 µg/L (CMC); 0.72 µg/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 5 mg/L as $CaCO_3$
		1.6 µg/L (CMC); 1.3 µg/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 10 mg/L as $CaCO_3$
		2.34 µg/L (CMC); 1.84 µg/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 15 mg/L as $CaCO_3$
		3.79 µg/L (CMC); 2.85 µg/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 25 mg/L as $CaCO_3$
Lead (hardness dependent)	Pb	0.54 µg/L (CCC) 14 µg/L (CMC)	EPA 2000	CTR for unfiltered sample assuming hardness of 25 mg/L as $CaCO_3$
Mercury	Hg	0.050 µg/L	EPA 2000 40 CFR 131.38	CTR/Federal Register 5/18/00
Nitrate-Nitrite	NO_3-N+NO_2-N	10 mg/L (combined total)	CDPH 2010 cited in CVRWQCB 1998	Title 22 Primary MCL (“Blue baby Syndrome”)

Basin Plan Water Quality Objective (Potentially Affected Beneficial Uses)	Symbol or Abbreviation	Benchmark Values	Reference	Notes
Silver (hardness dependent)	Ag	0.02 µg/L (CMC) instantaneous	EPA 2000	CTR for unfiltered sample assuming hardness of 5 mg/L as $CaCO_3$
		0.08 µg/L (CMC) instantaneous	EPA 2000	CTR for unfiltered sample assuming hardness of 10 mg/L as $CaCO_3$
		0.16 µg/L (CMC) instantaneous	EPA 2000	CTR for unfiltered sample assuming hardness of 15 mg/L as $CaCO_3$
		0.37 µg/L (CMC) instantaneous	EPA 2000	CTR for unfiltered sample assuming hardness of 25 mg/L as $CaCO_3$
Zinc (hardness dependent)	Zn	9.47 µg/L	EPA 2000	CTR for unfiltered sample assuming hardness of 5 mg/L as $CaCO_3$
		17.03 µg/L	EPA 2000	CTR for unfiltered sample assuming hardness of 10 mg/L as $CaCO_3$
		24.01 µg/L	EPA 2000	CTR for unfiltered sample assuming hardness of 15 mg/L as $CaCO_3$
		37.02 µg/L	EPA 2000	CTR for unfiltered sample assuming hardness of 25 mg/L as $CaCO_3$
Aldrin	--	3.0 µg/L	Marshack 2008	AWQC
Chlordane	--	0.0043 µg/L	Marshack 2008	AWQC
Chlorpyrifos	--	0.014 µg/L	Marshack 2008	AWQC
Diazinon	--	0.05 µg/L[5]	Marshack 2008	AWQC
Dieldrin	--	0.056 µg/L	Marshack 2008	AWQC
Endosulfan	--	0.056 µg/L	Marshack 2008	AWQC
Endrin	--	0.036 µg/L	Marshack 2008	AWQC
Heptachlor	--	0.0038 µg/L	Marshack 2008	AWQC
Heptachlor epoxide	--	0.0038 µg/L	Marshack 2008	AWQC
alpha-Hexachlorocyclohexane	--	0.08 µg/L	Marshack 2008	AWQC
beta-Hexachlorocyclohexane	--	0.08 µg/L[6]	Marshack 2008	AWQC
delta-Hexachlorocyclohexane	--	0.08 µg/L[6]	Marshack 2008	AWQC
gamma-Hexachlorocyclohexane	--	0.08 µg/L	Marshack 2008	AWQC
Toxaphene	--	0.0002 µg/L	Marshack 2008	AWQC

Basin Plan Water Quality Objective (Potentially Affected Beneficial Uses)	Symbol or Abbreviation	Benchmark Values	Reference	Notes
Turbidity (COLD, SPAWN, WILD, MUN)				
Turbidity	NTU	increase < 1 NTU for 1-5 NTU background; increase < 20% for 5-50 NTU background	CVRWQCB 1998	Aesthetics, disinfection, egg incubation

1 Note a chemical may be listed under more than one beneficial use.
2 CDPH Title 22 identified as minimum water quality thresholds, but acknowledged as insufficiently protective in some cases (CVRWQCB 1998).
3 Guidance level to protect those individuals restricted to a total sodium intake of 500 mg/day (Marshack 2008).
4 CMC: Criterion Maximum Concentration (one-hour acute exposure) for aquatic toxicity as defined by EPA (2000).
5 CCC: Criterion Continuous Concentration (four-day chronic exposure) for aquatic toxicity as defined by EPA (2000).
6 Value is for gama-hexachlorocyclohexane.

Key:
AGR = agricultural supply
AWQC = Ambient Water Quality Criteria
EPA = Environmental Protection Agency
$CaCO_3$ = Calcium carbonate
CMC = Criterion Maximum Concentration (1-hour acute exposure) for aquatic toxicity as defined by EPA (2000)
CCC = Criterion Continuous Concentration (4-day chronic exposure) for aquatic toxicity as defined by EPA (2000)
COLD = cold freshwater habitat
CTR = California Toxics Rule
MCL = Maximum Contaminant Level
MUN = municipal and domestic supply
REC-1 = water contact recreation
REC-2 = water non-contact recreation
µmhos = micromhos
µg/L = micrograms per liter
mg/L = milligrams per liter
MPN = Most Probable Number
NTU = Nephelometric turbidity units
SM = Standard Method
SPAWN = spawning, reproduction and/or early development
WILD = wildlife habitat

The Districts observed no inconsistencies for 13 of the 15 applicable Basin Plan WQOs, including : (1) Biostimulatory Substances, (2) Chemical Constituents, (3) Color, (4) pH, (5) Pesticides, (6) Sediment (7) Settleable Material, (8) Taste and Odor, (9) Toxicity, including mercury and methylmercury, (10) Turbidity, (11) Bacteria, (12) Floating Material, and (13) Oil and Grease. Some inconsistencies were observed for two objectives: (1) Toxicity and (2) DO.

Biostimulatory Substances

The Basin Plan requires that water shall not contain biostimulatory substances that promote aquatic growth in concentrations that cause nuisance or adversely affect designated beneficial uses.

In August 2012, nitrate concentrations ranged between 0.037 mg/L (estimated[7]) and 0.11 mg/L, and nitrite concentrations and total Kjeldahl Nitrogen were not detectable. Total phosphorous levels were similarly low, ranging between 0.025 mg/L (estimated) and the reporting limit of 0.10 mg/L. Orthophosphate concentrations were only detected in one sample at 0.051 mg/L (estimated). These low nutrient levels suggest that biostimulatory substances are not currently present in sufficient quantities to cause nuisance conditions related to algal blooms or decreased water clarity. The Districts are unaware of any instances where algal blooms or decreased water clarity have been reported as a nuisance.

7 If an analyte was detected at a concentration below the reporting limit, but above the laboratory method detection limit, its concentration was reported by the laboratory as estimated.

Chemical Constituents

The Basin Plan requires that water shall not contain chemical constituents in concentrations that adversely affect designated beneficial uses. The Basin Plan requires that water designated for use as domestic or municipal supply shall not contain concentrations of chemical constituents in excess of the maximum contaminant levels (MCLs) specified in the provisions of Title 22 of the CCR (CDPH 2010).

MCLs are intended to be applied to finished tap water, but were conservatively applied to untreated water in this study. Samples collected in August 2012 had concentrations less than the primary MCLs for all analytes, i.e. water quality at the sampled locations was found to be consistent with drinking water standards (TID/MID 2013a). Analytes with secondary MCLs for tastes and odors and aquatic toxicity are discussed below.

Color

The Basin Plan includes a narrative WQO regarding color. The FERC-approved study plan did not require sampling for color. The Districts are aware of no instances where the color of the water in the vicinity of the Don Pedro Project has been reported as a nuisance or has adversely affected designated beneficial uses.

pH

The Basin Plan requires that pH shall neither be depressed below 6.5 nor raised above 8.5. During August 2012 sampling, three locations had a pH value outside these limits: the inflow sample of the Tuolumne River above Don Pedro Reservoir (6.40 su), the mid-reservoir hypolimnion of Don Pedro Reservoir (6.47 su), and the near-dam hypolimnion of Don Pedro Reservoir (6.43 su). For a low nutrient, snow-melt derived reservoir, these values are within the sonde's measurement error of ± 0.1 mg/L and are therefore considered to be consistent with the objective. Also, the lowest value (6.40 su) was measured in the Tuolumne River upstream of the reservoir, i.e., above the influence of the Don Pedro Project.

Pesticides

Significant pesticide use does not occur within the Don Pedro Project Boundary or in association with Don Pedro Project O&M activities. Furthermore, the Districts are aware of no instances where pesticide use in the vicinity of the Project Boundary has been reported to cause a nuisance or adversely affect designated beneficial uses.

Downstream of the Project Boundary, the section of the Tuolumne River from Don Pedro Reservoir to the San Joaquin River is included in the State of California's CWA § 303(d) list in relation to the non-point discharge of some agricultural pesticides (SWRCB 2010). Agricultural chemicals on the 303(d) list are chlorpyrifos, diazinon, and the Group A Pesticides—aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexanes (including lindane), endosulfan, and toxaphene. Pesticides on the 303(d) list for the lower Tuolumne River were not detected in any of the August 2012 samples (TID/MID 2013a) analyzed at the commercially available reporting limits. However, because the detection limits for chlordane and toxaphene exceeded the reporting limits for those analytes, consistency with benchmarks could not be determined irrefutably. Nonetheless, as stated above, because significant pesticide use does not occur in association with the Don Pedro Project, these non-detects are considered applicable–chlordane and toxaphene are not present in Don Pedro Project waters.

Sediment

The Basin Plan requires that suspended sediment load and suspended sediment discharge to surface waters shall not alter surface waters in such a manner as to cause a nuisance or adversely affect beneficial uses of water within the Project Boundary or other water. Total dissolved solids and total suspended solids were low in August 2012 (10 to 38 mg/L and 1.0 to 3.1 mg/L, respectively). The Districts are aware of no sediment discharges to surface water related to the Don Pedro Project. Additionally, the Districts are aware of no suspended sediment levels or discharges that cause a nuisance or adversely affect any designated beneficial uses of water within the Project Boundary or other nearby water.

Settleable Material

The Basin Plan requires that waters shall not contain substances in concentrations that result in the deposition of material that causes nuisance or adversely affects beneficial uses. The FERC-approved study (TID/MID 2013a) did not include a provision for evaluating settleable material. The Districts are aware of no settleable material present in Don Pedro Project water or settleable material that causes a nuisance or adversely affects any designated beneficial uses of Don Pedro Project or other nearby water.

Tastes and Odor

The Basin Plan requires that waters shall not contain taste- or odor-producing substances in concentrations that impart undesirable tastes or odors to domestic or municipal water supplies or to fish flesh or other edible products of aquatic origin, or that cause nuisance, or otherwise adversely affect beneficial uses of Don Pedro Project or other nearby water.

During the 2012 sampling, iron was measured at a level less than its secondary MCL of 0.3 mg/L for taste and odors at all locations, but one. Above Don Pedro, the inflow sample had an iron concentration of 3.14 mg/L. Secondary MCLs are routinely applied at the point of use (i.e., “at the tap”) and existing water treatment methods appear to be adequate to meet these secondary water quality criteria. Furthermore, the 3.14 mg/L measurement reflects conditions upstream of the reservoir and therefore outside the influence of the Don Pedro Project. The Districts are aware of no reports that taste or odor of water or fish caught in Don Pedro Reservoir cause a nuisance or otherwise adversely affect designated beneficial uses of Don Pedro Project or other nearby water.

Toxicity

The Basin Plan requires that waters shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life. The FERC-approved study plan states that water quality data collected as part of the study would be compared to the aquatic life protective benchmarks from EPA (2000) CTR or benchmarks excerpted from Marshack (2008) *A Compilation of Water Quality Goals*. The low levels of hardness found throughout the study area are expected to increase the aquatic toxicity of some metals due to the greater proportion of free ions found in many trace metals. At the low hardness levels found in the study (i.e., 6 to 15 mg/L), sample-specific dissolved cadmium, copper, lead, silver, and zinc CTR criteria were calculated (see Attachment C, Table C-2 of TID/MID 2013a). Of these five metals, only copper exhibited a concentration greater than its sample specific CTR– and only in two samples. The mid-reservoir hypolimnion of Don Pedro Reservoir had a copper (dissolved) concentration of 6.25 micrograms per liter (μg/L), as compared to a CTR guideline of 1.8 μg/L, and the near-dam hypolimnion of Don Pedro Reservoir had a copper (dissolved) concentration of 8.16 μg/L. The Districts are aware of no O&M activity that may affect levels of copper. As reported in the PAD (TID/MID 2011), algaecides are not used to manage algae in Don Pedro Project waters.

Mercury and Methylmercury

The section of the Tuolumne River from the outlet of Don Pedro Reservoir to the San Joaquin River is included in the State of California's CWA Section 303(d) list of impaired and threatened waters. The pollutant stressors identified in the 303(d) list are primarily related to agriculture, but the list also includes mercury, a legacy contaminant of the gold mining era (SWRCB 2010). Mercury is bioaccumulated by transfer through the food-web to organisms at higher trophic levels, such as piscivorous fish, which can lead to adverse effects on the nervous systems of these higher trophic organisms.

In August 2012, mercury was detected at all locations at concentrations that ranged between 0.08 and 4.57 nanograms per liter (ng/L). These total mercury concentrations are far less than the MCL of 0.002 mg/L (2,000 ng/L), indicating that the drinking water beneficial use is being met everywhere in the Don Pedro Project Boundary for mercury. In addition, the samples were below the CTR benchmark of 50 ng/L.

Samples were also analyzed for total methylmercury and dissolved methylmercury. Methylmercury (total) was detected in three of the eight samples. Samples that contained methylmercury were collected from the Tuolumne River inflow above Don Pedro Reservoir (0.029 ng/L), the mid-reservoir hypolimnion of Don Pedro Reservoir (0.042 ng/L, estimated), and the near-dam hypolimnion of Don Pedro Reservoir (0.053 ng/L). Methylmercury (dissolved) was detected in the mid-reservoir hypolimnion of Don Pedro Reservoir (0.293 ng/L), and the near-dam hypolimnion of Don Pedro Reservoir (0.394 ng/L). These data show that methylmercury is present; however, the exact concentration is uncertain. The reported dissolved concentrations are greater than total concentrations, and the laboratory cannot explain why, other than the results reflect the difficulty of measuring methylmercury near its reporting limits.

These data are consistent with reports of water quality and fish tissue data collected between fall 2008 and spring 2009 in which water quality samples and higher trophic level fish species were collected from nine sites within, upstream of, and downstream of Don Pedro Reservoir (TID/MID 2009). Like this study, methylmercury was not detected below either the Don Pedro Dam or La Grange Diversion Dam, but methylmercury was detected in hypolimnetic samples in the Moccasin Creek arm (0.15 ng/L) and Woods Creek (0.145 ng/L) arm of Don Pedro Reservoir. However, unlike the 2012 study, no mercury was detected in water samples collected from the Tuolumne River upstream of Don Pedro Reservoir.

Stillwater Sciences (TID/MID 2009) found evidence of fish mercury bioaccumulation. Concentrations in excess of the EPA (2001) fish tissue residue criterion (0.3 milligrams/kilogram (mg/kg)) were found at all sites within Don Pedro Reservoir, as well as downstream of La Grange Diversion Dam in the lower Tuolumne River, with the highest fish tissue mercury concentrations (0.29 to 0.99 mg/kg) observed in largemouth bass sampled from the shallow Moccasin Creek and Woods Creek arms of Don Pedro Reservoir. The Office of Environmental Health Hazard Assessment (OEHHA) has not issued a fish ingestion advisory for Don Pedro Reservoir (OEHHA 2009).

The Districts are aware of no Don Pedro Project O&M activity that may affect mercury methylation and do not propose any activities that may be associated with the release or mobilization of mercury.

Turbidity

The Basin Plan requires that waters be free of changes in turbidity that cause nuisance or adversely affect beneficial uses. This objective is expressed in terms of changes in turbidity (NTU) in the receiving water body: where natural turbidity is 0 to 5 NTUs, increases shall not exceed 1 NTU; where natural turbidity is 5 to 50 NTUs, increases shall not exceed 20 percent; where natural turbidity is 50 to 100 NTUs, increases shall not exceed 10 NTUs; and where natural turbidity is greater than 100 NTUs, increase shall not exceed 10 percent.

Spatial upstream-to-downstream turbidity trends are best seen in the data as presented in Attachment C of the Water Quality study report, which provides sample results by location (TID/MID 2013a). In August 2012, turbidity was 8.6 NTU upstream of the Don Pedro Project (Tuolumne River above the Project Boundary) and 0 NTU downstream of the Project Boundary (below Don Pedro Dam). Three of the four intermediate locations also exhibited no turbidity. The mid-reservoir (surface) sample had a turbidity reading of 283 NTU. Review of temperature profiles indicated that this reading was near the metalimnion,[8] a location where plankton can accumulate. Turbidity was not recorded downstream of La Grange Diversion Dam.

There is no evidence to suggest that turbidity levels cause a nuisance or any adverse effects on beneficial uses in the study area or immediately downstream of the Don Pedro Project.

[8] The boundary between the thermal layers is the metalimnion, a zone of abrupt temperature change.

Bacteria

The Basin Plan includes a WQO (<200 MPN per 100 mL) for fecal coliform in waters designated for contact recreation (Table 3.4-2), but does not provide a WQO for total coliform or *Escherichia coli* (*E. coli*).

In 2012, all 12 recreation sites sampled had fecal coliform counts below the WQO for the time surrounding and including Independence Day (i.e., a period of intense recreational use of the Don Pedro Project area). The total coliform and *E. coli* benchmarks used to evaluate the bacteria counts are shown in Table 3.4-15. All total coliform counts and *E. coli* levels were below their respective benchmarks.

Floating Material

The Basin Plan's narrative WQO regarding floating material states that water shall be free of floating material in amounts that cause nuisance or adversely affect beneficial uses. The FERC-approved study did not include a provision for measuring floating material. The Districts are aware of no instances where floating material in Don Pedro Project waters has been reported as a potential problem.

Oil and Grease

The Basin Plan requires that water not contain oils, greases, waxes, or other material in concentrations that cause nuisance, result in visible film or coating on the surface of the water or on objects in the water, or otherwise adversely affect beneficial uses. In 2012, the Districts looked for and did not observe any oil and grease in Don Pedro Reservoir. Samples collected adjacent to 12 recreation sites on and around Independence Day were analyzed for total petroleum hydrocarbons. At all sites, total petroleum hydrocarbon levels were below the reporting limit of 50 µ/L.

Dissolved Oxygen

The general DO WQO of 7.0 mg/L applies to the Tuolumne River and its tributaries (CVRWQCB 1998). Synoptic measurements of DO in August 2012 were all above Basin Plan numerical limits (i.e., satisfying the WQO) except in the mid-reservoir hypolimnion (3.2 mg/L), and near-dam hypolimnion (4.8 mg/L) of Don Pedro Reservoir. These results were expected, because large, deep reservoirs and lakes generally form strong thermoclines[9] with oxygen poor hypolimnions in the late summer/fall period. DO concentrations were above the Basin Plan objective at all surface sites (TID/MID 2013a).

In addition to the 2012 Water Quality study data collection, the Districts have collected DO profiles since June 2011 in Don Pedro Reservoir. Tables 3.4-16 and 3.4-17 provide a summary of data collected from two of the eight locations, which are representative of conditions in the reservoir: (1) near the dam and (2) near the Highway 49 Bridge (approximately 13 miles upstream from the dam). Associated depths are shown in Figure 3.4-2.

[9] The thermocline is the location where the rate of temperature decrease with increasing depth is greatest.

Table 3.4-16. Monthly minimum, average and maximum dissolved oxygen (DO) concentrations (mg/L) in Don Pedro Reservoir near the dam for select months from June 2011 to September 2013.

Month	Minimum DO (mg/L)	Average DO (mg/L)	Maximum DO (mg/L)
2011			
June	7.7	8.4	9.3
July	7.0	8.0	9.8
August	6.6	7.5	8.4
September	6.2	7.1	8.1
October	5.7	7.0	8.4
November	5.9	6.9	8.1
2012			
March	5.0	6.8	10.5
April	3.7	7.0	11.0
May	4.1	6.6	9.6
June	4.0	5.9	8.2
July	4.2	6.3	8.9
August	4.6	6.6	8.1
September	3.3	5.6	7.9
October	3.3	5.5	8.0
November	3.4	5.7	8.2
2013			
February	2.6	4.7	7.5
March	0.7	5.4	7.8
April	5.1	5.7	6.9
May	5.7	6.8	8.5
June	5.7	6.7	8.9
July	5.1	6.1	7.8
August	No Data	No Data	No Data
September	5.7	6.7	8.5

Key: DO = Dissolved Oxygen
mg/L = milligram per Liter

Table 3.4-17. Monthly minimum, average and maximum dissolved oxygen (DO) concentrations (mg/L) in Don Pedro Reservoir near the Highway 49 Bridge for select months from June 2011 to September 2013.

Month	Minimum DO (mg/L)	Average DO (mg/L)	Maximum DO (mg/L)
2011			
June	5.7	9.3	10.6
July	6.8	8.4	9.4
August	0.8	6.8	8.4
September	2.1	6.3	8.0
October	0.8	6.3	8.1
November	5.4	7.0	8.0
2012			
March	8.6	9.0	9.9
April	No Data	No Data	No Data
May	7.8	8.7	9.5
June	5.9	6.9	7.4
July	5.5	6.6	7.2
August	No Data	No Data	No Data
September	0.6	4.4	7.9
October	No Data	No Data	No Data

Month	Minimum DO (mg/L)	Average DO (mg/L)	Maximum DO (mg/L)
November	0.0	4.7	8.3
2013			
February	7.5	8.0	8.7
March	6.9	7.8	8.3
April	6.6	7.2	7.6
May	6.6	7.8	8.4
June	5.8	7.5	8.5
July	4.5	5.9	6.8
August	No Data	No Data	No Data
September	1.4	4.3	8.4

Key: DO = Dissolved Oxygen
mg/L = milligram per Liter

DO concentrations in Don Pedro Reservoir are consistent with what is expected in deeper reservoirs and natural lakes of inland northern California. The profile is a positive heterograde curve indicating a metalimnetic[10] oxygen maxima. This occurs whenever a reservoir is stratified but most strongly in the summer. Increasing temperatures in the epilimnion result in decreased oxygen solubility, whereas typical oxygen consumption in the hypolimnion also results in a decrease in DO with depth. These metalimnetic oxygen maxima are almost always caused by algae populations producing oxygen in the metalimnion faster than they sink into the hypolimnion. The depth at which this occurs is often directly related to the transparency of water (Wetzel 1983). Figure 3.4-2 shows four reservoir DO profiles in Don Pedro Reservoir that demonstrate this condition. In the June, August, and October profiles, when the reservoir was stratified, the metalimnetic oxygen maxima are evident. Figure 3.4-3 provides the corresponding water temperature profiles.

[10] Near or around the metalimnion.

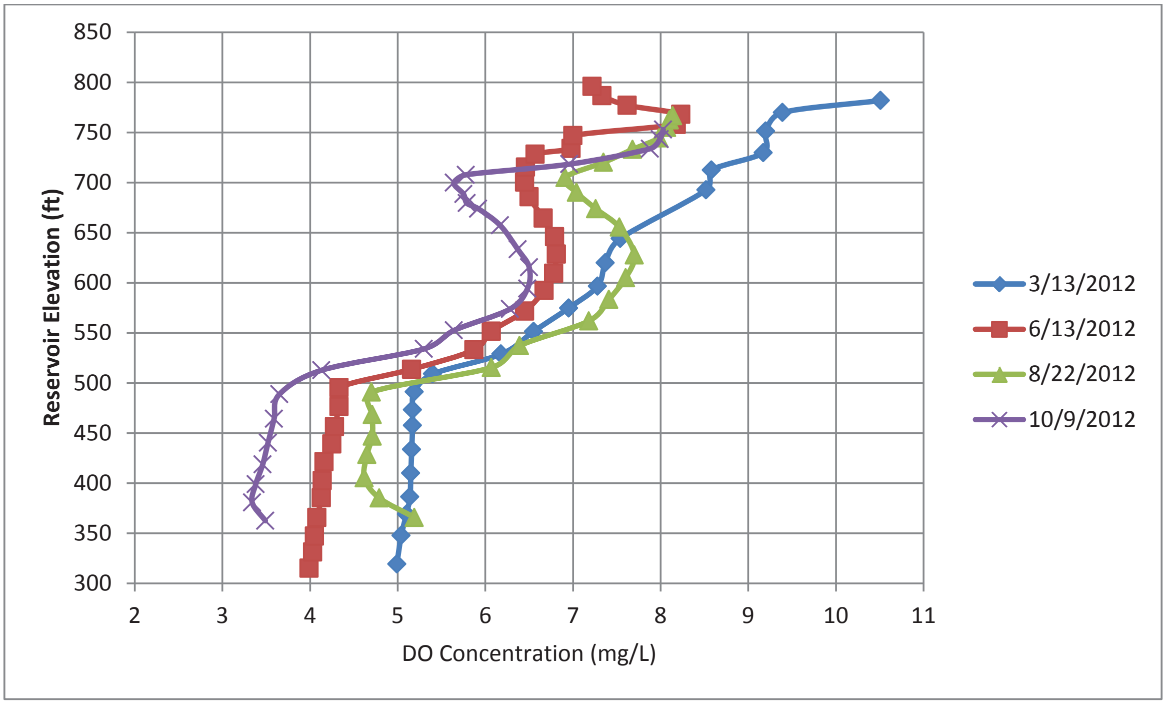

Figure 3.4-2. **Dissolved oxygen profiles collected in Don Pedro Reservoir near the dam during 2012.**

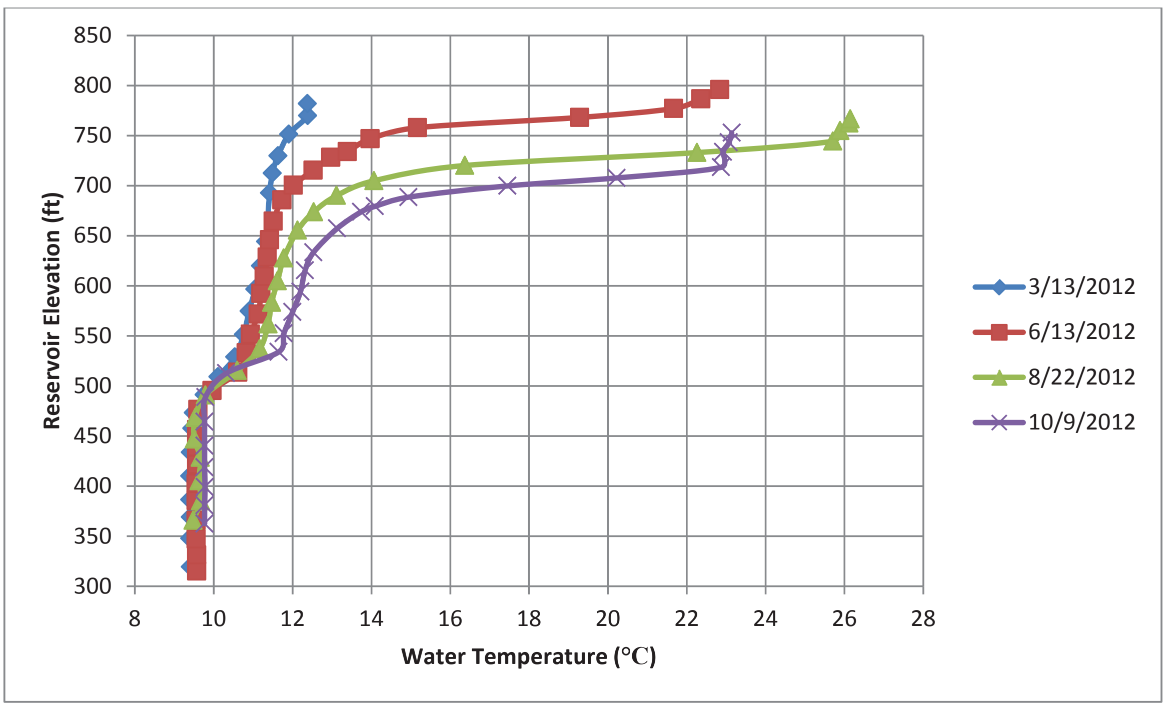

Figure 3.4-3. **Water temperature profiles collected in Don Pedro Reservoir near the dam during 2012.**

The Districts have also collected hourly DO data in the Tuolumne River downstream of Don Pedro Dam and powerhouse since late 2011. Table 3.4-18 shows the monthly minimum, maximum, and average hourly DO concentrations for 2012. In all but two months, October and November, each hour's DO concentration measured downstream of the dam is above the Basin Plan WQO of 7 mg/L. In October and November there were 17 days when at least one hourly recording was below 7 mg/L, with the lowest concentration being 5.8 mg/L. However, there were zero days in 2012 when the average of the day's 24 hourly DO measurements was below 7 mg/L.

Table 3.4-18. Monthly minimum, average and maximum dissolved oxygen (DO) concentrations (mg/L) in the Tuolumne River downstream of Don Pedro Dam and powerhouse in 2012.

Month	Minimum DO (mg/L)	Average DO (mg/L)	Maximum DO (mg/L)
2012			
January	8.6	10.1	11.4
February	8.2	10.0	12.4
March	8.4	9.2	12.1
April	8.4	9.3	10.9
May	8.8	9.6	10.6
June	8.6	9.6	10.7
July	8.3	9.2	10.3
August	8.2	9.1	10.4
September	7.4	8.8	10.3
October	6.8	8.4	10.7
November	5.8	8.7	11.0
December	8.6	8.9	9.1

Key: DO = Dissolved Oxygen
mg/L = milligram per Liter

3.4.1.5 Water Temperature Regime of Don Pedro Reservoir

A comprehensive set of water temperature data for Don Pedro Reservoir has been collected by both CDFW and the Districts. Since 2004, CDFW has collected monthly temperature profiles at six stations in Don Pedro Reservoir and, since 2010; the Districts' have collected monthly temperature profiles at eight locations (Table 3.4-19; Figure 3.4-4). The eight locations measured by the Districts consist of the six CDFW sites, a site upstream of old Don Pedro Dam, and a site downstream of old Don Pedro Dam.

Table 3.4-19. Don Pedro Reservoir temperature measurement locations with period of record.

Site Location[1]	Approximate River Mile	Latitude	Longitude	Period of Record
INFLOW TEMPERATURE				
Tuolumne River at Indian Creek Trail	83.0	37.88383	-120.15361	10/2010 - 11/2012
RESERVOIR TEMPERATURE				
At Ward's Ferry[2]	78.4	37.87744	-120.295	8/2004 – 11/2012
At Woods Creek Arm	--	37.88127	-120.415361	8/2004 – 11/2012
At Jacksonville Bridge	72.3	37.83733	-120.34525	8/2004 – 11/2012
At Highway 49 Bridge	70.1	37.83955	-120.378305	8/2004 – 11/2012
At Middle Bay	62.0	37.76794	-120.357	8/2004 – 11/2012
Upstream of Old Don Pedro Dam[3,4]	56.4	37.71316	-120.4005	7/2011 – 11/2012

Site Location[1]	Approximate River Mile	Latitude	Longitude	Period of Record
Downstream of Old Don Pedro Dam[3,4]	56.3	37.712083	-120.405	7/2011 – 11/2012
Upstream of Don Pedro Dam	55.1	37.702638	-120.421722	8/2004 – 11/2012
OUTFLOW TEMPERATURE				
Tuolumne River below Don Pedro Powerhouse[6]	54.3	37.6929	-120.421616	10/2010 - 11/2012

[1] Upstream and downstream data collection sites used to validate and calibrate the Reservoir Temperature Model are also listed herein (TID/MID 2013b).
[2] CCSF's site is located approximately at 763 msl and is riverine at reservoir elevations below that level. In recent years, CDFW started to collect the Ward's Ferry profiles at an alternative in-reservoir site.
[3] Old Don Pedro Dam at RM 56.4 was submerged in 1971 with the filling of Don Pedro Reservoir
[4] The Old Don Pedro Dam had 12 gated outlets arranged in two rows of six gates. Each outlet was 52-inches in diameter; the lower row of six have a centerline at elevation 421 ft and the upper row of six has a centerline of elevation 511 ft. All of these gates were left in the open position when Old Don Pedro Dam was inundated by the new Don Pedro Dam. There are also three 5-ft diameter sluiceway gates, each with a centerline at 355 ft; these gates are believed to be closed.
[5] Outflows from Don Pedro Reservoir are provided by the powerhouse intake tunnel with a centerline elevation of 534 ft.

Water temperatures in Don Pedro Reservoir are consistent with warm monomictic[11] lakes; temperatures do not drop below approximately 10º C and the reservoir circulates freely in winter and stratifies in summer. Ice does not form on the reservoir, and the reservoir mixes once in winter.

With respect to temperature patterns, the three years of data collection (2011, 2012, and 2013) represent a range of hydrologic conditions, with 2011 being a wet year, and 2012 and 2013 being dry years. Water temperature profiles are provided in Figure 3.4-5, Figure 3.4-6, and Figure 3.4-7, respectively. The 2011 vertical temperature profiles indicate that from January through March the reservoir was not stratified and equilibrium temperatures were around 10^{o} C. In April the data indicate significant warming at the surface, with temperatures around 18^{o} C, and initial reservoir stratification beginning to occur. The data for May and June look similar to April, but with the surface heat penetrating to some considerable depth. By July the surface temperatures have risen above 25^{o} C and the reservoir temperature stratification is well-defined. The profiles show a decrease in temperature with depth that extends some 200 ft until the temperature stabilizes around 10–12^{o} C. The temperature stratification remains strong through July, August, and September. At the end of September the reservoir is still strongly stratified, but surface temperatures have dropped by a couple of degrees and were just below 25^{o} C. When the last profiles were measured on October 13 of 2011 the reservoir remained stratified. Surface temperatures had continued to drop and were around 20^{o} C. The 2012 and 2013 years showed similar characteristics, but with some alteration probably due to being drier hydrologic years.

[11] A lake or reservoir that mixes one time each year.

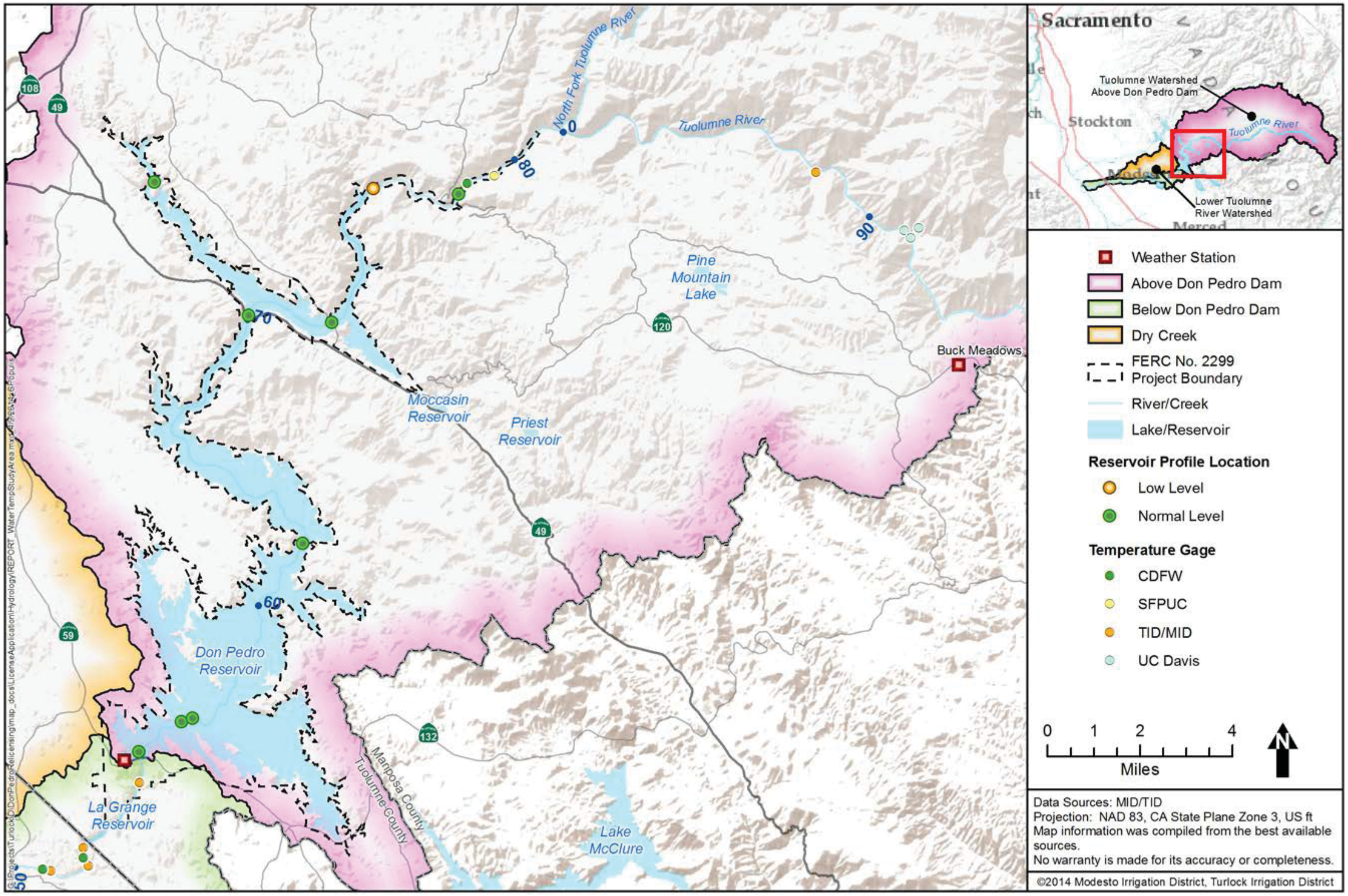

Figure 3.4-4. **Don Pedro Reservoir temperature profile locations.**

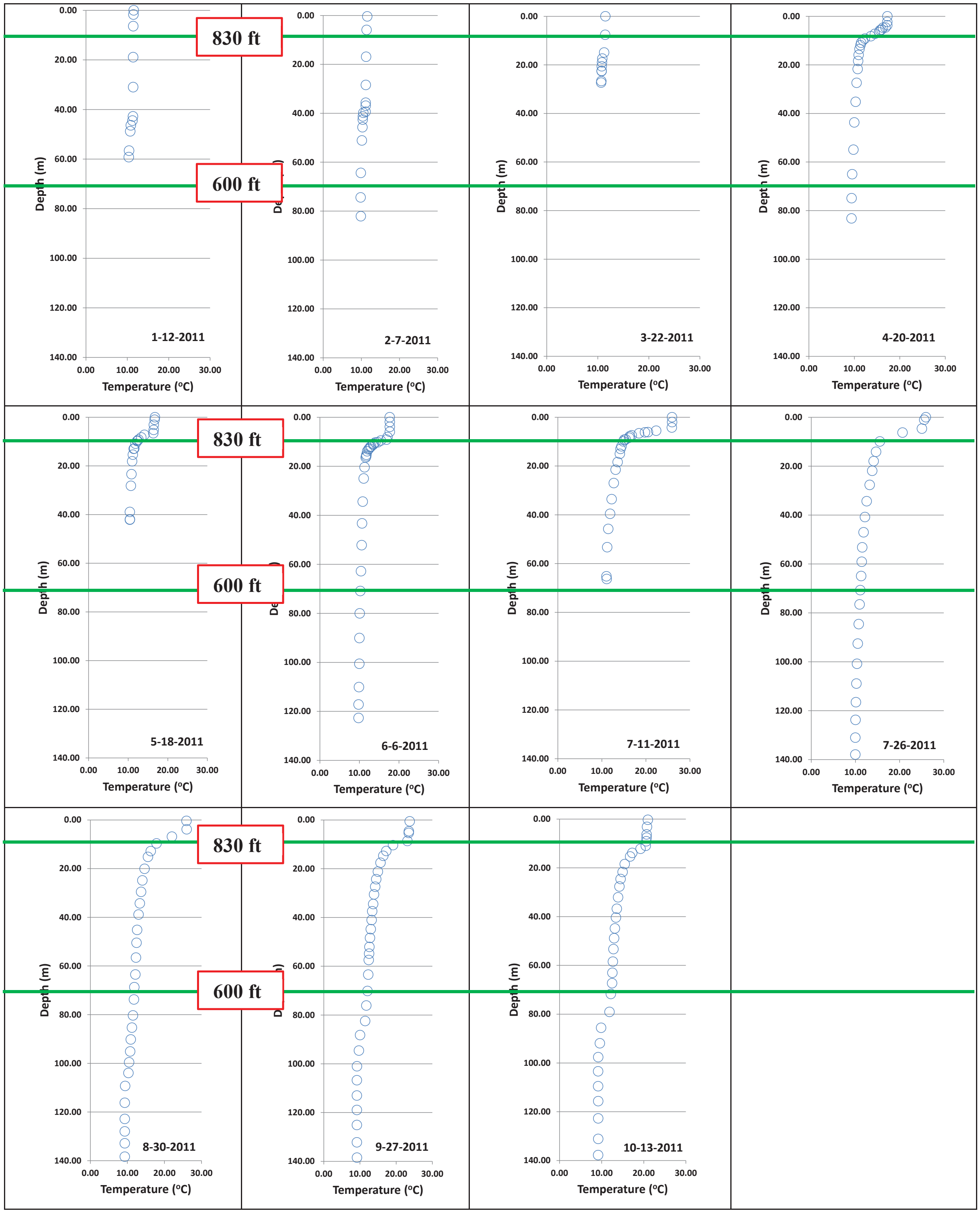

Figure 3.4-5. Water temperature profiles recorded in Don Pedro Reservoir in 2011; green lines indicate elevation.

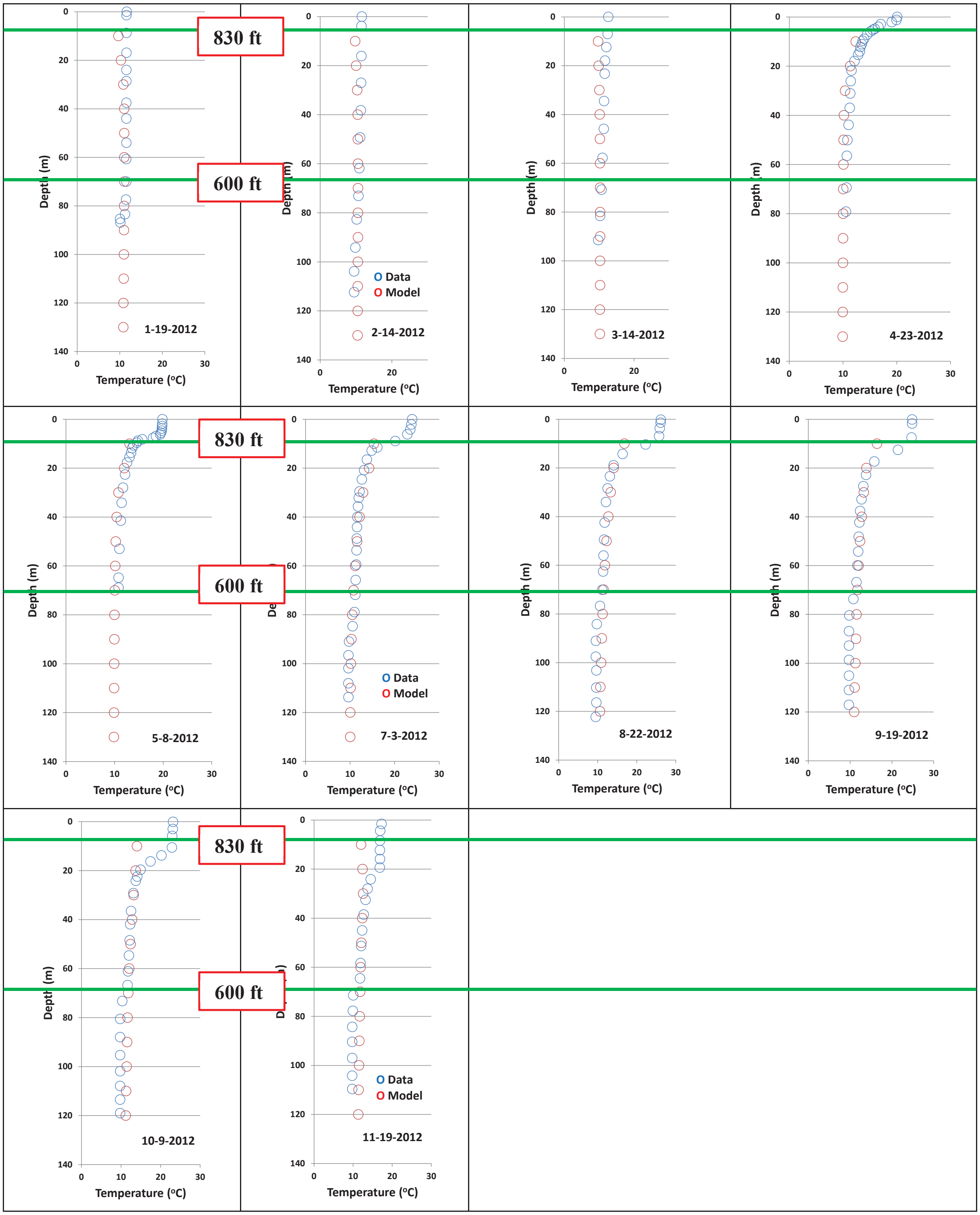

Figure 3.4-6. Water temperature profiles recorded in Don Pedro Reservoir in 2012; green lines indicate elevation.

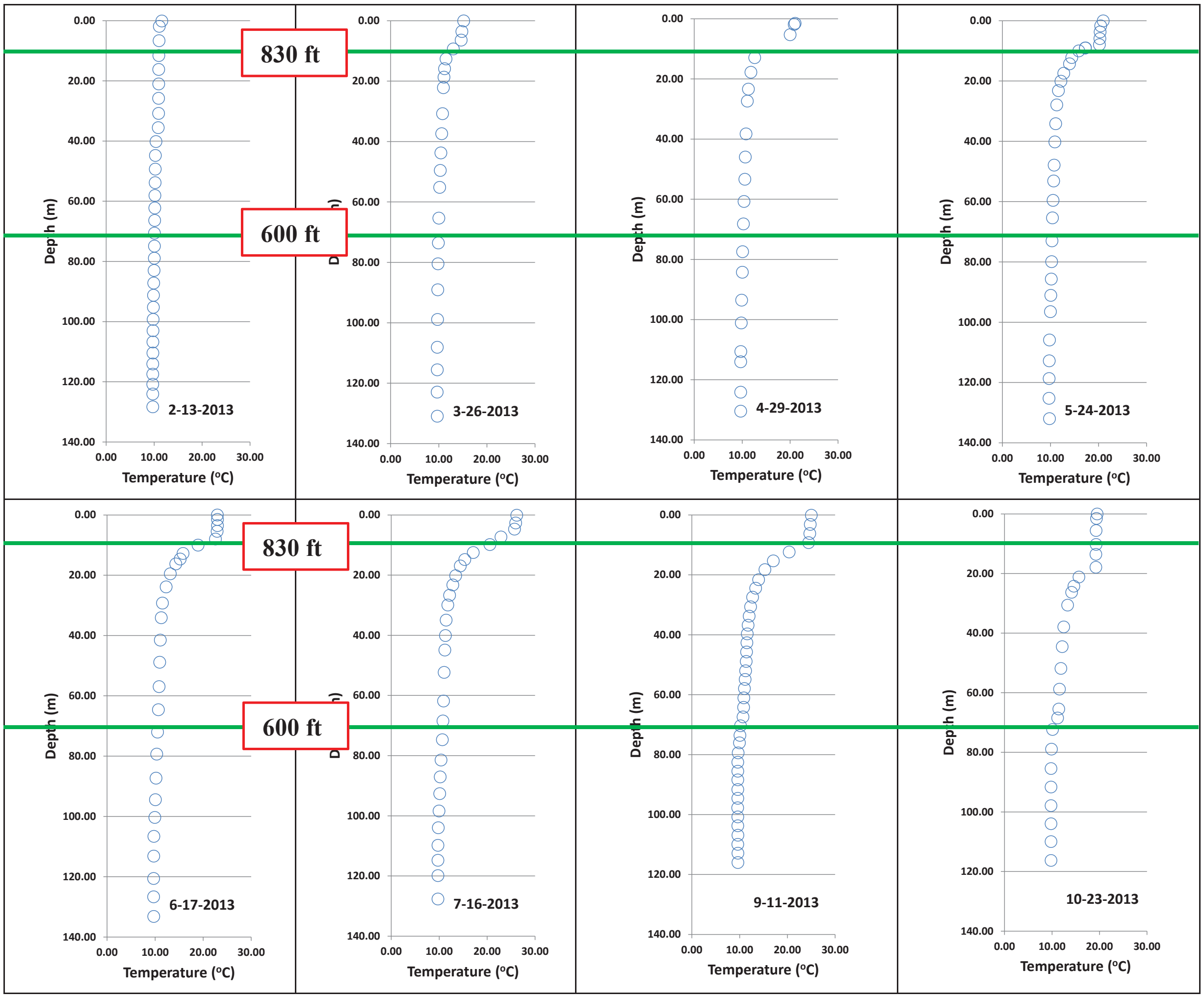

Figure 3.4-7. Water temperature profiles recorded in Don Pedro Reservoir in 2013; green lines indicate elevation.

3.4.1.6 Water Temperature between Don Pedro Dam and La Grange Diversion Dam

Temperatures in the Tuolumne River between Don Pedro Dam and La Grange Diversion Dam reflect the temperature of discharges released from the Don Pedro Project. Releases from Don Pedro Dam reflect hypolimnion temperatures in Don Pedro Reservoir and generally have not exceeded 13 ºC (55.4º F) and are often much cooler, being between 9, 5 degrees and 11.5 degrees most of the time (Table 3.4-20). The La Grange pool does not stratify because of its small size and low depths relative to the flow passing through it. By the time Don Pedro discharges reach La Grange Diversion Dam, water temperatures have warmed slightly, about 1ºC or less.

Table 3.4-20. Don Pedro hypolimnion, Don Pedro Project outflow, and La Grange pool temperature comparison.

Month	Average Temperature (°C)								
	Don Pedro Hypolimnion Upstream of Don Pedro Dam (DPDAM) Elevation 535 ft msl[1]; approx. RM 55.1			Don Pedro Project Outflow RM 54.3			Tuolumne River above La Grange Diversion Dam RM 52.2		
	8/2004 – 11/2012 (most of 2009 missing)			1/1987 - 9/1988 and 5/2010 - 2/2013			8/2011 – 12/2012		
	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest
January	10.8	11.4	10.2	10.5	11.7	8.9	11.3	11.3	11.3
February	10.1	11.0	9.5	9.7	11.4	8.5	10.8	10.8	10.8
March	10.1	10.7	9.3	9.3	11.1	7.8	10.8	10.8	10.8
April	10.2	11.4	9.3	9.4	10.9	8.3	10.9	10.9	10.9
May	10.4	10.8	9.8	9.8	11.1	8.6	11.0	11.0	11.0
June	10.7	11.6	10.0	10.2	11.7	9.0	11.2	11.2	11.2
July	11.0	12.1	10.4	10.6	11.7	9.4	11.5	11.5	11.5
August	11.3	12.2	10.6	10.9	12.2	9.4	11.8	11.8	11.8
September	11.4	11.9	10.8	11.1	12.2	10.0	12.0	12.0	12.0
October	11.5	11.9	11.0	11.3	12.2	10.0	12.1	12.1	12.1
November	11.4	12.0	10.7	11.3	13.3	9.3	11.2	11.2	11.2
December	11.5	12.3	11.1	11.2	12.2	10.1	11.2	11.2	11.2

[1] When profile did not extend down to 535 ft msl, the temperature measured at the bottom of the Don Pedro Reservoir profile was used for calculating averages.

Key: ft = feet, msl = mean sea level, RM = River Mile

The Basin Plan WQO for temperature states that "at no time or place shall the temperature of any COLD water be increased by more than 5°F above natural receiving water temperature" (CVRWQCB 1998, as amended). Temperatures in the reach downstream of the Project Boundary are dominated by the cold water released from the Don Pedro Project.

3.4.1.7 With- and Without-Dam Temperature Conditions

As explained previously, the focus of the Tuolumne River Flow and Water Temperature Model: Without Dams Assessment (Jayasundara et al. 2014) was to develop a flow and water temperature model to simulate water temperature conditions in the Tuolumne River without the existing Hetch Hetchy (including Cherry and Eleanor reservoirs), Don Pedro, and La Grange projects. The model was developed to complement detailed models developed for Don Pedro Reservoir and La Grange pool (TID/MID 2013c) and the lower Tuolumne River (TID/MID 2013d). Supporting data included the development of long-term flow and meteorological conditions to assess flow and water temperatures over a multi-decade period, i.e., 1970 to 2012.

Figures 3.4-8 through 3.4-17 provide a comparison of simulated without-dams 7DADM temperatures to simulated (below the Don Pedro Project) and empirically derived (above the Don Pedro Project) with-dams temperatures at the following locations: (1) below the South Fork Tuolumne River (≈ RM 98), (2) the Tuolumne River below Indian Creek (≈ RM 88), (3) immediately below Don Pedro Dam (≈ RM 54), (4) RM 51.5, 46, 40, 34, and 24 in the lower Tuolumne River above Dry Creek (5) and RM 10 and RM 1 on the lower Tuolumne River below Dry Creek.

Comparison of the 7DADM temperatures under with- and without-dams conditions upstream of the Don Pedro Project indicates that summer 7DADM water temperatures would be substantially warmer, up to 7°C, in the absence of the upstream Hetch Hetchy impoundments than they are under existing conditions, particularly at RM 98 (Figures 3.4-8 and 3.4-9). With-dams temperatures are nearly the same to slightly warmer, up to 2°C, than without-dams temperatures during much of the remainder of the year (Figures 3.4-8 and 3.4-9). As noted in the figure captions, plots for RM 98 and RM 88 compare simulated without-dams temperatures to empirically derived with-dams temperatures.

The without-dams simulation reveals that 7DADM water temperatures in the Tuolumne River mainstem, in the absence of impoundments, would approach thermal equilibrium well upstream of the current location of the Don Pedro Project, that is, without-dams temperature profiles at RMs 88 and 98 are essentially the same (Figures 3.4-8 and 3.4-9). Moreover, high without-dams 7DADM temperatures at RMs 88 and 98 (≈ 24°C) are similar to the high without-dams temperatures in the lower river (≈ 25°C) (compare Figures 3.4-8 and 3.4-9 to Figures 3.4-10–3.4-14).

Immediately below Don Pedro Dam (RM 54), with-dams 7DADM temperatures are relatively cool year-round, with little variability (Figure 3.4-10), because water is released from the reservoir's hypolimnion. Because of the thermal mass of the reservoir, water at depth is to a large degree buffered from the influence of seasonal and diel variability in air temperature and other climatic factors, at least when reservoir levels remain high. With-dams 7DADM temperatures are much cooler than without-dams temperatures in summer but are slightly warmer from November through February (Figure 3.4-10).

With-dams temperatures during summer rise significantly with increasing distance downstream of the Project Boundary. Under base case conditions, by RM 46, summer 7DADM temperatures have climbed back to 20°C, very close to the 7DADM temperatures experienced above Don Pedro Reservoir (Figure 3.4-12). However, this is still 5°C below without-dam conditions. By RM 40 (circa Roberts Ferry Bridge), average with-dam 7DADM temperatures in July reach 22°C (Figure 3.4-13). By RM 34, thermal equilibrium has largely been restored under with-dams conditions, i.e., the highest 7DADM temperatures in summer are around 24°C, very close to the 7DADM without-dams conditions (Figure 3.4-14). From this point downstream to the confluence with the San Joaquin River (Figures 3.4-15 - 3.4-17), with-dam 7DADM summer temperatures exceed without-dam temperatures by 2 to 3°C. Also, at all locations in the lower river, except immediately below Don Pedro Dam, there is a decrease in daily average water temperatures from mid-April to mid-May under the with-dams condition, which is the result of pulse flow releases scheduled to benefit fish downstream of La Grange Diversion Dam contained in the base case.

Without-dams temperatures are measurably cooler from mid-May (following the base case pulse flow) through the end of June downstream of about RM 40 under the base case.

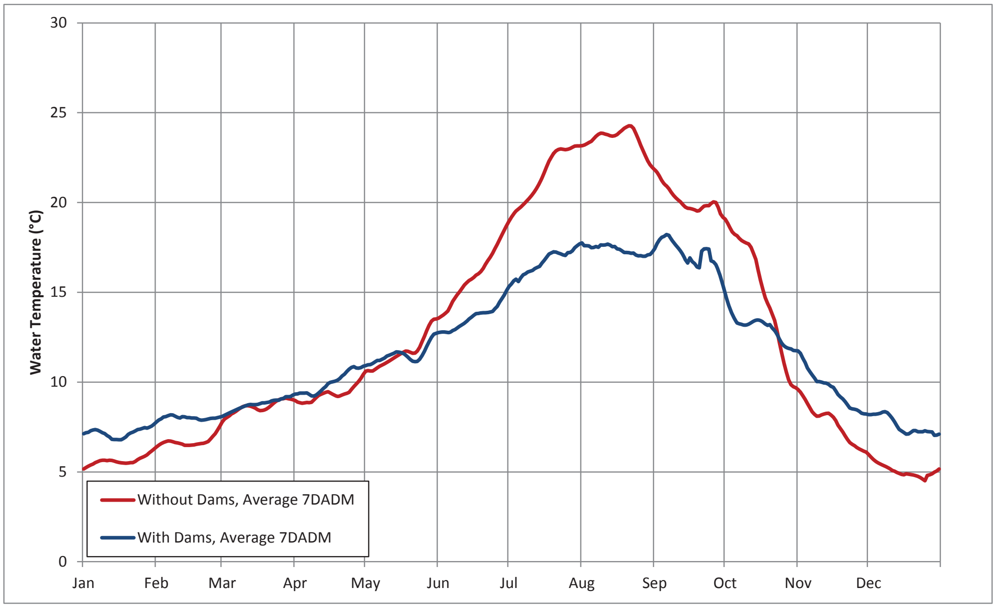

Figure 3.4-8. Comparison of 7DADM water temperatures under with- and without-dams conditions in the Tuolumne River below the South Fork Tuolumne River (≈RM 98). Without-dams temperatures are simulated based on the period 1970 - 2012 (Jayasundara et al. 2014), and with-dams temperatures are based on data collected by temperature loggers from 2005 - 2012.

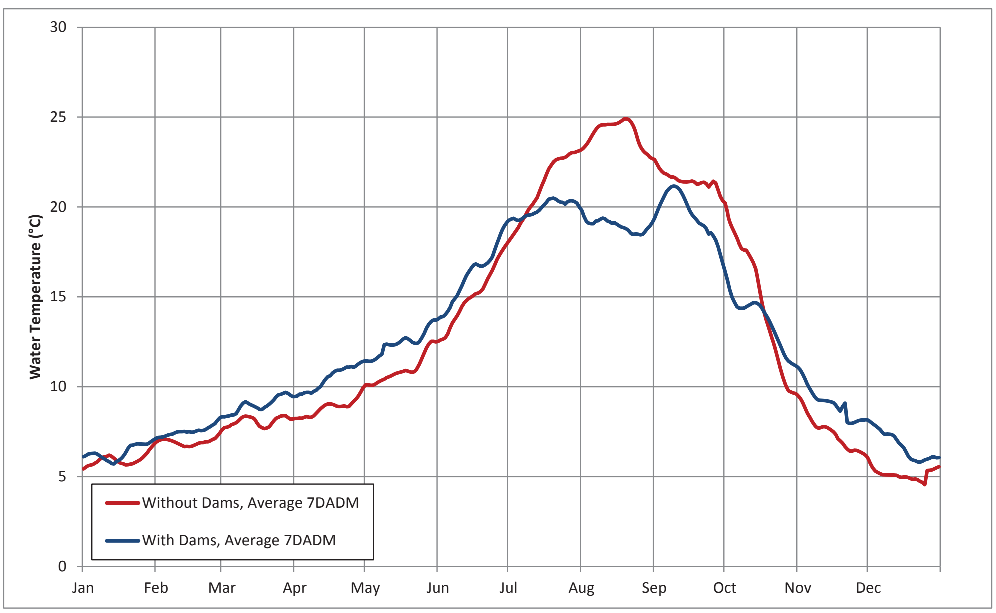

Figure 3.4-9. Comparison of 7DADM water temperatures under with- and without-dams conditions in the Tuolumne River below Indian Creek (≈RM 88). Without-dams temperatures are simulated based on the period 1970 - 2012 (Jayasundara et al. 2014), and with-dams temperatures are based on data collected by temperature loggers from 2009 – 2012.

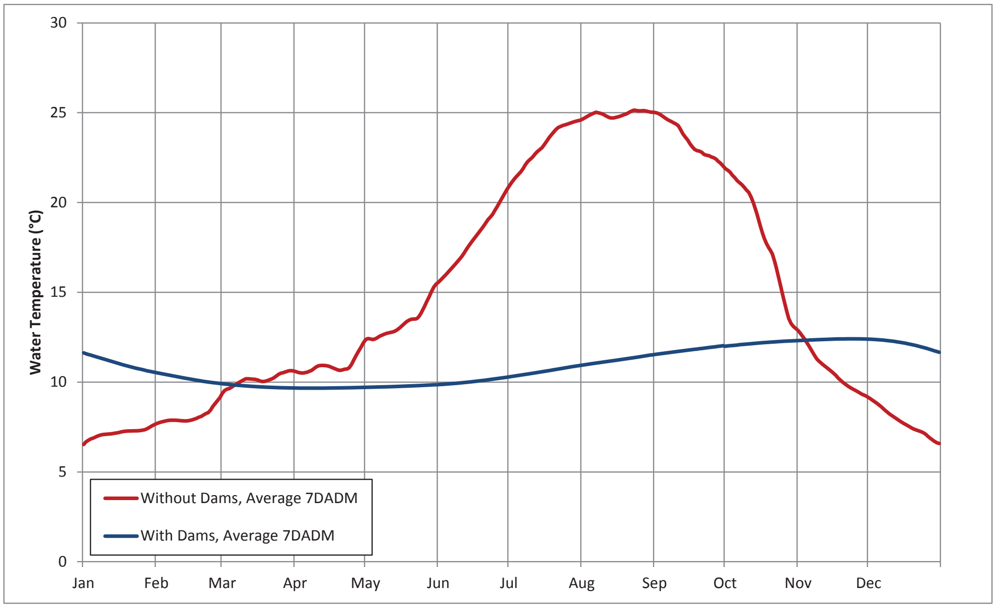

Figure 3.4-10. Comparison of 7DADM water temperatures under with- and without-dams conditions in the Tuolumne River below Don Pedro Dam (≈RM 54). Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 - 2012.

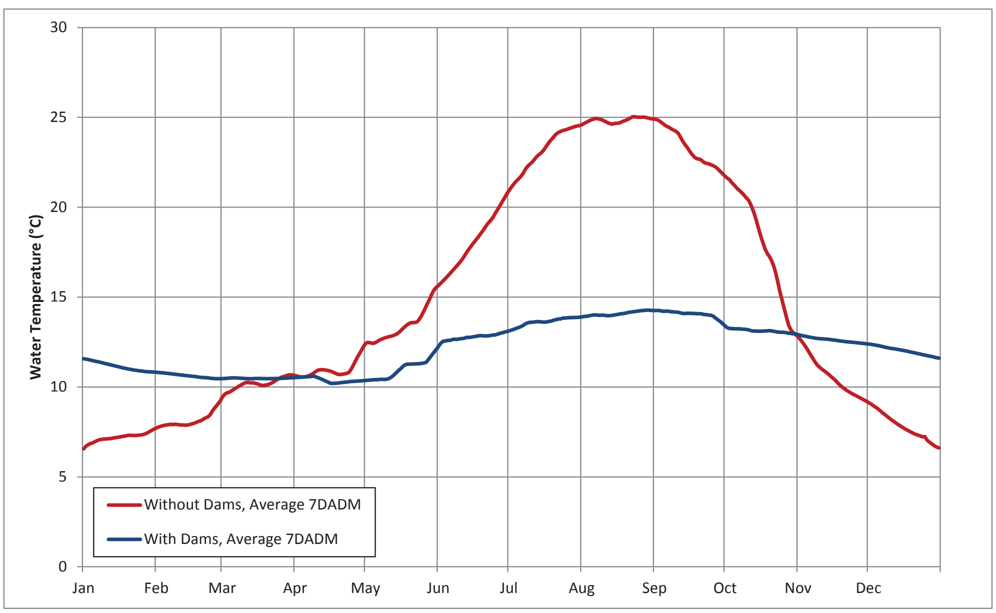

Figure 3.4-11. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 51.5. Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 – 2012.

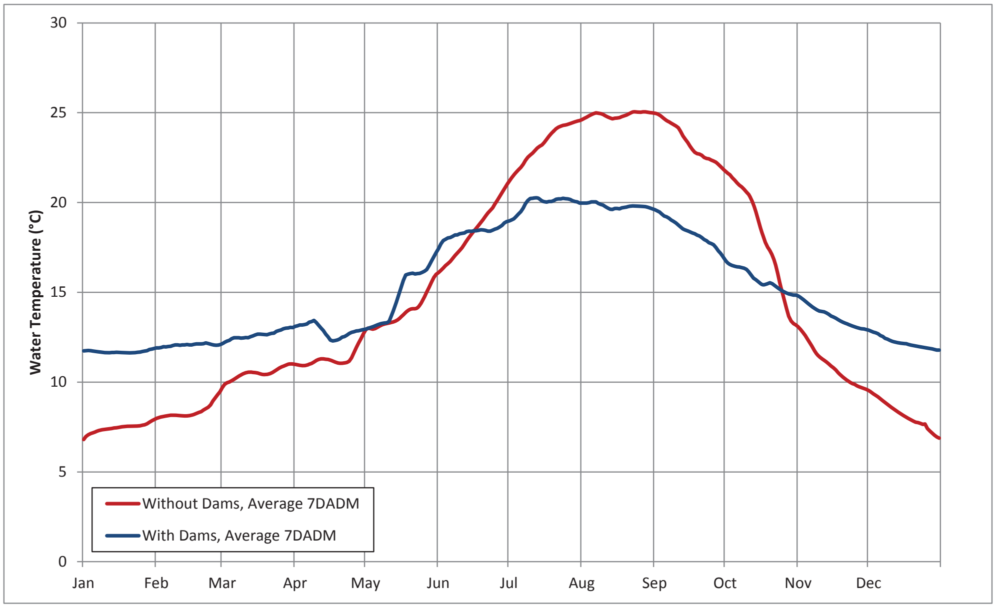

Figure 3.4-12. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 46. Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 - 2012.

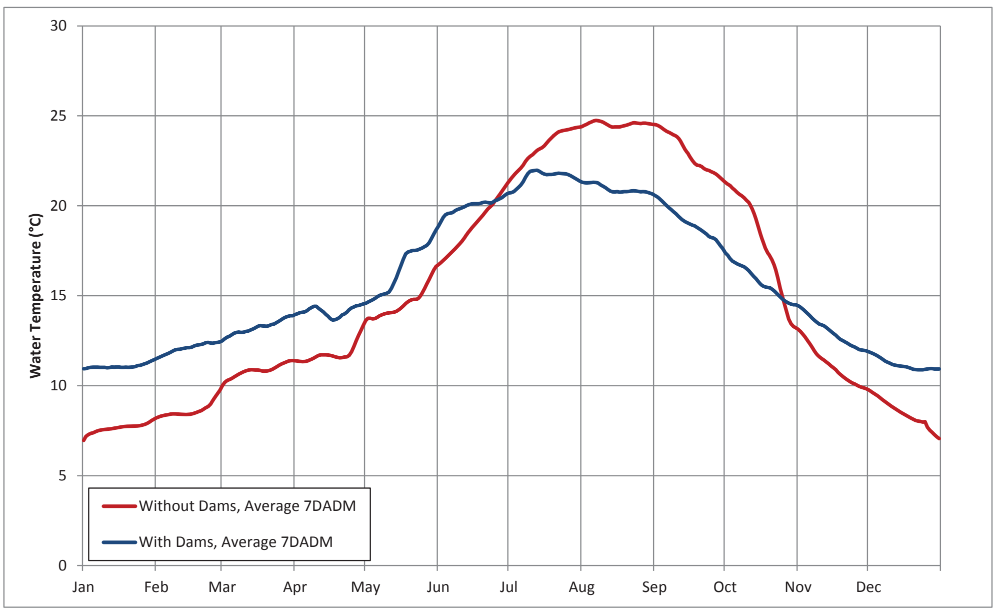

Figure 3.4-13. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 40. Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 - 2012.

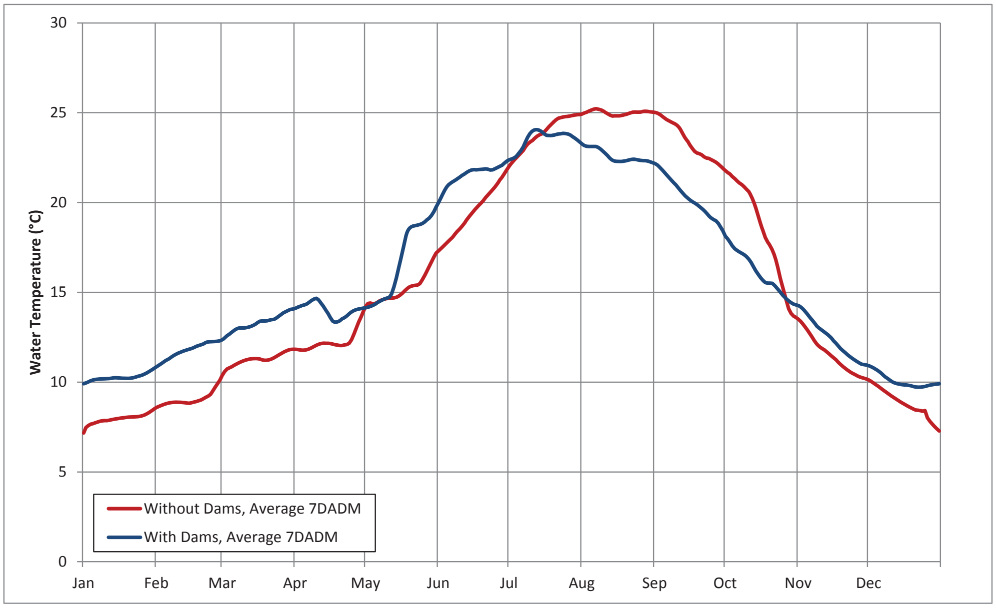

Figure 3.4-14. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 34. Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 - 2012.

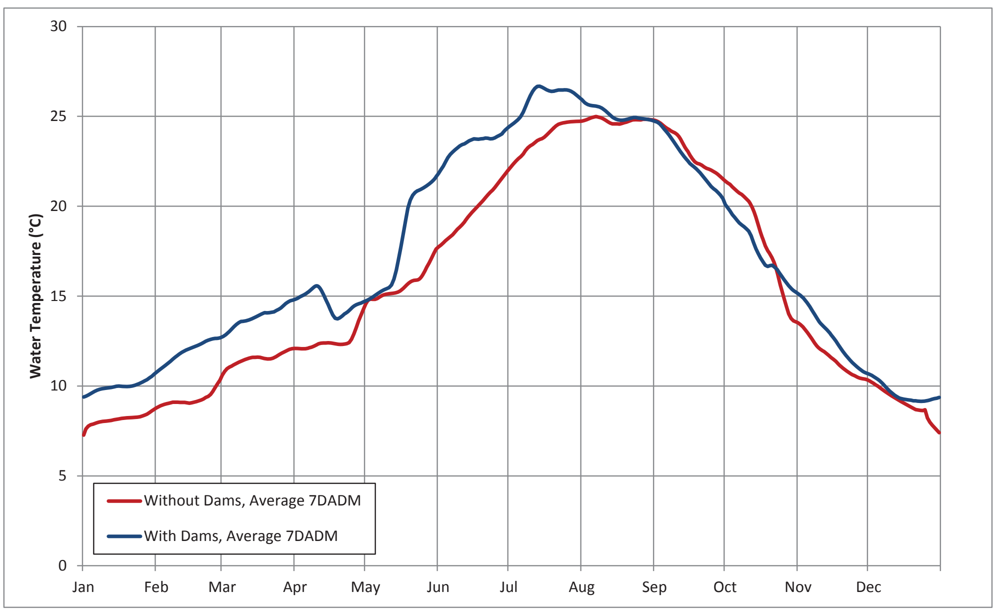

Figure 3.4-15. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 24. Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 - 2012.

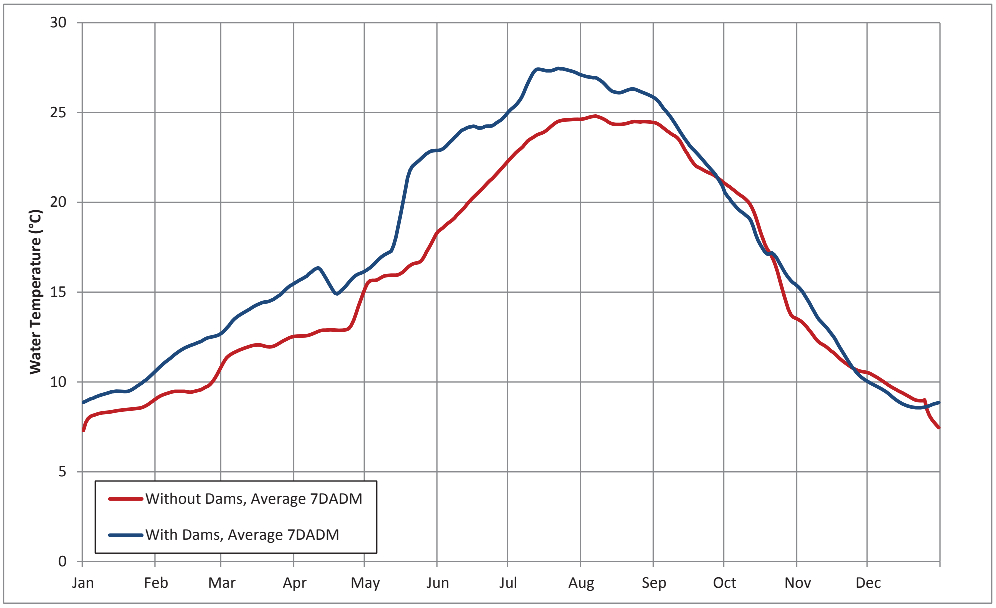

Figure 3.4-16. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 10. Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 - 2012.

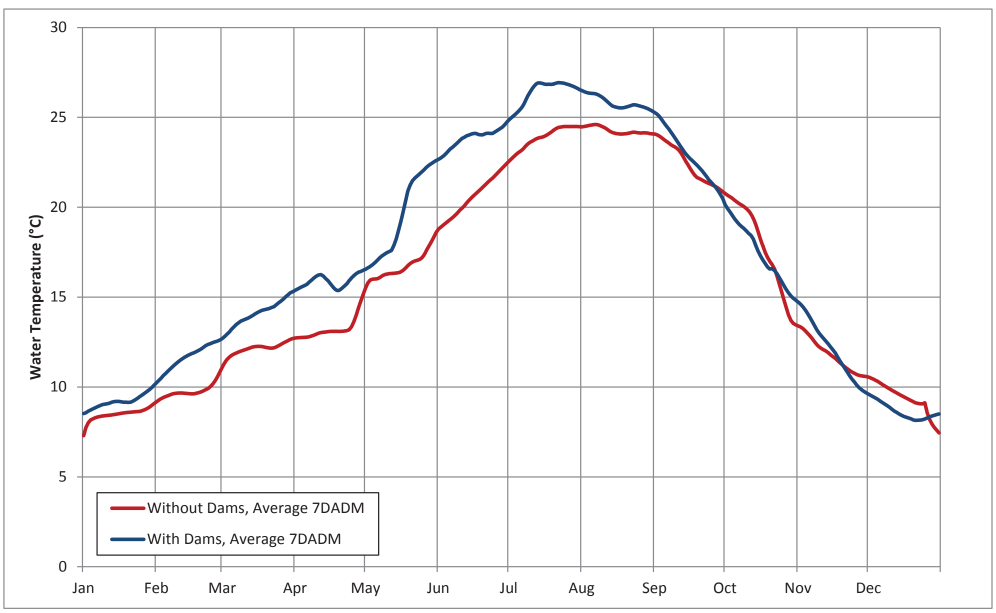

Figure 3.4-17. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 1. Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 - 2012.

3.4.2 Resource Effects of the Proposed Action

FERC's SD2 (page 35) identifies the following issues related to water resources:

- *Effects of project operation on the quantity and timing of streamflow in the project-affected downstream reach, including water storage, peaking operations, and ramping rates.*
- *Potential effects of project operation and maintenance on water quality, water temperature, and water quantity in the project reservoir and the project-affected downstream reach.*

The following paragraphs address the issues identified by FERC in its SD2, but in the context of what can be expected to occur under an extension into the future of existing Don Pedro Project baseline conditions. As explained above, water management is driven by the primary Don Pedro Project purposes; hydropower generation is a consequence of flows scheduled for release to satisfy the primary purposes of the Don Pedro Project.

3.4.2.1 Effects of the Proposed Action on Don Pedro Reservoir

The Proposed Action under review by FERC is the issuance of a new license to the Districts to authorize the continued generation of hydroelectric power at Don Pedro Dam. As such, and as generally described in FERC's SD2 issued on July 25, 2011, any alternatives to mitigate the Don Pedro Project's effects ("mitigation strategies") must be reasonably related to the purpose and need for the Proposed Action, which in this case is whether, and under what terms, to authorize the continuation of hydropower generation at the Don Pedro Project.

As explained in Exhibit B of this FLA, flows are released from Don Pedro Reservoir to satisfy the following requirements: (1) flood flow management, including pre-releases in advance of anticipated high flows during wet years to maintain river flows at the Modesto gage below 9,000 cfs, (2) the Districts' irrigation and M&I demands, including flows to maintain water storage in Turlock Lake and Modesto Reservoir, and (3) protection of aquatic resources in the lower Tuolumne River in accordance with the terms of the FERC license. The first two of these, i.e., flood control and water supply for irrigation and M&I uses, are primary purposes of the Don Pedro Project. Once the weekly and daily flow schedules are established based on these demands, outflows from the Don Pedro powerhouse are scheduled to deliver these flows. During on-peak periods of electric energy demand, outflows may be shaped to generate more electricity during on-peak periods and less during off-peak periods, subject to meeting the requirements of the pre-established flow schedule and the physical constraints of the Districts' irrigation system. In accordance with the Districts' "water-first" policy, flow releases are scheduled around the three requirements listed above, then delivered via the generation units up to their capacity and availability. Hydropower generation at the Don Pedro Project is a secondary consideration with respect to flow scheduling.

Both TID and MID experience their greatest on-peak demands during the summer months. As demonstrated in Exhibit B, the change in Don Pedro generation from off-peak to on-peak periods is relatively small on average. This change in generation from on-peak to off-peak periods reflects the minor degree of hourly shaping of daily flows that occurs. The amount of daily shaping that can be achieved is not only limited by the water supply scheduling consistent with the primary purposes of the Don Pedro Project, but also other physical and operational constraints. First, the volume of usable storage in La Grange pool is not sufficient to allow it to act as a re-regulating reservoir and flows released by the Don Pedro hydropower units simply pass through the La Grange pool virtually unchanged. Second, while the TID main canal, the larger of the two main canals, has a design hydraulic capacity of 3,400 cfs, flow may be restricted to a maximum of approximately 2,500 cfs for safety reasons and ramping rates in the main canal are constrained to about 300 cfs per hour, or 10 MW/hr, hardly conducive to a peaking or load-following operation. Also, the operation of the Districts' irrigation water storage reservoirs – Turlock Lake and Modesto Reservoir – have limited storage capacities, the use of which are driven by irrigation purposes and needs. Winter hydropower generation at Don Pedro is very limited because of the Don Pedro Project's "water first" operation. Except for minimum flows to the lower Tuolumne River, water is either being stored for water supply purposes, released for filling of the irrigation storage reservoirs, or released for flood management purposes without regard to on-peak/off-peak shaping. Exhibit B of this application provides more detailed information on each Districts' typical hydropower generation during the summer peak season.

As explained previously, the Don Pedro Project was constructed for the purposes of providing water storage for water supply and flood flow management. The Don Pedro Project is operated to provide water storage sufficient to satisfy annual flow requirements while considering the need for carry-over storage that may be necessary to satisfy consumptive use driven water demands over successive dry years. Achieving these primary purposes results in substantial annual and multi-year changes in Don Pedro Reservoir water levels. Based on examining water level changes by Water Year (versus the calendar year), the minimum annual reservoir water level generally occurs in the October/November time period, and the maximum water level generally occurs in the May/June time period. Reservoir storage changes over a Water Year can be as small as 100,000 AF to as high as 1 million AF or more, driven by the combination of hydrology and satisfying the Don Pedro Project's primary purposes. Hydropower generation is not a cause of, nor does it contribute to, these large scale changes in reservoir levels.

The effect of hydropower operations on reservoir water levels would be limited to the daily shaping of flows discussed previously. Using the data provided in Exhibit B (see Table 2.4-4); the greatest on-peak/off-peak change in generation was roughly 40 MW. If it is assumed that the on-peak period lasts for 16 hours during the summer, this equates to a flow of roughly 1,200 cfs more during on-peak periods than during the off-peak period. Over a 16-hour period, this amounts to a volume of 1,600 acre-feet. At the median reservoir level of 780 ft, this represents a change in reservoir level of 0.15 ft, or 1.8 inches occurring over a 16 hour period, compared to the off-peak flow occurring all day. This also assumes that there was zero inflow to the reservoir during the day. Flow-shaping for hydroelectric generation has only minor, if any, effects on conditions in the reservoir. Therefore, the Proposed Action would have no measurable effects on variation in reservoir water surface elevation, water quality, or any other environmental conditions.

3.4.2.2 Effects of the Proposed Action between Don Pedro Dam and La Grange Diversion Dam

Unlike Don Pedro Reservoir and the lower Tuolumne River, where the Proposed Action would have no effect on environmental conditions (see sections 3.4.2.1 and 4.0, respectively), the secondary Don Pedro Project purpose of hydropower generation would have a minor effect on water velocities in the reach between Don Pedro Reservoir and La Grange Diversion Dam. As explained previously, outflows through the powerhouse may be shaped to generate more electricity during on-peak periods and less during off-peak periods, subject to meeting the requirements of the pre-established flow schedule associated with the Don Pedro Project's primary purposes (i.e., deliveries for irrigation and M&I uses, water management for flood control) and releases for fish protection downstream of La Grange Diversion Dam. An increase of 40 MW during on-peak hours results in a change in flow of approximately 1,000 cfs. Using an average width of 250 ft and a minimum average transect depth of three feet, the maximum velocity change in the reach between Don Pedro Dam and La Grange Diversion Dam would be about 1.3 ft/sec. There would be very little change in water depth at such flows because the riverine reach just below Don Pedro Dam is quite deep and the remaining reach elevation is controlled by La Grange Diversion Dam spillway crest elevation.

The magnitude of flow variability within this reach that would result from the Proposed Action would have insignificant effects on temperature and water quality. The Don Pedro Project's primary purposes dictate the overall magnitude and timing of flows passed downstream, and these are the flows that influence conditions in the reach between the dams, not the relatively small variation that would be caused by the Proposed Action.

3.4.2.3 Effects of the Proposed Action in the Lower Tuolumne River

Effects of the Proposed Action on water resources in the lower Tuolumne River are addressed in Section 4.0, Cumulative Effects, of this Exhibit E.

3.4.3 Proposed Resource Measures

Because the Proposed Action of issuing a new license to continue hydropower generation would have no adverse effects on water resources in Don Pedro Reservoir (Section 3.4.2.1), in the reach of the Tuolumne River between Don Pedro Dam and La Grange Diversion Dam (Section 3.4.2.2), or in the lower Tuolumne River downstream of La Grange Diversion Dam (Section 4.2), the Districts are proposing no water resources related resource measures.

3.4.4 Unavoidable Adverse Impacts

The Proposed Action would have no unavoidable adverse effects on water resources in Don Pedro Reservoir (Section 3.4.2.1), in the reach of the Tuolumne River between Don Pedro Dam and La Grange Diversion Dam (Section 3.4.2.2), or in the lower Tuolumne River downstream of La Grange Diversion Dam (Section 4.2).

3.5 Fish and Aquatic Resources

3.5.1 Historical Distribution of Fishes in the San Joaquin Valley and Tuolumne River

The Tuolumne River is located within a region referred to as the Central Valley Zoogeographic Subprovince, which is characterized by a distinctive fish fauna (Moyle 2002). Species native to this region are adapted to a climate characterized by extended droughts and large floods (Moyle 2002). The four main native fish assemblages in the Central Valley Zoogeographic Subprovince are the (1) rainbow trout assemblage, (2) California roach assemblage, (3) Sacramento pikeminnow-hardhead-sucker assemblage, and (4) deep-bodied fish assemblage.

The San Joaquin River and its tributaries below an elevation of about 80 ft[12] are typically characterized by warm sluggish channels, swamps, and sloughs (Moyle 2002). Historically, the native fish fauna of the Central Valley floor was composed primarily of species from the deep-bodied fish assemblage, such as Sacramento perch (*Archoplites interruptus*), tule perch (*Hysterocarpus traskii*), hitch (*Lavinia exilcauda*), Sacramento blackfish (*Orthodon microlepidotus*), and Sacramento splittail (*Pogonichthys macrolepidotus*). Large Sacramento pikeminnow (*Ptychocheilus grandis)* and Sacramento sucker (*Catostomus occidentalis*) were also abundant, migrating upstream to spawn in tributaries to the San Joaquin River, including the Tuolumne River. Anadromous fish passed through the river reaches of the Central Valley floor on their way upstream to spawn (Moyle 2002).

Central Valley foothill streams and rivers, which extend from the valley floor to the Sierra Nevada and Coast Range mountains, were occupied by, from lowest to highest elevation, the pikeminnow-hardhead-sucker assemblage, the California roach assemblage, and the rainbow trout assemblage. The pikeminnow-hardhead-sucker assemblage occurred just above the valley floor at elevations of 80–1,500 ft and included Sacramento pikeminnow, Sacramento sucker, and hardhead (*Mylopharodon conocephalus*), among other species. The California roach assemblage, which overlapped in elevation with the pikeminnow-hardhead-sucker assemblage, included species that occurred in small, warm tributaries and larger streams that flowed through open foothill woodlands. Many of these streams were intermittent during summer and flood-prone during winter and spring. In the Tuolumne River watershed, the California roach assemblage included the endemic Red Hills roach (*Hesperoleucus symmetricus*). The rainbow trout assemblage overlapped with the upper extents of the pikeminnow-hardhead-sucker and California roach assemblages and extended to the highest elevations occupied by fish (i.e., about 3,600 ft). Species in this assemblage occurred in streams characterized by swift, perennial flows, steep gradients, cool temperatures, high dissolved oxygen concentrations, and abundant cover. Rainbow trout, sculpin, Sacramento sucker, and speckled dace (*Rhinichthys osculus*) are members of this assemblage.

Historically, three anadromous fish species occurred in the Tuolumne River: fall- and spring-run Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss*), and Pacific lamprey (*Entosphenus tridentatus)*. Fall-run Chinook salmon spawning escapement to the Tuolumne River has varied over a wide range. During some years it was larger than the escapement to any

[12] All elevations are NGVD 29.

other Central Valley river, except for the mainstem Sacramento River, and was estimated at 122,000 spawners in 1940 and 130,000 spawners in 1944 (California Department of Fish and Game [CDFG] 1946; Fry 1961, as cited in Yoshiyama et al. 1996). In contrast, escapement was as low as 500, 200, and 100 returning adults in 1961, 1962, and 1963, respectively.

According to Moyle et al. (1996), anadromous species did not reach Hetch Hetchy Valley (elevation 3,600 ft). The waterfalls just below Hetch Hetchy Dam on the mainstem, about 10 miles above Preston Falls, evidently stopped all fish that might have ascended that far. John Muir wrote that the river was barren of fish above these falls (Muir 1902, as cited in Yoshiyama et al. 1996). There is no indication that salmon reached Poopenaut Valley, which is located 3 miles downstream of Hetch Hetchy Valley (Yoshiyama et al. 1996). In addition, there is no archaeological or ethnographic evidence indicating that salmon were part of the subsistence economies of the native inhabitants along the Tuolumne River in the Yosemite region (Snyder 1993 unpublished memorandum, as cited in Yoshiyama et al. 1996).

Clavey Falls, at the confluence of the Tuolumne and Clavey rivers, may have also obstructed upstream migration of salmon at certain flows. Chinook salmon most likely did not pass over Preston Falls, located 4 miles above the current location of Early Intake Dam near the boundary of Yosemite National Park (about 51 miles upstream of Don Pedro Dam) (Yoshiyama et al.1996). Steep sections of stream in the Clavey River and in the South and Middle forks of the Tuolumne River most likely obstructed salmon migration. In the lower South Fork Tuolumne River, a 25–30-foot-high waterfall probably prevented upstream access (Stanley and Holbek 1984, as cited in Yoshiyama et al. 1996). The North Fork Tuolumne River, with a 12-ft waterfall located about 1 mile above its mouth, likewise had limited access. Yoshiyama et al. (1996) reported that steelhead may have ascended several miles into Cherry Creek, which is a tributary to the mainstem Tuolumne River located about 1 mile below Early Intake Dam. Large runs of Pacific lamprey once spawned in most of the same places as Chinook salmon (Moyle et al. 1996).

Anadromous fish abundance in the lower Tuolumne River downstream of La Grange Diversion Dam has been reduced by habitat degradation due to extensive instream and floodplain mining that began in the mid-1800s as well as other land uses. Dams and water diversions associated with mining had affected fish migration as early as 1852 (Snyder 1993 unpublished memorandum, as cited in Yoshiyama et al.1996). Access to historical spawning and rearing habitat was significantly restricted beginning in the 1870s, when a number of dams and irrigation diversion projects were constructed. Wheaton Dam, built in 1871 near the site of the La Grange Diversion Dam, ranged from 16 – 30 ft high (USGS 1899), and was a barrier to upstream fish migration. In 1884, the California Fish and Game Commission reported that the Tuolumne River was "dammed in such a way to prevent the fish from ascending" (California Fish and Game Commission 1884, as cited in Yoshiyama et al. 1996).

As noted above, gravel and gold mining adversely affected salmon runs prior to dam construction on the Tuolumne River (TID/MID 2005). These activities left large pits in the river and floodplain that altered the river's morphology and flow patterns and harbored predators, such as largemouth and smallmouth bass (both species were introduced by CDFW in the late 1800s and early 1900s for recreational fisheries). Introduced predators were, and continue to be, most abundant in the slow-water areas prevalent in the middle section of the lower Tuolumne River, downstream of the major Chinook spawning areas (Orr 1997). Much of this type of habitat was created by instream sand and gravel mining, making it likely that the present pattern and degree of predation mortality in the Tuolumne River is to a large extent a result of past sand and gravel mining coupled with the introduction of non-native piscivorous fish species (Orr 1997).

TID/MID (2005) noted that water management, riparian diversions, Delta and San Francisco Bay development activities, state and federal Delta water exports, water quality issues, hatchery programs, commercial and recreational harvest, and poaching, all affected historical patterns of anadromous salmonid abundance in the Tuolumne River. Pacific lamprey populations appear to have declined for reasons similar to those of salmon, e.g., dams, water management, habitat alteration (Moyle et al. 1996). The decline in major prey species, i.e., salmon and steelhead, may have been an additional contributing factor (Moyle et al. 1996).

3.5.2 Fish and Aquatic Resources in Don Pedro Reservoir

3.5.2.1 Existing Environment

Don Pedro Reservoir extends upstream from Don Pedro Dam (located at RM 54.8) for approximately 24 miles at the normal maximum water surface elevation of 830 ft. The surface area of the reservoir at this elevation is approximately 12,960 ac, and the reservoir shoreline, including the numerous islands within the lake, is approximately 160 miles long. The watershed upstream of Don Pedro Dam is approximately 1,533 mi^2. The reservoir contains both native and non-native and game and non-game fish species (Table 3.5-1), and because it thermally stratifies, supports viable warm-water and cold-water fisheries.

Within the Don Pedro Project vicinity, there are a number of tributaries that flow into Don Pedro Reservoir (see Section 3.1, General Description of the Tuolumne River Basin and Don Pedro Project). Because of their relatively low elevation, most of the streams contributing flow to the reservoir are ephemeral and rain-driven; in late summer and fall they contribute only a trickle of water, if any, to the reservoir. Regardless of the season, each of these tributary streams has a relatively small immediate watershed and thus contributes comparatively little water when compared to the mainstem Tuolumne River.

CDFW manages the Don Pedro Reservoir fishery as a put-and-take resource with substantial stocking and related fishing regulations, and has characterized the resident trout and inland salmon fisheries of Don Pedro Reservoir as being totally dependent on hatchery supplementation (CDFG and USFWS 2010). As part of its Inland Salmon Program, CDFW generally plants rainbow trout (*O. mykiss*), kokanee (*O. nerka*), and Chinook salmon in Don Pedro Reservoir annually. Don Pedro Reservoir is also managed by CDFW as a year-round fishery for black bass. In the past, CDFW planted brook trout (*Salvelinus fontinalis*) (beginning in 1959) and brown trout (*Salmo trutta*) (beginning in 1979) in Don Pedro Reservoir. The trout and salmon fisheries of Don Pedro Reservoir recovered from a copepod infestation that affected them during the early 1990s. CDFW stocked only brook trout and brown trout during the infestation years, because these species are not susceptible to the parasites. Rainbow trout stocking resumed in 1997, which resulted in a rebound of the trout fishery. The DPRA has been stocking black bass in the reservoir on an annual basis since the early 1980s (TID/MID 2013a), and because of the robust bass population supported by the reservoir, multiple fishing contests, permitted by CDFW, are held during most years (see Angler Use section below).

3.5.2.1.1 Fish Studies Conducted in Don Pedro Reservoir

In 2012, the Districts conducted a study to provide information concerning the distribution and occurrence of fish in Don Pedro Reservoir (TID/MID 2013a). The objectives of the study were to document fish species composition, relative abundance, age and size composition, and characterize the influence of existing operations on fish habitat. To address the objectives, integrated sampling was conducted, including: (1) reservoir boat electrofishing, (2) reservoir gillnet sampling, (3) creel surveys, (4) bass nesting assessments, (5) tributary access assessments, and (6) age-scale assessments. Boat electrofishing and gill net sampling locations are shown in Figure 3.5-1.

3.5.2.1.2 Fish Species Composition in Don Pedro Reservoir

Fourteen fish species were captured during the 2012 Reservoir Fish Population Study (Table 3.5-1) (TID/MID 2013a). Table 3.5-1 also includes information on fish size by species and fish condition (Kn) for select species. Figure 3.5-2 presents a summary of the proportion of species by raw catch (i.e., number) and measured biomass. Threadfin shad (*Dorosoma petenense*) was the most abundant species by number (20.8% of the catch). Most game fish were sunfishes (Family Centrarchidae), primarily largemouth bass (*Micropterus salmoides*). Other frequently collected centrarchids included green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*), spotted bass (*M. punctulatus*), and smallmouth bass (*M. dolomieu*). Trout and salmon (Family Salmonidae) included kokanee and rainbow trout. Other commonly collected species included channel catfish (*Ictalurus punctatus*) and common carp (*Cyprinus carpio*). During the 2012 study, one fish species, golden shiner (*Notemigonus crysoleucas*), was found that had not been previously collected in Don Pedro Reservoir(TID/MID 2013a). Overall, fish species composition in the reservoir in 2012 was similar to that documented by CDFW in past studies (Houk 2002, 2003).

Species that were well represented were generally present in multiple size classes. Largemouth bass ranged in length from 45 to 465 mm (mean 252.3 mm), and spotted bass ranged from 100 to 403 mm (mean 276.8 mm). Mean length for kokanee was 332.3 mm. No juvenile kokanee were collected during the study. Although largemouth bass were not the most numerically common species, they accounted for 31.6 percent of fish biomass (weight), the highest of all species. Common carp (17.7%), channel catfish (16.8%), and spotted bass (16.4%) also represented a significant proportion of biomass. Fish condition indicated that fish were healthy: average Kn ranged from 0.92 for kokanee to 1.06 for largemouth bass (Table 3.5-1).

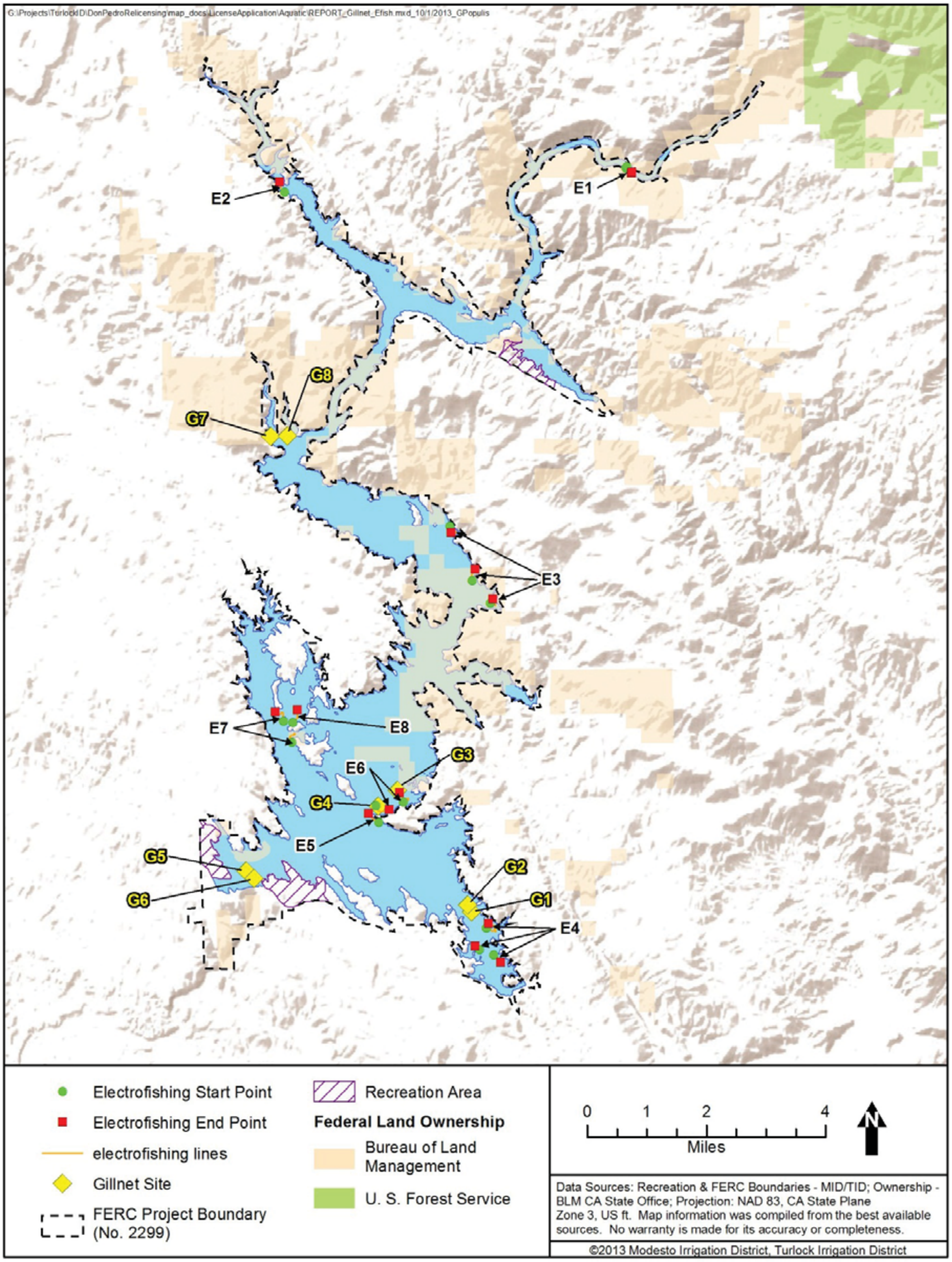

Figure 3.5-1. Location of fish population survey sites sampled using boat electrofishing and gill nets during the Don Pedro Reservoir fish population survey, October 2012.

Table 3.5-1. Summary of relative abundance, length, and weight of all fish species collected at Don Pedro Reservoir in 2012.

Species	Native Species (N)	Composition		Length (mm)			Weight (g)			Mean (Kn)[1]
		N	%	Min	Max	Mean	Min	Max	Mean	
Black bass (unidentified[2])	--	76	11.7	52	98	68.8	1.2	11.2	4.1	--
Bluegill sunfish (*Lepomis macrochirus*)	--	78	12.0	37	138	80.7	1.0	60.0	12.8	1.00
Channel catfish (*Ictalurus punctatus*)	--	30	4.6	60	575	326.1	3.3	2,350	760.8	0.99
Common carp (*Cyprinus carpio*)	--	8	1.2	450	686	578.0	1,420	4,678	2,910	--
Crappie (*Pomoxis* spp.)	--	1	0.2	57	57	57.0	2.2	2.2	2.2	--
Golden Shiner (*Notemigonus crysoleucas*)	--	5	0.8	53	90	70.6	2.6	11.5	6.0	--
Green sunfish (*Lepomis cyanellus*)	--	95	14.6	32	102	67.1	0.5	19.0	5.2	1.04
Kokanee (*Oncorhynchus nerka*)	--	18	2.8	308	412	332.3	172.0	965.0	380.6	0.92
Largemouth bass (*Micropterus salmoides*)	--	116	17.8	45	465	252.3	1.1	1,723	361.2	1.06
Rainbow trout (*Oncorhynchus mykiss*)	N	1	0.2	422	422	422.0	683.0	683.0	683.0	--
Sacramento sucker (*Catostomus occidentalis*)	N	9	1.4	322	495	406.9	322.0	1310	785.0	--
Smallmouth bass (*Micropterus dolomieu*)	--	20	3.1	54	410	201.7	2.1	1,107	285.3	1.04
Spotted bass (*Micropterus punctulatus*)	--	57	8.8	100	403	276.8	11.9	992.2	377.1	0.95
Threadfin shad *(Dorosoma petenense)*	--	135	20.8	58	111	76.3	1.0	18.7	6.0	0.99
White catfish (*Ameiurus catus*)	--	1	0.2	295	295	295	368.5	368.5	368.5	--
	Total	650	100.0							

[1] Species with 10 or fewer individuals or poor fit regressions did not have a reportable condition factor.
[2] Small-sized black bass were not identified to species.

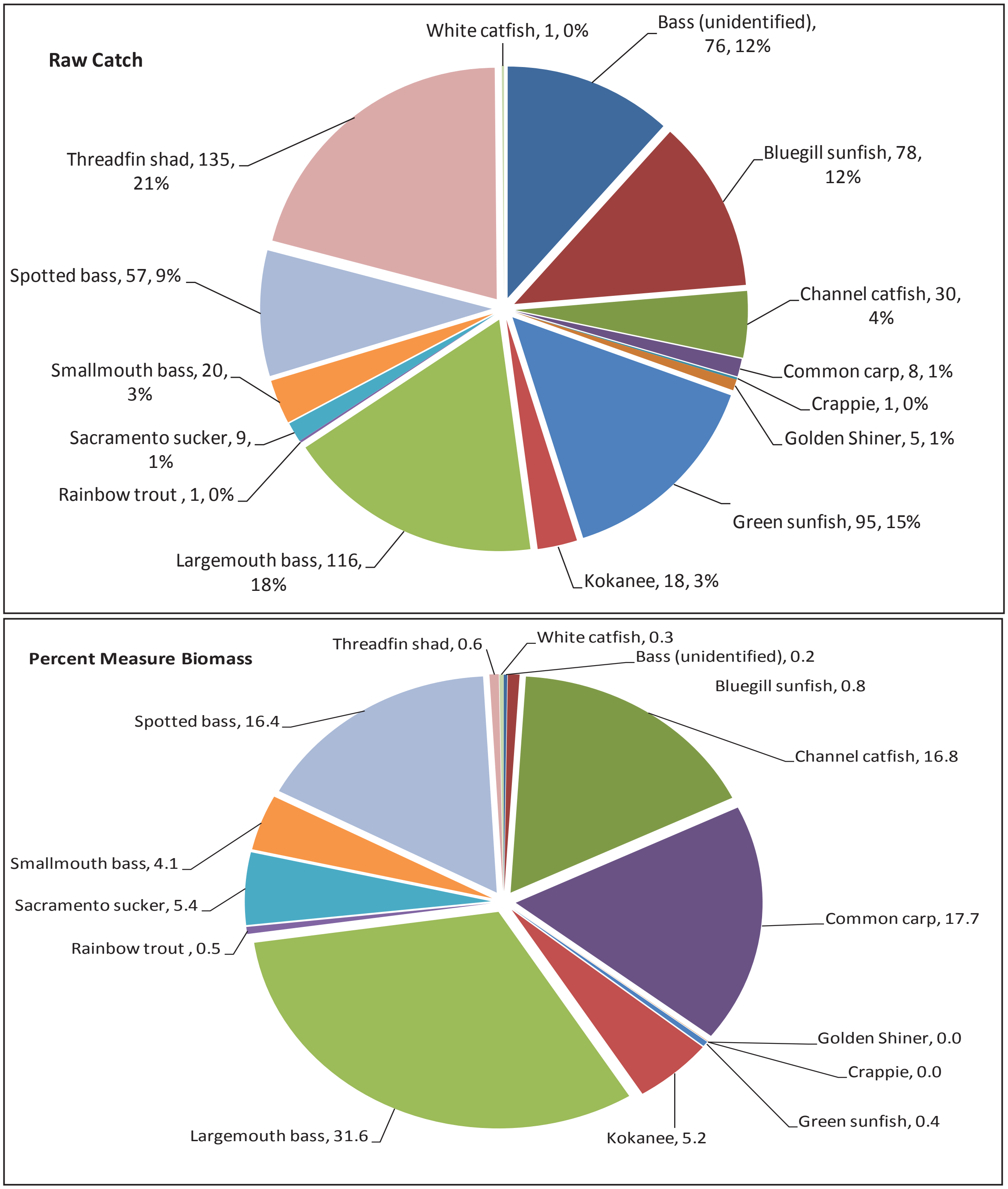

Figure 3.5-2. **Relative numbers of fish (top) and percent measured biomass (bottom) by species, combined from gillnet and boat electrofishing activities during the Don Pedro Reservoir fish population survey conducted in October 2012.**

Scales collected from black bass in the reservoir were used for age analysis (TID/MID 2013a). The number of salmonid (rainbow trout and kokanee) scales collected was insufficient to allow for meaningful scale aging, so no analysis was conducted for these species. Largemouth bass, smallmouth bass, and spotted bass length-frequency distributions and age classes are shown in Figure 3.5-3, Figure 3.5-4, and Figure 3.5-5, respectively. The presence of multiple age classes, including young-of-the-year fish, demonstrates that black bass reproduce successfully in the reservoir.

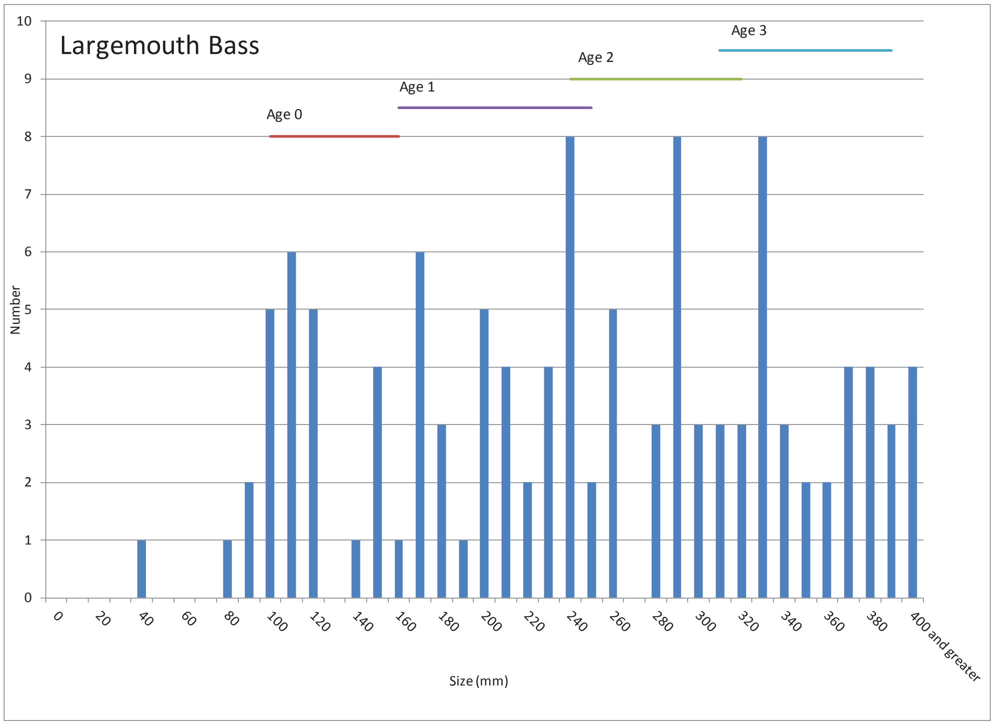

Figure 3.5-3. Length-frequency distribution of largemouth bass sampled during the Don Pedro Reservoir fish population survey, October 2012.

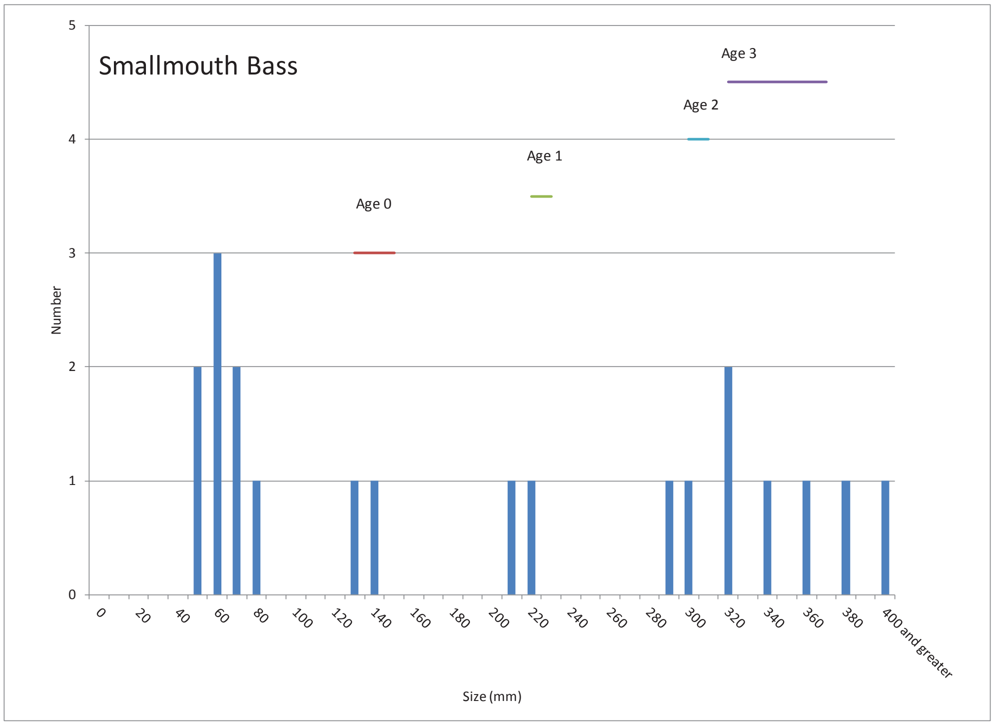

Figure 3.5-4. **Length-frequency distribution of smallmouth bass sampled during the Don Pedro Reservoir fish population survey, October 2012.**

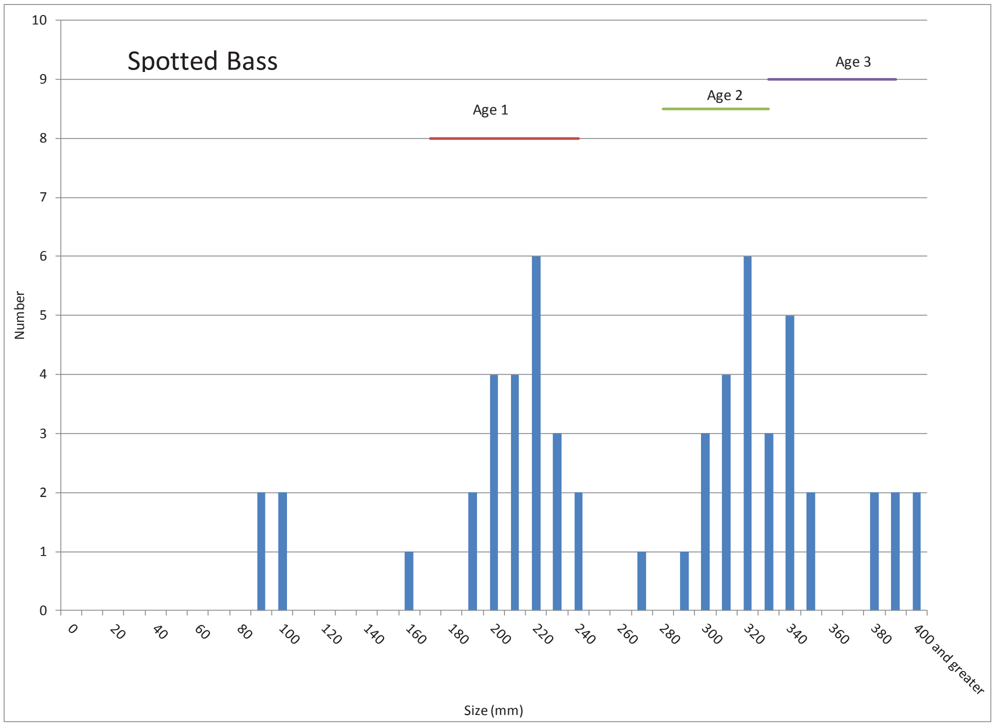

Figure 3.5-5. **Length-frequency distribution of spotted bass sampled during the Don Pedro Reservoir fish population survey, October 2012.**

There are three special status fish species–hardhead, Red Hills roach, and Sacramento-San Joaquin roach–that occur in tributaries to Don Pedro Reservoir or the mainstem Tuolumne River upstream and downstream of the reservoir (discussed below). However, these species have not been found within the Project Boundary.

Hardhead

The hardhead (*M. conocephalus*), which is included on the California Species of Special Concern watch list, is a large (up to 580 mm long) cyprinid (minnow) that generally occurs in large, undisturbed reaches of low- to mid-elevation rivers and streams (Moyle 2002). Hardhead mature following their second year, and spring spawning migrations into smaller tributary streams are common. The spawning season may extend into August in the foothill streams of the San Joaquin River basin. Spawning behavior has not been well documented, but hardhead appear to spawn in gravel riffles (Moyle 2002). Little is known about life-stage-specific water temperature requirements of hardhead, but temperatures ranging from approximately 18–24°C are believed to be suitable (Moyle 2002). Hardhead are omnivores, feeding primarily on benthic invertebrates and aquatic plants (Moyle 2002).

Historically, hardhead were widely distributed and locally abundant in the Central Valley. Their specialized habitat requirements, widespread alteration of lower elevation riverine habitats, and predation by bass have resulted in population declines and isolation of populations (Moyle 2002). Hardhead also have at times been abundant in reservoirs, but most of these reservoir populations have proved to be transitory, presumably extirpated after predators became established. Brown and Moyle (2004) found that hardhead disappeared from the upper Kings River when the reach was invaded by bass. Hardhead occur in the Tuolumne River both upstream and downstream of the Don Pedro Project, but no hardhead were collected or observed during the 2012 Reservoir Fish Population Study (Table 3.5-1) (TID/MID 2013a).

Red Hills Roach

The Red Hills roach (*Hesperoleucus symmetricus*), which is listed as endangered under the California Endangered Species Act, is also a cyprinid and part of the California roach complex. There is a recently discovered population of California roach (Brown et al. 1992, as cited in Jones et al. 2002); individuals within this population are abundant in several permanent pools located along the intermittent streams that drain into Six Bit Gulch and Poor Man’s Gulch, both of which are tributaries to Don Pedro Reservoir (Brown et al.1992, as cited in Jones et al. 2002; Moyle et al. 1995, as cited in Jones et al. 2002; USDOI BLM 2009). It is thought that these permanent pools are spring-fed (USDOI BLM 2009). During the dry part of the year, the fish are confined to these pools, surviving in warm shallow water until spring when they move upstream to spawn (USDOI BLM 2009). The Red Hills roach is specifically found in areas characterized by serpentine soils and stunted vegetation (Moyle 2002). The Red Hills variety of California roach has unique morphologic characteristics, primarily a chisel lip, which make it noticeably different from individuals of other roach populations. The chisel lip is used to scrape algae, a major food source, off submerged rocks (USDOI BLM 2009). The Red Hills region is currently listed as an Area of Critical Environmental Concern (ACEC) by the BLM and an

Aquatic Diversity Management Area (Moyle 1996). No Red Hills roach were collected or observed during the 2012 Reservoir Fish Population Study (Table 3.5-1) (TID/MID 2013a).

Sacramento-San Joaquin Roach

The Sacramento-San Joaquin roach (*Lavinius symmetricus symmetricus*), which is included on the California Species of Special Concern watch list, is also part of the California roach complex. The Sacramento-San Joaquin roach is found in the Sacramento and San Joaquin River drainages, except the Pit River, as well as other tributaries to San Francisco Bay. Sacramento-San Joaquin roach are generally found in small, warm, intermittent streams, and are most abundant in mid-elevation streams in the Sierra foothills and in the lower reaches of some coastal streams (Moyle 2002). The species tolerates relatively high temperatures (30–35°C) and low dissolved oxygen levels (1–2 mg/L) (Taylor et al. 1982). However, they are habitat generalists, also being found in cold, well aerated and clear "trout streams" (Taylor et al. 1982), in human-modified habitats (Moyle 2002), and in the main channels of rivers. Assuming that the Sacramento-San Joaquin roach is indeed a single taxon (which is considered unlikely), it is abundant in a large number of streams, although it is now absent from a number of streams and stream reaches where it once occurred (Moyle 2002). Adult Sacramento-San Joaquin roach have been observed and documented in the general vicinity of the Don Pedro Project, i.e., in Hatch and Second creeks, and Rough and Ready Creek, but not in the Tuolumne River mainstem. During the 2012 Reservoir Fish Population Study, no Sacramento-San Joaquin roach were collected or observed (Table 3.5-1) (TID/MID 2013a).

3.5.2.1.3 Bass Nesting

CDFW has concluded that a spawning nest survival rate of at least 20 percent is necessary to maintain long-term population levels of highly fecund, warm-water fish, such as black bass. The reservoir fish evaluation conducted by the Districts in 2012 shows that water surface elevation changes occurring in Don Pedro Reservoir during the past 27 years have been within a range that has maintained bass nest survival at or above the 20 percent criterion identified by CDFW (Lee 1999; TID/MID 2013a). The frequency with which monthly reservoir elevations decreased during the nesting period of March through June (estimated by comparing first-of-the-month and end-of-the-month water surface elevations from 1984 through 2010) is summarized in Table 3.5-2. The number of months that largemouth, smallmouth, and spotted bass nest survival equaled or exceeded the CDFW 20 percent survival rate, based on water surface elevation reductions in Don Pedro Reservoir from 1984 to 2010, is shown in Table 3.5-3 (TID/MID 2013a).

During the Districts' 2012 study, 14 bass nests were observed at depths ranging from 2.2 ft to 8.0 ft, with an average depth of 5.1 ft (TID/MID 2013a). Nest diameters ranged from 0.6 ft to 6.5 ft, with an average diameter of 3.0 ft. Most nests were located close to cover and within 30 ft of shore.

Table 3.5-2. Don Pedro Reservoir water surface elevation monthly reduction from 1984 to 2010.

Month	No. of Months Evaluated	Frequency of Monthly Elevation Reduction	Percent of Months with elevation reduction
March	27	9	33.3
April	27	12	44.4
May	27	6	22.2
June	27	4	14.8

Table 3.5-3. Number of months that largemouth, smallmouth, and spotted bass nest survival equaled or exceeded the CDFW 20 percent survival rate based on water surface elevation reductions in Don Pedro Reservoir from 1984 to 2010.

Month	No. of Months Analyzed	No. Months ≥20% Survival	Percent Total Months
Largemouth bass			
March	27	27	100
April	27	26	96.3
May	27	27	100
June	27	26	96.3
Smallmouth bass			
March	27	27	100
April	27	26	96.3
May	27	27	100
June	27	26	96.3
Spotted bass			
March	27	27	100
April	27	27	100
May	27	27	100
June	27	27	100

3.5.2.1.4 Potential Salmonid Spawning Tributaries

Streams that typically contain surface flows during spring and, in some cases, fall salmonid spawning periods are shown in Table 3.5-4 (TID/MID 2013a). Perennial tributary streams within the Don Pedro Project vicinity were identified as those that could potentially support fall spawning. Tributaries that potentially could attract salmonid spawners were evaluated by conducting an assessment of gradient within the inundation zone. Under existing operations, slopes at the locations where tributaries enter the reservoir are well below the 10 percent criterion defining a fish impediment (TID/MID 2013a). Potential fish passage impediments were identified only in Deer Creek, which is not considered a salmonid spawning stream (TID/MID 2013a). Cold-water fisheries in the reservoir are primarily supported by stocking; nonetheless, existing Don Pedro Project operations during the potential spring and fall fish migration periods accommodate fish access to possible cold-water spawning tributaries (TID/MID 2013a).

Table 3.5-4. Tributaries to Don Pedro Reservoir evaluated for potential fish passage impediments during the fall and spring salmonid spawning periods. A designation of "yes" indicates that flows are present in a given tributary during the respective spawning period.

Stream	Spring Spawning	Fall Spawning
Tuolumne River	Yes	Yes
Deer Creek	Yes	No
Moccasin Creek	Yes	Yes
Hatch and First Creeks	Yes	No
Willow Creek	Yes	No
Fleming Creek	Yes	No
Rogers Creek	Yes	Yes
Lucas Gulch	Yes	No
Ranchero Creek	Yes	No
West Fork Creek	Yes	No
Big Creek	Yes	Yes
Fortynine Creek	Yes	No
Sixbit Gulch	Yes	No
Poormans Gulch	Yes	No
Woods Creek	Yes	Yes
Sullivan Creek	Yes	No
Kanaka Creek	Yes	No
Rough and Ready Creek	Yes	No

3.5.2.1.5 Angler Use

Creel surveys were conducted by the Districts for nine months in 2012 (TID/MID 2013a). The highest catch rate (0.52 fish/hour) occurred in June and the lowest (0.12 fish/hour) in February. Average catch rate over all months was 0.22 fish/hour. During all months, except February and March, anglers released the majority of their catch. Black bass were the most commonly caught fish species (50.1 percent), and 78.4 percent of bass caught were released. Species composition and size statistics for fish caught by anglers interviewed during 2012 creel surveys are shown in Table 3.5-5.

CDFW regulates fishing contests in California through the issuance of permits. For example, from August 2010 through July 2011, 37 fishing contest permits were issued for Don Pedro Reservoir for black bass, and consisted of 16 annual and 21 event permits for a total of 41 contest days. For black bass contests, CDFW compiles fish catch and size information and publishes an annual *Summary Reports of Black Bass Fishing Contests held in California*. These reports summarize the annual information by California water body in terms of total contest days, total fish counted and weighed, total number of fish reported dead, total number of contest competitors, total contest hours, total fishing hours or effort, annual catch per hour (i.e., total fish counted/total fishing hours) and mean weight per fish. Many years have over 70 recorded contest days with substantial catches. Table 3.5-6 summarizes this information for Don Pedro Reservoir for the years 1985 through 2009.

Table 3.5-5. Species composition and size statistics of fish caught by anglers interviewed during creel surveys conducted on Don Pedro Reservoir between January and September 2012.

Species	Catch (released)	Catch Composition (%)	Length[1] (mm)			Weight[1] (g)		
			Min	Max	Mean	Min	Max	Mean
Black bass	338 (265)	50.1	178	559	364	385.6	3692.2	789.8
Bluegill	3 (3)	0.4	203	203	203	158.8	158.8	158.8
Catfish (spp.)	20 (15)	3.0	305	559	440	190.5	2449.4	880.0
Chinook salmon	117 (38)	17.4	324	559	398	326.6	1360.8	622.9
Kokanee	11(0)	1.6	274	373	313	226.8	567.0	381.8
Rainbow trout	177 (69)	26.3	305	559	396	340.2	907.2	550.1
Sucker (spp.)	6 (4)	0.9	356	483	415	331.1	1691.9	901.1
Total	672 (394)							

1 Length and weight measurements were collected opportunistically and do not represent the total number of fish caught.

Table 3.5-6. Annual black bass fishing contest results for the Don Pedro Reservoir.

Year	Contest Days[1]	Total Fish Count[2]	Total Fish Weight (lb)[2]	Total Reported Dead Fish	No. Of Competitors	Total Contest Hours	Total Hours Effort	Total Catch Per Hour[2]	Mean Weight (lb) Per Fish[2]
2009	73	3,798	7,409.4	43	1,937	556.50	17,380.00	0.22	1.95
2008	82	6,006	12,180.1	35	2,447	584.50	21,571.50	0.28	2.03
2007	54	5,463	12,694.5	67	1,796	395.20	17,357.00	0.31	2.32
2006	74	6,153	14,264.0	135	2,400	543.80	21,335.00	0.29	2.32
2005	73	5,266	10,913.6	62	2,283	570.50	21,781.00	0.24	2.07
2004	77	5,676	12,016.0	90	2,482	584.50	24,007.00	0.24	2.12
2003	82	5,430	10,513.8	70	2,607	613.50	23,830.00	0.23	1.94
2002	77	5,694	10,482.8	67	2,535	582.50	24,620.00	0.22	1.91
2001	89	6,572	14,296.4	112	3,012	640.50	27,883.00	0.24	2.18
2000	70	7,312	13,674.0	121	3,112	542.50	31,080.50	0.24	1.87
1999	24	2,194	3,976.0	10	1,262	195.00	11,269.00	0.20	1.80
1998	55	5,777	10,745.0	71	2,377	432.50	22,753.00	0.25	1.86
1997	82	10,036	19,120.0	149	3,459	654.50	33,872.00	0.30	1.91
1996	63	6,461	12,582.0	86	2,260	512.00	23,299.50	0.28	1.95
1995	69	6,084	10,364.0	72	2,841	542.50	27,731.50	0.22	1.70
1994	64	5,777	10,364.0	97	1,978	479.00	17,911.50	0.32	1.79
1993	60	4,280	7,147.0	54	1,964	491.00	19,542.00	0.22	1.67
1992	76	4,996	8,096.0	105	2,460	602.00	23,354.50	0.21	1.62
1991	82	4,515	6,682.0	62	3,297	620.50	30,559.00	0.15	1.52
1990	71	5,944	9,421.0	152	3,261	569.00	28,811.00	0.21	1.58
1989	26	4,408	6,584.0	114	2,205	198.00	19,796.00	0.22	1.49
1988	28	3,614	5,230.0	78	1,993	234.00	19,452.50	0.19	1.45
1987	11	2,892	4,648.0	91	1,280	107.00	12,141.00	0.24	1.61
1986	11	1,305	1,704.0	35	1,027	105.00	11,895.00	0.11	1.31
1985	3	631	801.0	18	338	27.00	3,042.00	0.21	1.27

1 Data represents results for permitted contests with complete contest reports only.

2 Tournament organizers seldom distinguished between species, so the Total Fish Count, Total Fish Weight, Total Catch per Hour and Mean Weight per Fish are for largemouth, smallmouth, and spotted bass combined.

Source: CDFG Summary Reports of Black Bass Fishing Contests held in California.

3.5.2.1.6 Summary of Don Pedro Reservoir Fisheries

The results of the 2012 Don Pedro Reservoir fish population survey substantiate existing information that indicates current habitat conditions in the reservoir, under ongoing management programs, support quality warm-water and cold-water fisheries (TID/MID 2013a). All three black bass species were prominent in the gill net and electrofishing catches and in the angler surveys. Age-scale information reveals that there are multiple age classes of black bass in the reservoir, demonstrating that successful reproduction is occurring. Bass nesting habitat was found to be of suitable quality and availability to support population recruitment, which along with the current bass stocking program, provides a popular bass fishery. The popularity of bass fishing is also evident from creel information collected in 2012, which shows that black bass were the most commonly caught fish species, and by the substantial number of black bass fishing contest days that occur on the reservoir each year.

The 2012 survey also confirmed the presence of good quality salmon and trout fisheries. Reservoir conditions in spring and fall are sufficient to provide access to potential spawning tributaries for trout and salmon, although the sustainability of cold-water fisheries in the reservoir depends on the stocking of hatchery fish (TID/MID 2013a; see Potential Spawning Tributaries section above). The three special status fish species with the potential to occur in the Don Pedro Project area–hardhead, Red Hills roach, and Sacramento-San Joaquin roach–have been documented in tributaries to Don Pedro Reservoir or, in the case of hardhead, the mainstem Tuolumne River upstream and downstream of the reservoir. However, these species have not been documented within the Project Boundary.

3.5.2.1.7 Aquatic Invasive Species

Aquatic invasive species of concern in the Central Valley include two species of mussel, quagga mussel (*Dreissena rostriformis bugensis*) and zebra mussel (*D. polymorpha*), and the New Zealand mudsnail (*Potamopyrgus antipodarum*). To date, neither the mussel species nor the mudsnail have been documented in Don Pedro Reservoir.

Quagga and zebra mussels have been a source of significant operational problems and maintenance expenditures for water projects in the eastern United States for decades. Quagga mussels were first found in the western United States in 2007 and quickly expanded their geographic range. Quagga mussels are currently found in the following western states: California, Arizona, Nevada, Utah, Colorado, and New Mexico[13]. In California, quagga mussels have been found in the Colorado River and in reservoirs in Riverside and San Diego counties that receive Colorado River water. Zebra mussels are currently found in the following western states: California, Utah, and Colorado[2]. The zebra mussel was found in California for the first time in January 2008, at the San Justo Reservoir in San Benito County. These two species of mussel could threaten water delivery and irrigation systems by clogging intake pipes and other conveyance structures.

Quagga and zebra mussels can be introduced to water bodies from the hulls of boats and through ballast water collected in mussel-invaded waters. The larval mussel life-stage is free-floating

[13] http://nas.er.usgs.gov/taxgroup/mollusks/zebramussel/quaggamusseldistribution.aspx

and microscopic; consequently, larval mussels can enter ballast water as well as bilges, live wells, or other equipment that holds water. These mussels are prolific breeders and attach themselves to hard and soft surfaces. They can survive out of water for up to a week.

Because boating is common in both the Don Pedro and Modesto reservoirs and in Turlock Lake, these water bodies are vulnerable to the introduction of invasive quagga and zebra mussels. Based on the impacts of these mussels in other systems, and the high cost of controlling the populations once they have been introduced, an invasion of quagga or zebra mussels could be a significant water quality and operational issue.

A report, Potential Distribution of Zebra Mussels *(Dreissena polymorpha)* and Quagga Mussels *(Dreissena bugensis)* in California, prepared for CDFW, assessed the threat of these mussels to California water bodies based on the mussels' ability to tolerate a range of temperatures, calcium concentrations, pH, dissolved oxygen, and salinity (Cohen 2008). Based on its ambient conditions, Don Pedro Reservoir is not considered to be particularly vulnerable to colonization.

The New Zealand mudsnail (*Potamopyrgus antipodarum*), an invasive gastropod species, has been found in more than 20 California water bodies since 2000, including Lake Shasta in December 2007 and more recently in water bodies in Stanislaus County. This species is often introduced via anglers' waders and other equipment.

New Zealand mudsnails are able to withstand desiccation, a wide range of temperatures, and are small enough to be inadvertently transported to aquatic systems where they have not yet been introduced. The mudsnail tolerates siltation and thrives in disturbed watersheds. It occurs among macrophytes and prefers the littoral zones of lakes or slow streams but can tolerate high-flow environments. Mudsnails have been found at depths ranging from 13 to 148 ft (4 to 45 m).

Because mudsnails reproduce asexually, a single individual is capable of populating an aquatic system once introduced. The New Zealand mudsnail has no natural predators or parasites in the United States, which has contributed to its successful dispersal. Control of this species depends on vigilant cleaning of boats and other equipment to avoid its introduction into unaffected areas.

The Districts participate in the State of California's program to reduce the spread of invasive species by providing information (at boat launches and at the DPRA Visitor Center), which educates recreational users on ways to reduce the spread of invasive species. The DPRA has attended workshops to learn about methods for preventing the spread of nonnative mussel species and met with water recreation managers to discuss relevant issues. Since June 2008, MID has been monitoring for zebra and quagga mussels at its water treatment plant using submerged vertical plates, which are inspected every two weeks for mussel attachment. MID has not detected any mussels.

3.5.2.2 Fish and Aquatic Resource Effects in Don Pedro Reservoir

FERC's SD2 identifies the following fish and aquatic resources related issues associated with Don Pedro Reservoir:

- *Effects of project operation and maintenance on fish populations in project reservoirs (page 35).*
- *Potential effects of project operations on stranding or displacement of fish (page 36).*
- *Potential effects of entrainment at the project dam and intake on fish populations (page 36).*

The Proposed Action under review by FERC is the issuance of a new license to the Districts to authorize the continued generation of hydroelectric power at Don Pedro Dam. As such, and as generally described in FERC's SD2 issued on July 25, 2011, any alternatives to mitigate the Project's effects ("mitigation strategies") must be reasonably related to the purpose and need for the Proposed Action, which in this case is whether, and under what terms, to authorize the continuation of hydropower generation at the Don Pedro Project.

As explained in Exhibit B of this FLA, flow releases from Don Pedro Reservoir are made for the following purposes: (1) flood flow management, including pre-releases in advance of anticipated high flows during wet years, (2) the Districts' irrigation and M&I demands, including flows to maintain water storage in Turlock Lake and Modesto Reservoir, and (3) protection of aquatic resources in the lower Tuolumne River in accordance with the terms of the FERC license. Once the weekly and daily flow schedules are established based on these demands, outflows from the Don Pedro powerhouse are scheduled to deliver these flows. During periods of greater electric energy demand, outflows may be shaped to generate more electricity during on-peak periods and less during off-peak periods, subject to meeting the requirements of the pre-established flow schedule. In accordance with the Districts' "water-first" policy, flow releases are scheduled around the uses listed above, then delivered via the generation units up to their capacity and availability. Hydropower generation at the Don Pedro Project is a secondary consideration with respect to flow scheduling.

The following paragraphs address the issues identified by FERC in its SD2, but in the context of what can be expected to occur under an extension into the future of existing baseline conditions. As explained above, water management is driven by the primary Don Pedro Project purposes and flow-shaping for hydroelectric generation has only secondary and minor effects on conditions in the reservoir. The effect of hydropower operations on reservoir water levels would be limited to the daily shaping of flows. Using the data provided in Exhibit B (see Table 2.4-4); the greatest on-peak/off-peak change in generation was roughly 40 MW. If it is assumed that the on-peak period lasts for 16 hours during the summer, this equates to a flow of roughly 1,200 cfs more during the on-peak period than during the off-peak period. Over a 16-hour period, this amounts to a volume of 1,600 AF. At the median reservoir level of 780 ft, this represents a change in reservoir level of 0.15 ft, or 1.8 inches, occurring over a 16-hour period, compared to the off-peak flow occurring all day. This also assumes that there was zero inflow to the reservoir during the day, i.e., the change in water level would have been less than 1.8 inches. Flow-shaping for hydroelectric generation has only minor, if any, effects on conditions in the reservoir. Therefore, the Proposed Action would have no measurable effects on variation in reservoir water surface elevation, water quality, or any other environmental conditions.

As noted previously, thermal stratification in Don Pedro Reservoir allows for the existence of both a cold-water and warm-water fishery. There are two primary reservoir conditions that influence habitat and fish populations in the reservoir: cold water pool volume and sustained spawning and juvenile rearing habitats for warm-water fish species during spring.

Don Pedro Project operations affect reservoir water temperatures, which in turn have the potential to affect cold-water fish species by influencing the volume of cold, oxygenated water during times of thermal stratification. The greater the volume of cold water during the warmer months, the greater the amount of cold-water habitat available to support the stocking-dependent cold-water fisheries. The findings of the Don Pedro Reservoir Fish Population Survey Study (TID/MID 2013a) are consistent with all available evidence that suggests Don Pedro Reservoir supports a quality cold-water fishery, indicating that the Don Pedro Project has no adverse effect on the persistence of cold-water fish species in the reservoir. The Districts are aware of no data or other evidence that indicate operations and maintenance associated with the primary Don Pedro Project purposes have an adverse effect on the reservoir's cold-water fishery.

FERC's SD2 identifies as an issue the potential effects of Don Pedro Project operations on stranding or displacement of fish. Changes in reservoir surface elevation that result from water uses associated with the Don Pedro Project's primary purposes have the potential to affect reservoir fish by influencing shoreline and tributary habitats. Variation in reservoir water surface elevation resulting from hydroelectric generation is insignificant and therefore has no substantial effect on shoreline habitats.

As noted, warm-water fisheries are primarily dependent on sustained spawning and juvenile rearing habitats during spring. These typically littoral, shallow areas could be impacted during the spawning season if reservoir levels were to drop significantly. Decreased water surface elevations during the bass nesting season could expose nests and decrease egg survival and bass recruitment. However, as explained in Section 3.5.2.1.3, there is no evidence that operations related to primary Don Pedro Project purposes have a significant adverse effect on bass nesting in Don Pedro Reservoir. The bass nest survival evaluation showed that reservoir elevation changes occurring during the past 27 years maintained bass nest survival at or above the acceptable level identified by CDFW (Lee 1999; TID/MID 2013a).

Fish could also be affected if tributary access is limited during spawning seasons as the result of fluctuations in reservoir water surface elevation related to the Don Pedro Project's primary purposes. Overall, under existing operations, slopes at the locations where tributaries enter the reservoir are well below the 10 percent criterion defining a fish impediment (TID/MID 2013a). Fish passage impediments were only identified in Deer Creek, which is not considered a salmonid spawning stream (TID/MID 2013a). Moreover, the Don Pedro Project is operated to accommodate access to possible cold-water spawning tributaries during the spring and fall fish migration periods (TID/MID 2013a).

FERC's SD2 also identifies as an issue the potential effects of entrainment at the Don Pedro Dam and intake on fish populations. The power tunnel intake at Don Pedro Reservoir is located at elevation 535 ft, or approximately 250 ft or more below the water surface throughout most years (TID/MID 2013a), and as a result it is very unlikely that warm-water fish species are entrained at the Don Pedro Project. Stocked cold-water species occupy cooler, deeper water during some periods of the year. However, given the depth of the Don Pedro Project intake and the low densities of fish in deep water, entrainment of cold-water species is also likely to be infrequent. In 2012, gillnetting was conducted at maximum depths ranging from 140 to 200 ft. Only 7.2 percent of the total adult gillnet catch was collected in the deep-water net sets, at a catch rate of 0.17 fish/hour (compared to a rate of 2.91 fish/hour in shoreline adult gillnet sets). Kokanee and Sacramento sucker were the two species captured in the deep-water nets, with kokanee accounting for 92 percent of the catch. Two of the gillnet sets were located near Don Pedro Dam (see Figure 3.5-1). At these sites, nets were able to sample to a depth of 100 ft. Only three fish were captured at these sites (two kokanee and one sucker) in 18.6 hours of fishing mid-water and deep-water gillnets. Even if stocked cold-water species are entrained at low rates during some times of year, the persistence of a quality cold-water fishery in the reservoir indicates that any entrainment that occurs does so at a level that has minimal adverse effects on cold-water species, including salmonids.

The findings of the Don Pedro Reservoir Fish Population Survey Study (TID/MID 2013a) are consistent with all available evidence, which demonstrates that current conditions in Don Pedro Reservoir support quality cold-water and warm-water fisheries. The Districts are aware of no evidence that indicates operations and maintenance activities related to the Don Pedro Project's primary purposes or to hydropower generation have an adverse effect on the reservoir's fish and aquatic resources. Because the Proposed Action would not significantly influence the operation or maintenance activities of the Don Pedro Project (i.e., as explained above, hydropower generation is a secondary purpose of the Don Pedro Project), no adverse effects on fish and aquatic resources in the reservoir are anticipated over the term of the new FERC license.

Potential effects of sediment and large woody debris (LWD) retention in Don Pedro Reservoir (also identified by FERC in its SD2) would manifest themselves in the lower Tuolumne River. As a result, the potential effects of sediment and LWD retention on aquatic resources are addressed in Section 4.0, Cumulative Effects.

3.5.2.3 Proposed Environmental Measures

Because the Proposed Action would have no adverse effects on fish and aquatic resources in Don Pedro Reservoir, the Districts are proposing no environmental measures.

3.5.2.4 Unavoidable Adverse Impacts

For the reasons identified in Section 3.5.2.2, the Proposed Action would result in no unavoidable adverse impacts on fish and aquatic resources in Don Pedro Reservoir.

3.5.3 Fish Populations between Don Pedro Reservoir and La Grange Diversion Dam

3.5.3.1 Existing Environment

3.5.3.1.1 Fish Studies Conducted between Don Pedro Dam and La Grange Diversion Dam

In 2012, the Districts conducted a study to characterize the fish assemblage in the reach of the Tuolumne River between Don Pedro Dam and La Grange Diversion Dam (TID/MID 2013b). Prior to this study, almost nothing was known about this reach, with all information based on a single sampling event that occurred in 2008 (Stillwater Sciences 2009a). No known angler harvest or stocking data exist for this reach.

The study reach between La Grange Diversion Dam (RM 52.2) and the Don Pedro powerhouse (RM 54.5), was approximately 2.3 miles long. During 2012, reconnaissance surveys were conducted to evaluate habitat in this reach, and fish sampling sites were selected to represent the availability of near-shore habitats (Figure 3.5-6). Boat electrofishing was conducted at each sampling site, with the duration of the sampling period recorded to ensure consistent sampling effort among sites.

3.5.3.1.2 Habitat Characteristics and Fish Species Composition, Relative Abundance, and Condition

Two types of habitat were identified in the study reach: riverine and lacustrine (TID/MID 2013b). Riverine sites were characterized by observable currents, large substrate particles, and a lack of rooted aquatic macrophyte beds. Lacustrine sites were characterized by a lack of observable current, smaller substrate particles, and a greater frequency of rooted macrophyte beds. Both riverine and lacustrine habitats were characterized by a lack of habitat complexity.

The 2012 study results indicate that the reach of river between the Don Pedro Dam and La Grange Diversion Dam contains two fish species, rainbow trout and prickly sculpin (*Cottus asper*), and that both species are distributed across the reach (TID/MID 2013b). Relative abundance, length, and weight of fish collected in 2012 are shown in Table 3.5-7.

The rainbow trout population exhibited four age classes, indicating that some reproduction occurs in the reach (as noted above, there are no records of stocking having been conducted in this reach). Rainbow trout were present in both lacustrine and riverine reaches, documenting that they use the range of available habitat (TID/MID 2013b). Overall, average condition (i.e., Kn=0.99) and appearance of the rainbow trout collected in 2012 indicated that fish were healthy (TID/MID 2013b).

The prickly sculpin population also exhibited multiple age classes (potentially three), and the presence of young-of-the-year fish indicates that reproduction is occurring in the reach (TID/MID 2013b). Sculpin were most abundant in riverine habitats (i.e., upstream sampling sites). Overall, sculpin condition indicated that fish appeared healthy (i.e., Kn = 0.99).

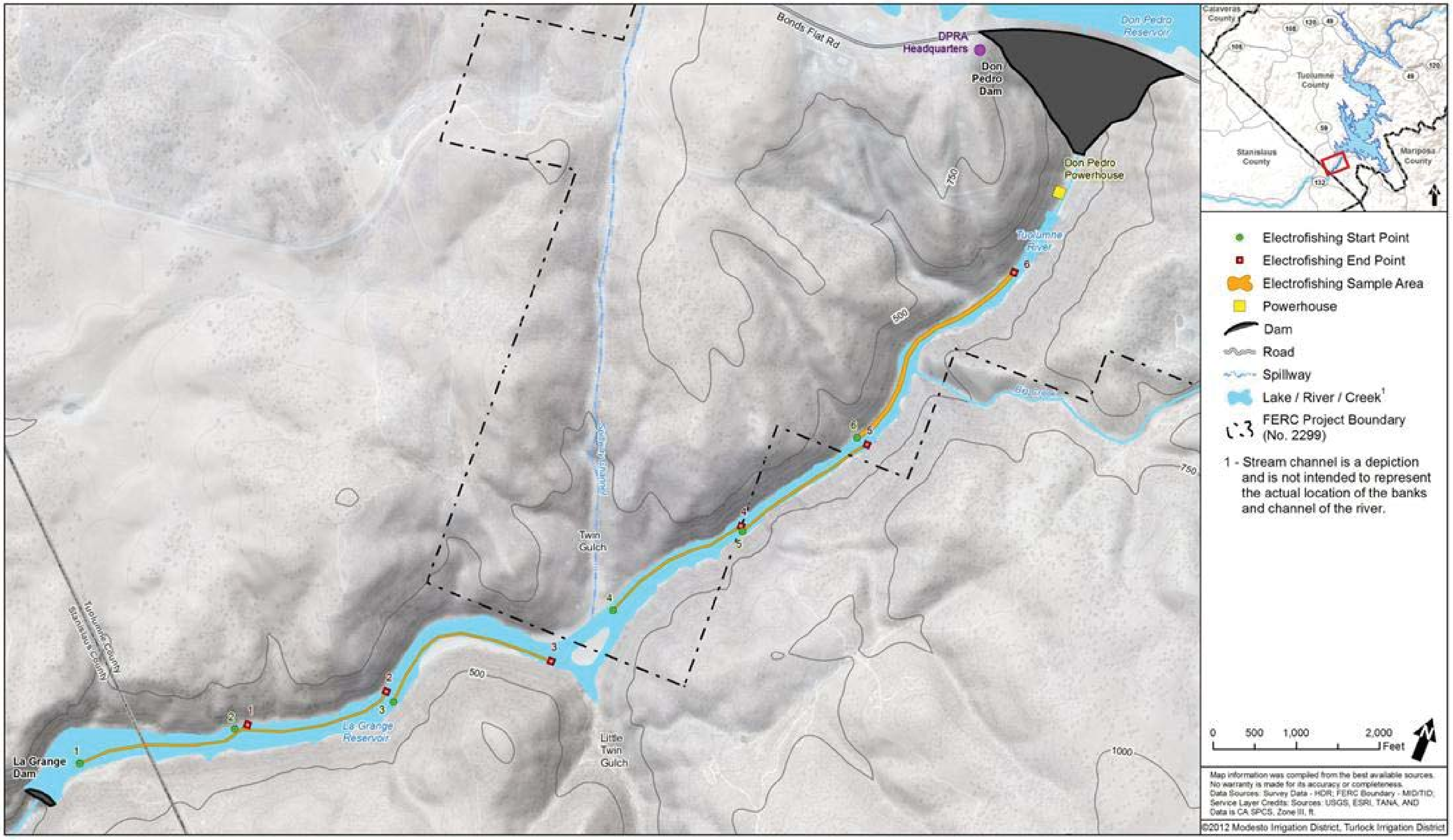

Figure 3.5-6. Study reaches and fish sampling areas in the reach between Don Pedro Dam and La Grange Diversion Dam in 2012.

Table 3.5-7. Summary of relative abundance, length, and weight of fish species collected at all sites between Don Pedro Dam and La Grange Diversion Dam in 2012.

Species	Composition		Length (mm)			Weight (g)		
	N	Percent	Min	Max	Mean	Min	Max	Mean
Rainbow Trout (*O. mykiss*)	86	64.7	85	344	153.5	5.5	469.5	67.1
Prickly sculpin (*C. asper*)	47	35.3	48	110	80.1	1.3	106.1	14.8
Total	133	100						

3.5.3.2 Fish and Aquatic Resource Effects between Don Pedro Reservoir and La Grange Diversion Dam

FERC's SD2 (page 35) identifies the following fish and aquatic resources related issue associated with the reach of the Tuolumne River between Don Pedro Reservoir and La Grange Diversion Dam:

- *Effects of project operation and maintenance on fish populations in project reservoirs and the project-affected stream reach including fall Chinook salmon.*

Unlike within the Don Pedro Reservoir and in the lower Tuolumne River, where the Proposed Action would have no effect on environmental conditions (see sections 3.5.3 and 4.0, respectively), hydropower generation would have an effect on water velocities in the reach between Don Pedro Reservoir and La Grange Diversion Dam. As explained previously, outflows through the powerhouse may be shaped to generate more electricity during on-peak periods and less during off-peak periods, subject to meeting the requirements of the pre-established flow schedule. These changes in outflows affect water velocities in the reach between the two dams. In the upper part of the reach, above the island at Twin Gulch, velocities range from 5 feet per second (fps) during high outflows (about 4,000 cfs) to 3 fps during low outflows (1,000 cfs) just below the powerhouse and from 2.5 fps (high flow) to 1 fps (low flow) in the deeper pool section just above Twin Gulch. Below the island at Twin Gulch, in the lower reach affected by the backwater of La Grange Diversion Dam, velocities range from 0.8 fps during higher flows to 0.3 fps during lower flows) (TID 2011). Rainbow trout would be able to move through these reaches to locate suitable velocity conditions. Water velocities within this range are suitable for all life stages of resident rainbow trout based on the habitat suitability criteria applicable to resident *O. mykiss* in the Tuolumne River (Stillwater 2013). The change in depth between lower flows (1,000 cfs) and higher flows (4,000 cfs) in the upper reach is approximately 1.5 ft from elevation 299 to 301.5 ft. In the lower reach affected by La Grange Diversion Dam, the change is depth is approximately 0.2 ft from 296.4 ft to 296.6 ft (TID 2011).

As noted above, results of the Fish Assemblage and Population between Don Pedro Dam and La Grange Diversion Dam Study conducted in 2012 (TID/MID 2013b) indicate that the reach of the Tuolumne River between the dams contains two fish species, rainbow trout and prickly sculpin, and that both species are distributed across the reach.

Because both rainbow trout and sculpin exhibit multiple age classes, reproduction of these species is apparently occurring within the reach (as noted above, there are no records of stocking having been conducted in this reach). In addition, fish of both species appear to be healthy, as indicated by average condition factors near 1.0 (average Kn=0.99). Given the multi-age structure of the populations and apparent health of individual fish, velocity fluctuations associated with existing operations allow for the persistence of the two species in the reach between the dams. Although physical habitat conditions, structural complexity in particular, are not optimal, the Don Pedro Project does not preclude rainbow trout and sculpin from living and reproducing in the reach and, therefore, would not be expected to have an adverse effect on these species over the term of the new license. In other words, because the range of operations under the Proposed Action would be the same as that under current operations, there would be no adverse effects on rainbow trout or sculpin relative to existing baseline.

3.5.3.3 Proposed Environmental Measures

As noted above, the Proposed Action would have no adverse effects on fish and aquatic resources in the reach between Don Pedro Reservoir and La Grange Diversion Dam, and as a result the Districts are proposing no environmental measures for this reach.

3.5.3.4 Unavoidable Adverse Impacts

For the reasons outlined in Section 3.5.3.2, the Proposed Action would result in no unavoidable adverse impacts on fish and aquatic resources in the reach between Don Pedro Reservoir and La Grange Diversion Dam.

3.5.4 Fish and Aquatic Resources in the Lower Tuolumne River

3.5.4.1 Existing Environment

The lower Tuolumne River extends approximately 52 miles from La Grange Diversion Dam (RM 52.2) downstream to its confluence with the San Joaquin River (RM 0). The lower river can be divided into two broad geomorphic zones defined by channel slope and bed material. The upper zone (RM 24–52) is gravel-bedded with moderate slope (0.10–0.15%), whereas the lower zone (RM 0–24) is sand-bedded with a slope generally less than 0.03 percent (McBain & Trush 2000). The gravel-bedded and sand-bedded zones are subdivided into seven reaches based on present and historical land uses, valley confinement, channel substrate and slope, and salmonid use:

- Reach 1 (RM 0–10.5): Lower sand-bedded reach,
- Reach 2 (RM 10.5–19.3): Urban sand-bedded reach,
- Reach 3 (RM 19.3–24.0): Upper sand-bedded reach,
- Reach 4 (RM 24.0–34.2): In-channel gravel mining reach,
- Reach 5 (RM 34.2–40.3): Gravel mining reach,
- Reach 6 (RM 40.3–45.5): Dredger tailings reach, and
- Reach 7 (RM 45.5–52.1): Dominant salmon spawning reach.

The lower Tuolumne River contains a fish community similar to those found throughout the San Joaquin River Basin (see the fish species composition and salmonid sections below for greater detail). Currently, hatchery-origin fish represent a large proportion of the Central Valley fall-run Chinook salmon escapement (TID/MID 2013c). Although precise estimates of the proportion of hatchery- and naturally-produced salmon cannot readily be discriminated in the historical record because hatchery-origin fish have not been consistently marked, straying of hatchery-origin fish has been documented in the Tuolumne River and has likely affected the numbers of salmon in annual spawning runs (TID/MID 2012b; TID/MID 2013c).

3.5.4.1.1 Fish Studies Conducted in the Lower Tuolumne River

Fish Studies Conducted Prior to Relicensing

The Don Pedro Project and its potential environmental effects have undergone continuous study and evaluation since the initial license was issued. The Districts, in cooperation with state and federal resource agencies and environmental groups, have conducted over 200 individual resource investigations since the Don Pedro Project began commercial operation in 1971. The first 20 years of study led in 1995 to the development of a FERC-mediated settlement agreement with resource agencies and NGOs, whereby the Districts agreed to modify their operations to increase the flows released to the lower Tuolumne River for the benefit of fish, especially fall-run Chinook salmon.

Conditions in the lower Tuolumne River have also benefited from the involvement of the Tuolumne River Technical Advisory Committee (TRTAC), the role of which was formalized in the 1995 Settlement Agreement. Since the early 1990s to the present, the TAC has been engaged in developing, reviewing, and participating in activities to improve and protect the fisheries of the lower Tuolumne River downstream of La Grange Diversion Dam. In addition to the Districts, the TAC includes members from state and federal resource agencies, CCSF, and NGOs.

On an annual basis, the Districts file with FERC, and share with the TAC, results of ongoing monitoring downstream of the Project Boundary. The up-to-date record created by the continuous process of environmental investigation and resource monitoring has produced detailed baseline information that has been useful during the relicensing of the Don Pedro Project.

Major studies conducted by the Districts since the 1995 Settlement Agreement and independent of the current relicensing are summarized in Table 3.5-8. Studies fall into the following general categories: (1) salmon population models, (2) salmon spawning surveys, (3) seine, snorkel, and fyke net reports and various juvenile salmon studies, (4) screw trap monitoring, (5) flow fluctuation assessments, (6) smolt monitoring and survival evaluations, (7) fish community assessments (8) invertebrate reports, (9) Delta salmon salvage reports, (10) gravel, incubation, and redd distribution studies, (11) water temperature and water quality assessments (12) instream flow incremental methodology (IFIM) assessments, (13) flow and delta water export reports, (14) restoration, monitoring, and mapping, and (15) general monitoring. Studies conducted as part of relicensing (see following section) draw on this extensive body of work as appropriate.

Chinook salmon and *O. mykiss* population models developed during relicensing are the most comprehensive versions yet developed, and are based on the most current available information. As such, the findings of the newly developed models supersede those of previous models unless otherwise noted.

Table 3.5-8. Fish studies conducted in the lower Tuolumne River independent of the current relicensing.

Study No.	Study Name
Salmon Population Models	
1992 Appendix 1	Population Model Documentation
1992 Appendix 26	Export Mortality Fraction Submodel
1992 Appendix 2	Stock Recruitment Analysis of the Population Dynamics of San Joaquin River System Chinook salmon
Report 1996-5	Stock-Recruitment Analysis Report
Salmon Spawning Surveys	
1992 Appendix 3	Tuolumne River Salmon Spawning Surveys 1971-88
Report 1996-1	Spawning Survey Summary Report
Report 1996-1.1	1986 Spawning Survey Report
Report 1996-1.2	1987 Spawning Survey Report
Report 1996-1.3	1988 Spawning Survey Report
Report 1996-1.4	1989 Spawning Survey Report
Report 1996-1.5	1990 Spawning Survey Report
Report 1996-1.6	1991 Spawning Survey Report
Report 1996-1.7	1992 Spawning Survey Report
Report 1996-1.8	1993 Spawning Survey Report
Report 1996-1.9	1994 Spawning Survey Report
Report 1996-1.10	1995 Spawning Survey Report
Report 1996-1.11	1996 Spawning Survey Report
Report 1996-1.12	Population Estimation Methods
Report 1997-1	1997 Spawning Survey Report and Summary Update
Report 1998-1	Spawning Survey Summary Update
Report 1999-1	1998 Spawning Survey Report
Report 2000-1	1999 and 2000 Spawning Survey Reports
Report 2000-2	Spawning Survey Summary Update
Report 2001-1	2001 Spawning Survey Report
Report 2001-2	Spawning Survey Summary Update
Report 2002-1	2002 Spawning Survey Report
Report 2002-2	Spawning Survey Summary Update
Report 2003-1	Spawning Survey Summary Update
Report 2004-1	2003 and 2004 Spawning Survey Reports
Report 2004-2	Spawning Survey Summary Update
Report 2006-1	2005 and 2006 Spawning Survey Reports
Report 2006-2	Spawning Survey Summary Update
Report 2007-1	2007 Spawning Survey Report
Report 2007-2	Spawning Survey Summary Update
Report 2008-2	Spawning Survey Summary Update
Report 2009-1	2008 and 2009 Spawning Survey Reports
Report 2009-2	Spawning Survey Summary Update
Report 2009-8	2009 Counting Weir Report
Report 2010-1	2010 Spawning Survey Reports
Report 2010-2	Spawning Survey Summary Update
Report 2010-8	2010 Counting Weir Report

Study No.	Study Name
Report 2011-2	Spawning Survey Summary Update
Report 2011-8	2011 Tuolumne River Weir Report
Report 2012-2	Spawning Survey Summary Update
Report 2012-6	2012 Tuolumne River Weir Report
Seine, Snorkel, Fyke Reports and Various Juvenile Salmon Studies	
1992 Appendix 10	1987 Juvenile Chinook salmon Mark-Recapture Study
1992 Appendix 12	Data Reports: Seining of Juvenile Chinook salmon in the Tuolumne, San Joaquin, and Stanislaus Rivers, 1986-89
1992 Appendix 13	Report on Sampling of Chinook Salmon Fry and Smolts by Fyke Net and Seine in the Lower Tuolumne River, 1973-86
1992 Appendix 20	Juvenile Salmon Pilot Temperature Observation Experiments
Report 1996-2	Juvenile Salmon Summary Report
Report 1996-2.1	1986 Snorkel Survey Report
Report 1996-2.2	1988-89 Pulse Flow Reports
Report 1996-2.3	1990 Juvenile Salmon Report
Report 1996-2.4	1991 Juvenile Salmon Report
Report 1996-2.5	1992 Juvenile Salmon Report
Report 1996-2.6	1993 Juvenile Salmon Report
Report 1996-2.7	1994 Juvenile Salmon Report
Report 1996-2.8	1995 Juvenile Salmon Report
Report 1996-2.9	1996 Juvenile Salmon Report
Report 1996-9	Aquatic Invertebrate Report
Report 1997-2	1997 Juvenile Salmon Report and Summary Update
Report 1998-2	1998 Juvenile Salmon Report and Summary Update
Report 1999-4	1999 Juvenile Salmon Report and Summary Update
Report 2000-3	2000 Seine/Snorkel Report and Summary Update
Report 2001-3	2001 Seine/Snorkel Report and Summary Update
Report 2002-3	2002 Seine/Snorkel Report and Summary Update
Report 2003-2	2003 Seine/Snorkel Report and Summary Update
Report 2004-3	2004 Seine/Snorkel Report and Summary Update
Report 2005-3	2005 Seine/Snorkel Report and Summary Update
Report 2006-3	2006 Seine/Snorkel Report and Summary Update
Report 2007-3	2007 Seine/Snorkel Report and Summary Update
Report 2008-3	2008 Seine Report and Summary Update
Report2008-5	2008 Snorkel Report and Summary Update
Report 2009-3	2009 Seine Report and Summary Update
Report 2009-5	2009 Snorkel Report and Summary Update
Report 2010-3	2010 Seine Report and Summary Update
Report 2010-5	2010 Snorkel Report and Summary Update
Report 2011-3	2011 Seine Report and Summary Update
Report 2011-5	2011 Snorkel Report and Summary Update
Report 2012-3	2012 Seine Report and Summary Update
Report 2012-5	2012 Snorkel Report and Summary Update
Screw Trap Monitoring	
Report 1996-12	Screw Trap Monitoring Report: 1995-96
Report 1997-3	1997 Screw Trap and Smolt Monitoring Report
Report 1998-3	1998 Tuolumne River Outmigrant Trapping Report
Report 1999-5	1999 Tuolumne River Upper Rotary Screw Trap Report
Report 2000-4	2000 Tuolumne River Smolt Survival and Upper Screw Traps Report
Report 2000-5	1999-2000 Grayson Screw Trap Report
Report 2001-4	2001 Grayson Screw Trap Report
Report 2004-4	1998, 2002, and 2003 Grayson Screw Trap Reports

Study No.	Study Name
Report 2004-5	2004 Grayson Screw Trap Report
Report 2005-4	2005 Grayson Screw Trap Report
Report 2005-5	Rotary Screw Trap Summary Update
Report 2006-4	2006 Rotary Screw Trap Report
Report 2006-5	Rotary Screw Trap Summary Update
Report 2007-4	2007 Rotary Screw Trap Report
Report 2008-4	2008 Rotary Screw Trap Report
Report 2009-4	2009 Rotary Screw Trap Report
Report 2010-4	2010 Rotary Screw Trap Report
Report 2011-4	2011 Rotary Screw Trap Report
Report 2012-4	2012 Rotary Screw Trap Report
Flow Fluctuation Assessments	
1992 Appendix 14	Fluctuation Flow Study Report
1992 Appendix 15	Fluctuation Flow Study Plan: Draft
Report 2000-6	Tuolumne River Chinook Salmon Fry and Juvenile Stranding Report
2005 Ten-Year Summary Report Appendix E	Stranding Survey Data (1996-2002)
Predation Evaluations	
1992 Appendix 22	Lower Tuolumne River Predation Study Report
1992 Appendix 23	Effects of Turbidity on Bass Predation Efficiency
Report 2006-9	Lower Tuolumne River Predation Assessment Final Report
Smolt Monitoring and Survival Evaluations	
1992 Appendix 21	Possible Effects of High Water Temperature on Migrating Salmon Smolts in the San Joaquin River
Report 1996-13	Coded-wire Tag Summary Report
Report 1998-4	1998 Smolt Survival Peer Review Report
Report 1998-5	CWT Summary Update
Report 1999-7	Coded-wire Tag Summary Update
Report 2000-4	2000 Tuolumne River Smolt Survival and Upper Screw Traps Report
Report 2000-8	Coded-wire Tag Summary Update
Report 2001-5	Large CWT Smolt Survival Analysis
Report 2001-6	Coded-wire Tag Summary Update
Report 2002-4	Large CWT Smolt Survival Analysis
Report 2002-5	Coded-wire Tag Summary Update
Report 2003-3	Coded-wire Tag Summary Update
Report 2004-7	Large CWT Smolt Survival Analysis Update
Report 2004-8	Coded-wire Tag Summary Update
Report 2005-6	Coded-wire Tag Summary Update
Report 2006-6	Coded-wire Tag Summary Update
Report 2007-5	Coded-wire Tag Summary Update
Fish Community Assessments	
1992 Appendix 24	Effects of Introduced Species of Fish in the San Joaquin River System
1992 Appendix 27	Summer Flow Study Report 1988-90
Report 1996-3	Summer Flow Fish Study Annual Reports: 1991-94
Report 1996-3.1	1991 Report
Report 1996-3.2	1992 Report
Report 1996-3.3	1993 Report
Report 1996-3.4	1994 Report
Report 2001-8	Distribution and Abundance of Fishes Publication
Report 2002-9	Publication on the Effects of Flow on Fish Communities
Report 2007-7	2007 Rainbow Trout Data Summary Report
Report 2008-6	2008 July *Oncorhynchus mykiss* Population Estimate Report

Study No.	Study Name
Report 2010	Tuolumne River *Oncorhynchus mykiss* Monitoring Report (submitted January 15)
Attachment 5	March and July 2009 Population Estimates of *Oncorhynchus mykiss* Report
Report 2011	Tuolumne River *Oncorhynchus mykiss* Monitoring Summary Report (submitted January 15)
Report 2010-6	2010 *Oncorhynchus mykiss* Population Estimate Report
Report 2010-7	2010 *Oncorhynchus mykiss* Acoustic Tracking Report
Report 2011-6	2011 *Oncorhynchus mykiss* Population Estimate Report
Report 2011-7	2011 *Oncorhynchus mykiss* Acoustic Tracking Report
Invertebrate Reports	
1992 Appendix 16	Aquatic Invertebrate Studies Report
1992 Appendix 28	Summer Flow Invertebrate Study
Report 1996-4	Summer Flow Aquatic Invertebrate Annual Reports: 1989-93
Report 1996-4.1	1989 Report
Report 1996-4.2	1990 Report
Report 1996-4.3	1991 Report
Report 1996-4.4	1992 Report
Report 1996-4.5	1993 Report
Report 1996-9	Aquatic Invertebrate Report
Report 2002-8	Aquatic Invertebrate Report
Report 2004-9	Aquatic Invertebrate Monitoring Report (2003-2004)
Report 2008-7	Aquatic Invertebrate Monitoring (2005, 2007, 2008) and Summary Update
Report 2009-7	2009 Aquatic Invertebrate Monitoring and Summary Update
Delta Salmon Salvage	
Report 1999-6	1993-99 Delta Salmon Salvage Report
Gravel, Incubation, and Redd Studies	
1992 Appendix 6	Spawning Gravel Availability and Superimposition Report (incl. map)
1992 Appendix 7	Salmon Redd Excavation Report
1992 Appendix 8	Spawning Gravel Studies Report
1992 Appendix 9	Spawning Gravel Cleaning Methodologies
1992 Appendix 11	An Evaluation of the Effect of Gravel Ripping on Redd Distribution
Report 1996-6	Redd Superimposition Report
Report 1996-7	Redd Excavation Report
Report 1996-8	Gravel Studies Report: 1987-89
Report 1996-10	Gravel Cleaning Report: 1991-93
Report 2000-7	Tuolumne River Substrate Permeability Assessment and Monitoring Program Report
Report 2006-7	Survival to Emergence Study Report
Report 2008-9	Monitoring of Winter 2008 Runoff Impacts from Peaslee Creek
Water Temperature and Water Quality	
1992 Appendix 17	Preliminary Tuolumne River Water Temperature Report
1992 Appendix 18	Instream Temperature Model Documentation: Description and Calibration
1992 Appendix 19	Modeled Effects of La Grange Releases on Instream Temperatures in the Lower Tuolumne River
Report 1996-11	Intragravel Temperature Report: 1991
Report 1997-5	1987-97 Water Temperature Monitoring Data Report
Report 2002-7	1998-2002 Temperature and Conductivity Data Report
Report 2004-10	2004 Water Quality Report
Report 2007-6	Flow, Delta Export, Weather, and Water Quality Data Report: 2003-2007
IFIM Assessment	
1992Appendix 4	Instream Flow Data Processing, Tuolumne River
1992 Appendix 5	Analysis of 1981 Lower Tuolumne River IFIM Data

Study No.	Study Name
	1995 USFWS Report on the Relationship between Instream Flow and Physical Habitat Availability (submitted by Districts to FERC in May 2004)
Flow and Delta Exports	
Report 1997-4	Streamflow and Delta Water Export Data Report
Report 2002-6	1998-2002 Streamflow and Delta Water Export Data Report
Report 2003-4	Review of 2003 Summer Flow Operation
Report 2007-6	Flow, Delta Export, Weather, and Water Quality Data Report: 2003-2007
Report 2008-8	Review of 2008 Summer Flow Operation
Report 2009-6	Review of 2009 Summer Flow Operation
Restoration, Project Monitoring, and Mapping	
Report 1996-14	Tuolumne River GIS Database Report and Map
Report 1999-8	A Summary of the Habitat Restoration Plan for the Lower Tuolumne River Corridor
Report 1999-9	Habitat Restoration Plan for the Lower Tuolumne River Corridor
Report 1999-10	1998 Restoration Project Monitoring Report
Report 1999-11	1999 Restoration Project Monitoring Report
Report 2001-7	Adaptive Management Forum Report
Report 2004-12	Coarse Sediment Management Plan
Report 2004-13	Tuolumne River Floodway Restoration (Design Manual)
2005 Ten-Year Summary Report Appendix D	Salmonid Habitat Maps
2005 Ten-Year Summary Report Appendix F	GIS Mapping Products
Report 2005-7	Bobcat Flat/River Mile 43: Phase 1 Project Completion Report
Report 2006-8	Special Run Pool 9 and 7/11 Reach: Post-Project Monitoring Synthesis Report
Report 2006-10	Tuolumne River La Grange Gravel Addition, Phase II Annual Report
Report 2006-11	Tuolumne River La Grange Gravel Addition, Phase II Geomorphic Monitoring Report
General Monitoring Information	
Report	1992 Fisheries Studies Report
Report 2002-10	2001-2002 Annual CDFW Sportfish Restoration Report
Report	2005 Ten-Year Summary Report

Fish Studies Conducted by the Districts as Part of Relicensing

Spawning Gravel in the Lower Tuolumne River (W&AR-04)

In 2012, the Districts conducted a spawning gravel survey (TID/MID 2013d) in the Tuolumne River from just downstream of La Grange Diversion Dam at RM 52.1 to RM 23, which accounts for the extent of riffle habitats documented in historical surveys (TID/MID 1992a, TID/MID 2013d). The survey involved the application of a variety of analyses and modeling to: (1) estimate average annual sediment yield to Don Pedro Reservoir, (2) estimate changes in the volume of coarse bed material in the lower Tuolumne River channel from 2005 to 2012, (3) map fine bed material in the lower Tuolumne River and compare the results with previous surveys, (4) develop a reach-specific coarse sediment budget to evaluate the Don Pedro Project's contribution to cumulative effects on river sediment in the lower Tuolumne River, (5) map current riffle, spawning gravel, and suitable spawning habitat areas in the lower Tuolumne River and compare the results with previous surveys, and (6) estimate theoretical maximum Chinook spawning run sizes supported under current conditions.

Salmonid Population Information Integration and Synthesis (W&AR-05)

The Districts conducted a Salmonid Population Information Integration and Synthesis Study in 2012 (TID/MID 2013c) to collect and summarize existing information to characterize Chinook salmon and *O. mykiss* populations in the Tuolumne River and develop hypotheses related to factors potentially affecting those populations. The study area included the lower Tuolumne River from La Grange Diversion Dam (RM 52.2) downstream to the confluence with the San Joaquin River (RM 0), the lower San Joaquin River from the Tuolumne River confluence (RM 84) to Vernalis (RM 69.3), the Delta[14], San Francisco Bay Estuary[15], and the Pacific Ocean. Local and regional information, as well as broader scientific literature sources, were reviewed to examine issues affecting habitat use and life history progression of Tuolumne River salmonids, including fall-run Chinook salmon and *O. mykiss*.

Chinook Salmon Population Model Study (W&AR-06)

The Districts have developed the Tuolumne River Chinook Salmon Population Model (TID/MID 2013e) to investigate the relative influences of various factors on the life-stage-specific production of Chinook salmon in the Tuolumne River, identify critical life-stage-specific limitations that may represent a population "bottleneck," and compare relative changes in population size between potential alternative management scenarios. Drawing on information developed through interrelated studies, linked sub-models were developed using functional relationships of habitat use, growth, movement, and predation. This model was developed with substantial involvement of interested parties in accordance with a Workshop Consultation Process used to obtain critical input at key model development stages.

Predation (W&AR-07)

In 2012, the Districts conducted a study to understand the effects of predation on rearing and outmigrating juvenile Chinook salmon in the lower river (TID/MID 2013f). The study, which built upon previously conducted evaluations (TID/MID 1992a), involved estimating the relative abundance of native and non-native piscivores, updating estimates of predation rates, and evaluating habitat use by juvenile Chinook salmon and predator species at typical flows encountered during the juvenile outmigration period. The study area included the Tuolumne River from La Grange Diversion Dam (RM 52.2) to the confluence with the San Joaquin River (RM 0).

On May 21, 2013, FERC issued its Determination on Requests for Study Modifications and New Studies, which included a recommendation that the Districts conduct another year of predation studies in 2014. Following consultation with relicensing participants, and review and revision of the study plan based on agency comments, the 2014 final study plan was approved by FERC on

[14] The Delta received its first official boundary in 1959 with the passage of the Delta Protection Act (Section 12220 of the California Water Code), with the southern boundary in the San Joaquin River located at Vernalis (RM 69.3) and the western boundary at the confluence of the Sacramento and San Joaquin Rivers (RM 0) near Chipps Island.

[15] The greater San Francisco Bay estuary extends from the Golden Gate Bridge in San Francisco Bay eastward across salt and brackish water habitats included in San Leandro, Richardson, San Rafael, and San Pablo bays, as well as the Carquinez Strait, Honker, and Suisun bays further to the east near the western edge of the Delta.

October 18, 2013. The Districts have received an extension from FERC and this study will be filed with the Commission in April 2016.

Salmonid Redd Mapping (W&AR-08)

In 2012–2013, the Districts conducted salmonid redd mapping (TID/MID 2013g) to document the spatial distribution of Chinook salmon redds and any evidence of redd superimposition in the Tuolumne River. The study involved identifying locations of redds, documenting evidence of redd superimposition, and comparing redd counts and densities at recent gravel augmentation sites to nearby control sites. The study area included the reach from La Grange Diversion Dam (RM 52.2) to Santa Fe Avenue Bridge (RM 22), which encompasses the area of Chinook salmon spawning in riffles as documented in recent annual spawning surveys conducted by CDFW.

Oncorhynchus mykiss Population Study (W&AR-10)

The Districts developed the Tuolumne River *O. mykiss* population model as part of the *O. mykiss* Population Study (TID/MID 2014). This study synthesizes the best available information and provides a quantitative population model to investigate the relative influences of various factors on the life-stage-specific production of *O. mykiss* in the Tuolumne River, identify critical life-stage-specific limitations that may represent a population "bottleneck," and compare relative changes in population size between potential alternative management scenarios. Drawing on information developed through interrelated studies, linked sub-models were developed using functional relationships of habitat use, growth, movement, and predation. This model was developed with substantial involvement of interested parties in accordance with a Workshop Consultation Process used to obtain critical input at key model development stages.

Chinook Salmon Otolith Study (W&AR-11)

The Chinook Salmon Otolith Study (TID/MID 2013h) examines evidence of the geographic origin and early life-history of Tuolumne River Chinook salmon spawners as a means of comparing the relative contribution of fry and smolt life-stages to subsequent escapement and any associations with flow or antecedent hydrology. CDFW completed its inventory of otolith in August 2013 and in September 2013 the Districts, CDFW, and the University of California Davis entered into a Memorandum of Understanding to share data. Analysis of Chinook otolith samples from representative wet and dry years (outmigration years 1998, 1999, 2000, 2003, and 2009) is underway. The W&AR-11 Study Report will be filed with FERC in February 2015.

Oncorhynchus mykiss Habitat Survey (W&AR-12)

The 2012 *O. mykiss* habitat survey (TID/MID 2013i) consisted of an inventory of instream habitat types and physical habitat characteristics and an appraisal of the distribution, abundance, and function of LWD. The study area extended from La Grange Diversion Dam to Roberts Ferry Bridge (from approximately RM 52 to 39), and for the purpose of evaluating LWD from RM 52 downstream to RM 24.

Temperature Criteria Assessment (W&AR-14)

The Temperature Criteria Assessment (TID/MID 2013j), which is currently being conducted, includes the following tasks: (1) a literature review of available temperature tolerances of Chinook salmon and *O. mykiss*, (2) a desktop analysis examining the influence of temperature on the growth of Chinook salmon in the Tuolumne River, (3) a desktop analysis examining the influence of temperature on the timing of Chinook salmon spawning initiation in the Tuolumne River, (4) an empirical study of local adaptation of temperature tolerance of *O. mykiss* juveniles in the lower Tuolumne River, and (5) an analysis of existing empirical information on the spatial distribution of juvenile *O. mykiss* in response to temperature.

Oncorhynchus mykiss Scale Collection and Age Determination (W&AR-20)

In 2012, the Districts conducted the *Oncorhynchus mykiss* Scale Collection and Age Determination Study (TID/MID 2013k) to use scales to estimate the age-at-length relationship of *O. mykiss* in the lower Tuolumne River. Fish were collected in the reach that extends from La Grange Diversion Dam (RM 52.2) to Turlock Lake SRA (RM 42), and a single sample was collected from the rotary screw trap survey near Waterford (RM 30).

Lower Tuolumne River Floodplain Hydraulic Assessment (W&AR-21) [16]

The July 16, 2009 FERC Order (128 FERC 61,035) required the Districts to conduct a two-dimensional (2-D) pulse flow study. The purpose of the 2-D Pulse Flow Study (Stillwater Sciences 2012a) was to assess habitat suitability for lower Tuolumne River fish species, including Chinook salmon, at conditions above bankfull discharge, and gather empirical data on the relationship between water temperature and flow during pulse flow events (i.e., >1,200 cfs). The study included the development of a 2-D hydraulic model at three study sites to assess the habitat suitability of overbank inundation areas during in-channel at flows up to 5,000 cfs.

The Lower Tuolumne River Floodplain Hydraulic Assessment (TID/MID 2013l) is being undertaken by the Districts to supplement the 2-D modeling described above and the USFWS (2008) assessment of floodplain inundation (i.e., flow-overbank inundation relationship for potential fall-run Chinook salmon and steelhead/rainbow trout juvenile outmigration habitat in the Tuolumne River). The objective of the study is to assess the floodplain area inundated between RM 52.5 and 21.5 of the lower river at flows between 1,100 and 3,100 cfs, 3,100 and 5,300 cfs, and 5,300 and 8,400 cfs. The study will allow for a comparison of floodplain inundation frequency and period under baseline conditions and under a range of alternative flows.

One-Dimensional (1-D) PHABSIM model (Stillwater Sciences 2013)

A number of previous instream flow studies have been conducted on the lower Tuolumne River. The most recent study was filed with FERC in April 2013. The purpose of this latest one-dimensional (1-D) physical habitat simulation (PHABSIM) model (Stillwater Sciences 2013), conducted per a July 16, 2009 FERC Order (128 FERC 61,035), was “to determine instream

[16] Per FERC’s May 21, 2013 study determination.

flows necessary to maximize fall-run Chinook salmon and *O. mykiss* production and survival throughout their various life stages." The instream flow assessment methodology (Bovee 1982) applied a mesohabitat and transect-based approach (i.e., 1-D model) for implementing the PHABSIM component of the USFWS IFIM to address flow-habitat relationships in the lower Tuolumne River from RM 51.7 to 29.0. PHABSIM study site locations in the lower Tuolumne River are shown in Figure 3.5-7. As a supplement to this PHABSIM study (Stillwater Sciences 2013), weighted usable area (WUA) versus flow analyses for Sacramento splittail and Pacific lamprey, using existing habitat suitability criteria (HSC), were conducted.

The Districts will complete additional analysis in 2014-2016 to supplement the PHABSIM instream flow studies (Stillwater Sciences 2012a, 2013). One analysis (in 2014) will provide an evaluation of effective weighted usable area (eWUA) of affected *O. mykiss* life stages using the final lower Tuolumne River water temperature model (TID/MID 2013m). The eWUA analysis relates to summer water temperature suitability for *O. mykiss* and will integrate both micro- and macro-habitat considerations. The results from the water temperature model over a range of flows will be combined with the summer WUA results so that macrohabitats with unsuitable water temperatures are excluded from the total WUA estimate.

Another analysis will include an evaluation of smallmouth, largemouth, and striped bass habitat based on existing habitat suitability criteria. The results will pertain to the assessment of predation on juvenile fall-run Chinook salmon (to be filed with the W&AR-07 Predation Study Report in 2016).

3.5.4.1.2 Physical Habitat Conditions in the Lower Tuolumne River

Physical habitat conditions in the lower Tuolumne River, from La Grange Diversion Dam (RM 52.2) to the confluence with the San Joaquin River, have been affected by a wide range of human actions conducted over many decades. Prior to widespread European settlement, channel form in the gravel-bedded zone of the lower Tuolumne River (RM 24.0–52.1) consisted of a combination of single-thread and split channels that migrated and avulsed (McBain & Trush 2000). Anthropogenic changes that have occurred in the lower Tuolumne River corridor since the mid-1800s include gold mining, aggregate mining, grazing, agriculture, water management, and more recently, urban encroachment (greater detail regarding anthropogenic impacts on the lower Tuolumne River is provided in Section 4.0, Cumulative Effects).

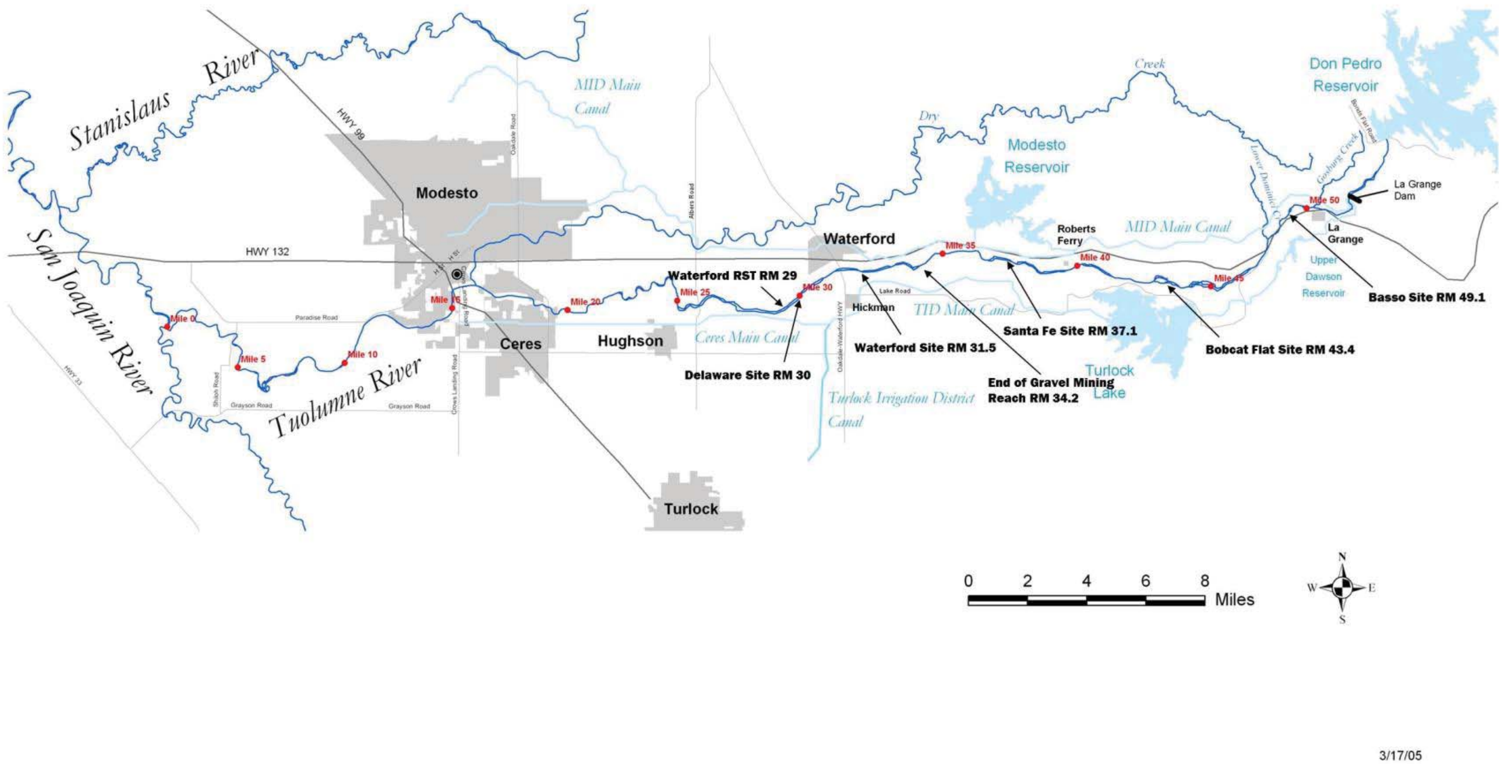

Figure 3.5-7. Vicinity map and study site locations for the Lower Tuolumne River Instream Flow Study.

Riverbed material has been excavated to depths well below the thalweg to mine gold and aggregate, eliminating active floodplains and terraces and creating large in-channel and off-channel pits. A historical timeline of mining in the San Joaquin River's tributaries includes placer mining (1848–1880), dredge mining (1880–1960s), and sand and gravel mining (1940s–present) (McBain & Trush 2000). On the Tuolumne River, dredge mining during the early 1900s resulted in the excavation of channel and floodplain sediments and left dredger tailings deposits between RM 38.0 and 50.5. Large scale, off-channel aggregate mining continues today.

Historically, sand and gravel were mined directly from the active river channel, creating large, in-channel pits now referred to as Special Run Pools (SRPs). These SRPs are as much as 400 ft wide and 35 ft deep, occupying 23 percent of the channel length in the gravel-bedded reach of the lower Tuolumne River, and are characterized by much lower water velocities and greater depths than those found in river reaches that were not mined. More recent aggregate mining operations have excavated sand and gravel from floodplains and terraces immediately adjacent to the river channel at several locations downstream of Roberts Ferry Bridge (RM 39.5) (TID/MID 2011a). Floodplain and terrace pits in this reach are typically separated from the channel by narrow berms that can breach during high flows, resulting in capture of the river channel. For example, the January 1997 flood caused extensive damage to dikes separating deep gravel mining pits from the river, breaching or overtopping nearly every dike along a 6-mile-long reach of river (TID/MID 2011a).

Agricultural and urban encroachment along the lower river, combined with a reduction in high flows and coarse sediment supply, have resulted in a relatively static channel within a floodway confined by dikes and agricultural uses. Many miles of river bank have been leveed and stabilized with riprap by agencies or landowners. Levees and bank revetment extend along portions of the river bank from near Modesto (RM 16) downstream through the lower San Joaquin River and Delta.

The relative abundance of habitat types in the lower Tuolumne River during the 2012 Spawning Gravel in the Lower Tuolumne River survey (TID/MID 2013i) was as follows: 14 percent riffle, 61 percent flat water, and 25 percent pool. Sediment model simulations indicate that without gravel augmentation, the channel bed from RM 52 to 39.7 would be slowly degrading (as opposed to aggrading) and coarsening in response to a reduction in coarse sediment supply due to sediment retention in upstream reservoirs. Gravel augmentation, however, has helped to increase coarse sediment storage in this area (TID/MID 2013d). Although the results of sediment modeling and topographic differencing indicate little overall change in storage from RM 52 to 45.5 during the period 2000 to 2012, high flows in water year (WY) 2006 and WY 2011 resulted in substantial pool scour, with coarse sediment re-deposited in pool tails and riffles and fine bed material mobilized to channel margins (TID/MID 2013d). Most riffle mesohabitat units (i.e., 84% of total riffle habitat) mapped in 2012 from RM 52.1 to 23 contained spawning gravel (TID/MID 2013c).

The lower Tuolumne River has limited LWD (TID/MID 2013i). There was a total of 118 LWD pieces in the 16,905 linear ft of habitat surveyed in 2012, which when extrapolated to the reach extending from RM 52 to RM 39, is an estimated 453 pieces (TID/MID 2013i). The importance of LWD in habitat formation decreases with increasing channel width. The lower Tuolumne

River between RM 52 and 26 has channel widths averaging 119 ft, and LWD has a limited effect on channel morphology in this reach (TID/MID 2013i). Compared to smaller streams, Bilby and Bisson (1998) observed that wood has less effect on channel form in larger streams, which is consistent with the W&AR-12 surveyors' observations that LWD has a limited effect on channel morphology in the lower river.

Most LWD captured in Don Pedro Reservoir originates upstream of the reservoir, and given the size of this LWD, a majority of it would pass through the lower Tuolumne River during high flows if it were not trapped in the reservoir (TID/MID 2013i). However, it is unknown to what extent smaller pieces of LWD would add to existing wood accumulations or initiate small woody debris jams in the lower river.

Although LWD provides habitat for salmonids in some systems, there are no data available for the Tuolumne River or neighboring Merced River that specifically address the role of LWD on salmonid abundance (TID/MID 2013i). Of the 121 locations within the W&AR-12 study reach where LWD was recorded, about 80 percent of it was located in or adjacent to runs or pools, which are not typically the preferred habitat of juvenile or adult salmonids in the lower Tuolumne River. Because most LWD in the lower Tuolumne River is partially or wholly out of the channel, and due to its small size, it does not provide significant cover for fish, which in turn limits its value as protection from avian and aquatic predators. Due to its generally small size, location, and lack of complexity, most LWD from RM 52 to 24 provides little habitat value for salmonids.

The Districts 2012 Lower Tuolumne River Riparian Information and Synthesis Study (TID/MID 2013n) shows that native riparian vegetation occupies 2,691 ac along a nearly continuous but variable-width band along the lower Tuolumne River corridor. In addition, the number of locations and areal extent of lands dominated by non-native plants has decreased over the past 15 years (TID/MID 2013n).

Overall, the native riparian vegetation is slowly increasing, with a 419-ac increase in the net extent of native vegetation between 1996 and 2012, brought about primarily through active restoration projects (TID/MID 2013n). Areas with the greatest extent of native riparian vegetation per river mile were found along the 12 miles immediately downstream of La Grange Diversion Dam. Closer to the confluence with the San Joaquin River, several large restoration projects have also increased the extent of native riparian vegetation. However, there is limited natural replacement of mature and senescent plants with younger cohorts outside the restored areas. Areas with the least riparian vegetation and narrowest riparian corridor occur from RM 10.5 to 19.3, i.e., the section of river that runs through the urban areas of Modesto and Ceres (TID/MID 2013n). The river corridor between RM 19.3 and 40.3 includes large areas that are sparsely vegetated due to historical mining and dredger tailings deposits (see Section 3.6 of this FLA, Botanical Resources, for greater detail on riparian vegetation).

3.5.4.1.3 Fish Species in the Lower Tuolumne River

Fish species composition in the lower Tuolumne River is shown in Table 3.5-9 (Ford and Brown 2001; TID/MID 2010a,b,c, Reports 2009-3, 2009-4, and 2009-5), with a notation as to whether a species is native or non-native and resident or migratory. The distributions of native and non-native fishes are influenced by water temperature and velocity, which vary by location, season, and in response to flow. Most native resident fish species are riffle spawners and are generally more abundant in the gravel-bedded reach (RM 24-52). Existing data show that the Sacramento sucker is the most abundant and widespread native fish species in the lower river. Non-native fishes are present throughout the lower river but are typically most abundant in the sand-bedded reach and the lower 6-7 miles of the gravel-bedded reach, where water temperatures are warmer and SRPs provide habitat (Ford and Brown 2001). Sunfishes are the most abundant and widespread non-native fish in the lower river. The non-native predator fish community in the lower river includes largemouth, smallmouth, and striped bass (*Morone saxatilis*) (TID/MID 1992a; TID/MID 2007a).

Of the 22 non-native fish species documented in the lower Tuolumne River, 18 were introduced by state or federal agencies (CDFW, NMFS, USFWS, and the State Board of Human Health) between 1874 and 1954, and one was introduced with permission from CDFW (1967) (Dill and Cordone 1997; Moyle 2002). The remaining three were introduced by aquarists (goldfish [*Carassius auratus*] in 1862), catfish farms (red shiner [*Cyprinella lutrensis*] in 1954), or private individuals (common carp in 1877, although released in the same year by CDFW) (Dill and Cordone 1997). Sixteen of the fish species released by state or federal agencies were introduced intentionally for sport or commercial fisheries, as a prey base for sport fish, or for mosquito control; two were introduced incidentally with shipments of sport fish (Dill and Cordone 1997). The most abundant and widespread non-native fish species in the lower Tuolumne River (bluegill, redear sunfish, and green sunfish) were first released in California between 1891 and 1954. Largemouth and smallmouth bass were first released in California by CDFW between 1874 and 1891 (Dill and Cordone 1997; TID/MID 1992a).

Table 3.5-9. Fish species documented in the lower Tuolumne River.

Family/Common Name	Scientific Name	Native (N) Or Introduced (I)	Resident (R) Or Migratory (M)
Lampreys (Petromyzontidae)			
Pacific lamprey	*Entosphenus tridentatus*	N	M
Shad and Herring (Clupeidae)			
Threadfin shad	*Dorosoma petenense*	I	R
Salmon and Trout (Salmonidae)			
Chinook salmon	*Oncorhynchus tshawytscha*	N	M
Rainbow trout/steelhead	*Oncorhynchus mykiss*	N	R/M
Minnows (Cyprinidae)			
Common carp	*Cyprinus carpio*	I	R
Fathead minnow	*Pimephales promelas*	I	R
Golden shiner	*Notemigonus crysoleucas*	I	R
Goldfish	*Carassius auratus*	I	R
Hardhead	*Mylopharodon conocephalus*	N	R
Hitch	*Lavinia exilicauda*	N	R
Red shiner	*Cyprinella lutrensis*	I	R
Sacramento blackfish	*Orthodon microlepidotus*	N	R
Sacramento splittail	*Pogonichthys macrolepidotus*	N	M
Sacramento pikeminnow	*Ptychocheilus grandis*	N	R
Suckers (Catostomidae)			
Sacramento sucker	*Catostomus occidentalis*	N	R

Family/Common Name	Scientific Name	Native (N) Or Introduced (I)	Resident (R) Or Migratory (M)
Catfish (Ictaluridae)			
Black bullhead	*Ameiurus melas*	I	R
Brown bullhead	*Ameiurus nebulosus*	I	R
Channel catfish	*Ictalurus punctatus*	I	R
White catfish	*Ameiurus catus*	I	R
Livebearers (Poeciliidae)			
Western mosquitofish	*Gambusia affinis*	I	R
Silversides (Atherinidae)			
Inland silverside	*Menidia beryllina*	I	R
Temperate Basses (Percichthyidae)			
Striped bass	*Morone saxatilis*	I	M
Basses and Sunfish (Centrarchidae)			
Black crappie	*Pomoxis nigromaculatus*	I	R
Bluegill	*Lepomis macrochirus*	I	R
Green sunfish	*Lepomis cyanellus*	I	R
Largemouth bass	*Micropterus salmoides*	I	R
Redear sunfish	*Lepomis microlophus*	I	R
Smallmouth bass	*Micropterus dolomieu*	I	R
Warmouth	*Lepomis gulosus*	I	R
White crappie	*Pomoxis annularis*	I	R
Perch (Percidae)			
Bigscale logperch	*Percina macrolepida*	I	R
Surf Perch (Embiotocidae)			
Tule perch	*Hysterocarpus traski*	N	R
Sculpins (Cottidae)			
Prickly sculpin	*Cottus asper*	N	R
Riffle sculpin	*Cottus gulosus*	N	R

Sources: Ford and Brown 2001; TID/MID 2010a,b,c, Reports 2009-3, 2009-4, and 2009-5.

Fall-Run Chinook Salmon

Fall-Run Chinook Life History

Chinook Spawning

Chinook salmon spawning occurs primarily from October through December (with peak activity in November) in the gravel-bedded reach of the lower Tuolumne River (RM 24 to 52), where water temperatures are suitably cool and spawning riffles are present (TID/MID 2013c). Egg incubation and fry emergence occur from October through January.

During the period of pre-Don Pedro Project record, maximum and minimum Chinook run sizes were 130,000 spawners in 1944 (Fry 1961, as cited in Yoshiyama et al. 1996) and 100 in 1963 (Fry and Petrovich 1970). Since the completion of Don Pedro Dam in 1971 (1971–2009), spawner estimates have ranged from 40,300 in 1985 to 77 in 1991 (TID/MID 2010d, Report 2009-2). From 1971 to 2009 the date of the peak weekly live spawner count has ranged from October 31 (1996) to November 27 (1972), with a median date of November 12 (TID/MID 2010d, Report 2009-2). Since fall 2009, escapement monitoring has been conducted at a counting weir established at RM 24.5, just below the downstream boundary of the gravel-bedded reach (TID/MID 2010e, Report 2009-8).

The availability, distribution, and quality of gravel for Chinook salmon spawning in the lower river was assessed through a series of studies conducted by the Districts from 1986 to 1992. Results showed that riffle areas extended downstream to approximately RM 23.0, although the actual area available for spawning was less extensive due to site-specific flow characteristics and gravel quality (TID/MID 1992a). Redd superimposition was estimated to occur at 44 percent of all Chinook salmon redds within the study area (RM 48.8 to 51.6), with an estimated egg loss on the order of 20 percent (TID/MID 1992a; McBain & Trush 2000). Gravel quality was poor in riffles, with an associated estimated survival-to-emergence of 16 percent (TID/MID 1992b). Gravel quality in redd locations was greater, but still considered poor, with an associated average estimated survival-to-emergence of 34 percent. Following the 1997 flood, which introduced large volumes of fine sediment to the lower Tuolumne River, an in-situ egg-survival-to-emergence study was conducted to assess the effects of various fine sediment levels within spawning gravels (TID/MID 2007b, Report 2006-7). Study results included an estimated survival-to-emergence rate ranging from near zero to approximately 40 percent, depending on fine sediment levels and intra-gravel flows. Beginning in 2001, gravel augmentation projects were undertaken to improve the quality of spawning gravel in the lower Tuolumne River (see Fish Habitat Restoration Projects, below).

In 2012, the Districts conducted biweekly redd mapping surveys between October 1 and November 2 and weekly surveys between November 5 and November 26 to evaluate peak Chinook salmon spawning (TID/MID 2013g). Biweekly redd surveys were again conducted between December 10 and April 19, 2013. A total of 653 completed Chinook salmon redds were observed and cataloged between October 1, 2012 and April 19, 2013, 622 (95%) of which were observed between October 29 and November 29 (Table 3.5-10) (TID/MID 2013g). An additional 233 Chinook salmon redds were classified as incomplete. Peak spawning in all survey reaches occurred during the week of November 12, when 186 new Chinook salmon redds were identified. Approximately 40 percent of Chinook salmon spawning occurred between October 1 and November 9, 2012, and more than 90 percent by November 18, 2012. Nine new Chinook redds were identified during the January to April time period. These redds were classified as Chinook redds based on either the presence of fish or a similarity in size to Chinook redds identified earlier in the spawning season. During the 2012–2013 sampling season, evidence of superimposition was noted at 15.2 percent (99 of 653) of the observed Chinook salmon redds, and most (88%) superimposition was identified during peak spawning activity between November 5 and November 21, 2012 (TID/MID 2013g).

Table 3.5-10. New Chinook salmon redds identified by reach and date during the 2012–2013 survey period.

Week[1]	Survey Dates	Reach (RM)				Grand Total	Percent
		1 (52.0–47.4)	2 (47.4–42.0)	3 (42.0–31.6)	4 (31.6–22.0)		
1	10/1–10/4/12	7	1	1	0	9	1.4%
3	10/15–10/18/12	1	0	0	0	1	0.2%
5	10/29–11/2/12	28	13	30	5	76	11.6%
6	11/5–11/9/12	86	48	36	11	181	27.7%
7	11/12–11/15/12	87	48	37	14	186	28.5%
8	11/18–11/21/12	84	15	37	8	144	22.1%
9	11/26–11/29/12	14	9	4	8	35	5.4%
11	12/10–12/13/12	3	4	5	0	12	1.8%

Week[1]	Survey Dates	Reach (RM)				Grand Total	Percent
		1 (52.0–47.4)	2 (47.4–42.0)	3 (42.0–31.6)	4 (31.6–22.0)		
14	1/2–1/5/13	0	1	2	0	3	0.5%
15	1/7–1/10/13	2	0	0	0	2	0.3%
17	1/21–1/24/13	0	0	1	0	1	0.2%
19	2/5–2/8/13	2	0	0	0	2	0.3%
21	2/18–2/21/13	0	0	0	0	0	0.0%
23	3/4–3/7/13	0	0	0	0	0	0.0%
25	3/18–3/21/13	1	0	0	0	1	0.2%
27	4/1–4/4/13	0	0	0	0	0	0.0%
29	4/17–4/19/13	0	0	0	0	0	0.0%
	Grand Total	315	139	153	46	653	100%
	Percent	48.2%	21.3%	23.4%	7.0%	100%	--

[1] Week refers to the number of weeks after the week of 10/1/12.

In general, Chinook salmon spawning activity (by absolute number of redds and densities) increased as RM increased, with the highest abundance (48.2%) of observed redds occurring in Reach 1 (RM 52.0 to RM 47.4) (TID/MID 2013g). Reaches 2 and 3 accounted for 21.3 and 23.4 percent of redds, respectively, with Reach 4 accounting for 7.0 percent of Chinook spawning activity. Spawning activity at recent gravel augmentation sites accounted for 21.6 percent (141 of 653) of the new Chinook salmon redds observed during 2012–2013, the majority of these observed at the CDFW augmentation sites near La Grange (RM 50.6 to 51). Spawning habitat use was concentrated at upstream locations (Table 3.5-10), and most superimposition of Chinook salmon redds occurred upstream of RM 44.

Results from the current PHABSIM study (Stillwater Sciences 2013) corroborate results of previous studies, i.e., Chinook salmon spawning habitat (as estimated by WUA) is maximized at flows between 175 and 400 cfs (Table 3.5-11).

Straying of hatchery Chinook can be linked to reduced fish size at return (Flagg et al. 2000) and as a result can reduce subsequent fry and smolt productivity per spawner. However, although as much as 90 percent of the Central Valley harvest consists of hatchery salmonids, and in recent years hatchery Chinook have accounted for a large proportion of the annual escapement to the Tuolumne River, Chinook size at return in the Tuolumne River does not appear to be declining in response to hatchery introgression (TID/MID 2013c).

Table 3.5-11. Lower Tuolumne River Instream Flow Study result comparisons of maximum WUA results between 1981, 1995, and 2013.

Species/Life stage	TID/MID 2013b 2013 (cfs)	TID/MID 2013b (FWS 1995 HSC)[1] (cfs)	FWS 1995[2] (cfs)	CDFG 1981[3] (cfs)
Chinook fry	≤100	≤100	<75 cfs	40–280
Chinook juvenile	50–300	50–400	75–225	80–340
Chinook spawn	200–400	200–400	175–325	180–360
O. mykiss fry	<125	--	--	--
O. mykiss juvenile	50–350	100–300	50–170	40–140

Species/Life stage	TID/MID 2013b 2013 (cfs)	TID/MID 2013b (FWS 1995 HSC)[1] (cfs)	FWS 1995[2] (cfs)	CDFG 1981[3] (cfs)
O. mykiss adult	>275	>200	50–425	140–280
O. mykiss spawn	>225	--	--	--

[1] These results reflect the current PHABSIM model run with the HSC used in the FWS 1995 study.
[2] The USFWS 1995 study did not include *O. mykiss* fry and spawning criteria and limited the simulations for rainbow trout to 500 cfs, primarily as a means of evaluating summer conditions (USFWS 1995). Rainbow trout results were reported separately by habitat type only (i.e., riffle, run/glide, and pool) with significant habitat indicated as being primarily associated with riffle and run/glide types.
[3] The CDFG 1981 study (reported in TID/MID 1992b) simulated results to 600 cfs and did not include *O. mykiss* fry and spawning criteria. This study showed contrasting results for Chinook fry and juvenile between the two study reaches, with a 1991 reanalysis (TID/MID 1992b) documenting that the lower reach (Reach 2) results were disproportionally due to the influence of a single transect. As a consequence, only the results from Reach 1 are included above in order to maximize comparability of the data.

Chinook In-River Rearing and Outmigration

Chinook salmon rearing in the Tuolumne River primarily occurs from January to May (TID/MID 2013c). Low numbers of over-summering juveniles have been found downstream of the La Grange gage (RM 51.7) during routine snorkel surveys in most years (TID/MID 2013d,). Based on seine and rotary screw trap monitoring, juvenile Chinook salmon outmigrate from the lower Tuolumne River into the San Joaquin River and Delta as fry (<50 mm) as early as February in years with high flows, with smolts (>70 mm) emigrating during April and May in most years (TID/MID 2013c).

High levels of predation-related mortality have been documented by the Districts in multi-year smolt survival studies and by comparisons of upstream and downstream smolt passage at rotary screw traps (TID/MID 2013c). Predator distribution, year class success, habitat suitability, and activity all vary with differences in inter-annual runoff flows as well as seasonal variations in flow and water temperature. Historical changes in the Tuolumne River, primarily creation of in-channel mining pits, have created suitable habitat for non-native predators over a wide range of river flow.

Previous predation studies in the lower Tuolumne River identified 13 fish species[17] that potentially prey on Chinook salmon fry and juveniles, but largemouth and smallmouth bass were found to be the primary predators (TID/MID 1992a). Based on estimates of predator abundance from mark-recapture electrofishing surveys and estimated rates of consumption from gut samples, predation on juvenile salmon by largemouth bass was estimated to be approximately 8,600–14,300 individuals per day during the spring pulse flow period (300–600 cfs, USGS gage 11289650) (TID/MID 1992a).

In 2012, the potential impact of predation was assessed by estimating the abundance of target predator species between RM 5.1 (location of the Grayson rotary screw trap) and RM 30.3 (location of the Waterford rotary screw trap). Predator abundance was estimated based on shoreline lengths in this reach. The total estimate of juvenile Chinook salmon potentially consumed was estimated by multiplying the estimated number of predators, the Chinook

[17] The 13 fish species[17] that potentially prey on Chinook salmon fry and juveniles in the lower Tuolumne River, as identified in TID/MID (1992a), are as follows: smallmouth bass, largemouth bass, striped bass, bluegill, redear sunfish, green sunfish, warmouth, channel catfish, white catfish, brown bullhead, Sacramento pikeminnow, riffle sculpin, and *O. mykiss*.

migration period (in days), and the estimated predation rate (in number of juvenile Chinook salmon consumed per day) (TID/MID 2013f).

Average consumption rates of juvenile Chinook salmon (i.e., number of Chinook salmon per predator) by largemouth and smallmouth bass in the lower Tuolumne River (not scaled by gastric evacuation rates) ranged from 0–0.20 during the 2012 predation study (TID/MID 2013f). In 2012, predation rates averaged for all habitat types and sampling events were 0.07 Chinook salmon per largemouth bass per day and 0.09 per smallmouth bass per day. Striped bass predation rates in the lower river were generally higher than those of smallmouth bass and largemouth bass (TID/MID 2013f). In 2012, predation rate averaged for all habitat types and sampling events was 0.68 Chinook salmon per striped bass per day.

Largemouth bass and smallmouth bass were estimated to have consumed about 37 percent and 49 percent, respectively, of the total potential juvenile Chinook salmon consumed by the three primary non-native predator species (i.e., largemouth bass, smallmouth bass, and striped bass). Despite making up only a small fraction (< 4%) of the total of piscivore-sized fish (> 150 mm FL), striped bass were estimated to have consumed nearly 15 percent of the total potential juvenile Chinook salmon consumed by the three predator species. There was no evidence of consumption of Chinook salmon by Sacramento pikeminnow during either the 2012 study or the Districts' previous study (TID/MID 1992).

A conservative estimate of the total consumption of juvenile Chinook salmon by striped, largemouth, and smallmouth bass is about 42,000 during March 1-May 31, 2012, based on observed predation rates and estimated predator abundance. This suggests that nearly all juvenile Chinook salmon may be consumed by introduced predators between the Waterford and Grayson rotary screw traps. Only 2,268 Chinook salmon were estimated to have survived migration through the 25 miles between the screw-trapping sites (Robichaud and English 2013) during January through mid-June, making it plausible that most losses of juvenile Chinook salmon in the lower Tuolumne River between Waterford and Grayson during 2012 can be attributed to predation by non-native piscivorous fish species.

Acoustic tracking results revealed habitat overlap of juvenile Chinook and predators at three tested flows (280 cfs, 415 cfs, and 2,100 cfs) (TID/MID 2013f). Striped bass had the greatest overlap (18.4–46.3%) of habitat use with Chinook salmon, followed by largemouth bass (5.8–30.5%), and smallmouth bass (0.2–38.2%).

An earlier study on the Tuolumne River (McBain & Trush and Stillwater Sciences 2006) hypothesized that at flows exceeding 2,500 cfs, higher velocities would increase Chinook salmon migration rates through SRPs, and therefore reduce predation risk. However, the results of the 2012 Predation Study (TID/MID 2013f) showed that transit times across SRP 6 and SRP 10 were fastest at 280 cfs, suggesting that higher flows may decrease transit rates through SRPs due to eddy effects. Comparison of transit rates between sites showed no statistically significant difference at a given flow, suggesting that the results may apply more broadly to other SRP sites as well. Based on review of individual acoustic tracks, extended residence times were due to fish circling within the array rather than passing directly through the SRP; circling was likely caused by hydraulic conditions within the SRPs.

Results from the current PHABSIM study (Stillwater Sciences 2013) corroborate results of previous studies, indicating that WUA for Chinook fry and juveniles is maximized at lower flows, with juveniles maintaining high habitat values up to around 300 cfs (Table 3.5-11). Chinook salmon juvenile and fry WUA exhibits a similar pattern of annual fluctuation across all water year types, except for reductions in WUA that occur during high flows in wet years.

Surveys to assess the impact of flow fluctuations on salmonids in the lower Tuolumne River were conducted from 1986 to 2002. Rapid flow reductions can cause stranding and entrapment of fry and juvenile salmon on gravel bars and floodplains and in off-channel habitats that may become cut off from the main channel when flows are reduced. A comprehensive evaluation of stranding surveys was conducted on the lower Tuolumne River (TID/MID 2001, Report 2000-6) and is summarized in the 2005 Ten-Year Summary Report (TID/MID 2005). This evaluation indicated that the highest potential for stranding occurred at flows between 1,100 and 3,100 cfs, i.e., the range of flows under which the floodplain is inundated in several areas of the spawning reach. However, under current operations, the risk of salmonid stranding is considered to be low. The Districts curtailed large hydropower-related flow fluctuations in the river well before the 1995 Settlement Agreement, which established ramping rates developed to minimize the potential for stranding. As such, since 2002 there have been no requirements to monitor salmonid stranding, and all current floodplain restoration projects include design requirements for minimizing stranding potential.

Results of the Pulse Flow Study (Stillwater Sciences 2012a) show that flows above bankfull discharge at the locations studied were associated with increases in overbank habitat area suitable for juvenile life stages of Tuolumne River salmonids. Suitable habitat areas for juvenile salmonid life stages increased most rapidly between bankfull discharges of 1,000 and 3,000 cfs, corresponding to floodplain inundation. The increase in suitable habitat areas was less rapid at nearly all sites from 3,000 to 5,000 cfs. The availability of floodplain habitat at downstream locations increases at higher flows, i.e., higher flows inundate a greater area of floodplain. The potential benefits of overbank rearing habitat have not been evaluated relative to the risk of stranding and entrapment of juvenile salmonids as high-flows recede from overbank areas.

Based on the results of the Pulse Flow Study, potential predation risk to juvenile salmonids may be reduced when overbank areas are inundated (Stillwater Sciences 2012a). The increases in habitat area may effectively reduce the encounter frequency of predators and prey and provide additional hiding cover in flooded vegetation. Also, many of the larger piscivores may be precluded from accessing the shallow, inundated habitat. However, several reaches with pool habitats inhabited by predator species lack adjacent floodplain habitats (McBain & Trush 2000), so the probability of encounter between predators and juvenile salmonids remains high in these areas.

Results of rotary screw trap monitoring and Delta outmigrant tracking and survival studies generally support the utility of increased spring pulse flows during April–May as a means of improving outmigrant salmonid survival from tributaries to the San Joaquin River Delta (Stillwater Sciences 2012a), if timed correctly. Based on rotary screw trap monitoring data from the Waterford (RM 29.8) and Grayson (RM 5.2) locations, Robichaud and English (2013) suggested that, on average, 35 percent of Chinook smolts moved during the first day of increased flows, and 66 percent moved within the first three days.

Chinook Rearing and Outmigration in the Delta

Predation in the lower San Joaquin River Delta and predation related mortality within the Clifton Court forebay of the State Water Project (SWP) and Central Valley Project (CVP) water export facilities affect the number of Chinook salmon recruited to the ocean fishery (TID/MID 2013c). For Chinook salmon out-migrants from the Tuolumne River, increased flows in the San Joaquin River at Vernalis have been shown to reduce predation-related mortality, but the relationship is highly dependent on the presence of the Head of Old River Barrier.[18] Salvage losses of Chinook entrained into the SWP and CVP export facilities increase with increasing export flows, and pre-screen losses of 63–99 percent have been estimated for fish entrained into the Clifton Court forebay. For juvenile Chinook salmon not entrained by the SWP and CVP export facilities, non-native fish introductions, levee construction, and changes in flow magnitudes and timing have increased predator ranges. In addition, water temperature related mortality during late spring explains much of the variation observed during past smolt survival studies in the Delta (TID/MID 2013c).

Reductions in marsh and floodplain habitats in the lower San Joaquin River and South Delta, along with changes in tributary flow magnitudes and timing, have reduced access to Delta habitats historically used by rearing and emigrating Chinook salmon smolts from the Tuolumne River. Although warmer water in the Delta could increase growth rate relative to that in upstream tributary habitats, degradation of Delta habitat has reduced the primary and secondary productivity that support the food web, resulting in low growth rates of juvenile Chinook salmon.

Chinook Ocean Rearing

Environmental conditions and commercial harvest of Chinook salmon in the ocean exert a strong influence on the size and health of the Chinook salmon population in the Tuolumne River. Rates of ocean harvest of Central Valley Chinook salmon stocks have averaged more than 60 percent for many years, directly affecting the numbers of adults escaping the ocean fishery (TID/MID 2013c). Harvest mortality of larger fish has reduced the age- and size-at-return, resulting in reduced fecundity of upstream migrating spawners. Multi-year El Niño Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO) variations in ocean circulation patterns affect food web productivity, growth, and year-class strength of Chinook salmon. For example, the recent dramatic collapse of Sacramento fall-run Chinook stocks during the 2007 and 2008 spawning years was attributed to highly anomalous coastal ocean conditions during 2005 and 2006, i.e., late and weakened seasonal upwelling associated with warmer sea surface temperatures led to the deterioration of coastal food webs on which juvenile salmon depend (CalCOFI 2006, 2007; NMFS 2009). The timing of large hatchery releases in the Central Valley may result in competition between hatchery and wild fish during the first few months following ocean entry. Conditions in the ocean during the early growth period of salmonids affect year-

[18] For the protection of out-migrating fall-run Chinook salmon in years when spring flow in the San Joaquin River is less than 5,000 cfs, a temporary barrier has typically been placed at the head of Old River from April 15 to May 15 in most years to prevent drawing these fish towards the pumps near Tracy (TID/MID 2013c).

class strength and the number of salmon escaping the ocean fishery to spawn in the lower Tuolumne River.

Chinook Upstream Migration

Adult Chinook salmon migration in the Tuolumne River extends upstream to La Grange Diversion Dam and occurs from September through December, with peak activity occurring in October and November (TID/MID 2013c). Cumulative adult fall-run Chinook salmon counts at the Tuolumne River weir (RM 24.5, downstream of the majority of Chinook spawning) from 2009–2013 are shown in Figure 3.5-8. During upstream migration, Tuolumne River flows, flows of other San Joaquin River tributaries, and flows entrained by the SWP and CVP water export facilities may affect homing of Tuolumne River origin Chinook salmon, and may also affect straying of fish from other rivers into the Tuolumne River (TID/MID 2013c).

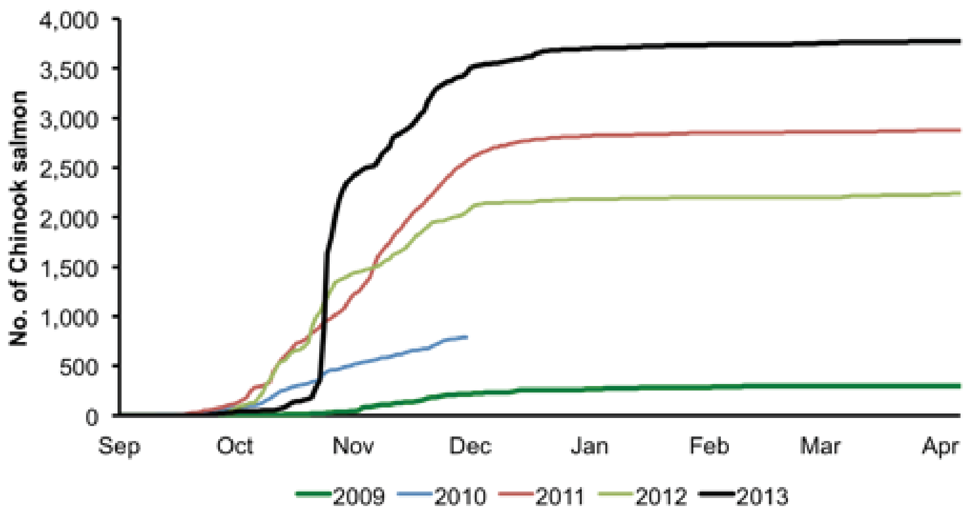

Figure 3.5-8. Cumulative adult fall-run Chinook salmon counts at the Tuolumne River weir (RM 24.5) 2009–2013.

Variations in ocean productivity and commercial harvest directly affect the number of fall-run Chinook salmon escaping the ocean troll fishery to spawn in the lower Tuolumne River (TID/MID 2013c). The Central Valley Harvest Rate Index (i.e., catch/[catch + escapement]) has been in excess of 70 percent in many years (TID/MID 2005), suggesting that year-to-year variations in ocean survival and harvest may affect Tuolumne River escapement and subsequent population levels (TID/MID 2013c). Commercial harvest in the San Joaquin River basin is prohibited, and the Valley District[19], which includes rivers in San Joaquin, Stanislaus, and

[19] Per the 2013-2014 California Freshwater Sport Fishing Regulations (http://www.dfg.ca.gov/regulations/), the Valley District consists of all of Butte, Colusa, Glenn, Kern, Kings, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, Yolo and Yuba counties; Tulare County west of the west boundaries of Sequoia National Forest and Sequoia National Park; Fresno County west of the west boundaries of Sierra and Sequoia National Forests (including all of Pine Flat Lake); Madera County west of the west boundary of the Sierra National Forest; Amador, Calaveras, El Dorado, Mariposa, Nevada, Placer and Tuolumne counties west of Highway 49 (including all of Don Pedro, McClure and New Melones lakes); that portion of Alameda County which is both east of Interstate 680 and north of Interstate 580; and all of Contra Costa County east of Interstate 680 and that portion of Contra Costa County which is both north of Highway 4 and east of Interstate 80; and all of Black Butte Lake.

Tuolumne counties, is currently closed to the take of salmon. There are no available estimates of salmon lost to poaching in the San Joaquin and Tuolumne rivers (TID/MID 2013c).

Hatchery origin fish represent a large proportion of the Central Valley fall-run Chinook salmon ocean harvest (TID/MID 2013c). Although the proportions of adipose-fin-clipped Chinook salmon identified as originating from hatcheries has been historically low in Tuolumne River spawning surveys, this proportion has increased dramatically from the 1990s to the present (TID/MID 2005; Mesick 2009; TID/MID 2012a, Report 2011-8). Recent estimates of the composition of Chinook salmon escapement indicate that up to 50 percent of the escapement to the Tuolumne River is made up of hatchery-produced salmon from other rivers (Merced ID 2012). In the Central Valley as a whole, it is estimated that hatchery production has provided over half of the Central Valley harvest and escapement of salmon in some years (CDFG and NMFS 2001). Barnett-Johnson et al. (2007) recently estimated that only 10 percent of Central Valley Chinook salmon captured in the ocean troll fishery were not raised in a hatchery setting. Assuming roughly equivalent survival of hatchery- and natural-origin fish from the fishery to the spawning grounds, these results imply that up to 90 percent of annual escapement could consist of hatchery reared fish (TID/MID 2013c).

Straying of hatchery-origin fish has been documented in the Tuolumne River and has likely affected the numbers of salmon in annual spawning runs. Depending on prior San Joaquin River basin hatchery broodstocks and management practices, progeny of stray hatchery-origin fish spawned in the Tuolumne River may have contributed to alterations of run-timing (TID/MID 2013c). Lindley et al. (2007) suggest that hatchery introductions have altered the genetic structure of salmonid populations in the Central Valley.

Chinook Salmon Population Model

To integrate existing information on in-river life stages of fall-run Chinook salmon (i.e., information developed under the Tuolumne River Salmonid Information Synthesis Study [TID/MID 2013c]), the Tuolumne River Chinook salmon population model was developed. The population model (TID/MID 2013e) was used to investigate the relative influences of various factors on life-stage-specific production of Chinook salmon in the Tuolumne River and identify critical life-stage-specific limitations that may represent a population "bottleneck." Model sensitivity testing suggests that Chinook salmon production under existing conditions is influenced by a number of environmental factors. The following provisional findings are based on a base-case simulation, i.e., under existing conditions (TID/MID 2013e). These findings represent a simulation modeling results only, and as such do not constitute conclusions based directly on empirical population data.

Using an overall productivity metric of smolts/spawner, parameters related to the following life-stage processes were shown to exert the greatest influence on subsequent juvenile Chinook salmon production in the calibrated model:

- Upmigration and spawning**:** Sensitivity to parameters related to redd disturbance suggests that modeled smolt productivity is affected by spawning habitat availability (i.e., area of suitable gravel).

- Egg incubation and fry emergence: Sensitivity to parameters related to redd disturbance suggest that modeled smolt productivity is affected by spawning habitat availability. Sensitivity to parameters related to egg development rates suggest modeled smolt productivity is affected by egg survival-to-emergence, which in turn is affected by gravel quality, intra-gravel flow, etc.
- Fry rearing: Sensitivity to parameters related to fry movement suggests that modeled smolt productivity is affected by predation related mortality. .
- Juvenile rearing: Sensitivity testing suggests that reductions in food availability within overbank habitats, below estimates used in the model calibration, may result in lower smolt productivity.
- Smolt emigration: Sensitivity to parameters related to smolt survival suggests that modeled smolt productivity is affected by predation related mortality and flow.

Spawning Habitat Availability

Modeling results show that reductions in smolt productivity (i.e., smolts per female spawner) with increasing escapement are consistent with redd superimposition effects suggested by sensitivity analyses and the results of Tuolumne River spawning habitat investigations summarized in the Synthesis Study (TID/MID 2013c). Because estimates of weighted usable area for Chinook salmon spawning is near optimal under current FERC minimum flow requirements (Stillwater Sciences 2013), increases in spawning flows may result in only minor increases in available spawning habitat. The Spawning Gravel Study (TID/MID 2013d) indicates relatively little change in available spawning area relative to historical estimates. Nevertheless, potential non-flow measures that could be evaluated with the model to increase spawning habitat include gravel augmentation at upstream locations of the lower Tuolumne River (McBain & Trush 2000, 2004) and the use of movable spawning barriers to force increased use of downstream spawning areas (TID/MID 1992b, Volume 2). In addition, gravel cleaning identified in previous studies (TID/MID 1992b, Appendix 9; McBain & Trush 2004) might improve gravel quality by reducing fine sediment intrusion, thereby increasing intra-gravel flow, egg survival-to-emergence, and subsequent smolt productivity.

Juvenile Rearing Habitat Availability

Modeling results show that rearing habitat is not limiting smolt productivity under current conditions, consistent with findings of the Synthesis Study (TID/MID 2013c). Sensitivity testing shows that reductions in fry and juvenile rearing density parameters used in the model are not accompanied by reductions in subsequent smolt productivity. For the highest run sizes evaluated (10,000 female spawners), the resulting fry and juvenile production is shown to be insufficient to fully saturate available rearing habitat under current conditions. The implication of the low sensitivity to fry and juvenile rearing density is that changes in in-channel rearing habitat area through measures recommended to improve access to potential floodplain rearing areas, such as floodplain re-contouring (McBain & Trush 2000) as well as extended high flows to maintain floodplain inundation (Mesick 2009), will not result in large increases in subsequent smolt productivity on the basis of relieving any rearing habitat limitation. Although reductions in floodplain food availability below historical ration estimates used in the calibration of the model can be shown to reduce modeled smolt productivity, increases in assumed food availability at in-channel and overbank locations are not accompanied by increased smolt productivity (TID/MID 2013e). This is consistent with materials reviewed as part of the Synthesis Study (TID/MID 2013c), which found adequate food resources for juvenile Chinook salmon in the lower Tuolumne River.

Flow and Temperature Effects

Modeling results for the base case show that smolt productivity is consistently higher in years with increased spring discharge at La Grange Diversion Dam. Flow variations affect all life stages to some degree by influencing water temperatures, habitat area and suitability, and movement related mortality due to predation on fry and juveniles. Sensitivity testing shows that smolt productivity is strongly influenced by parameters of the smolt survival versus flow relationship. This is consistent with the Synthesis Study (TID/MID 2013c), which summarizes several studies examining the relationship between spring flows and subsequent adult escapement (TID/MID 1992b, Volume 2; Speed 1993; TID/MID 1997, Report 96-5; Mesick and Marston 2007; Mesick et al. 2008) and variations in annual smolt passage (Mesick et al. 2008). The historical patterns of increasing smolt productivity and subsequent adult escapement with discharge are consistent with flow effects on predation as a primary mortality source.

In addition to the direct effects of increasing discharge on smolt productivity (i.e., smolt survival with flow), model results show changes in smolt emigration timing due to water temperature effects on development rates, as found in other rivers (e.g., Rombough 1985, Roper and Scarnecchia 1999). These and other modeled effects on life history timing (e.g., spawning timing, run sizes) produce results with greater or lesser overlap with the scheduled pulse flow period (April 15 - May 15). Because of the higher smolt survival expected at higher flow rates, pulse flow timing is shown to affect smolt productivity, suggesting that variable pulse flow timing or duration by water year type or other means (e.g., real-time monitoring of fish sizes, shaped pulse flows) could be used to optimize water use and smolt productivity.

Sensitivity testing indicates that water temperature is not limiting smolt productivity under current conditions, consistent with findings of the Synthesis Study (TID/MID 2013c). Because water temperatures are generally suitable for life history timing of all in-river life stages in the lower Tuolumne River under both drier and wetter years, reductions in mortality threshold parameters did not result in corresponding changes in smolt productivity. Although water temperature is an important factor controlling egg incubation rates and fry and juvenile growth rates, with the exception of issues related to the timing of smoltification and emigration discussed above, smolt productivity is unaffected by normal seasonal variations in air and water temperatures. Specifically, because the majority of spawning takes place under suitable temperatures, modeled egg mortality effects due to potentially unsuitable water temperatures for early arriving spawners during late summer or early fall do not appear to affect subsequent smolt productivity. Further, the majority of smolt emigration occurs prior to periods of potentially unsuitable water temperature in late spring.

Steelhead/Rainbow Trout (Oncorhynchus mykiss)

Steelhead/Rainbow Trout Life History

Steelhead/Rainbow Trout Spawning

Central Valley steelhead and rainbow trout generally spawn from December through April, with peak activity occurring in February and March (TID/MID 2013c). Although the tendency for anadromy or residency in sympatric populations of resident *O. mykiss* and any steelhead that may arrive in the Tuolumne River is poorly understood (TID/MID 2013h), there is no empirical evidence of a self-sustaining "run" or population of steelhead currently in the Tuolumne River (TID/MID 2013c). Of the 147 individual fish examined by Zimmerman et al. (2008), otolith chemistry results indicated that only one was a steelhead (had displayed anadromy) and eight were spawned by a steelhead (i.e., of anadromous maternal origin). Of the eight *O. mykiss* with an anadromous parent, the range of age classes indicated that not all were spawned at the same time (i.e., did not originate from the same parent), and any indication of parental origin is unknown due to historical planting operations and straying of steelhead; most steelhead as well as resident rainbow trout in the Central Valley are genetically similar (Pearse et al. 2009) and of common hatchery origin (Garza and Pearse 2008). Nielsen et al. (2005) examined the relatedness and origins of Central Valley *O. mykiss* using genetic techniques and determined that *O. mykiss* populations in Central Valley rivers, including the Tuolumne River, are not genetically distinct from one another. Nielsen et al. (2005) did find, however, that Tuolumne River *O. mykiss* residing upstream of Don Pedro Reservoir exhibited genetic separation from those found downstream of La Grange Diversion Dam in the lower Tuolumne River.

The results of recent investigations suggest that flow and temperature management of tailwater fisheries downstream of many dams in the Central Valley may be preferentially selecting for resident rainbow trout over anadromous steelhead (TID/MID 2013c). The probability of *O. mykiss* smolting has been shown to vary with anadromous/resident parental origin, water temperature, and food availability (Satterthwaite et al. 2010). In one recent study, *O. mykiss* held in warm thermal regimes had higher rates of smolting because they were able to grow to larger total sizes but had lower body lipid stores than fish held in cold thermal regimes (Sloat 2013). These findings relate to both fish size (larger fish tend to survive at higher rates in the ocean than smaller fish) as well as fat stores (fish with higher lipid content have higher energy reserves required for sexual maturation). McMillan et al. (2012) found that higher body lipid stores were significantly correlated with an increased probability of maturation in freshwater. In other words, if a juvenile *O. mykiss* has sufficient lipid reserves to allow maturation in freshwater, there is no need to undergo smoltification and migrate to the ocean to gain sufficient lipid stores to mature (TID/MID 2014). Recognizing that decreased survival associated with Delta emigration and ocean rearing may not be offset by increased size (fecundity) of anadromous as compared to resident *O. mykiss*, it is apparent that increased summer flows since 1996 have resulted in large increases in resident fish, but no evidence of a steelhead run (TID/MID 2014). The very low numbers of anadromous *O. mykiss* adults entering the Tuolumne River (Zimmerman et al. 2008) and potential for straying support this interpretation, suggesting that increased cold water releases during summer reduce, but do not necessarily eliminate, the possibility of smoltification within the overall sympatric *O. mykiss* population (TID/MID 2014).

In 2012, the Districts conducted biweekly redd mapping surveys between October 1 and November 2 and weekly surveys between November 5 and November 26 (TID/MID 2013g). Biweekly redd surveys were again conducted between December 10 and April 19, 2013. Thirty-eight *O. mykiss* redds were observed from October 1, 2012 through April 19, 2013 (TID/MID 2013g). The first *O. mykiss* redds were observed on January 7, 2013, and peak observations occurred during the week of April 1, when 10 new redds were identified (Table 3.5-12). The majority (63 percent) of *O. mykiss* redds were observed between RM 52.0 to RM 47.4, and 97 percent were observed upstream of RM 42. *O. mykiss* were observed to be actively guarding or constructing only two of the identified redds. No *O. mykiss* redds were identified below RM 39, and there was no evidence of *O. mykiss* redd superimposition during the 2012–2013 study period (TID/MID 2013g).

Table 3.5-12. New *O. mykiss* redds identified by reach and date during the 2012-2013 survey period.

Week[1]	Survey Dates	Reach				Grand Total	Percent
		1 (52.0-47.4)	2 (47.4-42.0)	3 (42.0-31.6)	4 (31.6-22.0)		
1	10/1–10/4/12	0	0	0	0	0	0.0%
3	10/15–10/18/12	0	0	0	0	0	0.0%
5	10/29–11/2/12	0	0	0	0	0	0.0%
6	11/5–11/9/12	0	0	0	0	0	0.0%
7	11/12–11/15/12	0	0	0	0	0	0.0%
8	11/18–11/21/12	0	0	0	0	0	0.0%
9	11/26–11/29/12	0	0	0	0	0	0.0%
11	12/10–12/13/12	0	0	0	0	0	0.0%
14	1/2–1/5/13	0	0	0	0	0	0.0%
15	1/7–1/10/13	5	0	0	0	5	13.2%
17	1/21–1/24/13	3	2	0	0	5	13.2%
19	2/5–2/8/13	5	2	1	0	8	21.1%
21	2/18–2/21/13	0	1	0	0	1	2.6%
23	3/4–3/7/13	5	2	0	0	7	18.4%
25	3/18–3/21/13	0	2	0	0	2	5.3%
27	4/1–4/4/13	6	4	0	0	10	26.3%
29	4/17–4/19/13	0	0	0	0	0	0.0%
	Grand Total	24	13	1	0	38	--
	Percent	63.2%	34.2%	2.6%	0.0%	--	100%

O. mykiss redds at recent gravel augmentation sites accounted for 31.6 percent (12 of 38) of the total observed during the 2012–2013 survey period (TID/MID 2013g). Eleven of these were observed at the CDFW 2011 augmentation site near La Grange (RM 51), and a single *O. mykiss* redd was identified at the Bobcat Flat augmentation site (RM 43).

O. mykiss often spawn in tributary habitats and smaller habitat patches, and because spawning gravels in the Tuolumne River are generally larger than those typically used by spawning *O. mykiss*. However, the *O. mykiss* population model found a lack of sensitivity to redd disturbance area and related defended area, which suggests that under current conditions, juvenile *O. mykiss* productivity is unlikely to be limited by the availability of suitable gravel (TID/MID 2013g). Results from the current PHABSIM study (Stillwater Sciences 2013) show that spawning habitat is maximized at flows greater than 225 cfs (Table 3.5-11), with variation in spawning WUA results across water-year types; the WUA versus flow relationship was not appreciably altered by spawning gravel availability. Flows within the current FERC flow schedule provide 91 to 100 percent of the estimated maximum suitable habitat available for *O. mykiss* spawning based on gravel, depth, and velocity parameters analyzed in the Spawning Gravel in the Lower Tuolumne River Study (TID/MID 2013d).

Recruitment of Resident Rainbow Trout from Upstream Populations

Reproducing resident *O. mykiss* populations occur in and above Don Pedro Reservoir (TID/MID 2013c) and in the reach between Don Pedro Dam and La Grange Dam (TID/MID 2013b). The Tuolumne River *Oncorhynchus mykiss* model validation results (TID/MID 2014) (discussed below) indicate that adult rainbow trout from upstream of La Grange Diversion Dam may be introduced into the lower Tuolumne River during spill events. For example, the September 2011 population estimates for both juvenile and larger fish were substantially higher than in previous years, with observations of larger fish (≥ 150 mm) dominated by fish in the 150–200-mm size class (54% of all observations) (Stillwater Sciences 2012c). Because these fish are generally too large to be age 0+ (i.e., they could not have been produced by spawning in the lower river), the substantially larger population in 2011 relative to 2010 appears to be the result of an influx of fish that originated upstream of La Grange Diversion Dam (RM 52.2). The potential interaction of these resident rainbow trout with the *O. mykiss* population downstream of La Grange Diversion Dam is poorly understood and complicates any future monitoring of population response to potential management measures intended to benefit *O. mykiss*, including any Central Valley steelhead, in the lower Tuolumne River.

Steelhead/Rainbow Trout In-River Rearing

Following emergence in winter and spring, *O. mykiss* fry occupy shallow, low-velocity areas near the stream margin and may use interstitial spaces among cobbles for resting and cover habitat (Bustard and Narver 1975). Juvenile steelhead typically rear for 1–3 years in fresh water before migrating to the ocean as smolts (McEwan 2001).

In 2010, juvenile and adult *O. mykiss* population sizes in the lower Tuolumne River were estimated to be 2,405 and 2,139, respectively (Stillwater Sciences 2012b). Population estimates of *O. mykiss* for the lower Tuolumne River from 2008 to 2011 are shown in Table 3.5-13. However, as noted above, there is little evidence of a self-reproducing anadromous run of Central Valley steelhead in the Tuolumne River. For any steelhead originating in the Tuolumne River, anthropogenic modifications to the flow regime and physical habitat, as well as variations in rainfall, runoff, and temperature, affect in-river rearing and successful smolt emigration (TID/MID 2013c).

Table 3.5-13. Population estimates of *O. mykiss* for the lower Tuolumne River, from 2008 to 2009.

Survey Date	*O. mykiss* <150 mm				*O. mykiss* ≥150 mm			
	No. Obs.[1]	Est.	St. Dev.	95% CI[2]	No. Obs.[1]	Est.	St. Dev.	95% CI[2]
Jul 2008	128	2,472	616.9	1,263–3,681	41	643	217.7	217–1,070
Mar 2009	5	63	--	--	7	170	86.3	7–339
Jul 2009	641	3,475	1,290.5	945–6,004	105	963	254.4	464–1,461
Mar 2010	1	1	0.3	1–2	13	109	30	50–168
Aug 2010	313	2,405	908.1	625–4,185	324	2,139	720.6	727–3,552
Sep 2011	4,913	47,432	5,662.2	36,334–58,530	813	9,541	1,200.9	7,188–11,895

[1] Largest numbers seen in any single dive pass for each unit, summed over units.
[2] Nominal confidence intervals (CI) calculated as ± 1.96 standard deviations (SD).
Source: Adapted from Stillwater Sciences 2012b

Stillwater Sciences (2012b) reported that *O. mykiss* in the lower Tuolumne River were observed primarily in riffle and run habitats, where higher percentages of cobble were reported relative to other substrates. Adult fish habitat use was concentrated at upstream sampling units (above RM 45.0), and primarily occurred at transitional run head and pool head habitats. Juvenile fish habitat use showed a similar distribution from upstream to downstream and occurred primarily in riffle habitats, along with transitional run head and pool head habitats.

Because of its generally small size, location in the channel, and lack of complexity, most LWD in the lower Tuolumne River is unlikely to provide significant cover and habitat for *O. mykiss* (TID/MID 2013i). In addition, the amount of instream shelter in the form of boulders, aquatic vegetation, small woody debris, and terrestrial vegetation is very low. During a 2012 survey, riffles, flat water, main channel pools, and scour pools had shelter ratings (on a scale of 0–300) of 10, 31, 49, and 40, respectively (TID/MID 2013i). Low levels of instream cover for juvenile *O. mykiss* result in greater exposure to predation. Cover provided by overhanging terrestrial vegetation and small woody debris accumulations in the mainstem may persist to a greater extent under the current regulated flow regime than they would under more widely varying flows (TID/MID 2013i).

There is apparent density-dependent exclusion of age 0+ juvenile *O. mykiss* from riffle/pool transitions by age 1+ and older fish (TID/MID 2013c). The absence of other structural features (e.g., boulders, LWD) characteristic of alluvial rivers of the Central Valley is associated with reduced rearing densities for all age classes (TID/MID 2013i).

The downstream extent of suitable water temperatures may limit habitat for age 0+ *O. mykiss* (TID/MID 2013c). Results from the current IFIM study (Stillwater Sciences 2013) show that juvenile *O. mykiss* habitat is maximized in the 50–350 cfs range, and adult WUA is maximized in the 150–400 cfs range (Table 3.5-11). Prior PHABSIM modeling combined with water temperature suitability (Stillwater Sciences 2003) suggest that flows which maximize habitat for larger fish are generally higher, and therefore flow management for adult life stages may potentially limit juvenile habitat (TID/MID 2013c). Although *O. mykiss* abundance has increased since implementation of increased summer flows, stable flows and temperatures in summer, as noted above, appear to select for a resident life history. Zimmerman et al. (2008) showed that very few steelhead occur in the Tuolumne River, and smolt-sized *O. mykiss* are rarely captured in rotary screw traps in the lower river (Ford and Kirihara 2010).

Suitable water temperatures for smolt emigration in the range of 18–21°C (65–70°F) are available in the San Joaquin River at Vernalis as late as mid-May in most years, and it is likely that Delta conditions are suitable for smolt emigration as late as June in some years. Unsuitable temperature conditions in excess of 25°C (77°F) are likely exceeded at Vernalis by late June in most years, limiting successful emigration or any Delta rearing opportunities during summer.

Results of the Pulse Flow Study (Stillwater Sciences 2012a) show that flows above bankfull discharge at the locations studied along the Tuolumne River were associated with increases in overbank habitat area suitable for life stages of salmonids. Although little information exists suggesting juvenile *O. mykiss* use floodplain habitats in the Central Valley (TID/MID 2013c), suitable habitat areas for juvenile *O. mykiss* life stages increased most rapidly between bankfull discharges of 1,000 and 3,000 cfs, corresponding to floodplain inundation.

Steelhead Ocean Rearing

Little is known about how Central Valley steelhead respond to changes in productivity patterns along the California coast (TID/MID 2013c). Studies of steelhead in the North Pacific concluded that competition for food resources and inter-annual changes in sea surface temperatures are factors limiting steelhead growth, and as a result, escapement to fresh water.

Steelhead Upstream Migration

Adult Central Valley steelhead upstream spawning migration generally occurs from July through March, with peak activity occurring from December through February (TID/MID 2013c). There is no evidence of a steelhead run in the Tuolumne River. Small numbers of *O.* mykiss have been documented in recent recent weir monitoring evaluations (TID/MID 2013h). However, weir operations are limited to flows of approximately 1,400 cfs; therefore, steelhead upmigration as well as upstream movements of resident *O. mykiss* may not be detected during high-flow events. Tuolumne River flows, flows of other San Joaquin River tributaries, and flows entrained by the SWP and CVP water export facilities would affect homing of any steelhead originating in the Tuolumne River (TID/MID 2013c). Tributary flows and flow entrainment by the Delta water export facilities may also affect the number of hatchery-origin steelhead that stray into the Tuolumne River.

Annual fishing report cards (Jackson 2007) do not provide data to quantitatively assess hooking mortality or other sport fishing impacts on steelhead, and no data are available to evaluate the potential impacts of poaching.

Steelhead /Rainbow Trout Age Determination

The results of the 2012 *Oncorhynchus mykiss* Scale Collection and Age Determination Study (TID/MID 2013k) were combined with those of Zimmerman et al. (2009) to develop an age-at-length relationship for the Tuolumne River that is based on a larger dataset (Table 3.5-14).

Table 3.5-14. Combined Zimmerman et al. (2009) and TID/MID 2013 (2013k) age and size ranges of *O. mykiss*.

Age	No. Sampled	Fork Length Range (mm)
0	1	78
1	38	145–199
2	53	194–315
3	54	267–395
4	12*	365–450

*Includes only results from the W&AR-20 study age 4 fish.

Annual growth observed for each age group of *O. mykiss* was similar within and among years: mean annual growth ranged from 74 mm (age 2) to 78 mm (age 4) in 2011, 69 mm (age 4) to 72 mm (age 3) in 2010, and 2009 values for both the age three and age four groups were the same as 2010. The combined mean annual growth rates for all age groups ranged from 70 mm in 2010 to 76 mm in 2011.

Tuolumne River *O. mykiss* Population Model

As explained above, there is no empirical evidence of a self-sustaining run or population of steelhead currently existing in the Tuolumne River (TID/MID 2013c). However, the Districts developed the Tuolumne River *O. mykiss* model (TID/MID 2014) to examine the relative influences of various factors on the production of in-river life stages of what appear to be resident *O. mykiss* in the Tuolumne River, and to identify critical life-stages that may represent a life-history "bottleneck" for the population.

Using the calibrated *O. mykiss* population model, *O. mykiss* production was evaluated for a base case simulation period (1971–2009), which provides a 37-year time series of varying hydrology and meteorology to examine variations in *O. mykiss* production in the lower Tuolumne River under a variety of water year types.

Model sensitivity testing was used to identify model parameters affecting juvenile and adult *O. mykiss* population levels as well as potential smolt production from any steelhead arriving in the Tuolumne River. Using *O. mykiss* productivity metrics for juveniles (end-of-year Age 0+ fish/spawners), adults (Age 2+ and older fish/Age 2+ and older fish 1 year prior), and smolts (Age 1+ and older smolts/Age 1+ and older fish one year prior), parameters related to the following life stage processes were shown to exert the greatest influence on subsequent *O. mykiss* production.

- Upmigration and Spawning: Moderate sensitivity to parameters related to spawning timing and fecundity.
- Egg incubation and fry emergence: High sensitivity of juvenile productivity to parameters related to spawning timing as well as gravel quality parameters affecting egg survival-to-emergence; low sensitivity of juvenile productivity to other spawning related parameters.
- Fry rearing: High sensitivity of juvenile productivity to parameters related to growth and initial fish size affecting the timing of fry/parr transition. Moderate sensitivity of juvenile productivity to parameters related to fry movement and water temperature related mortality. Low sensitivity of juvenile productivity to maximum fry rearing density.

- Juvenile rearing: High sensitivity of juvenile productivity to background mortality rate parameter estimate. Moderate sensitivity of juvenile productivity to parameters related to maximum rearing density at high population sizes as well as parameters related to water temperature related mortality and movement rates.
- Resident rearing: High sensitivity of adult replacement to parameters related to water temperature related mortality in "dry" water year types. Moderate sensitivity of adult replacement to spawning probability, spawning-related mortality, and background mortality rates. Low sensitivity of adult replacement to food availability and maximum adult rearing density.
- Smolt emigration: High sensitivity of smolt productivity to parameters related to the probability of smoltification based upon anadromous parentage as well as water temperatures for smoltification. Low sensitivity of smolt productivity to parameters related to adult or smolt emigration mortality.

Spawning Habitat Availability

There was a lack of model sensitivity to redd disturbance area and related defended area. This agrees with the results of the Redd Mapping Study (TID/MID 2013g), which showed no evidence of *O. mykiss* redd superimposition during 2013 surveys, and with the results of the Spawning Gravel Study (TID/MID 2013d), which suggest that gravel availability is not limiting juvenile productivity of *O. mykiss*. Because estimates of weighted usable area for *O. mykiss* spawning are near optimal under current FERC (1996) minimum flow requirements (Stillwater Sciences 2013), increases in spawning flows may result in only minor increases in available spawning habitat for *O. mykiss*. Because the Spawning Gravel Study (TID/MID 2013d) indicates little change in available spawning area relative to historical estimates, the model results suggest that other than gravel quality improvements related to egg survival-to-emergence, potential spawning habitat enhancements such as gravel augmentation would have little effect on subsequent juvenile productivity.

Juvenile Rearing Habitat Availability

Modeling results show that in-channel juvenile habitat availability may be limiting during summer at high population sizes. Rearing density information from recent snorkel surveys summarized as part of the Synthesis Study (TID/MID 2013c) suggests an apparent exclusion of juveniles from riffle/pool transitions. Modeling results suggest that the apparent density-dependence in modeled juvenile productivity for the base case is primarily due to migration related mortality (i.e., predation) as well as high water temperatures at downstream rearing locations (TID/MID 2014). Information developed as part of the *Oncorhynchus mykiss* Habitat Survey Study (TID/MID 2013i) suggests that the absence of structure (e.g., boulders, LWD) in the lower Tuolumne River may increase effective territory size of rearing juveniles. Nevertheless, because fry and juvenile movement rules in the model do not include avoidance of unsuitable temperatures, any fish displaced into downstream habitats may be subject to water temperature related mortality. Lastly, although increased food availability was shown to affect the timing of the fry/parr transition and increased subsequent juvenile productivity, materials reviewed as part of the Synthesis Study (TID/MID 2013c) found that there are adequate food resources to support juvenile *O. mykiss* rearing in the lower Tuolumne River.

Adult Rearing Habitat Availability

Although adult replacement was shown to be sensitive to assumed background mortality rates and spawning related mortality, modeling results show that separate from temperature related issues, rearing habitat is not limiting adult *O. mykiss* under current conditions. Information developed as part of the *Oncorhynchus mykiss* Habitat Survey Study (TID/MID 2013i) suggests that the absence of structure (e.g., boulders, LWD) in the lower Tuolumne River may increase effective territory size of adults. Nevertheless, model simulations show very little difference in adult replacement ratio corresponding to increases in population size for the base case, and sensitivity testing shows that reductions in adult rearing density parameters are not accompanied by reductions in subsequent adult replacement. This implies that even for the high population size evaluated (10,000), the number of adult *O. mykiss* is insufficient to fully saturate available rearing habitat under current conditions. Sensitivity testing also indicates that increased food availability is unlikely to be affecting adult replacement.

Modeled Flow and Water Temperature Effects

Sensitivity to parameters related to fry movement and base-case results for juvenile productivity and adult replacement suggest that *O. mykiss* production is affected by the relative influences of flow magnitude and timing on life stage progression. Modeling results for the base case show that juvenile productivity and adult replacement are generally higher with increased discharge at La Grange Diversion Dam; juvenile productivity and adult replacement are generally higher in “wet” years than in “dry” years. For juveniles, early fry displacement with higher flows in “wet” years reduces subsequent movement-related mortality due to exceedance of local carrying capacity. For both juveniles and adults, a greater downstream extent of cool water during summer in “wet” years corresponds to lower temperature related mortality.

Water temperature affects egg incubation rates and juvenile and adult *O. mykiss* growth rates. Water temperatures for over-summering *O. mykiss* are generally below identified mortality thresholds upstream of Roberts Ferry Bridge (RM 39.5) in “above normal” and “wet” years and corresponding estimates of juvenile productivity are relatively high in comparison to juvenile productivity evaluated in drier years. Modeling assumptions do not currently allow redistribution of fry or parr from areas approaching water temperature mortality thresholds, and low levels of juvenile mortality during summer are apparent for model fish displaced into downstream habitats. Base-case modeling results indicate that summer water temperatures may limit juvenile productivity and adult replacement in “dry” years. For adults, model implementation includes avoidance and redistribution from habitats exceeding water temperature preference limits (i.e., increased avoidance for temperatures of 20–24°C [68–75°F]). However, because adult habitat selection is made on a weekly timestep, any model fish occupying habitats exceeding assumed daily mean water temperature mortality thresholds (25°C [77°F]) at a daily time step are subject to temperature-related mortality. These results are consistent with summaries of historical monitoring data provided in the Synthesis Study (TID/MID 2013c), which show reduced *O. mykiss* abundance and a reduced extent of habitat use downstream of La

Grange Diversion Dam (RM 52.2) in "dry" years. For the progeny of any steelhead arriving in the lower Tuolumne River, model sensitivity to parameters related to water temperatures for smoltification suggests that the assumed smolt emigration timing may be affected by elevated water temperatures during later spring months.

Hardhead

The hardhead (*M. conocephalus*), which is included on the California Species of Special Concern watch list, occurs in the Tuolumne River both upstream and downstream of the Don Pedro Project. The life-history, habitat use, and status of this species are discussed in Section 3.5.2.1.2 of this FLA.

Sacramento Splittail

The Sacramento Splittail (*Pogonichthys macrolepidotus*), a California Endangered Species Act threatened species, is a large cyprinid (minnow) that can grow to 30 cm or more. Unlike most minnows, it is adapted to living in estuarine habitats and alkaline lakes and sloughs as well as fresh water (Moyle 2002). Historically, splittail inhabited sloughs, lakes, and rivers of the Central Valley, with populations extending upstream to Redding in the Sacramento River, to Oroville in the Feather River, to Folsom in the American River, and to Friant in the San Joaquin River (Moyle et al. 2004).

The current distribution of splittail is limited by dams and other barriers, and the species is largely confined to the Delta, Suisun Bay, Suisun Marsh, Napa River, Petaluma River, and other parts of the Sacramento-San Joaquin estuary (Moyle 2002). Currently, the species is known to migrate up the Sacramento River to Red Bluff Diversion Dam and up the San Joaquin River to Salt Slough in wet years as well as into the lower reaches of the Feather and American rivers.

In the 1980s, successful spawning was documented in the lowest 6.8 miles of the Tuolumne River, with both adults and juveniles observed near Modesto (Moyle et al. 1995). To the extent that spawning occurs in the Tuolumne River during a given year it would take place from February through May, and juvenile rearing would take place from March through September (Stillwater Sciences 2014).

As a supplement to the Districts' PHABSIM study (Stillwater Sciences 2013), WUA versus flow analyses for Sacramento splittail, using existing HSC, were conducted in 2013-2014 (Stillwater Sciences 2014). Available HSC for Sacramento splittail, which are very limited, were developed for the Merced Hydroelectric Project relicensing based on species habitat descriptions from the literature, i.e., not from site-specific surveys. Site-specific HSC validation surveys were conducted in the lower Tuolumne River from just below La Grange Diversion Dam (RM 52) downstream to Waterford (RM 31), but no Sacramento splittail were observed during those surveys, which were conducted across a range of seasons (winter, spring, and summer) and a range of flows (100 cfs, 350 cfs, and 2,000 cfs) (Stillwater Sciences 2014).

Results for Sacramento splittail juveniles show peak WUA values at approximately 50–175 cfs, with relatively high WUA values below 300 cfs (Figures 3.5-9 and 3.5-10). Results for

Sacramento splittail spawning show high WUA at about 300-400 cfs, with relatively small increases in WUA over the remaining simulation range (Figures 3.5-9 and 3.5-10). Habitat time series analyses show that under critical, dry, and below normal water year scenarios, juvenile WUA is maximized during periods of low flow and quickly drops when flow increases. In contrast, Sacramento splittail spawning WUA is minimized at lower flows and increases as flows increase above 1,000 cfs. Under above normal and wet water year scenarios, Sacramento splittail juvenile WUA is minimized when flow increases above approximately 600 cfs, and spawning WUA is maximized as flow increases up to 1,200 cfs.

The section of the Tuolumne River where splittail have been observed, i.e., in the lowest 6.8 miles of the river, is within the slow-moving, low-gradient, sand-bedded reach. Water temperatures in this reach are generally influenced by ambient air temperatures, as opposed to releases from Don Pedro Dam. The instream flow study reach (RM 29–52) is within the higher-gradient, gravel-bedded reach farther upstream and generally has lower water temperatures. The WUA results apply to the study reach only (RM 29–52), so shallow depths and low velocities preferred by juvenile splittail are maximized at lower flows in this higher gradient reach. However, the WUA results are not directly applicable to the portion of the river (RM 0.0–6.8) where the species is known to occur.

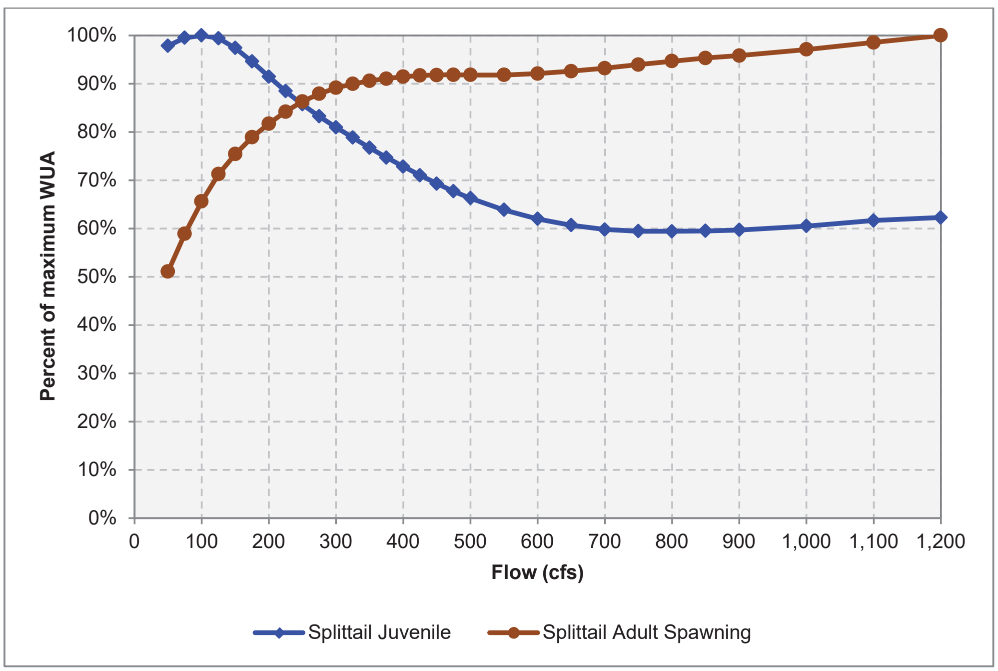

Figure 3.5-9. Sacramento splittail WUA results (percent of maximum) for the lower Tuolumne River.

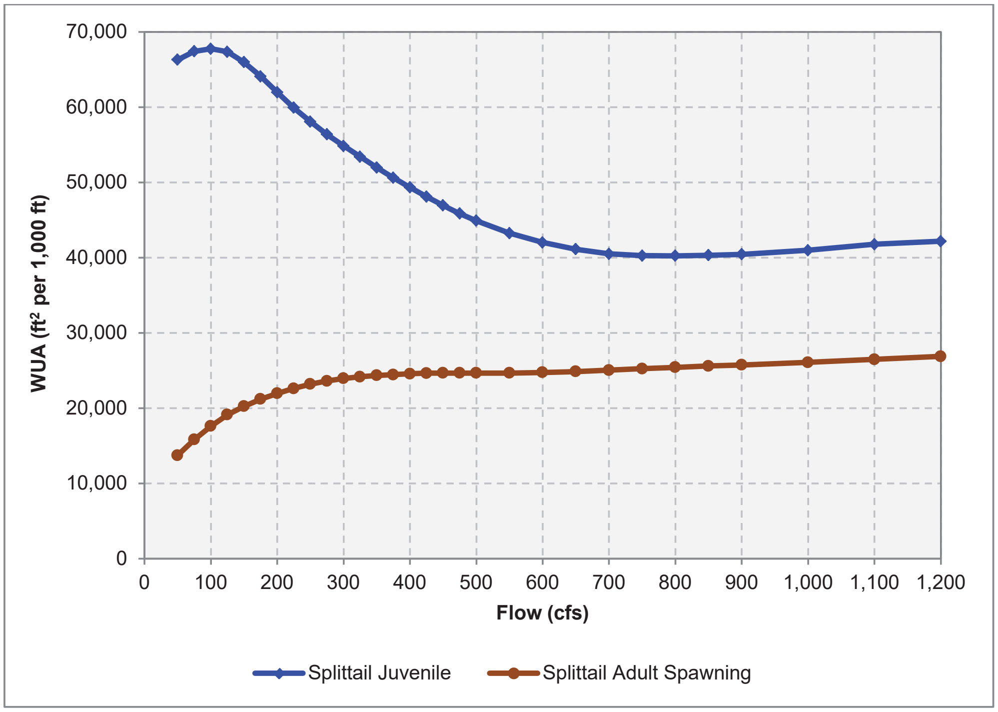

Figure 3.5-10. Sacramento splittail WUA results for the lower Tuolumne River.

Green Sturgeon

It is unknown whether green sturgeon (*Acipenser medirostris*) were present within the San Joaquin River Basin prior to large-scale human disturbance of the system, and there is no evidence that adult, larval, or juvenile green sturgeon currently occupy or historically occupied the Tuolumne River (TID/MID 2013o).

Although habitat requirements for some green sturgeon life-stages may be suitable within the Tuolumne River, this does not mean that the species would be able to complete its life cycle in the river (TID/MID 2013o). Based on the more extensively studied white sturgeon, it appears that very specific combinations of "suitable" habitat conditions are necessary for sturgeon to select locations for breeding and subsequent rearing, as indicated by spawning fish that do not use many sites containing apparently suitable substrate, velocity, and depth (Beamesderfer et al 2005). The presence of apparently suitable or restorable habitat elements is not an indication that those elements would actually function to support green sturgeon. Based on NMFS' determination that the river does not provide critical habitat for green sturgeon, and 36 years of fisheries monitoring without encountering any sturgeon, the species is unlikely to occur within the Tuolumne River basin.

Pacific Lamprey

As a supplement to the Districts' PHABSIM study (Stillwater Sciences 2013), WUA versus flow analyses for Pacific lamprey, using existing HSC, were conducted in 2013-2014 (Stillwater Sciences 2014). Available HSC for Pacific lamprey are very limited, i.e., developed for the

Merced Hydroelectric Project relicensing based on species habitat descriptions from literature, and not from site-specific surveys. Site-specific HSC validation surveys were conducted in the lower Tuolumne River from just below La Grange Diversion Dam (RM 52) to Waterford (RM 31), but no Pacific lamprey were observed during those surveys, which were conducted across a range of seasons (winter, spring, and summer) and flows (100 cfs, 350 cfs, and 2,000 cfs) (Stillwater Sciences 2014). However, Pacific lamprey have been observed during snorkel surveys conducted between La Grange Diversion Dam (RM 52) and Waterford (RM 31) (Stillwater Sciences 2009b, 2010).

Results for Pacific lamprey ammocoetes show that potential habitat is maximized at low flows, with peak WUA (≥ 95% of maximum) at flows less than about 150 cfs, followed by a slight decline, but still relatively high WUA over the remaining range of simulated flows (Figures 3.5-11 and 3.5-12) (Stillwater Sciences 2014). Results for Pacific lamprey spawning show peak WUA values at 75–150 cfs, with a steady decline in (but still relatively high) WUA values up to about 250 cfs, followed by a more gradual decline over the remaining range of simulated flows (Figures 3.5-11 and 3.5-12). Habitat time series analyses show that under critical, dry, and below normal water year scenarios, Pacific lamprey ammocoete WUA remains relatively stable, but spawning WUA fluctuates with flow until flow nears 1,200 cfs, where WUA is minimized.
Under above normal and wet water year scenarios, Pacific lamprey ammocoete WUA also remains relatively stable, whereas spawning WUA decreases with increased flow, until flow nears 1,200 cfs where WUA is minimized.

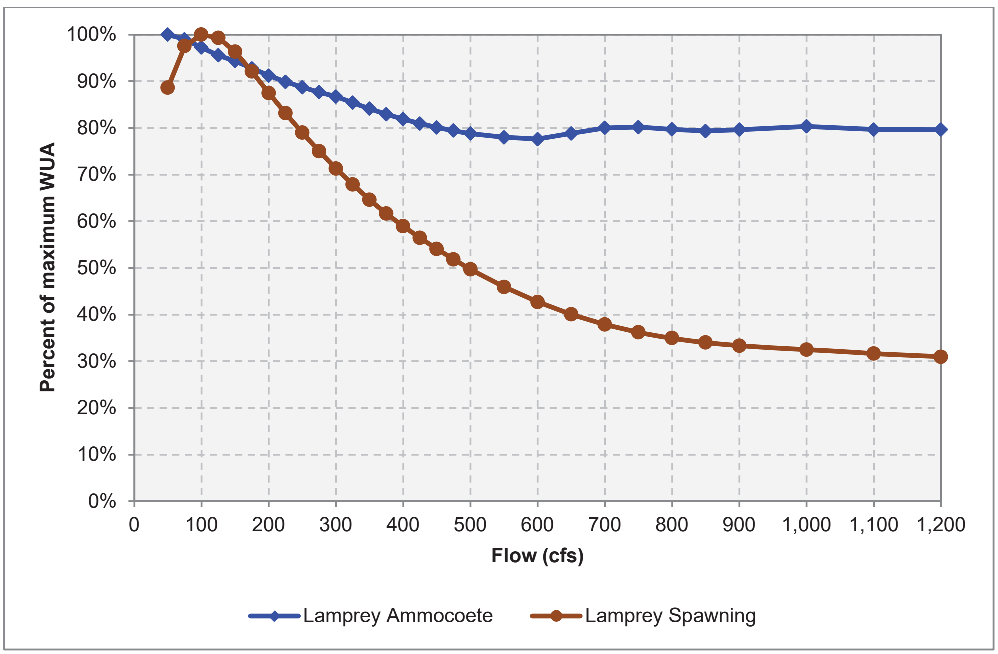

Figure 3.5-11. Pacific lamprey WUA results (percent of maximum) for the lower Tuolumne River.

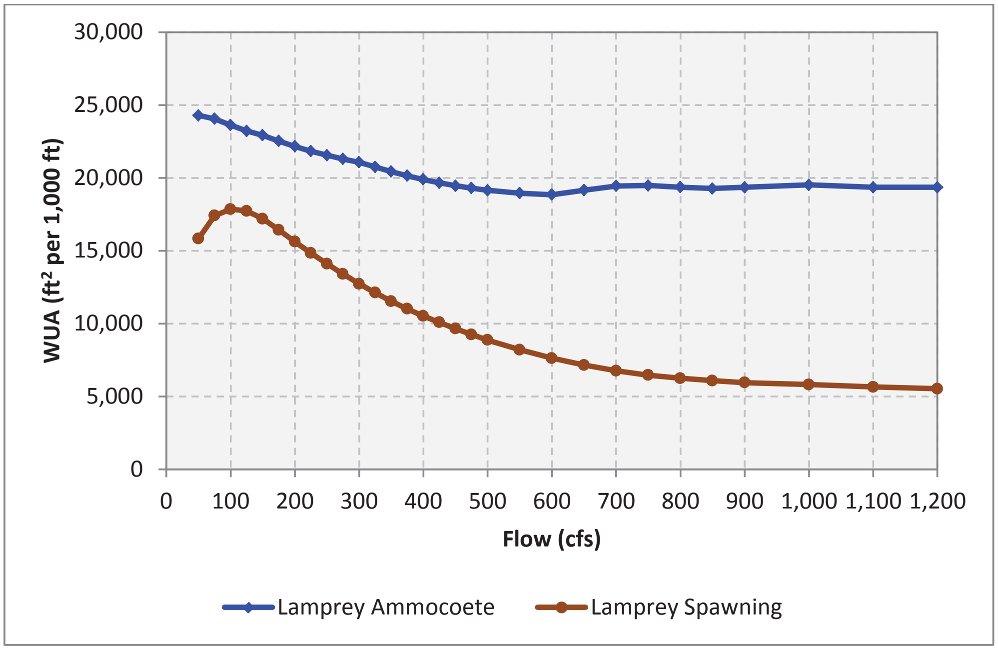

Figure 3.5-12. Pacific lamprey WUA results for the lower Tuolumne River.

Pacific lamprey occur in the study reach between La Grange Diversion Dam (RM 52) and below Waterford (RM 29) (Stillwater Sciences 2014). Ammocoetes are present year-round and typically prefer slow backwater or edge-water habitat, which is available in the study reach at all modeled flows. In contrast, lamprey spawning may be limited by higher flows in late winter and spring, as habitat availability decreases with increases in flow. As a result, lamprey spawning habitat availability declines during flood control or other high-flow releases in spring.

Black Bass

Largemouth, smallmouth, and spotted bass (collectively black bass) were all introduced into the State of California by CDFW and are now actively managed by CDFW in many locations. Largemouth and smallmouth bass were first released in California by CDFW between 1874 and 1891 (Dill and Cordone 1997; TID/MID 1992a), and spotted bass were introduced in 1976. According to CDFW (2014), "Bass angling provides recreation and economic value to the state of California." Also according to CDFW (2014), "…California has been the center of attention for producing trophy-sized black bass. In a list of the top 25 largest largemouth bass caught in the U.S., 21 of the bass are from California waters." Black bass can be highly piscivorous and prey heavily on salmonids and other fish species in the lower Tuolumne River. Predation by black bass on fall-run Chinook in the Tuolumne River is addressed in the "Chinook In-River Rearing and Outmigration" section of this FLA (above).

Largemouth bass are most common in shallow, warm waters with moderate clarity and beds of aquatic macrophytes. They can be displaced from mainstem fluvial habitats by high flows, but move back into the river channel when flows recede. Largemouth bass can survive in oxygen-poor water, even to levels as low as 1 mg/L.[20] Largemouth bass become primarily piscivorous at 100-125 mm in length, although crayfish, tadpoles, and frogs are also consumed by larger individuals. Growth varies depending on genetics, food availability, temperature, and competition.

In 1990, largemouth bass abundance estimated for the lower Tuolumne River (RM 0.0 to RM 52.0) based on shoreline lengths was 11,074 individuals (TID/MID 1992c). During 2012, abundance of largemouth bass from RM 0.0 to RM 39.4 was estimated to be 3,323 based on shoreline length, and 3,891 based on habitat area (TID/MID 2013f). However differences in study methods between the two sampling years preclude comparison of these estimates. For largemouth bass, site-specific density estimates ranged from 0 to 218 fish per mile (collected in 1998, 1999, and 2003) (McBain & Trush and Stillwater Sciences, 2006) and 4 to 196 per mile in 2012.

Smallmouth bass are most common in cool, clear streams with abundant cover, where they prefer complex habitat with pools, riffles, runs, rocky bottoms, and overhanging vegetation. Ideal water temperatures for adult fish range from 25°C - 27°C. Smallmouth bass can survive in areas with dissolved oxygen concentrations as low as 1-3 mg/L but require at least 6 mg/L for normal growth. As fish grow they switch from crustaceans and insects to fish and crayfish. Smallmouth bass grow from 6 - 18 cm in their first year and up to 25 - 41 cm in their fourth year. The California state record smallmouth bass is 9 pounds 13 ounces (CDFW 2014).

Smallmouth bass density estimates for the lower Tuolumne River (converted to fish per mile) from McBain & Trush and Stillwater Sciences (2006) (collected in 1998, 1999, and 2003) ranged from 2 to 97 fish per mile. In 2012, site-specific density estimates of smallmouth bass ranged from 0 to 251 fish per mile (TID/MID 2013f).

Spotted bass are most common in clear, low gradient rivers, where they prefer to occupy pools. During summer they seek water temperatures ranging from 24°C to 31°C. The diet of spotted bass becomes more varied with age, with individuals relying mainly on fish and crayfish when they reach a length of about 75 mm. Growth varies with temperature and food availability, but, on average, individuals reach 65-170 mm total length (TL) in their first year and 245-435 mm TL in their fourth year. Angler catches of Alabama spotted bass over six pounds from many California waters have been verified by CDFW biologists, including one that weighed 10 pounds 4 ounces (CDFW 2014).

After monitoring largemouth and smallmouth bass in the Tuolumne River from 1996 to 2004, the Districts (TID/MID 2005) concluded that (1) populations were depleted during the 1997 floods but by 2003 had recovered to levels observed before the flood (2) largemouth bass are more abundant than smallmouth bass, and (3) velocity is the primary factor limiting bass abundance. Black bass density in the lower Tuolumne River could be reduced by re-contouring the channel to enhance riffle and run habitats, where velocities would be less suitable to black bass than in the slower-velocity habitats that are abundant under current conditions.

[20] Source: http://calfish.ucdavis.edu/species/?uid=92&ds=241

Striped Bass

Striped bass spawn from April to mid-June, beginning when water temperatures reach 16 °C. Striped bass spawn in open freshwater habitats with moderate to high water velocities. Striped bass are voracious piscivores and feed opportunistically on forage fish of the appropriate size. Small striped bass feed on planktonic crustaceans, and then switch to mysid shrimp and amphipods. Large striped bass feed mainly on fish. In the marine environment, anchovies, shiner perch, and herring are important in the diet, and in the Delta and upriver areas, large striped bass feed primarily on threadfin shad, young striped bass, and other small fish.[10]

The Delta, particularly the San Joaquin River between the Antioch Bridge and the mouth of Middle River and other channels in this area, are important spawning grounds (CDFW 2014). Another important spawning area is the Sacramento River between Sacramento and Princeton (CDFW 2014). Sublegal striped bass, under 18 inches long, are found all year in large numbers upstream of San Francisco Bay, but their migratory patterns are poorly understood. After spawning, most adult striped bass move out of the rivers and into brackish and salt water for the summer and fall. However, some adult fish remain in freshwater during summer, and many anglers have caught striped bass at unexpected times and places (CDFW 2014).

There is limited information regarding the abundance of striped bass in the Tuolumne River. However, there is anecdotal evidence of large numbers of striped bass being found in the Tuolumne River as far back as 1903 (State Board of Fish Commissioners 1904). Striped bass were captured by electrofishing in the lower Tuolumne River in 1989 (TID/MID 1992) and during predator surveys in 1998, 1999, and 2003 (McBain & Trush and Stillwater Sciences 2006). The Districts' 2012 Predation Study estimated striped bass abundance in the lower river to be in the range of 500-750 individuals during summer 2012 (TID/MID 2013f).

3.5.4.1.4 Fish Habitat Restoration Projects in the lower Tuolumne River

As directed under the 1995 Settlement Agreement, the Tuolumne River TAC developed 10 priority habitat restoration projects aimed at improving geomorphic and biological aspects of the lower Tuolumne River corridor (listed below).

- Channel and Riparian Restoration Projects (RM 34.3 to RM 40.3):
    - Gravel Mining Reach Phase I (Completed in 2003),
    - Gravel Mining Reach Phase II (Not completed),
    - Gravel Mining Reach Phase III (Not completed), and
    - Gravel Mining Reach Phase IV (Not completed).
- Predator Isolation Projects:
    - SRP 9 (RM 25.7 to 25.9) (Completed in 2001), and
    - SRP 10 (RM 25.5) (Not completed).
- Sediment Management Projects (RM 47.5 to RM 51.8):

- Riffle Cleaning (Fine sediment) (Not completed),
- Gasburg Creek basin (Fine sediment) (Completed prior to 2008),
- Gravel Augmentation (Coarse sediment) (Not completed), and
- RM 43 (Coarse sediment) (Completed in 2005).

Other restoration efforts have been implemented in the lower Tuolumne River corridor by various groups, including Friends of the Tuolumne (FOT), Tuolumne River Trust (TRT), National Resource Conservation Service (NRCS), East Stanislaus Resource Conservation District (ESRCD), USFWS, CDFW, Stanislaus County, and the cities of Waterford, Ceres, and Modesto. Habitat restoration projects are discussed in detail in Section 5.3.2.2 of the Districts' PAD (TID/MID 2011a).

CDFW placed about 27,000 yd^3 of gravel in the river near La Grange from 1999 to 2003 to increase spawning gravel area to help offset gravel losses due to the 1997 flood. The FOT, TRT, NRCS, and ESRCD implemented several large floodplain restoration projects on the lower Tuolumne River near Modesto, including the Grayson River Ranch project. The TRT, in partnership with the NRCS, CDWR, the National Oceanic and Atmospheric Association (NOAA), and the ESRCD, acquired approximately 250 ac on both sides of the Tuolumne River from RM 5.8 to 7.4 ("Big Bend"). Restoration at the Big Bend project site was completed from 2004 to 2006. FOT, funded by the California Bay-Delta Authority (CBDA), acquired about 250 ac of river and floodplain habitat at Bobcat Flat (RM 42.4 to 44.6). A restoration plan was developed, with the goal of enhancing natural floodplain function at the parcel.

The Adaptive Management Forum (AMF) was initiated in 2001 to review designs for restoration projects in Central Valley rivers and assist resource agencies and tributary restoration teams. The AMF panel of technical experts reviewed and made recommendations concerning tributary restoration projects and made recommendations for incorporating adaptive management into projects and maximizing restoration success.

3.5.4.1.5 Benthic Macroinvertebrates

Benthic macroinvertebrate (BMI) monitoring has been conducted by the Districts in the lower Tuolumne River since 1987. The sampling locations, design, methodology, and analysis metrics have varied over the years, and are described in the Districts' PAD. Study results show that the lower Tuolumne River supports a high species diversity of aquatic invertebrates and indicate that juvenile Chinook salmon preferentially prey on chironomids (midges), ephemeropterans (mayflies), and dipterans (true flies) (TID/MID 1992a).

Results of California Monitoring and Assessment Program (CMAP) metrics for the lower Tuolumne River exhibit a pattern of slightly decreasing BMI habitat quality from upstream (higher quality) to downstream (lower quality) (Table 3.5-15). Long-term comparisons of historical data collected prior to WY 2000 are confounded by differences in invertebrate emergence timing and sampling methodology. Table 3.5-16 provides a long-term comparison of Hess samples collected at riffles 4A (RM 48.4) and 23C (RM 42.3). Analysis of Hess sampling data gathered from 1988 to 2009 at Riffle 4A (RM 48.8) support the observations that increased summer flows released since the 1995 Settlement Agreement have resulted in beneficial shifts in food supply for fishes. Although overall invertebrate abundances in Riffle 4A samples declined slightly from 1996 to the present, community composition shifted away from pollution-tolerant organisms and toward those with higher food value for juvenile salmonids and other fish (TID/MID 2010f, Report 2009-7).

3.5.4.1.6 Aquatic Invasive Species

Aquatic Invasive Invertebrates

As with Don Pedro Reservoir, aquatic invasive invertebrate species of concern in the lower Tuolumne River include quagga mussels, zebra mussels, and New Zealand mudsnails. Background on the life history, ecological requirements, and current ranges of these species is included in Section 3.5.2.1.7 of this FLA.

A report, Potential Distribution of Zebra Mussels *(Dreissena polymorpha)* and Quagga Mussels *(Dreissena bugensis)* in California, prepared for CDFW, assessed the threat of these mussels to California water bodies based on the their ability to tolerate a range of temperatures, calcium concentrations, pH, dissolved oxygen, and salinity (Cohen 2008). Based on its ambient conditions, the Tuolumne River at Modesto is considered vulnerable to colonization, but was assigned a low priority designation. To date, quagga mussels, zebra mussels, and New Zealand mudsnails have not been documented in the lower Tuolumne River.

Water Hyacinth

Water hyacinth (*Eichhornia crassipes*), a plant species native to the Amazon River basin, has spread to all tropical and subtropical countries and is considered one of the world's most invasive aquatic weeds (Parsons 1992, as cited in Cal-IPC 2014). It was introduced into the United States in 1884 as an ornamental plant, spread rapidly in the warmer states, and was first documented in California in 1904 (Thomas and Anderson 1984, as cited in Cal-IPC 2014). In California, water hyacinth is usually found below about 650 ft elevation in the San Francisco Bay Area, along the South Coast, and in the Central Valley (Cal-IPC 2014), including the lower Tuolumne River.

Water hyacinth is a floating aquatic plant with bright green, waxy leaves and violet flowers. The leaf stem is usually swollen and filled with spongy tissue that acts as a float, and the plants often form dense mats on the water's surface. Sometimes water hyacinth can be found growing in muddy soils near the edge of a river or pond, and in these situations the leaf stems tend not to be swollen.

Table 3.5-15. Selected CMAP metrics for historical kick-net samples collected in the lower Tuolumne River, by RM (2001–2009).

Year	*2001*						*2002*						*2003*					
Riffle	**A4**	**4A**	**23C**				**A4**	**4A**	**23C**	**31**	**57**		**A4**	**4A**	**23C**	**31**	**57**	**72**
RM	**51.6**	**48.8**	**42.3**				**51.6**	**48.8**	**42.3**	**38.1**	**31.5**		**51.6**	**48.8**	**42.3**	**38.1**	**31.5**	**25.4**
Taxonomic Richness	25	21	25				20	22	20	25	23		25	33	21	21	30	22
EPT Taxa	8	6	7				5	7	5	8	5		7	8	9	7	10	7
Ephemeroptera Taxa	2	4	3				1	3	2	5	4		3	3	5	5	6	3
Plecoptera Taxa	1	0	0				1	0	0	0	0		1	0	0	0	0	0
Trichoptera Taxa	5	2	4				3	4	3	3	1		3	5	4	2	4	4
Abundance (total in sample)	1,307	835	1,642				6,680	833	310	1,642	944		3,554	7,548	1,611	943	1,110	335
Density (No./m^2)	6,873	3,655	8,634				35,953	4,482	1,668	8,634	5,079		6,231	13,234	2,825	1,654	1,946	587
Year	*2004*						*2005*						*2007*					
Riffle	**A4**	**4A**	**23C**	**31**	**57**	**72**	**A4**	**4A**	**23C**	**31**	**57**	**72**	**A4**	**4A**	**23C**	**31**	**57**	**72**
RM	**51.6**	**48.8**	**42.3**	**38.1**	**31.5**	**25.4**	**51.6**	**48.8**	**42.3**	**38.1**	**31.5**	**25.4**	**51.6**	**48.8**	**42.3**	**38.1**	**31.5**	**25.4**
Taxonomic Richness	28	23	20	25	27	26	31	33	37	23	20	16	25	28	28	17	23	22
EPT Taxa	8	9	7	10	11	8	7	10	7	5	4	5	9	8	9	6	11	8
Ephemeroptera Taxa	4	4	5	7	7	4	3	5	5	3	3	3	5	5	5	4	6	4
Plecoptera Taxa	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0
Trichoptera Taxa	3	5	2	3	4	4	3	4	2	1	1	2	4	3	4	2	5	4
Abundance (total in sample)	3,519	3,468	2,749	2,232	813	659	1,057	1,031	463	1,201	513	273	306	522	388	247	428	240
Density (No./m^2)	6,169	6,081	4,820	3,913	4,276	3,466	1,853	1,808	812	2,106	899	479	537	915	680	433	750	421
Year	*2008*						*2009*											
Riffle	**A4**	**4A**	**23C**	**31**	**57**	**72**	**A4**	**4A**	**23C**	**31**	**57**	**72**						
RM	**51.6**	**48.8**	**42.3**	**38.1**	**31.5**	**25.4**	**51.6**	**48.8**	**42.3**	**38.1**	**31.5**	**25.4**						
Taxonomic Richness	24	30	16	16	23	27	27	33	27	27	30	29						
EPT Taxa	7	10	9	9	7	7	5	9	9	11	10	8						
Ephemeroptera Taxa	3	6	7	6	4	2	2	5	6	6	6	4						
Plecoptera Taxa	0	1	0	0	0	0	0	1	0	0	0	0						
Trichoptera Taxa	4	3	2	3	3	5	3	3	3	5	4	4						
Abundance (total in sample)	296	360	275	185	118	345	4,720	1,507	2,146	882	428	1,189						
Density (No./m^2)	520	632	483	324	207	606	8,280	2,643	3,765	1,547	750	2,086						

Adapted from TID and MID (2010, Report 2009-7).

Table 3.5-16. BMI community metrics for long-term Hess sampling sites at riffles R4A (RM 48.8) and R23C (RM 42.3) in the lower Tuolumne River (1988–2009).

Year	San Joaquin Valley Water Year Index	Summer Flow (cfs)	30-Days Prior Flow (cfs)	Sampling Location	EPT Index (%)	EPT / Chironomid Ratio	Shannon Diversity	Percent Chironomid	Percent Insects	Percent Dominant Taxon	Density [No./m^2]
1988	1.48 (C)	16	16	R4A	9	0.52	2.28	29	53	19	33,700
1989	1.96 (C)	47	45	R4A	35	0.94	2.4	38	81	24	34,400
1990	1.51 (C)	21	26	R4A	14	0.26	2.13	53	81	33	52,658
1991	1.96 (C)	25	22	R4A	26	1.05	2.64	25	60	19	35,047
1992	1.56 (C)	20	23	R4A	14	0.28	2.13	60	76	38	23,272
1993	4.2 (W)	466	464	R4A	15	0.38	1.77	44	66	41	24,813
1994	2.05 (C)	23	23	R4A	22	1.73	2.62	17	42	22	3,897
1996	4.12 (W)	335	189	R4A	84	11.09	1.59	8	93	47	22,987
1997	4.13 (W)	283	290	R4A	28	0.45	1.31	63	94	62	20,780
2000	3.38 (AN)	459	305	R4A	52	2.57	2.13	25	79	33	28,832
2001	2.2 (D)	91	89	R4A	44	1.44	2.7	30	30	25	17,037
				R23C	48	2.17	2.43	22	75	30	15,528
2002	2.34 (D)	85	87	R4A	49	1.52	2.0	34	84	40	24,798
				R23C	11	0.38	2.26	32	59	31	11,649
2003	2.82 (BN)	241	240	R4A	41	0.85	2.32	48	90	32	23,547
				R23C	51	8.16	2.37	8	65	28	11,767
2004	2.21 (D)	113	114	R4A	68	3.18	1.92	21	90	52	28,994
				R23C	79	26.86	1.79	3	84	48	19,120
2005	4.75 (W)	1706	803	R4A	76	7.52	1.56	10	95	64	27,440
				R23C	85	15.34	1.42	3	98	66	6,710
2007	1.96 (C)	110	118	R4A	58	1.91	2.73	30	90	26	10,040
				R23C	80	15.95	1.84	5	89	59	4,143
2008	2.07 (C)	96	102	R4A	61	0.88	2.58	18	80	28	4,733
				R23C	68	23.28	2.12	3	86	48	2,762
2009	2.73 (BN)	116	110	R4A	50	1.82	2.79	28	79	19	28,516
				R23C	49	12.99	2.33	4	71	36	23,917

Source: TID and MID 2010, Report 2009-7.

Water hyacinth proliferates by fragmentation of established plants, sprouting from rhizomes, or germinating from seeds (Penfound and Earle 1948, as cited in Cal-IPC 2014). Seeds are dispersed by water currents and by adhering to the feet of birds. Migratory birds are thought to play a role in far-ranging dispersal (Parsons 1992, as cited in Cal-IPC 2014). The major means of dispersal, and the one most difficult to control, is active transport by humans, through deliberate plantings, disposal of surplus, or inadvertent transport by boats.

Water hyacinth can quickly dominate an aquatic system because of its rapid proliferation. It often degrades waterfowl habitat by reducing open water areas and displaces native aquatic plants used for food or shelter by other wildlife species (Cal-IPC 2014). Water hyacinth can increase water losses from lakes and rivers because of the plant's high transpiration rate (Parsons 1992, as cited in Cal-IPC 2014) and can alter water quality beneath dense mats by reducing dissolved oxygen and affecting pH and turbidity (Penfound and Earle 1948; Center and Spencer 1981, as cited in Cal-IPC 2014). Alteration in water quality can lead to adverse effects on aquatic biota, and decaying water hyacinth beds can make water unsuitable for drinking by wildlife.

Water hyacinth can obstruct navigable waterways, impede drainage, foul hydroelectric generators and water pumps, and block irrigation channels (Cal-IPC 2014). By 1897 it had occluded many waterways in the United States and was interfering with shipping (Parsons 1992, as cited in Cal-IPC 2014). Agricultural production in California's Central Valley was at one time threatened by significant reductions in the efficiency of irrigation channels and pumping equipment caused by water hyacinth. However, control efforts have reduced the problem significantly in recent years (Parsons 1992, as cited in Cal-IPC 2014). Decaying water hyacinth beds can also make water unsuitable for drinking by humans and livestock.

During the 2012 Lower Tuolumne River Lowest Boatable Flow Study researchers documented the existence of dense mats of water hyacinth, and in the reach between Riverdale Park (RM 12.3) and Shiloh Bridge (RM 4.0) these mats blocked the entire river in two locations, interfering with boat passage (TID/MID 2013p). The California Division of Boating and Waterways considers water hyacinth to be too well established in the lower Tuolumne River for eradication, although herbicides are used to control its abundance when no undue risks to special-status species or subsequent human water uses are anticipated.

3.5.4.2 Fish and Aquatic Resource Effects in the Lower Tuolumne River

Effects of the Proposed Action on fish and aquatic resources in the lower Tuolumne River are addressed in Section 4.0, Cumulative Effects, of this Exhibit E.

3.5.4.3 Proposed Environmental Measures

The Districts are proposing no environmental enhancement measures for fish and aquatic resources in the lower Tuolumne River.

3.5.4.4 Unavoidable Adverse Impacts

Unavoidable adverse impacts of the Proposed Action on fish and aquatic resources in the lower Tuolumne River are addressed in Section 4.0, Cumulative Effects, of this Exhibit E.

3.6 Botanical Resources

California supports a variety of botanical resources, including vegetation communities and individual species that provide regional biodiversity, wildlife habitats, and other services. The Don Pedro Project is located in the central Sierra Nevada Foothills geographic subregion of California (Jepson Flora Project 2013) and the Central Valley and South Sierra CalVeg vegetation mapping zones (USFS 2009). The local climate is characterized by hot, dry summers, and limited annual rainfall (under 20 inches of precipitation annually [Western Regional Climate Center 2013]).

The Project Boundary encompasses over 5,538 ac of terrestrial habitats, dominated by blue oak woodlands and open annual grass-forb vegetation, and substantial components of shrub-dominated chaparral. Wetland and riparian habitats are uncommon; the bulk of Don Pedro Reservoir shoreline is steep-sided, with upland plant communities adjacent to the reservoir margin. Areas below the normal maximum surface elevation that are periodically exposed are sparsely vegetated or bare. The majority of terrestrial habitats within the Project Boundary are unmanaged and geographically removed from any Project activity. Routine maintenance activities, including vegetation management and noxious weed control efforts, are restricted to facilities and the Districts' three recreation areas.

The PAD compiled and presented existing information regarding botanical resources in the Don Pedro Project vicinity. Additionally, the Districts' consultation with stakeholders resulted in the development and implementation of a suite of botanical resource studies that address each of the botanical resource issues identified during consultation and in FERC's SD2. Existing information and the results of the botanical resource studies are presented below, including descriptions of the existing environment, including: (1) vegetation types within the Project Boundary; (2) special-status plants; (3) wetland and littoral habitats; and (4) noxious weeds.

3.6.1 Existing Environment

3.6.1.1 Vegetation Type Distribution and Abundance

In 2011, vegetation within the Project Boundary was characterized using existing vegetation mapping and classifications from the USFS' CalVeg mapping and data system (USFS 2009). Vegetation types (CalVeg "alliances") within the Project Boundary were mapped and quantified using GIS software. The Don Pedro Project falls within two CalVeg mapping zones, Central Valley and South Sierra. Within these, the Project Boundary is dominated by three vegetation alliances: Blue Oak, Chamise, and Annual Grasses and Forbs. There are also large areas of Gray Pine, and smaller inclusions of Lower Montane Mixed Chaparral and Interior Live Oak (Table 3.6-1).

Table 3.6-1. CalVeg vegetation alliances, zones and acres mapped within the Project Boundary.

CalVeg Zone	CalVeg Alliances	Total Acres in Project Boundary
South Sierra	Canyon Live Oak	0.2
	Interior Live Oak	10.8
	Annual Grasses and Forbs	3.8
Central Valley	Douglas Fir- Pine	5.2
	Gray Pine	447.5
	Riparian Mixed Hardwood	0.6
	Blue Oak	3,326.9
	Interior Live Oak	166.9
	Chamise	542.2
	Lower Montane Mixed Chaparral	277.0
	Annual Grasses and Forbs	2,276.7
	Barren/Rock	549.7

The majority of the Project Boundary is dominated by the Blue Oak and Annual Grasses and Forbs alliances (i.e., open habitats dominated by non-native grasses). However, lands near Willow Creek Arm, Hatch Creek Arm, and Don Pedro Bar support dense stands of the Chamise alliance, a chaparral shrub alliance dominated by a single species. The Tuolumne Arm and Wood's Creek Arm support a mixture of alliances, including Lower Montane Mixed Chaparral, Chamise, Interior Live Oak, Gray Pine, Annual Grasses and Forbs and a few small areas of Riparian Mixed Hardwoods.

Vegetation alliance descriptions from the CalVeg mapping system (USFS 2009) are presented below.

Canyon Live Oak Alliance - Canyon live oak (*Quercus chrysolepis*) as a dominant species has been frequently mapped in scattered stands in the foothills at elevations below about 6,400 feet. Its main conifer associates include Douglas fir (*Pseudotsuga menziesii*), ponderosa pine (*Pinus ponderosa*) and gray pine (*Pinus sabiniana*). Interior live oak (*Quercus wislizeni*), wedgeleaf ceanothus (*Ceanothus cuneatus*) and annual grasses are also likely to be found within and adjacent to these stands.

Interior Live Oak Alliance - The Interior Live Oak alliance occurs throughout the Central Valley on recent alluvial terraces, older terraces and rolling hills. It is in semi- open or closed stands and may associate with the Canyon Live Oak alliance at the higher elevations of this alliance's range. Gray pine and blue oak (*Quercus douglasii*) are associated species. This alliance is generally found below about 4,400 feet and is often located at higher elevations than the Blue Oak alliance (range up to about 3,900 feet).

Annual Grasses and Forbs Alliance - Annual grasslands are the most commonly encountered plant community of the Central Valley Ecological Province, generally occurring between urban/agricultural developments and the foothill woodlands. Dominant species in this alliance include ripgut brome

(*Bromus diandrus*), Italian ryegrass (*Lolium multiflorum*), soft chess (*Bromus hordeaceus*), wild oats (*Avena barbata*), and silver hairgrass (*Aira carophyllea*). The invasive Bermudagrass (*Cynodon dactylon*) is common in this alliance. Vernal pools (small depressions often containing hardpan soil layers and ephemeral ponding) occur throughout the Annual Grasses and Forbs alliance. Species common to vernal pools include downingia (*Downingia* spp.), meadowfoam (*Limnanthes douglasii*), goldfields (*Lasthenia chrysostoma*), water atarwart (*Callitriche marginata*), popcorn flower (*Plagiobothrys* spp.), Johnny-tuck (*Orthocarpus erianthus*), bur medic (*Medicago hispida*), and linanthus (*Linanthus* spp.).

Douglas Fir-Pine Alliance - This alliance is a mixture of Douglas fir and ponderosa pine that usually occur on moderately steep slopes below an elevation of about 5,200 feet. Canyon live oak, interior live oak, and blue oak are common hardwood associates. Shrubs in low to mid montane environments are also likely to be associated with these stands, such as whiteleaf manzanita (*Arctostaphylos viscida*).

Gray Pine Alliance - Gray pine forms prominent open or sparse stands throughout the lower elevations of the foothills east and west of the Sacramento Valley (Central Valley Ecological Province). In the Project Boundary, these diverse stands occur mainly with blue oak and interior live oak. Shrubs associated with this alliance include chamise (*Adenostoma fasciculatum*), wedgeleaf ceanothus, whiteleaf manzanita, and birchleaf mountain mahogany (*Cercocarpos betuloides*). In the southern Sierra foothills, mixed stands of gray pine and canyon live oak in this alliance have been mapped in the elevation range of about 4,200 to 4,600 feet, but the pine has been mapped as low as 100 feet.

Interior Mixed Hardwood Alliance - No single species is dominant in the Interior Mixed Hardwood alliance. It has been identified in scattered pockets in the valley and more abundantly in the foothills. The density of blue oak and interior live oak usually exceeds that of black oak in this mixture. Minor amounts of California buckeye (*Aesculus californica*), California bay (*Umbellularia californica*), and coast live oak (*Quercus agrifolia*) may also be part of this alliance. Because this alliance has been mapped mainly at elevations below about 5,000 feet, it is likely to have inclusions of low-elevation chaparral species such as wedgeleaf ceanothus, scrub oaks (*Quercus* spp.), and chamise.

Blue Oak Alliance - This alliance is dominated by blue oak, which naturally occurs in an oak-grass association on well drained, gentle slopes. Blue oak and gray pine are the major trees in this hillside alliance. Blue oak may be the only hardwood species, although interior live oak, valley oak (*Quercus lobata*) and/or California buckeye may also be present. Shrubs such as wedgeleaf ceanothus, manzanitas (*Arctostaphylos* spp.), coffeeberry (*Rhamnus* spp.), birchleaf mountain mahogany and poison oak (*Toxicodendron diversilobum*) are also part of this alliance. The understory of the Blue Oak alliance is dominated by annual grasses such as wild oats and cheatgrass (*Bromus* spp.). This alliance generally occurs below about 3,900 feet.

Chamise Alliance - Relatively pure stands of chamise occupy xeric sites at elevations up to about 4,000 feet and often occupy upper ridge slope positions. Other chaparral shrub species such as wedgeleaf ceanothus, whiteleaf manzanita and birchleaf mountain mahogany are often occur in this alliance. Scattered gray pine and interior live oak are found in this alliance.

Lower Montane Mixed Chaparral Alliance - This alliance is a mixture of low-elevation chaparral species such as whiteleaf manzanita, wedgeleaf ceanothus, chamise, birchleaf mountain mahogany and other shrub species. No single species is dominant in the mixture. In general, this alliance is mapped between elevations of about 1,300 to 5,200 feet.

3.6.1.2 Special-Status Plants

In 2012, botanical surveys were conducted targeting special-status plants within the Project Boundary. Prior to the surveys, the California Native Plant Society (CNPS) database (CNPS 2012) was reviewed for special-status plant species occurring within the nine USGS quadrangle maps on which the Project Boundary is located. Additionally, a query of CDFW's California Natural Diversity Database (CNDDB) Rarefind 4 (CDFG 2012) identified 31 plant species that are considered special-status and have a reasonable potential to occur in the Project Boundary. For the purposes of the study, species that were considered special-status were those meeting one or more of the following criteria:

- Found on public land administered by the BLM and formally listed by the BLM-S.
- Listed under the ESA as Proposed or a Candidate for listing as endangered or threatened or proposed for delisting.
- Listed under the State of CESA as proposed for listing.
- Found on the CDFG list of California Rare (SR) species listed under the Native Species Plant Protection Act of 1977.
- Found on the CNPS Inventory of Rare Plants and formally listed as a CNPS 1, 2, or 3 plants (CNPS 1, CNPS 2, CNPS 3).

Plants listed under the federal ESA or the CESA – even if they are also considered BLM-S, CNPS 1, CNPS 2 or CNPS 3 – are considered separately, in Section 3.8 – Threatened and Endangered Species.

Survey protocols were developed in consultation with relicensing participants and were consistent with the botanical survey protocol section of CDFW's *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (CDFG 2009). Prior to field work, nearby reference occurrences of special-status plants were visited, and herbarium records from the Consortium of California Herbaria were used to help determine blooming periods. Field surveys were floristic in nature (i.e., all vascular plant species were identified). A random meander technique was employed, with additional focus in high quality habitat or other areas with a higher probability of supporting special-status plants.

Field studies were performed in portions of the Project Boundary where there was potential for effects, including all Don Pedro Project facilities, recreation areas, and high-use dispersed recreation areas as identified during study plan consultation. The study area extended outside of the Project Boundary as needed to survey the full extent of plant occurrences, up to 300 ft outside the Project Boundary within high-use recreation areas or the BLM's Red Hills ACEC, and, where necessary to document the full extent of each special-status plant occurrence, up to 0.25 mi outside the Project Boundary. The study area included in surveys consisted of approximately 3,870 ac.

Surveys located a total of 86 occurrences (either a single plant or a distinct geographic collection of plants) of eight different special-status plants, all listed as BLM-S (BLM 2012): 58 occurrences were on public land administered by the BLM and 28 occurrences were on private land owned by the Districts. Table 3.6-2 summarizes the 85 special-status plant occurrences by land ownership.

Table 3.6-2. Special-status plant species found in the study area, with status and land ownership.

Common Name/Scientific Name	Status[1]	No. of Occurrences by Land Owner	
		Public (BLM)	TID/MID
Red Hills onion *Allium tuolumnense*	BLM-S, CNPS 1B	10	--
Red Hills soaproot *Chlorogalum grandiflorum*	BLM-S, CNPS 1B	20	--
Mariposa clarkia *Clarkia biloba* ssp. *australis*	BLM-S, CNPS 1B	2	23
Mariposa cryptantha *Cryptantha mariposae*	BLM-S, CNPS 1B	10	1[2]
Tripod buckwheat *Eriogonum tripodum*	BLM-S	4	--
Congdon's lomatium *Lomatium congdonii*	BLM-S, CNPS 1B	7	--
Shaggyhair lupine *Lupinus spectabilis*	BLM-S, CNPS 1B	4	3
Red Hills ragwort *Packera clevelandii*	BLM-S, CNPS 1B	1	1
	Total Occurrences	**58**	**28**

[1] Special-status:
BLM-S = Bureau of Land Management Sensitive Plant Species.
CNPS 1B = California Native Plant Society list endangered in California and elsewhere.
[2] Occurrence is primarily on public lands but crosses into TID/MID lands.

The most abundant special-status plants were Mariposa clarkia (*Clarkia biloba* ssp. *australis*) (25 occurrences), Red Hills soaproot (*Chlorogalum grandiflorum*) (20 occurrences), and Mariposa cryptantha (*Cryptantha mariposae*) (10 occurrences). In addition, a number of serpentine-adapted species were found in the Red Hills ACEC, including Red Hills onion

(*Allium tuolumnense*) (10 occurrences), Congdon's lomatium (*Lomatium congdonii*) (seven occurrences), shaggy-haired lupine (*Lupinus spectabilis*) (seven occurrences), tripod buckwheat (*Eriogonum tripodum*) (four occurrences), and Red Hills ragwort (*Packaera clevelandii*) (two occurrences).

3.6.1.2.1 Red Hills Onion

Ten occurrences of Red Hills onion were documented within the study area, all on public land administered by the BLM. Six occurrences were at Sixbit Gulch, two at Kanaka Point, one near Moccasin Point Recreation Area and one at Poor Man's Gulch for a total of over 700 individuals over a combined area of approximately 0.3 ac. Two potential disturbances were associated with Red Hills onion: noxious weeds and grazing. In addition, small parts of two occurrences extended below the reservoir normal maximum surface elevation, one was found in proximity to a county-maintained road, and two were within developed or dispersed recreation areas. Other special-status plants growing in association with Red Hills onion included Layne's ragwort (*Packera layneae*),[21] Congdon's lomatium, Red Hills soaproot, tripod buckwheat, shaggy-haired lupine, and Mariposa cryptantha.

3.6.1.2.2 Red Hills Soaproot

Twenty occurrences of Red Hills soaproot were documented within the study area, all on public land administered by the BLM; 12 were at Sixbit Gulch and eight at Poor Man's Gulch for a total of over 1,600 individuals combined over 0.4 ac. At the time of survey, approximately 80 percent of plants were in vegetative form and approximately 20 percent were in bloom (i.e., reproductive form). Two potential disturbances, noxious weeds and grazing, were associated with Red Hills soaproot. No disturbances associated with O&M were observed. Other special-status plants growing in association with Red Hills soaproot included Layne's ragwort, Red Hills onion, Congdon's lomatium, tripod buckwheat, shaggy-haired lupine, and Mariposa cryptantha.

3.6.1.2.3 Mariposa Clarkia

Twenty-five occurrences of Mariposa clarkia were documented within the study area, of which two were documented on public land administered by the BLM. Occurrences were found at the Moccasin Point Recreation Area, at Rogers Creek Arm, near the Moccasin transmission line, and along Shawmut Road for a total of over 35,000 individuals. Additionally, one occurrence was in an area associated with a burn pile from debris removal activities, and parts of some occurrences extended below the reservoir normal maximum surface elevation. At the time of survey, the majority of plants were in bloom. Five potential disturbances were associated with Mariposa clarkia: recreation, noxious weeds, grazing, use of a burn pile, and road and transmission line maintenance. No disturbances associated with O&M were observed in these areas. Other special-status plants were located with Mariposa clarkia occurrences, including Red Hills onion.

[21] Layne's ragwort is an ESA-listed species. Plants listed under the federal ESA or the CESA, even if they are also considered special-status, are considered separately, in Section 3.8.

3.6.1.2.4 Mariposa Cryptantha

Ten occurrences of Mariposa cryptantha were documented within the study area at Kanaka Point, all on public lands administered by the BLM (one crossed the ownership boundary onto TID/MID land). Occurrences were found at Moccasin Point Recreation Area, Railroad Canyon, and Sixbit Gulch for a total of about 2,300 individuals over a combined area of approximately 1.24 ac. At the time of survey, the majority of the plants were either in flower or fruit, with a small percentage still vegetative. Potential disturbances associated with these occurrences included noxious weeds and dispersed recreation. Additionally, Mariposa cryptantha at Moccasin Point Recreation Area was observed in the middle of an equipment and vehicle storage yard, sometimes growing around equipment. The Mariposa cryptantha occurrences were primarily scattered on rocky, serpentine slopes amidst grassy openings of toyon (*Heteromeles arbutifolia*), chamise and gray pine.

3.6.1.2.5 Tripod Buckwheat

Four occurrences of tripod buckwheat were documented within the study area, of which all were on public land administered by the BLM at Sixbit Gulch. A total of approximately 277 individuals, over a combined area of approximately 0.07 ac, were observed, nearly all in bloom. A review of existing information indicated that the species had not previously been documented within one mile of the Project Boundary. Noxious weeds were the only potential disturbance associated with tripod buckwheat; however, part of one occurrence grew below the reservoir normal maximum surface elevation. Special-status plants growing in association with tripod buckwheat included Layne's ragwort, Red Hills onion, Congdon's lomatium, shaggy-haired lupine and Red Hills soaproot.

3.6.1.2.6 Congdon's Lomatium

Seven occurrences of Congdon's lomatium were documented within the study area, all of which were documented on public land administered by the BLM; five occurrences were documented at Sixbit Gulch and two at Poor Man's Gulch. At the time of survey, an estimated 80 percent of the plants were in fruit and 20 percent were in flower. Two potential disturbances associated with Congdon's lomatium, recreational use and noxious weeds, were observed. In addition, part of one occurrence extended below the reservoir normal maximum surface elevation. Special-status plants were frequently growing in association with Congdon's lomatium, including Layne's ragwort, Red Hills onion, Red Hills soaproot, tripod buckwheat, shaggy-haired lupine and Mariposa cryptantha.

3.6.1.2.7 Shaggy-haired Lupine

Seven occurrences of shaggy-haired lupine were documented within the study area, four of which were observed on public land administered by the BLM. Two were documented at Poor Man's Gulch and five were documented at Railroad Canyon. Individual occurrences ranged from one to 2,000 plants, totaling a combined area of approximately 0.25 ac. At the time of survey, over 90 percent of the individuals were in fruit and the rest were in flower. All but one occurrence was at the margin (just above or partially below) the reservoir normal maximum surface elevation. Special-status plants growing in association with shaggy-haired lupine include Layne's ragwort, Red Hills onion, Red Hills soaproot, tripod buckwheat, and Congdon's lomatium.

3.6.1.2.8 Red Hills Ragwort

Two occurrences of Red Hills ragwort were documented within the study area, one of which was documented on public land administered by the BLM. Red Hills ragwort was also found at Recreation Bay and Sixbit Gulch. A total number of 268 individuals were observed over a combined area of approximately 0.02 ac. At the time of survey, an estimated 65 percent were in flower and 35 percent were vegetative. Three potential disturbances, recreation, weeds, and grazing, were associated with Red Hills ragwort. In addition, part of one occurrence extended below the reservoir normal maximum surface elevation. Special-status plants found growing in association with Red Hills ragwort included Red Hills soaproot and shaggy-haired lupine.

3.6.1.3 Wetland and Riparian Habitats

Wetland and riparian habitats are uncommon within the Project Boundary. Most of Don Pedro Reservoir is steep-sided, with upland plant communities directly adjacent to the reservoir margin. Areas below the normal maximum surface elevation that are periodically exposed are sparsely vegetated or bare. National Wetland Inventory mapping identifies a total of 82.4 ac of wetland and riparian habitats within the Project Boundary (Table 3.6-3) (USFWS 1987). In general, these areas are present as narrow margins to steep ephemeral streams which drain to Don Pedro Reservoir.

Table 3.6-3. Wetland and riparian habitats within the Project Boundary as mapped by the National Wetland Inventory (USFWS 1987).

Type	NWI Code	Acres in Project Boundary
Palustrine Emergent	PEM	22.4
Palustrine Scrub-Shrub	PSS	1.2
Palustrine Unconsolidated Bottom	PUB	10.5
Palustrine Unconsolidated Shore	PUS	0.4
Riverine Unconsolidated Bottom	RUB	30.9
Riverine Unconsolidated Shore	RUS	1.7
Riverine Streambed	RSB	15.3
	Total	**82.4**

In 2012, these National Wetland Inventory mapping data were supplemented with a field study of wetland habitats associated with Don Pedro Reservoir. A total of 10 drainages were examined for the presence of wetlands. The condition of each wetland was assessed using the California Rapid Assessment Methodology (CRAM) (CWMW 2012). The drainages were selected in cooperation with relicensing participants during the study plan development process. CRAM evaluates each wetland for a series of attributes: (1) Topographic Complexity, (2) Hydrology, (3) Physical Structure, and (4) Biotic Structure. CRAM then provides a measurement of wetland services, such as water storage, retention of particles, dissipation of energy (e.g., energy associated with high flow events), cycling of nutrients, and the maintenance of plant and animal communities. The maximum CRAM score possible is 100; a score of 100 indicates that every wetland service is provided by the wetland. Scores identify how many services are observed. The accompanying narrative description provides details on the functional qualities and any limiting factors present (i.e., limitations of plant establishment due to bedrock substrates, or anthropogenic stressors).

Of the ten drainages examined, nine supported wetlands. The CRAM scores for these wetlands ranged from 59 to 97. At eight of these wetlands, the majority of the wetland habitat was observed outside the Project Boundary and consisted primarily of patches of riparian vegetation along intermittent or ephemeral drainages to Don Pedro Reservoir. In each of these drainages, wetland conditions began at or above the reservoir normal maximum surface elevation and continued upstream (often beyond the Project Boundary) where conditions allowed. Wetland habitat below reservoir normal maximum surface elevation was not observed except for open water represented by Don Pedro Reservoir itself. In general, most wetlands were dominated by bedrock or cobble and boulder substrates, which do not support hydric soils, but do allow the development of hydrophytic vegetation. In addition, other indicators of ground saturation during some part of the growing season, such as watermarks, were often evident.

The ninth wetland, Big Creek, is not hydrologically associated with Don Pedro Reservoir; instead, it appears to be supported by subsurface drainage from the swimming lagoon at Fleming Meadows Recreation Area located upslope. Big Creek has no defined channel but supports hydrophytic vegetation and hydric soils throughout. The tenth area specified for study, Three Springs Gulch, did not support wetlands.

No facilities, access roads, recreational use, or O&M activities occur in any of the studied wetlands. Additionally, noxious weeds were infrequent within the wetland habitats examined. Those that were present were generally upland species at the wetland margin. The most prevalent invasive species observed were Himalayan blackberry (*Rubus armeniacus*) and wooly mullein (*Verbascum thapsus*); neither of these species is listed as a noxious weed (California Department of Food and Agriculture (CDFA) 2010).

Each documented wetland is described below.

3.6.1.3.1 Sixbit Gulch

Sixbit Gulch is small drainage located within the Red Hills ACEC that supports two wetland types: riverine intermittent streambed, seasonally flooded (R4SBC) and palustrine scrub-shrub, temporarily flooded (PSSA) (USFWS 1987). It is moderately confined by slopes of annual grasslands interspersed with buck brush (*Ceanothus cuneatus*) and gray pine (*Pinus sabiniana*). Large bedrock and boulder outcrops occur along the perimeter of the wetland.

Vegetation communities alternate between hummocks of naked sedge (*Carex nudata*) interspersed with herbs, and dense patches of red willow (*Salix laevigata*) and spicebush (*Calycanthus occidentalis*) surrounding pools. The wetland area alternates between dense cover and open bedrock, with medium vertical and horizontal vegetation complexity. Although three vertical layers are present within the wetland vegetation, most areas support no more than two vertical overlapping layers (e.g., willow mid-story over sedge ground-cover) and have horizontally alternating, rather than mixed patches, of vegetation types.

An old road crosses the channel near the midpoint of the wetland. The road is paved where it crosses the channel and is graded dirt on either side. The Districts do not use this road; the BLM closed the road to vehicle traffic and brush has overgrown the route both in and out of the channel. The road provides an opening in the dense riparian shrubs for sedge, springseep monkeyflower (*Mimulus guttatus*), and Sonoma hedgenettle (*Stachys stricta*) to flourish.

Sixbit Gulch received a CRAM Overall Attribute Score of 83. The score indicates that the wetland is meeting its potential, experiences few stressors from upland or hydrologic sources, and provides a multitude of wetland services.

3.6.1.3.2 Poor Man's Gulch

Poor Man's Gulch is a small drainage located within the Red Hills ACEC. It supports one wetland type, riverine intermittent streambed, seasonally flooded (R4SBC) (USFWS 1987). The drainage is unconfined within a narrow valley of non-native annual grasslands dotted with gray pines, buckbrush, and occasional hollyleaf redberry (*Rhamnus ilicifolia*). Shallow soils overlie bedrock. Hummocks of naked sedge and mixed herbs alternate with exposed bedrock with tufts of perennial ryegrass (*Lolium perenne*) and rabbitfoot grass (*Polypogon monspeliensis*) occur at the perimeter. Alternating with these areas are patches of red willow and spicebush, which occur with more frequency near the upstream end assessment area. The vertical and horizontal complexity is limited in this system, with few overlapping vertical layers, and alternating, rather than mixed, vegetation patches. The micro-topography is somewhat complex, while the macro-topography is simple, with the channel at the center of the gently sloping valley floor.

Poor Man's Gulch received a CRAM Overall Attribute Score of 83. The score indicates that the wetland is meeting its potential, experiences few stressors from upland or hydrologic sources, and provides a multitude of wetland services.

3.6.1.3.3 Moccasin Creek

Moccasin Creek supports one type of NWI-classified wetland, riverine intermittent streambed, seasonally flooded, excavated (R4SBCx) (USFWS 1987). Moccasin Creek is moderately confined within a valley; its floodplain becomes narrower and steeper as the creek winds upstream from the reservoir. Upslope vegetation is comprised of non-native annual grassland and oak woodlands. The channel is low gradient, with well-sorted bed material dominated by cobbles, with some boulders and finer sediments. The banks tend to be soil, stabilized by mature alder (*Alnus incana*) and red willow trees and shrubs, with occasional California sycamore (*Platanus racemosa*) and narrowleaf willow (*Salix exigua*). The canopy is well developed, providing shade throughout the creek. Herbaceous vegetation is rich, but not overly abundant, with many species occurring in small patches around tree roots. The creek supports complex vertical and horizontal stratification, with multiple layers of vegetation present throughout.

The creek is accessed frequently by fishermen, with trails weaving through upslope Himalayan blackberries, black mustard (*Brassica nigra*), and other weedy species. The river left bank just upstream of the Hatchery discharge has a short eroded area, where the dirt bank has collapsed. Established root systems on either side will prevent extension of the bank failure. The Highway 120 Bridge crosses over the creek near the upstream end of the assessment area, but does not create a break in riparian vegetation connectivity.

Two CRAM assessments were performed at Moccasin Creek to capture differences in channel width and discharge. Both received the same CRAM Overall Attribute Score of 97, indicating that the wetlands in Moccasin Creek experience few stressors from upland or hydrologic sources and provides a multitude of wetland services.

3.6.1.3.4 Hatch Creek

Hatch Creek supports one NWI-mapped wetland type, riverine intermittent streambed, temporarily flooded (R4SBA) (USFWS 1987). It is moderately unconfined with some incision in areas with soil terraces. Although access to the area is limited due to a lack of landowner permission, study of the area was possible to a limited extent by looking upstream or downslope from two public roads, respectively: Sunset Oaks Lane Bridge, which crosses Hatch Creek at the Project Boundary, and Marshes Flat Road, which roughly parallels Hatch Creek for a short distance.

The Hatch Creek channel bed alternates between bedrock and cobble dominated areas, with pooling in many of the bedrock areas. Non-native annual grasses meet the bankfull edge and continue upslope, dotted with canyon live oak (*Quercus chrysolepis*) and gray pines. Patches of riparian plants are present just downstream of the Project Boundary, but are discontinuous through the length of the assessment area. Cattle were present during the time of the survey and all herbaceous plants occurring within the bankfull area were grazed. Red willow, mule fat (*Baccharis salicifolia*), and spicebush are present between stretches of open, rocky banks and pools. Himalayan blackberry is present on many of the banks under a canopy of red willow or upland canyon live oaks. There is little vertical overlap and limited horizontal interspersion, with vegetation occurring in isolated patches.

The Sunset Oaks Bridge crosses Hatch Creek in an area with limited vegetation that appears to be typical for the system. No adverse effects from the bridge are apparent. Bank failure, possibly caused by the compounded effects of grazing and debris jam in the channel, is present at a short stretch of dirt terrace on the north bank.

Hatch Creek supports a limited riparian system, and received a CRAM Overall Attribute Score of 68. The score indicates that the wetland experiences limited stressors from upland or hydrologic sources and provides some wetland services. Channel and vegetation complexity are limited by the bedrock substrate and possibly by cattle grazing.

3.6.1.3.5 Big Creek

The emergent wetland system at Big Creek is contained within the Project Boundary and is located roughly east of Don Pedro Dam and south of the Reservoir. (All other assessed wetlands began within the Project Boundary, but continued upstream, with most wetland habitat occurring outside the Project Boundary.) Big Creek is identified on USGS topographic maps as "intermittent" and is not identified on NWI maps as supporting any wetland types (USFWS 1987). It drains runoff from surrounding slopes and does not have a surface hydrologic connection with the Reservoir.

The Big Creek wetland is a swale formed by the meeting of adjacent hillslopes, with no distinct bed or banks. The surrounding landscape consists of non-native annual grasslands and blue oak (*Quercus douglasii*) woodland. The wetland is characterized by a change from upland grasses to more hydrophytic plants where it appears to be saturated to inundated for most of the year, with some intermittent ponding. The creek supports primarily herbaceous species, such as broad-leaved cattail (*Typha latifolia*), tall flatsedge (*Cyperus eragrostis*), rabbitfoot grass, dallisgrass (*Paspalum dilatatum*), spike rush (*Eleocharis ovata*), and lady's thumb (*Persicaria maculosa*). A few red willow shrubs and trees occur near saturated areas. Two small ponds in the channel support aquatic plants, including floating primrose (*Ludwigia peploides*) and duckweed (*Lemna minor*), the presence of which indicates that surface water is present during the majority of the year. The channel has very little vertical or horizontal complexity, consisting predominantly of the same herbaceous dominants throughout. Micro- and macro-topography are also simple, with very few patch types.

Big Creek is bisected by Bonds Flat Road, a public two lane road with a culvert connecting the upper and lower portions of the creek. A fenced area in the lower portion of the creek is highly grazed, with most of the wetland vegetation grazed to a nub. Recent cattle activity is evident. In this same area, a vehicle crossing is present joining a dirt road on either side. The road is not currently used by the Districts, but was originally created to support transmission lines and other infrastructure in the area.

Big Creek received a CRAM Overall Attribute Score of 71, which indicates that the wetland experiences limited stressors from upland and hydrologic sources, and provides some wetland services. However, the system is not structurally complex, and has limited vegetative richness.

3.6.1.3.6 Kanaka Creek

Kanaka Creek supports one NWI-mapped wetland, a riverine intermittent streambed, seasonally flooded (R4SBC) (USFWS 1987). It is unconfined and supports riparian vegetation on narrow floodplains flanking both sides of the channel. Surrounding upslope areas support non-native annual grasslands and mixed oak woodlands.

Vegetation occurs throughout all vertical layers, and is horizontally complex with well-stratified vegetation communities throughout the channel, wetted edge, and floodplain. Watercress (*Rorippa nasturtium-aquaticum* [*Nasturtium officinale*]) is present in the channel where the canopy is more open, and herbaceous vegetation such as seepspring monkeyflower and sneezeweed (*Helenium puberulum*) dots the banks. The shrub layer alternates between spicebush and red willow, with patches of Himalayan blackberry and fig (*Ficus carica*). An overstory of red willows and canyon live oak provides structure for climbing vines of California wild grape (*Vitis californica*), which traverses all layers of the vegetation.

The channel bed is steep bedrock and boulder controlled falls with deep pools alternating with low gradient cobble riffles. The macro- and micro-topography of the channel and floodplain are complex, with high connectivity between the channel and floodplain. Some signs of human access were observed in the lower areas of the reach, where litter was present and a mining shack appeared to be in active use. A public two-lane highway, Jacksonville Drive, crosses the wetland over a culvert, with pools formed on either side. The slopes of the highway support abundant yellow star thistle (*Centaurea solstitialis*), with a few individual plants occurring in the creek downstream.

Kanaka Creek received a CRAM Overall Attribute Score of 87, indicating that the wetland experiences few stressors from upland or hydrologic sources and provides most wetland services. Two non-native plant species, fig and Himalayan blackberry, are common throughout.

3.6.1.3.7 Deer Creek

Deer Creek supports one type of NWI-mapped wetland, a R4SBC (USFWS 1987). The channel is highly confined in a steep bedrock-dominated canyon, with non-native annual grasses, weedy forbs, poison oak (*Toxicodendron diversilobum*), and interior live oak scrub occurring upslope. Ward's Ferry Road roughly parallels Deer Creek for a short distance upslope on the north side.

The bed and banks of Deer Creek are dominated by bedrock and boulder substrates, with limited vegetation present below bankfull elevation. The channel is mostly bare, with small patches of herbaceous vegetation, alternating with lower gradient areas supporting red willow, spicebush, and button willow (*Cephalanthus occidentalis*). Bedrock pools are common in the streambed. The vegetation community is horizontally and vertically simple, with patchy vegetation and few areas with overlapping layers. The micro- and macro-topography is somewhat complex, but limited by the bedrock substrates.

A limited amount of debris is present in Deer Creek, with car parts and other trash likely originating from individuals using Ward's Ferry Road. Non-native herbaceous species dot the northern slope of the Deer Creek canyon wall, with denser populations near the top of the slope near the roadway. These species include Klamath weed, wooly mullein, and Italian thistle; while occasionally present within the riparian area, they are mostly limited to upslope habitats.

Deer Creek received a CRAM Overall Attribute Score of 71. The score indicates the wetland experiences few stressors from upland or hydrologic sources and provides some wetland services, although the bedrock bed and banks limit the vegetative capacity of the wetland.

3.6.1.3.8 Drainage #7

Drainage #7 is located within the Red Hills ACEC and supports one type of NWI-mapped wetland, R4SBC (USFWS 1987). Wetland habitats within Drainage #7 do not occur within the Project Boundary; no riparian or wetland vegetation is present until approximately 100 m upstream of the Project Boundary. The inclusion of this drainage as a wetland is based primarily on the NWI classification (USFWS 1987), as the plant species investigation indicated that the majority of plants present are not hydrophytic, indicating that the area likely does not meet formal wetland criteria.

The areas surrounding Drainage #7 consist of steep slopes supporting non-native annual grasslands with buck brush intermittently interspersed throughout. The grasslands end abruptly at the edge of the drainage, which has almost vertical bedrock walls and bedrock floors. California buckeye (*Aesculus californica*), red willow, and spicebush grow from within the drainage, with the canopy just overtopping the lip of the drainage. Some herbaceous vegetation grows along the bed and walls, such as seepspring monkeyflower, naked sedge, and canyon liveforever (*Dudleya cymosa*).

Drainage #7 received a CRAM Overall Attribute Score of 59. The score indicates that the wetland does not experience stressors from upland or hydrologic sources and provides some wetland benefits, but has little vegetation because of the bedrock substrates dominating the drainage.

3.6.1.3.9 Drainage #8

Drainage #8 is located within the Red Hills ACEC and supports one type of NWI-mapped wetland, R4SBC (USFWS 1987). The lower portion of Drainage #8, just upstream of Gardner Falls, is composed of bedrock and boulder bed, with banks of either bedrock or shallow soils overlying bedrock.

Areas dominated by bedrock and boulders have limited vegetation, with red willows and small patches of naked sedge or stream orchid (*Epipactis gigantea*) occurring in crevices between boulders. Alternating areas with soils support lush herbaceous vegetation with narrow-leaf milkweed (*Asclepias fasicularis*), Deptford pink (*Dianthus armeria*), stream orchid, and naked sedge. Spicebush and red willow occur with the forbs, becoming dense near the wetted edge. The alternating pattern of substrates and patchiness within each type of substrate provide complex horizontal stratification, although the vertical stratification is typically limited to two overlapping layers of herbs and shrubs. One ESA-listed plant, California vervain, was identified within this wetland.

Drainage #8 exhibits three distinct habitats, defined by gradient and substrates that determine the potential of each area. The upper portion of Drainage #8 has a steep gradient composed exclusively of bedrock and boulders. A series of falls, plunge-pools, chutes, and sheets form the channel, with intermittent red willows, spicebush, and California buckeyes occurring at the channel edge and in areas where sediment is present. Drainage #8 opens to Don Pedro Reservoir at Gardner Falls, a waterfall over a bedrock cliff. The lower portion of drainage #8 is low gradient, and supports multiple vertical layers of vegetation, including sediment retaining herbs and graminoids, mid-layers of spicebush and red willows, and a taller layer of California buckeye. The waterfall area supports little vegetation, although California buckeye and California wild grape were both observed.

Two CRAM assessments were performed at Drainage #8 to reflect the differences in the geomorphic and vegetative characteristics of the channel. The lower portion, just upstream of Gardner Falls, received a CRAM Overall Attribute Score of 91. The score indicates that the wetland does not experience stressors from upland or hydrologic sources and provides a multitude of wetland benefits.

The upstream portion of Drainage #8 is steeper and is almost exclusively composed of bedrock or boulder substrate; it received a CRAM Overall Attribute Score of 73. The score indicates the wetland experiences few stressors from upland or hydrologic sources and provides some wetland services, although the bedrock bed and steep gradient banks limit the vegetative capacity of the wetland.

3.6.1.4 Noxious Weeds

In 2012, a noxious weed survey was conducted addressing those lands potentially affected by O&M and recreational use, and adjacent lands as specified in the Noxious Weed Study Plan. The study area covered approximately 3,870 ac. For the purpose of the study, noxious weeds were defined as those species meeting one or more of the following criteria:

- listed as "noxious" under the Federal Plant Protection Act (FPPA);
- listed as "noxious" and with a pest rating of A, B or C by the CDFA; or
- listed as a Target Species in the Districts' Noxious Weed Survey study plan.

This effort identified twelve noxious weed species in the study area (Table 3.6-4). These species were distributed in 623 geographically distinct occurrences; however, one species (Italian thistle [*Carduus pychnocephalus*]) was considered ubiquitous such that individual occurrences were not mapped. Each of the species located is listed by the CDFA: eight are C-listed species considered widespread and generally not warranting management, and four are CDFA B-listed, indicating management efforts may be warranted in some instances. Table 3.6-4 summarizes noxious weed occurrences by land ownership.

Table 3.6-4. Noxious weeds/invasive plant occurrences identified in the study area.

Common Name/ Scientific Name	2013 CDFA[1] Rating	No. of Occurrences by Land Ownership	
		Districts/Private Lands	Public (BLM)
Barbed goatgrass *Aegilops triuncialis*	B	1	4
Tree-of-heaven *Ailanthus altissima*	C	4	3
Giant reed *Arundo donax*	B	--	1

Common Name/ Scientific Name	2013 CDFA[1] Rating	No. of Occurrences by Land Ownership	
		Districts/Private Lands	Public (BLM)
Italian thistle *Carduus pychnocephalus*	C	n/a	n/a
Smooth distaff thistle *Carthamus creticus*	B	9	6
Yellow starthistle *Centaurea solstitialis*	C	21	17
Bermudagrass *Cynodon dactylon*	C	57	19
Medusahead grass *Elymus caput-medusae*	C	293	24
Klamathweed *Hypericum perforatum*	C	147	11
Russian thistle *Salsola tragus*	C	2	--
Tamarisk *Tamarix* sp.	B	1	--
Puncturevine *Tribulus terrestris*	C	3	--
	Total	**538**	**85**

[1] California Department of Food and Agriculture (CDFA) Rating:
A = Eradication, containment, rejection, or other holding action at the state-county level. Quarantine interceptions to be rejected or treated at any point in the state.
B = Eradication, containment, control, or other holding action at the discretion of the commissioner. State endorsed holding action and eradication only when found in a nursery.
C = Action to retard spread outside of nurseries at the discretion of the commissioner; reject only when found in a crop seed for planting or at the discretion of the commissioner (CDFA 2010).

Noxious weeds are common throughout the study area and Project Boundary, occurring in most habitat types. The most widespread and common weed was Italian thistle, which occurred in all habitat types (including the gabbro soils of the Red Hills ACEC). Bermudagrass was also common, occurring in a discontinuous band around Don Pedro Reservoir just below the normal maximum surface elevation, as well as at an additional 76 occurrences within the study area. Other frequently located weeds included medusahead grass (*Elymus caput-medusae*), with 317 occurrences, and Klamathweed (*Hypericum perforatum*), with 158 occurrences. Yellow starthistle (*Centaurea solstitialis*) was the fifth most common weed located in the study area, with 38 occurrences. Among all the noxious weed occurrences, eight species were observed in 85 occurrences on public land administered by the BLM.

3.6.1.4.1 Barbed Goatgrass

Five occurrences of barbed goatgrass (*Aegilops triuncialis*) were surveyed at three locations: four occurrences on public land administered by the BLM (two at Sixbit Gulch and two at Poor Man's Gulch) directly adjacent to Red Hills ACEC, and one occurrence on Districts' land above Recreation Bay. Over 10,000 stems were estimated in these occurrences, primarily in Sixbit and Poor Man's gulches. The estimated area of the combined occurrences is approximately 21.6 ac.

3.6.1.4.2 Tree-of-heaven

Tree-of-heaven (*Ailanthus altissima*) were found at three locations: one occurrence on Districts' land at Fleming Meadows Point, three on TID/MID and private land at Shawmut Road and three on public land administered by the BLM below Don Pedro Dam and the powerhouse. Nearly 150 trees were counted at these occurrences. The estimated area of the combined occurrences was less than an acre.

3.6.1.4.3 Giant Reed

Giant reed (*Arundo donax*) was found at one location within the study area, on public land administered by the BLM at a turn along the Don Pedro powerhouse access road. There were over 500 plants growing in an area of approximately 0.1 ac.

3.6.1.4.4 Italian Thistle

Italian thistle is prevalent throughout the Project Boundary, particularly in the annual grasslands and blue oak woodlands of Don Pedro Reservoir. Italian thistle was found in denser patches in shady areas and wet drainages, but also grew in more diffuse occurrences in sunny grasslands and on exposed slopes. The only areas where Italian thistle was less common were the Red Hills ACEC and dense areas of chamise. There were hundreds of thousands of plants covering many acres through the study area.

3.6.1.4.5 Smooth Distaff Thistle

Smooth distaff (*Carthamus creticus*) thistle was found at 15 locations: six occurrences on public land administered by the BLM and nine occurrences on Districts' lands. Of these occurrences, five were on Kanaka Point (BLM), one was on Jacksonville Road, one was on Harney Road, seven were in Moccasin Point Recreation Area, and one was on Woods Creek Arm below the normal maximum surface elevation. Approximately 1,600 plants were counted over a combined area of nearly 2 ac.

3.6.1.4.6 Yellow Starthistle

Yellow starthistle was found at a total of 38 locations; there were four occurrences near the Grizzly Road area, two at the Highway 49 bridge, five occurrences at multiple locations along Jacksonville Road, four within or near Kanaka Point, 19 within or near Moccasin Point Recreation Area and single occurrences at Poor Man's Creek, Shawmut Road, Wood's Creek Arm, and within the Moccasin Transmission Line area. Seventeen of these occurrences were located on public land administered by BLM (nine in the Moccasin Point Recreation Area, one at Kanaka Point, two in the Grizzly Road area, two in the area of Jacksonville Road, one in the Moccasin transmission line area, and one each at Poor Man's Creek and the Kanaka Creek area), while the rest (21) were located on Districts' or private lands. Tens of thousands of individual plants were observed in these occurrences, which were estimated to cover over 20 ac.

3.6.1.4.7 Bermudagrass

Bermudagrass was found growing in a thin, discontinuous band below the normal maximum water surface elevation mark of Don Pedro Reservoir. An additional 76 occurrences at other locations were documented within the study area. The majority of these additional occurrences were in disturbed areas within recreation sites and along roadways. Nineteen of these occurrences were located on public land administered by the BLM (one at the Grizzly Road area, five near Don Pedro powerhouse access road, two at Kanaka Point, three in the area of Jacksonville Road, one at Moccasin Point Recreation area, four in the Moccasin Transmission Line area, and one each at Poor Man's Creek, Sixbit Gulch and Don Pedro Bar), while the rest (58) were located on Districts' or private lands. The 76 occurrences not growing below the reservoir normal maximum surface elevation were estimated to contain over 50,000 stems on around 20 ac.

3.6.1.4.8 Medusahead Grass

Medusahead grass was found at 19 locations with a total of 317 occurrences; this plant was found mostly in large, diffuse patches within annual grasslands. Twenty-four of the occurrences were located on public land administered by the BLM (two in the Moccasin Recreation Area, 17 near Don Pedro powerhouse access road area, one at Don Pedro Bar, and five in the Blue Oaks Recreation Area), and the majority (293) were on TID/MID and private lands. Hundreds of thousands of plants were observed.

3.6.1.4.9 Klamathweed

Klamathweed was found at 13 locations with a total of 158 occurrences. Eleven of the occurrences were located on public land administered by the BLM (two at Moccasin Point Recreation Area, two in the Grizzly Road area, one at Jacksonville Road, one at Ward's Ferry Bridge, two in the Ramos Creek area, two at Don Pedro Bar, and one near the Don Pedro powerhouse access road), while the rest (147) occupied TID/MID or private lands. Over 100,000 plants were observed.

3.6.1.4.10 Russian Thistle

Russian thistle (*Salsola tragus*) was found at two locations: one occurrence on Districts' land in the DPRA staff housing area and one occurrence on TID/MID land within the Blue Oaks Campground. The occurrences covered less than 0.1 ac and contained about 35 plants.

3.6.1.4.11 Tamarisk

Tamarisk (*Tamarix* sp.) was found at one location. Ten plants were located on TID/MID land adjacent to a restroom facility within the Moccasin Point Recreation Area. The occurrence was approximately 0.1 ac in size.

3.6.1.4.12 Puncturevine

Three occurrences of puncturevine (*Tribulus terrestris*) were found on TID/MID lands within Fleming Meadows Recreation Area. All occurrences were found along the paved road to the marina and contained around 50 plants. The estimated area of the combined occurrences was approximately 0.02 ac.

3.6.2 Resource Effects

Page 36 of FERC's SD2 specifically identifies the following potential issues associated with botanical resources:

- *Potential effects of project operation, including water level fluctuations, ground-disturbing activities, and maintenance on special-status plant species and botanical resources.*
- *Potential effects of project operation, including recreation, water level fluctuations, ground-disturbing activities, and maintenance on the presence and spread of noxious weeds, including yellow starthistle.*
- *Effects of project operation, including water level fluctuations, ground-disturbing activities, and maintenance activities on wetland, riparian, cottonwood and willow, and littoral vegetation communities.*
- *Effects of maintenance and use of project recreation facilities by recreationists on special-status plant species and botanical resources, and shoreline vegetation.*
- *Effects of vegetation clearing for project maintenance on botanical resources, and the presence and spread of noxious weeds.*

Each of these potential effects of the Don Pedro Project[22] is analyzed below.

3.6.2.1 Special-Status Plants

Of more than 700 plant species identified during botanical surveys, a total of 58 occurrences of eight special-status plant species were located within the Project Boundary. Each is listed by the BLM as Sensitive. For the majority of these occurrences, noxious weeds and private grazing activities were the only stressors identified. Over half of the occurrences of special-status plants were located with noxious weed occurrences, many in areas geographically removed from any O&M activity where evidence of private grazing was observed. In general, lands with evidence

[22] The Proposed Action covered in this application is the Districts' proposal to continue hydroelectric generation at the Don Pedro Project. While reservoir water level fluctuations have the potential to affect botanical resources, the water level fluctuations of the Don Pedro Reservoir are due to operations for the purposes of water supply and flood control. Hydroelectric project operations are dependent upon water released for these purposes; therefore, reservoir water level fluctuations are not the result of hydroelectric operations. The effect of the Proposed Action has no measurable impact on reservoir water level fluctuations. During relicensing of the Don Pedro Hydroelectric Project, the Districts undertook comprehensive investigations of the botanical resources associated with the Don Pedro Project within the study area identified in the study plan. The Districts intend to address effects to botanical resources of Don Pedro Project operations within the Draft Vegetation Management Plan.

of substantial grazing were observed to have some of the highest concentrations of noxious weed occurrences. Both grazing and noxious weed occurrence may affect the health, distribution, or abundance of special-status plants, and may have compounded impacts where they occur in tandem.

Three instances of routine maintenance activities were observed with the potential to affect special-status plants, based on their proximity to the occurrences: (1) road maintenance (one occurrence of Red Hills onion and six occurrences of Mariposa clarkia); (2) a storage area, where a special-status plant occurrence is growing among stored equipment (one occurrence of Mariposa cryptantha); and (3) a burn pile associated with woody debris removal and disposal (one occurrence of Mariposa clarkia). Although these special-status plant occurrences are not currently affected by these maintenance activities, future activities associated with maintenance or use of these areas could stress or physically cause damage to (e.g., trampling) individual special-status plants or the entire occurrence.

Six occurrences of special-status plants were located in areas where they could be affected by recreation near developed recreation areas (two Red Hills onion, two Mariposa clarkia, and two Mariposa cryptantha). Potential threats presented by recreation activities include trampling or soil disturbance, and the associated spread of noxious weeds. Additionally, portions of seven special-status plant occurrences of five species are located near or below normal maximum water surface elevation; for each, this represented the outside boundary of the occurrence. These plants are not adversely affected by current operations

3.6.2.2 Wetland and Riparian Habitats

Wetland and riparian habitats are uncommon within the Project Boundary. The bulk of Don Pedro Reservoir is steep-sided, with upland grass or shrub habitats directly adjacent to the reservoir margin. Periodically exposed areas below the normal maximum surface elevation are sparsely vegetated or bare. Wetlands that do occur are generally in valleys that drain into Don Pedro Reservoir from surrounding hillslopes. These wetlands each sustain hydrophytic vegetation that is influenced primarily by the channel gradient, substrate, and flow duration, rather than operations. Wetland conditions in these drainages begin at above the normal maximum surface elevation of Don Pedro Reservoir, and continue upstream (often well beyond the Project Boundary) where conditions allow. No wetland conditions below the Reservoir normal maximum surface elevation were observed during study efforts, and no water backs up into wetlands as a result of operations. As a result, operations and Don Pedro Reservoir fluctuations do not affect wetland systems, each of which was documented by CRAM assessments as providing wetland services at or near its overall potential, with few upstream or downstream stressors.

One wetland, at Big Creek, occurs in a swale downslope of Fleming Meadows Recreation Area, and appears created by drainage from a settling pond and a swimming lagoon. The wetland is not hydrologically associated with Don Pedro Reservoir. It has no defined channel but supports hydrophytic vegetation and hydric soils throughout; wetland services provided by the Big Creek wetland are limited but present. The area shows signs of substantial anthropogenic disturbance, including grazing and vehicle use. While the Big Creek wetland appears to be created by Don

Pedro facilities and contained within the Project Boundary, these anthropogenic uses appear to be the primary drivers of habitat quality.

No facilities, access roads, recreational use, or O&M activities occur in any of the other wetlands examined. Additionally, the wetlands support few noxious weed occurrences, these generally represented by upland species at the wetland margin. The most prevalent non-native plants observed in wetlands were Himalayan blackberry and wooly mullein, neither of which is listed as a noxious weed. Study efforts identified cattle grazing, noxious weeds, and human use as the primary potential causes for stress on wetland habitats associated with Don Pedro Reservoir. These disturbances are not associated with the Don Pedro Project.

3.6.2.3 Noxious Weeds

Botanical surveys documented twelve noxious weed species in 636 occurrences (one species, Italian thistle, was not mapped into individual occurrences due to its ubiquitous distribution). Of the 12 species, four are CDFA B-listed: barbed goatgrass, giant reed, smooth distaff thistle and tamarisk. CDFA B-listed weeds are usually subject to eradication on BLM lands and can be subject to eradication on all lands (CDFA 2010). Of the 22 occurrences of CDFA B-listed weeds, 11 of them occurred on BLM lands. This included four occurrences of barbed goatgrass in and two occurrences of distaff thistle directly adjacent to the Red Hills ACEC.

Nearly 100 occurrences of noxious weeds along or in roads within the study area were documented. Distaff thistle (CDFA B-listed) was observed at one location on Jacksonville Road and one location on Harney Road. The most common weeds associated with roads were Bermudagrass, medusahead grass, and Klamathweed. Roads within the Project Boundary are generally managed by Tuolumne County. However, roads in and along the Fleming Meadows, Blue Oaks, and Moccasin Point Recreation Areas, which are managed by the Districts, also supported substantial numbers of noxious weeds. These roads, and all lands associated with developed recreation facilities within the Project Boundary, are subject to periodic noxious weed management efforts using herbicides or mechanical methods.

Nearly 150 occurrences of noxious weeds were mapped within developed recreation areas. Recreationists frequently cause disturbances to vegetation and soils through normal use of an area which can facilitate noxious weed colonization. Additionally, recreationists carry seeds and plant parts on their clothing, vehicles, and other equipment, potentially facilitating noxious weed dispersal (CDFA 2012). Seven of the 15 occurrences of distaff thistle (CDFA B-listed) were located in areas of high recreation use, such as Moccasin Point Recreation Area and Kanaka Point. Additionally, the one occurrence of tamarisk (CDFA B-listed) was found in the Moccasin Point Recreation Area and appeared to have been planted adjacent to a restroom facility. The majority of yellow starthistle (CDFA C-listed) occurrences were also located in developed recreation areas.

Numerous occurrences of noxious weeds in areas subject to cattle grazing were identified, though most occurrences were found on lands not associated with the four existing TID/MID grazing permits. Cattle can spread noxious weeds via transport on their hooves, hair or skin, and in their digestive tracts, and ground disturbance and overgrazing caused by cattle can also open areas to invasion by noxious weeds (CDFA 2012). The most common noxious weeds found in grazed areas were medusahead grass, Bermudagrass and Klamathweed (all CDFA C-listed). Additionally, one occurrence of barbed goatgrass (CDFA-B listed) was found on Recreation Bay in a grazed area not associated with the Districts' four grazing permits.

Nineteen occurrences of noxious weeds were observed below the normal maximum water surface elevation of Don Pedro Reservoir, including four occurrences of distaff thistle. Operations restrict the development of most vegetation below the Reservoir normal maximum surface elevation, potentially providing a favorable environment for these species. Additionally, because distaff thistle and other noxious weed seeds may be dispersed by water, these occurrences may disperse to adjacent or downstream areas. Propagules of barbed goatgrass, tree-of-heaven, giant reed, smooth distaff thistle, Bermudagrass, medusahead grass, Klamathweed, and tamarisk can similarly be transported by water (CDFA 2012).

A variety of other routine maintenance activities (e.g., grading, mowing, and vegetation management) were also found to occur within or near noxious weed occurrences. Ten occurrences of noxious weeds were located in areas of grading, five were found in waste or storage areas, and 19 were located in areas that were mowed. Although the genesis of these occurrences is undetermined, the overlap of O&M and existing weeds may facilitate the potential for weed dispersal or establishment.

Each of the noxious weeds located is common throughout the Central Valley and California as a whole, and their distributions are generally reflective of region-scale biotic invasions combined with local land use patterns. Study efforts documented multiple contributing factors related to the distribution and abundance of noxious weeds within the Project Boundary.

3.6.3 Proposed Resource Measures

The Districts propose to develop and implement a Vegetation Management Plan to guide noxious weed and other vegetation management activities within the Project Boundary during the term of a new license (Appendix E-1). Components of the plan include best management practices to limit the spread of existing noxious weed occurrences or the establishment of new occurrences, special-status plant monitoring, employee training, and agency consultation. The implementation of the Vegetation Management Plan is expected to protect and enhance botanical resources within the Project Boundary.

3.6.4 Unavoidable Adverse Impacts

There are no unavoidable adverse impacts affecting botanical resources associated with the Don Pedro Project.

3.7 Wildlife Resources

This discussion of wildlife resources is divided into three subsections: (1) general information and context for wildlife resources in the Don Pedro Project vicinity; (2) a description of available information on individual wildlife species, including special-status species that potentially occur in the Project Boundary or were the subject of study efforts; and (3) analysis of Don Pedro Project effects on wildlife resources. Information on species listed under the ESA and CESA is presented separately, in Section 3.8 of this Exhibit E.

The PAD provided existing information on wildlife resources, including special-status species that are known to occur or have the potential to occur in the Don Pedro Project vicinity (TID/MID 2011). Additionally, the Districts' consultation with stakeholders resulted in the development and implementation of three studies covering 14 special-status wildlife species in order to address wildlife resource issues identified during consultation and in FERC's SD2.

Existing information and the results of 2012 wildlife resource studies are presented below, including results from the following relicensing studies:

- Special-Status Amphibians and Aquatic Reptiles Study (TR-06),
- Bald Eagle Study (TR-10), and
- Special-Status Wildlife – Bats Study (TR-09).

3.7.1 Existing Environment

3.7.1.1 Wildlife Habitats and Setting

The Don Pedro Project is situated in the foothills of the west slope of California's Sierra Nevada. The Project Boundary encompasses over 5,538 acres of terrestrial wildlife habitats, dominated by blue oak (*Quercus douglasii*) woodlands and open annual grass-forb vegetation, and substantial components of shrub-dominated chaparral. Wetland and riparian habitats are uncommon; the bulk of Don Pedro Reservoir shoreline is steep-sided, with upland plant communities adjacent to the reservoir margin. Areas below the normal maximum surface elevation that are periodically exposed are sparsely vegetated or bare. The majority of terrestrial habitats within the Project Boundary are unmanaged and geographically removed from any Don Pedro Project activity. O&M activities, including local vegetation management efforts, are restricted to facilities and the Districts' three recreation areas.

Don Pedro Reservoir consists of two distinct morphological sections. The narrow, upstream portion of the reservoir occupies the steep-sided, rocky and winding Tuolumne River canyon. The downstream portion of the reservoir fills the gentler-sloped canyon where the Tuolumne River emerges into the low Sierra foothills and then into the wider Tuolumne River valley. The foothills area in this portion of the watershed is dominated by gently rolling grasslands and agricultural areas.

Don Pedro Reservoir itself is characterized by perennial, deep, slow-moving, open water and steep poorly vegetated banks. Wetland and riparian habitats are uncommon; shallow areas and areas of emergent vegetation are primarily associated with tributary mouths. Fishing is a common recreation activity; CDFW manages the Don Pedro Reservoir fishery as a put-and-grow resource with substantial stocking.

In 2011, wildlife habitats within the Project Boundary were classified using CDFW's California Wildlife Habitat Relationship (CWHR) system (deBecker and Sweet 2005; CDFG 2008). The dominant CWHR habitat type within the Project Boundary is Lacustrine, representing Don Pedro Reservoir, while the dominant terrestrial CWHR habitat types are Blue Oak Woodland and Annual Grasslands (Table 3.7-1) (TID/MID 2011).

Table 3.7-1. CWHR wildlife habitat types within the Project Boundary and their equivalent CalVeg community types.

California WHR[1]	CalVeg Community Types[2]	Acres	%
Annual Grasslands (AGS)	Annual Grasses and Forbs	2,280.5	12.4
Barren (BAR)	Barren	549.7	3.0
Blue Oak Woodland (BOW)	Blue Oak, Interior Live Oak	3,504.6	19.1
Montane Hardwood (MHW)	Canyon Live Oak	0.2	0.0
Chamise-Redshank Chaparral (CRC)	Chamise	542.2	3.0
Douglas-Fir (DFR)	Douglas-Fir-Ponderosa Pine	5.2	0.0
Blue Oak-Foothill Pine	Gray Pine	447.5	2.4
Montane Hardwood (MHW)	Interior Mixed Hardwood	0.6	0.0
Mixed Chaparral (MCH)	Lower Montane Mixed Chaparral	277	1.5
Lacustrine (LAC)	Water (General)	10,762.6	58.6
	Total	**18,370.1**	**100**

[1] Source: deBecker and Sweet 2005; CDFG 2008.
[2] Source: USFS 2009. See Section 3.6 for CalVeg community type descriptions

In addition to classifying wildlife habitat, the CWHR model predicts wildlife presence and use based on habitat type, age class, size class, canopy closure or cover, and occurrence of specific habitat elements (e.g., natural or manmade features such as cliffs, springs, or transmission lines). For the habitat types and elements identified within the Project Boundary, a total of 339 terrestrial vertebrate wildlife species are predicted to have the potential to occur. Of these species, CDFW's CNDDB includes records for a total of five special-status vertebrates[23] from within quadrangles occupied by the Project Boundary (CDFW 2013a):

- Western pond turtle (WPT) (*Actinemys* [*Emys*] [formerly *Clemmys*] *marmorata*),
- Foothill yellow-legged frog (FYLF) (*Rana boylii*),
- Bald eagle (*Haliaeetus leucocephalus*),
- Sierra Nevada yellow-legged frog (*Rana sierrae*), and
- Coast horned lizard (*Phrynosoma blainvillii*).

Sierra Nevada yellow-legged frog is not considered further here, as it is restricted to elevations generally above 6000 ft mean sea level (msl), well above those present in the Project Boundary (International Union for the Conservation of Nature [IUCN] 2013).

Additionally, the coast horned lizard is not known to occur in the Project Boundary; only one record exists in the vicinity, and it is more than four miles from the Project Boundary. Because

[23] A special-status wildlife species is a species that has a reasonable possibility of occurring in the Project vicinity on lands managed by the BLM and listed on the *California - BLM Animal Sensitive Species List, Updated September 2006* (BLM 2006). With the exception of Bald Eagle, addressed herein, species listed by CDFW under the CESA or as Fully Protected are addressed in Section 3.8.

there is limited potential for the O&M to affect this species, coast horned lizard is not considered further here.

In its SD2, FERC indicated its environmental review will evaluate the effects of the Don Pedro Project on special-status wildlife, including the following species:

- WPT (*Actinemys* [*Emys*] [formerly *Clemmys*] *marmorata*),
- FYLF (*Rana boylii*),
- Swainson's hawk (*Buteo swainsoni*),
- Bald eagle (*Haliaeetus leucocephalus*),
- Osprey (*Pandion haliaetus*), and
- Special-status bats.

Each of these species is addressed below. Additionally, discussion is included of one species not included in CNDDB records, Golden eagle (*Aquila chrysaetos canadensis*), but that has been observed in the vicinity.

3.7.1.2 Western Pond Turtle

Western pond turtle (WPT) surveys and evaluations were conducted in 2012 in an area consisting of: (1) suitable aquatic habitats within the Project Boundary within 0.5 miles from the normal maximum water surface elevation of Don Pedro Reservoir, including accessible sections of the Tuolumne River up to RM 79, and (2) tributaries up to 1.0 mi upstream of the reservoir (TID/MID 2013a).

WPT is listed as a Sensitive species by the BLM. There are two known records of WPT within the study area (Cranston 2012), with additional records just outside the FERC-approved study area. Additional WPT occurrences further outside the study area (e.g., reservoirs in Mariposa County) are also known (CDFW 2012).

WPT is a habitat generalist occurring in a wide variety of aquatic habitats up to about 6,000 ft elevation, particularly permanent ponds, lakes, side channels, backwaters, and pools of streams. WPT is uncommon in high-gradient streams (Jennings and Hayes 1994). To attain suitable body temperature ("thermoregulate"), individuals engage in basking behavior. Basking sites are an important habitat element (Jennings and Hayes 1994) and substrates include emergent and/or floating LWD, overhanging vegetation, rock outcrops, mats of submergent vegetation, mud banks, rocks, logs, and root wads on banks (Ashton et al. 1997).

As part of the 2012 study, an initial desktop assessment of WPT habitat was performed within the study area. Field habitat assessment locations and basking survey site locations were determined based on this assessment and property access. A total of 15 non-reservoir and 29 reservoir sites were assessed for essential WPT habitat characteristics such as basking substrate, depth, hydrology, bank habitat, vegetation, and exposure. Basking surveys were conducted at both reservoir and non-reservoir locations. Basking surveys sites on the reservoir were chosen based on the presence of suitable basking habitat and were diversified to represent each geographic area of the reservoir. Non-reservoir basking survey sites were selected based on the presence of suitable WPT habitat, including open water over one meter deep and suitable aquatic and terrestrial refugia. Potential WPT nesting habitat within 100 m of the reservoir and other water bodies associated with the Don Pedro Project was mapped in GIS according to available data on nesting habitat suitability criteria (slope of two to 15 degrees and southeast, south, or southwest aspect).

WPT basking surveys were conducted at five non-reservoir sites and eight reservoir sites. Six WPT were observed during basking surveys; one WPT was observed at a non-reservoir site and five WPT were observed at four reservoir sites. Within the reservoir, WPT were only observed at sites that were located in narrower coves.

An additional 10 WPT (eight live and two dead) were observed incidentally during the performance of the relicensing studies. Of the 10 locations where WPT were incidentally observed, six were within Don Pedro Reservoir or on the shoreline, one was noted in a pool in the Don Pedro spillway channel, and three were noted in a tributary to Don Pedro Reservoir.

Reviews of aerial imagery and field reconnaissance indicate potential suitable habitats for WPT are largely concentrated in backwater inlets, typically associated with seasonal or perennial tributary streams where shallower water occurs. In many areas, the only potential basking substrate was along steep banks. Partially submerged woody debris and cut stumps were rarely observed on aerial imagery but were observed in some locations during field reconnaissance. Boulders and bedrock outcrops were also identified as potential basking sites and were most numerous when the water surface elevation of Don Pedro Reservoir was low. At high water, partly submerged shoreline vegetation may provide basking habitat.

The Project Boundary has a limited availability of terrestrial areas suitable for WPT oviposition, aquatic habitats suitable for hatchlings (i.e., warm, shallow water with ample hiding cover in the form of dense submergent or short emergent vegetation), and basking sites for juveniles and adults. Don Pedro Reservoir is a large, deep reservoir, with mostly steep slopes and open expanses of water that rarely support WPT. Site assessments documented sparse to abundant amounts of emergent vegetation in areas associated with tributary mouths; however, most of the shoreline of Don Pedro Reservoir consists of steep poorly vegetated banks. In areas upstream of the reservoir, surveyors observed few areas of submerged or emergent vegetation. Some tributaries with low to moderate slope gradients and suitable water depths have the potential to support WPT, including West Fork Big Creek, Big Creek, Six-Bit Gulch, Poor Man's Gulch, Woods Creek, Sullivan Creek, Blue Gulch, Smarts Gulch, and Rough and Ready Creek.

Potential WPT nesting habitat is common within the study area based on aspect, slope, and distance-to-water criteria. No WPT nests were observed.

3.7.1.3 Foothill Yellow-Legged Frog

Foothill yellow-legged frog (FYLF) surveys and evaluations were conducted in 2012 in an area consisting of: (1) suitable aquatic habitats within the Project Boundary within 0.5 mi from the normal maximum water surface elevation of Don Pedro Reservoir, including accessible sections of the Tuolumne River up to RM 79, and (2) tributaries up to 1.0 mi upstream of the reservoir (TID/MID 2013a).

FYLF is a stream-adapted species usually found in streams with backwater habitats and coarse substrates (Seltenrich and Pool 2002) that occur between approximately 600 to 5,000 ft in elevation (Moyle 1973; Seltenrich and Pool 2002; ECORP Consulting, Inc. 2005). Populations of FYLF persist on at least some portions of most drainages with known historical occurrences (NatureServe 2009). FYLF populations may require both mainstem and tributary habitats for long-term persistence. Streams too small to provide breeding habitat for this species may be critical as seasonal habitats, such as in winter and during the hottest part of the summer (VanWagner 1996). There is also evidence that habitat use by young-of-the-year, sub-adult, and adult frogs differs by age-class and can change seasonally (Randall 1997). Breeding tends to occur in spring or early summer. Eggs are laid in areas of shallow, slow moving waters near the shore. FYLF are less abundant in habitats where introduced fish and bullfrogs are present (Jennings and Hayes 1994).

FYLF is listed as Sensitive by the BLM. Two historic occurrences of FYLF are known from the study area (Cranston 2012). FYLF are known to occur more than three miles upstream of the Project Boundary in Moccasin Creek and Mountain Pass Creek. Additionally, FYLF were observed in Hatch Creek, upstream of the Project Boundary, in 1970 (TID/MID 2011).

As part of 2012 studies, desktop FYLF habitat assessments were conducted at twenty locations along perennial streams within in the study area. Based on potential habitat identified during desktop assessments and property access, 17 of those locations were assessed for FYLF habitat in the field. FYLF visual encounter surveys (VES) were performed at five tributary sites: Six-Bit Gulch, Poor Man's Gulch, Woods Creek, Moccasin Creek, and Drainage #8 (an unnamed tributary of Don Pedro Reservoir at Gardiner Falls). No FYLF were observed at any VES sites during surveys. No FYLF were incidentally observed during the course of other relicensing studies. Suitable FYLF breeding habitat was scarce. Additionally, bullfrogs were observed throughout the Don Pedro Project vicinity, including at three FYLF VES sites (Six-Bit Gulch, Poor Man's Gulch, and Woods Creek). Crayfish were also found throughout the vicinity. Predatory fish species have been documented in each of the tributaries surveyed for FYLF (BLM 1980).

Don Pedro Reservoir is characterized by perennial, deep, slow-moving water and steep, poorly vegetated banks. Tributaries to the reservoir have limited aquatic habitat suitable for oviposition and larval development (i.e., shallow, flowing water with at least some cobble-sized substrate). American bullfrog and a variety of introduced predatory fish are present, limiting the suitability of the habitat for FYLF. No surveyed tributaries to Don Pedro Reservoir were found to support FYLF or suitable habitat for FYLF. Therefore, Don Pedro Reservoir does not provide potential habitat for FYLF.

3.7.1.4 Bald Eagle

Bald eagle surveys were conducted in 2012 and 2013 on a study area consisting of a 1,000 ft area around the entirety of Don Pedro Reservoir and facilities, including those accessible portions of the Tuolumne River that are within the Project Boundary (TID/MID 2013b).

Bald eagle was listed by the USFWS as an endangered species in 1978, primarily due to population declines related to habitat loss and contamination of prey species by past use of organochlorine pesticides, such as dichlorodiphenyltrichloroethane (DDT) and dieldrin (USFWS 2007). On August 11, 1995, the bald eagle's federal status was changed to "threatened" in all lower 48 states. The USFWS delisted the bald eagle on August 9, 2007 (72 FR 37346). Although delisted with the USFWS, the bald eagle was listed by CDFG as a California endangered species on June 27, 1971, and is fully protected in wintering and nesting habitat. Additionally, the bald eagle is protected by the federal Bald and Golden Eagle Protection Act, enforced by the USFWS.

Bald eagle breeds and winters throughout most of California, except for desert areas (CDFG 2000). Most breeding in the state occurs in the northern Sierra Nevada, Cascades, and North Coast Ranges, and is expanding into the central and southern Sierra Nevada and Sierra Nevada foothills. California's bald eagle breeding population is resident year-round in most areas where the climate is relatively mild (Jurek 1988). Between mid-October and December, migratory birds from areas north and northeast of California arrive in the state. Wintering populations remain through March or early April.

In general, bald eagle foraging habitat consists of large bodies of water or free-flowing rivers with abundant fish and adjacent snags and other perches (USFWS 2007). Breeding bald eagles are typically found in reservoirs in the northern Sierra Nevada, Cascades, and north Coast Ranges. While Don Pedro Reservoir is located in the central Sierra Nevada foothills, outside of what is thought to be the historic breeding range for bald eagles in California (i.e., northern Sierra Nevada, Cascades and north Coast Ranges), occupied nests are a strong indicator that the reservoir possess suitable nesting sites. Bald eagles typically nest in large trees with open branching, and within two mi of a lake, reservoir, or river inhabited by fish. Most nesting territories in California are located in elevations ranging from 1,000 to 6,000 ft; however, nesting can occur from near sea level to over 7,000 ft (Jurek 1988). Nest trees typically provide an unobstructed view of the associated water body and are often prominently located on the topography. Bald eagles often construct up to five nests within a territory and alternate among them from year to year.

Nine bald eagle nests were located during surveys of the Don Pedro Project in 2012, three of which were occupied by nesting bald eagle pairs. Three nests were found in Woods Creek Arm, and one nest was found at each of the following locations: Upper Bay, Big Creek Arm, Mine Island, Jenkins Hill, South Bay, and Tuolumne River Arm. Of these, two nests (one at Mine Island and one at Woods Creek Arm) successfully produced bald eagle nestlings that were observed during the second 2012 survey. Because these nestlings were not observed through fledging, both of these nests were categorized as Occupied, Success Unknown. A third nest (at South Bay) was occupied by a bald eagle pair during the first survey, but no adult bald eagles or nestlings were located during the second survey. This nest was categorized as Occupied, Not Successful. The remaining six nests were categorized as Not Occupied; these nests likely serve as alternate nests to the three occupied nests located in 2012.

Ten bald eagle nests were found during surveys in 2013. Two of these nests, Mine Island nest and Woods Creek Arm No. 1, were occupied in 2013. Both of these nests were also occupied in 2012. Nestlings were present at both of these nests. The single nestling at the Woods Creek Arm nest likely fledged prior to the second survey visit. The two nestlings at the Mine Island nest had also fledged. Both nests were categorized as Occupied, Successful.

Incidental sightings of bald eagles were also recorded as part of other 2012 and 2013 relicensing studies. Twenty-one incidental sightings of bald eagles were recorded during relicensing studies in 2012. Eight incidental observations of nine bald eagles were made in the study area during the two survey visits in 2013. Sightings included both adult and juvenile bald eagles either perched, feeding near the reservoir bank, or in flight. Incidental sightings of bald eagles from 2012 are shown in Table 3.7-2, and incidental sightings of eagles from 2013 are shown in Table 3.7-3. Additionally, the BLM reported an incidental observation from June 12, 2013 of a juvenile bald eagle perched in a tree with a nest, and a second bald eagle in flight near the nest (Cranston 2013). The observation was upstream of the Ward's Ferry Bridge on the Tuolumne River.

Table 3.7-2. Results of incidental bald eagle sightings on Don Pedro Reservoir in 2012.

Date	No. of Bald Eagles	Location	UTM-N	UTM-E	Activity/Observation[1]	Perch Type
1/26/2012	1	Blue Oaks Recreation Area	--	--	perched	--
2/10/2012	2	Woods Creek Arm	4195114	727510	adults – nesting	--
2/10/2012	1	Hatch Creek Arm	4180762	732779	juvenile – perched	--
3/7/2012	1	Blue Oaks Boat Launch	--	--	perched	--
3/7/2012	1	Mine Island	4178397	729669	adult – perched	--
3/19/2012	2	Don Pedro Recreation Agency Headquarters	4175411	727029	flying	--
3/20/2012	1	North end of Mine Island	4179762	728485	flying in area near nest, on nest	gray pine (*Pinus sabiniana*)
4/3/2012	1	West Bay of Don Pedro Reservoir	4176529	726937	perched on boulder near waters edge	boulder
4/3/2012	1	Blue Oaks Boat Launch Fish Cleaning Station	4176010	726313	flying around fish cleaning station	--
4/17/2012	2	Big Creek upstream of Don Pedro Reservoir	4183779	727495	1 adult feeding, juvenile and adult seen flying together shortly after initial observation	creek bank
4/18/2012	1	49er Bay	4181134	729015	juvenile – perched	ground
4/19/2012	1	Rogers Creek	4173124	734437	adult – soaring	--
5/9/2012	1	Near siphon	--	--	feeding	on land at water's edge
5/9/2012	1	Middle Bay	4182123	731523	flying	--

Date	No. of Bald Eagles	Location	UTM-N	UTM-E	Activity/Observation[1]	Perch Type
5/9/2012	1	Upper Bay	4186873	728035	perched	on land at water's edge
5/22/2012	1	Six Bit Gulch near outlet	4188644	727592	juvenile – soaring, perched	pine
6/25/2012	1	Rogers Creek Arm	4173712	733736	juvenile, perched	snag
6/27/2012	2	End of Woods Creek Arm	4195370	727690	adult – soaring, w/prey; perched	--
--	1	South Bay	4176928	733342	juvenile – 1 year old	--
--	1	Middle Bay	4182123	731523	juvenile – 1 year old flying	--
--	1	Upper Bay	4186497	727999	juvenile	on land at water's edge

[1] Activity/Observation = the observation made of the individual(s) or nest during helicopter surveys.
Perched – the individual was found perched on an object; on nest – indicates the individual was found on a nest.
Feeding – individual was observed in the act of feeding.
Flying – individual was observed in flight.
Nest – indicates the presence of a nest.
Perch Type = Type of structure or tree used as a perch or in which nest was built.
-- indicates information was not included in the incidental observation report.

Table 3.7-3. Results of incidental bald eagle sightings on Don Pedro Reservoir in 2013.

Species	No.	Age[1]	UTM-N	UTM-E	Observation Notes
Bald Eagle (*Haliaeetus leucocephalus*)	1	Adult	4194720	733577	In flight along northeast rim of Tuolumne River Arm canyon, direction of flight was up-canyon towards Ward's Ferry Bridge.
Bald Eagle	1	Adult	4193764	733774	In flight along northeast rim of Tuolumne River Arm canyon, direction of flight was up-canyon towards Ward's Ferry Bridge.
Bald Eagle	1	2 yr. old	4187184	728949	Perched on north shore of the west end of Upper Bay.
Bald Eagle	1	3 yr. old	4187331	727346	Perched on south shore of west end of Upper Bay.
Bald Eagle	1	2 yr. old	4187346	728277	In flight, entering Railroad Canyon from Upper Bay.
Bald Eagle	2	Adult	4184374	731273	Two adults perched together. Both flew due west after 20 minutes of observation.
Bald Eagle	1	2 yr. old	4182252	729593	In flight between 49er Bay and Upper Bay, individual pursued by male from Mine Island Nest.
Bald Eagle	1	2 yr. old	4176348	727228	Perched on island adjacent to Don Pedro Dam.

[1] The age of bald eagles is based on plumage phase as described by Jackman and Jenkins (2004).

3.7.1.5 Golden Eagle

Golden eagle is listed by CDFW as a Fully Protected Species, and is found throughout California, generally as year-round residents. Golden eagles use a range of terrestrial habitats, including forests, chapparal, grasslands, and oak woodlands, feeding on mammals, birds, and terrestrial reptiles, including as carrion. Open water is not considered foraging habitat for the species (CDFW 2013b). Nesting is generally in high cliffs, artificial structures, and large trees (Pagel et al. 2010). No golden eagle nests are known to occur in the Project Boundary or in the vicinity, but one golden eagle was incidentally observed on and above a high ridgetop near the Project Boundary in 2012, and suitable habitat is present within the Project Boundary.

3.7.1.6 Swainson's Hawk

Swainson's hawks are a highly mobile species with wide ranges that inhabit open grasslands with scattered trees, riparian areas, juniper-sage flats, savannahs, and agricultural lands, particularly alfalfa fields; hawks tend to avoid mountainous areas and steep canyons, particularly during the nesting season (CDFW 2013c; Woodbridge 1998). Swainson's hawks migrate to the Central Valley of California in late February and early March for the nesting season, departing in early September (Woodbridge 1998). Hawks feed mainly on insects, except during nesting periods, where the diet includes voles, other small mammals and birds (CDFW 2013c; Woodbridge 1998). Hawks will often nest in lone trees close to foraging habitat, typically in large trees associated with riparian forest. Adults usually have only one brood per year of one to four eggs. Hatchlings take about four to six weeks to fledge, and then remain dependent upon adults for food for an additional two to four weeks (Woodbridge 1998).

Swainson's hawk is listed as California Threatened Species under the CESA (ST) by CDFW and Sensitive by the BLM. Swainson's hawk has declined due to loss of nesting and foraging habitat to residential development and riparian habitat removal (Woodbridge 1998). Additionally, pesticide use on the hawk's migration routes and wintering areas have caused an increase in mortality (Woodbridge 1998).

Nests are not uncommon near roads and active agricultural lands, suggesting that nesting Swainson's hawks are not heavily impacted by regular and consistent human activity (Woodbridge 1998). However, hawks can be sensitive to new activity in areas that were previously inactive and nest abandonment may occur (Woodbridge 1998).

Suitable habitat within the Project Boundary for Swainson's hawk includes approximately 2,300 acres of annual grasslands, as well as adjacent habitats. No Swainson's hawk were observed during relicensing studies, and there have been no reported occurrences of Swainson's hawk nests within the Project Boundary. The closest reported occurrence of a Swainson's hawk nest to the Project Boundary was in 2001 and was over four miles south of the Project Boundary (CDFW 2013a).

3.7.1.7 Osprey

Osprey range throughout North, Central, and South America. In California, breeding primarily occurs in northern parts of the state. The osprey's diet primarily consists of fish in most open-water habitats along the coast and freshwater lakes and rivers. Osprey feed by flying over water and diving feet-first to grasp fish with their talons. Osprey are not listed as a special-status species by the BLM or other agencies.

Osprey winter in South and Central America, as well as parts of southern California and Arizona. Nesting usually begins in December and lasts until February. Nests are found at the top of large snags, utility poles, channel markers, and in urbanized areas where ospreys readily utilize man-made nesting platforms. Like other raptors, ospreys will reuse their nests for many years. Females lay two to four yellowish eggs that are incubated for approximately 32 days. Both adults tend to the eggs and nestlings, though the female typically provides the majority of care to nestlings, while the male brings food to the nest for the female and young. Adult osprey provide food for young for about 3 months. Young begin to fly at around 55 days after hatching.

Osprey were frequently observed on Don Pedro Reservoir during relicensing studies, either in flight, or perched on or near nests (TID/MID 2013b). Osprey foraging behavior was observed on multiple occasions, although a predator-prey interaction was not directly observed. Surveyors observed eight osprey nests on Don Pedro Reservoir, with concentrations in the areas of the Upper and Middle Bays (three nests and two nests, respectively). Additionally, one nest was recorded in the vicinity of the Highway 49 Bridge, one nest in the West Bay area, and one adjacent to Jacksonville Road close to Jacksonville Road Bridge. Table 3.7-4 summarizes observations of osprey and osprey nests documented during bald eagle surveys, as well as incidental observations reported during other relicensing studies.

Table 3.7-4. Incidental osprey observed on Don Pedro Reservoir.

Date	No.	Location	UTM-N	UTM-E	Activity/Observation[1]	Perch Type
3/7/2012	1	West Bay	4177624	728581	adult – nesting	--
3/20/2012	1	Mine Island	4179763	728490	adult – nesting	--
3/20/2012	2	Below Don Pedro Dam	4174987	726816	soaring	--
3/26/2012	2	Riley Ridge/Big Creek	4175092	727993	soaring	--
4/9/2012	1	Middle Bay	4179061	731281	adult – soaring	--
4/9/2012	1	Rogers Creek	4173368	733675	adult – soaring	--
4/9/2012	1	Rogers Creek	4173237	733975	adult – foraging	--
4/17/2012	2	Middle Bay	4182896	731263	adult – soaring/perched	--
4/17/2012	2	Middle Bay	4179000	732207	adult – soaring/perched	--
4/18/2012	2	Jacksonville Rd/Kanaka Point	4191537	733124	nest – occupied	Power pole
4/18/2012	1	49er Bay	4181492	728977	adult – foraging	--
5/8/2012	--	Riley Ridge/Big Creek	4175290	727876	nest – occupancy unknown	--
5/9/2012	--	Highway 49 bridge area	4190906	730818	nest – occupied	--
5/9/2012	--	Upper Bay	4186601	728220	nest – occupied	--
5/9/2012	--	Upper Bay	4186748	729201	nest – occupied	--
5/9/2012	--	Upper Bay	4186546	730333	nest – occupied	--
5/9/2012	--	Middle Bay	4181418	730771	nest – occupied	--
5/9/2012	--	Mine Island	4179797	728452	nest – occupied	--
5/9/2012	--	West Bay	4178038	728199	nest – occupied	--
2013	--	Woods Creek Arm	4193446	729257	nest – occupied	--

[1] Activity/Observation = the observation made of the individual(s) or nest during helicopter surveys.
Perched – the individual was found perched on an object; on nest – indicates the individual was found on a nest.
Flying – individual was observed in flight.
Nest – indicates the presence of a nest.
Perch Type = Type of structure or tree used as a perch or in which nest was built.
-- indicates information was not included in the incidental observation report.

3.7.1.8 Special-status Bats

Nine special-status bats are known to occur or have the potential to occur in the vicinity of the Don Pedro Project. These nine species are pallid bat (*Antrozous pallidus*), Townsend's big-eared bat (*Corynorhinus townsendii*), spotted bat (*Euderma maculatum*), western mastiff bat (*Eumops perotis*), western red bat (*Lasiurus blossevillii*), western small-footed myotis (*Myotis ciliolabrum*), long-eared myotis (*Myotis evotis*), fringed myotis (*Myotis thysanodes*), and Yuma myotis (*Myotis yumanensis*). The long-eared myotis, and Yuma myotis are designated as sensitive species by the BLM; the Western red bat is a Species of Special Concern by the CDFW; the pallid bat, Townsend's big-eared bat, spotted bat and Western mastiff bat are designated as both Species of Special Concern by the CDFW and Sensitive by the BLM.

3.7.1.8.1 Pallid Bat

Pallid bats are most abundant in low elevation xeric ecosystems, including rocky arid deserts and canyon lands, shrub-steppe grasslands, karst formations and higher elevation coniferous forests (0–7,000 ft elevation). Pallid bats roost alone, or in small groups of two to 20 individuals, or in larger groups of more than 100. Common roosts include caves, rocky outcrops, crevices, and manmade structures such as buildings and bridges. Pallid bats are primarily gleaning bats that take prey from surfaces; preferred forage consists of insects, including beetles and grasshoppers (Western Bat Working Group (WBWG) 2005a).

3.7.1.8.2 Townsend's Big-Eared Bat

Townsend's big-eared bats occupy a wide variety of habitats from sea level to over 10,000 ft in elevation. They can be found in coniferous forests, mixed mesophytic forests, deserts, native prairies, riparian communities, active agricultural areas, and coastal habitat types. Distribution is strongly correlated with the availability of caves and cave-like roosting habitat, including abandoned mines. Townsend's big-eared bats are communal roosters, with maternity colonies ranging in size from a few individuals to several hundred. Foraging occurs on the wing, with over 90 percent of its diet composed of moths (WBWG 2005b).

3.7.1.8.3 Spotted Bat

Spotted bats occur throughout the western United States, and have been found from below sea level up to 8,800 ft. They inhabit a wide range of ecosystems including arid deserts, grasslands, and mixed conifer forests. Spotted bats roost singularly, but occasionally can be found in small groups. Prominent rock features appear to be necessary for roosting, and include cracks, crevices, and caves, usually high in fractured rock cliffs. Spotted bats forage on the wing; their primary prey species are moths (WBWG 2005c).

3.7.1.8.4 Western Mastiff Bat

Western mastiff bats are primarily a cliff-dwelling species found in a variety of habitats, including desert scrub, chaparral, oak woodland and ponderosa pine, and high elevation meadows. Recent surveys documented western mastiff bats roosting as high as 4,500 ft in

California. Maternity colonies range from 30 to several hundred individuals. Roosts are often high above the ground, and can be found under exfoliating rock slabs. They forage on the wing at heights of 100 to 200 ft. Their common prey items are moths (WBWG 2005d).

3.7.1.8.5 Western Red Bat

Western red bats are widely distributed throughout the western United States and are associated with intact riparian habitats. They roost singularly in tree foliage. Western red bats forage on the wing and have been reported to eat insects, beetles, wasps, flies, and moths (WBWG 2005e).

3.7.1.8.6 Long-Eared Myotis

Long-eared myotis range across the western United States, occurring in semiarid shrublands, sage, chaparral, and agricultural areas, but are usually associated with coniferous forests. Roost sites include under exfoliating tree bark, in hollow trees, caves, mines, cliff crevices, sinkholes, and rocky outcrops on the ground. They may also be found roosting in buildings and under bridges. Long-eared myotis females form small maternity colonies. Long-eared myotis is a gleaning bat, taking prey off foliage, tree trunks, rocks, and from the ground. Prey items include moths, small beetles, flies, lacewings, wasps, and true bugs (WBWG 2005f).

3.7.1.8.7 Yuma Myotis

Yuma myotis are known to use variety of habitats including riparian, arid scrublands, deserts and forests. They are usually associated with permanent water sources. Yuma myotis are roost generalists and can be found in buildings, bridges, cliff crevices, caves, mines and trees. Maternity colonies may have several thousand individuals. They feed on the wing, primarily on aquatic emergent insects (WBWG 2005g).

Reconnaissance surveys, focused surveys, and long-term acoustic monitoring efforts for special-status bats were conducted within the Project Boundary during 2012 (TID/MID 2013c). The reconnaissance survey took into consideration habitat suitability, accessibility, and sampled a broad range of habitat types and localities within the Project Boundary. During the initial reconnaissance for focused survey and Long Term Acoustic Monitoring sites, facilities and recreation sites throughout the study area were evaluated for evidence of bat use. The Districts do not operate or maintain bridges, overpasses, or related structures; as a result, these structures were not considered during study efforts. At each site evaluated, possible bat foraging opportunities and flight corridors were noted, and a visual inspection of structures was performed. The information collected during the initial reconnaissance was used to prioritize locations for focused bat surveys.

During the 2012 relicensing study, seven special-status bat species were documented:

- Pallid bat was documented at four of five survey locations selected for this study: Fleming Meadows Recreation Area swimming lagoon, Don Pedro Dam spillway, Blue Oaks Recreation Area, and Don Pedro powerhouse.

- Western red bat was documented at three sites: Fleming Meadows Recreation Area swimming lagoon, Don Pedro Dam spillway, and Don Pedro powerhouse.
- Long-eared myotis was documented at three sites: Don Pedro Dam spillway, Moccasin Recreation Area, and Don Pedro powerhouse.
- Both Townsend's big-eared bat and Western mastiff bat were documented at two sites: Don Pedro Dam spillway and Don Pedro powerhouse.
- Spotted bat was documented at Don Pedro powerhouse.
- Yuma myotis was documented at Don Pedro Dam spillway.

No maternity roosts or winter hibernacula were identified at facilities or recreation sites. Based on observed use patterns, maternity roosts and winter hibernacula are likely within the study area or vicinity, but none occur at facilities or areas affected by O&M. Two facilities are likely used as day roosts: the Fixed Wheel Gate building and the tunnel adjacent to Don Pedro powerhouse.

A total of 32 night roots were identified, many adjacent to DPRA campgrounds and likely subject to indirect disturbance related to recreational use. Evidence of roosting at campground facilities identified during the 2012 bat study suggests that in general, disturbance to night roosts is limited and is unlikely to result in abandonment by bats. However, the small cinderblock structure near the A2 restroom in the Blue Oaks campground, used by pallid bats as a night roost, showed evidence of human activity (burn marks on the interior walls of the structure, broken glass on the floor).

3.7.2 Resource Effects

Page 36 of FERC's SD2 identifies the following special-status wildlife related issues:

- *Effects of project operation, including water level fluctuations, ground-disturbing activities, and maintenance on special-status wildlife species and habitat.*[24] *[…]*
- *Effects of maintenance and use of project recreation facilities by recreationists on special-status wildlife species,* ***special-status plant species and botanical resources****,* *and shoreline vegetation.*
- *Effects of vegetation clearing for project maintenance on wildlife and botanical resources,* ***and the presence and spread of noxious weeds****.*

Each of these potential effects[25] is analyzed below.

[24] Special-status wildlife species cited during scoping include the western pond turtle, foothill yellow-legged frog, swainson's hawk, bald eagle, osprey, and the California roach or Red Hill roach.

[25] The Proposed Action covered in this application is the Districts' proposal to continue hydroelectric generation at the Don Pedro Project. While Don Pedro Project activities and/or water level fluctuations may have the potential to effect wildlife resources, these operations and routine maintenance activities are for the purposes of water supply and flood control. Hydroelectric project operations are dependent upon water released for these purposes; therefore, reservoir water level fluctuations are not the result of hydroelectric operations. The effect of the Proposed Action has no measurable impact on reservoir water level fluctuations. During relicensing of the Don Pedro Hydroelectric Project, the Districts undertook

3.7.2.1 Terrestrial Wildlife Habitats

The bulk of the Project Boundary is undeveloped land that is well-removed from any O&M activity and unaffected by the Don Pedro Project. Near facilities and developed recreation areas, O&M includes basic maintenance, including vegetation management, minor ground disturbance, use of county roads within the Project Boundary, and related efforts. In general, these efforts maintain currently developed lands in a developed state, as required for daily operations and recreation uses. This work has the potential to affect wildlife using these habitats, as noise, movement, and disturbance may disrupt wildlife and animals may be flushed or displaced. However, these efforts are infrequent, concentrated in already-disturbed habitats, and are limited in scope and duration. As a result, the effects of O&M on wildlife habitats are minor.

3.7.2.2 Western Pond Turtle and Foothill Yellow-Legged Frog

A total of 14 live WPT were reported in the course of various relicensing studies. Six WPT were detected at five basking survey sites and 10 WPT (eight live, two dead) were observed incidentally at 10 locations. Although Don Pedro Reservoir does support WPT, the majority of the reservoir does not represent favorable habitat for WPT. Don Pedro Reservoir is characterized by deep, open water and steep banks, a scarcity of basking areas except for backwater areas associated with major tributaries, abundant introduced predatory fish, and occurrences of American bullfrog. These conditions are considered suitable for adult and sub-adult WPT; however, they are less suited for hatchling WPT (approximately 2.5 cm in length) and growing juveniles until they attain size and shell hardness sufficient to escape predation (Ashton et al. 1997). Suitable habitats for juvenile WPT consist of vegetated shallow water which is limited in extent at Don Pedro Reservoir and primarily associated with the mouths of tributaries. Because of vulnerability to predation by introduced predatory fish and bullfrogs, WPT population recruitment at Don Pedro Reservoir appears low.

Don Pedro Reservoir is primarily operated as a storage reservoir; following peak storage the water level is gradually drawn down until its lowest elevation is reached in midwinter. As a result, for those few WPT that do occur, water level changes resulting from reservoir fluctuations could affect potential WPT nesting habitat below the normal maximum water surface elevation in Don Pedro Reservoir. Young WPT in nests (eggs are laid in summer and hatchling turtles remain in the nest for approximately one year) within the fluctuation zone have the potential to be flooded out and/or drowned. The average increase in water surface elevation from May 1 through July 31 during the period of record is 16.9 ft; this suggests there is potential for nests below the normal maximum water surface elevation to be flooded if eggs are laid prior to the peak water surface elevation. However, because WPT typically select sites with at least some vegetation (low grasses and forbs), these sites are likely not impacted by frequent inundation (Holt 1988). While individual nests in the fluctuation zone have the potential to be impacted, a population effect from those impacts (i.e., population decline) is unlikely.

comprehensive investigations of the wildlife resources associated with the Don Pedro Project within the study area identified in the study plan.

Interactions between recreationists and WPT are likely. Much of the area from Railroad Canyon south is open to shoreline camping, and boating occurs across all of Don Pedro Reservoir. WPT are relatively sensitive to disturbance, and loud or invasive activities may affect the frequency and duration of basking or foraging behavior. Interruptions in basking may lead to a delay in the maturation and deposition of eggs, decreasing hatching success or overwinter behavior (Holland 1991). However, no direct impacts from recreational activities were observed during surveys, and overall use of the Reservoir by WPT, including in recreational areas, is low.

The Districts have granted four grazing permits on a total of 559 acres within the Project Boundary. The Districts' permits require that no grazing is to occur below the normal maximum water surface elevation for Don Pedro Reservoir. As a result, permitted grazing has little potential to affect WPT basking or other habitat uses. However, WPT nesting, which can occur in upland areas above the normal maximum water surface elevation, may be reduced or precluded by animal use within grazing permit areas. Of the 1648 acres of potential WPT nesting habitat identified within the Project Boundary during 2012 study efforts, approximately 184 acres are within the Districts' grazing permit areas, which is approximately 11 percent of the total potential nesting habitat.

No FYLF were detected during study efforts, and FYLF are not reported to occur within the Project Boundary. Don Pedro Reservoir is characterized by perennial, deep, slow-moving water and steep, poorly vegetated banks. A variety of introduced predatory fish are present, and American bullfrog tadpoles larval and post-metamorphic life stages were observed at many locations within the study area. Although BLM records document two historical FYLF records within the study area upstream of Don Pedro Reservoir, the reservoir itself does not represent potential habitat for FYLF. Tributaries to the reservoir have limited availability of aquatic habitat suitable for oviposition and larval development (i.e., shallow, flowing water with at least some cobble-sized substrate). Additionally, the presence of introduced aquatic predators such as fish and bullfrogs limits the suitability of the habitat for FYLF. Because FYLF are not present in Don Pedro Reservoir and habitat suitability is poor within the study area as a whole, O&M activities are unlikely to affect FYLF populations.

3.7.2.3 Bald Eagle, Osprey, Swainson's Hawk, and Golden Eagle

The results of the 2012 and 2013 bald eagle surveys on Don Pedro Reservoir suggest that the Don Pedro Project is compatible with successful bald eagle foraging and nesting. The majority of Don Pedro Reservoir is subject to recreational uses, such as camping, hiking, motorized and non-motorized boating, and off highway vehicle use, providing the potential for disturbance to bald eagles. However, USFWS guidelines note that bald eagles are "unlikely to be disturbed by routine use of roads, homes, and other facilities where such use pre-dates the eagles' successful nesting activity…[I]n most cases, ongoing existing uses may proceed…with little risk of disturbing bald eagles"[26]. Recreational use of Don Pedro Reservoir has been ongoing since Don Pedro Project construction, and two of the three occupied bald eagle nests observed were located in areas of high recreational use. In particular, the Mine Island nest is located in an area that experiences frequent and heavy recreational boat traffic during the spring and summer seasons. Similarly, the nest in the Woods Creek Arm is located in an area that not only receives regular

[26] USFWS 2007

use by boaters, but was constructed in a narrow portion of the canyon that exposes the nest to all passing boats. Disturbances to nesting birds as a result of the O&M does not occur, since no facilities or maintenance activities are located within 1.5 mi of a bald eagle nest.

O&M includes periodic ground squirrel management in developed recreation areas. Two methods are used: (1) burrow blasting, which injects oxygen and propane into ground squirrel burrows for subsequent ignition, most recently in the 2012–2013 season, and (2) targeted use of pelleted rodent poison, most recently during the 2009–2010 season. Because fish forage is plentiful adjacent to bald eagle nest sites and pelleted rodent bait is infrequently used, ground squirrel management is unlikely to affect bald eagles.

Don Pedro Reservoir provides abundant foraging and nesting habitat for osprey, which are frequently observed in the Project Boundary. Osprey are known to have a high tolerance level for human activity in the vicinity of their nests relative to most other raptors, and often select nest sites in close proximity to high levels of human activity. As a result, the Don Pedro Project is not likely to have a substantial impact on osprey.

O&M activities are unlikely to affect Swainson's hawk populations because there are no known Swainson's hawks or hawk nests in the vicinity of the Don Pedro Project. Similarly, while one golden eagle was observed on ridgetops in the vicinity, no nests are known or reported to occur, and the species does not forage on Don Pedro Reservoir. Although both species likely use lands within the Project Boundary, any coincidence of such use and O&M is likely to be limited in frequency and scope.

3.7.2.4 Special-status Bats

A total of seven species of special-status bats were documented in the Project Boundary. Because use of Don Pedro Project facilities and developed recreation areas by special-status bats is common, the use of facilities and disturbance associated with recreation has the potential to affect special-status bats. Bats are sensitive to various disturbances and can be affected by human activities, including the presence of humans at roost sites, or disturbance to roosting and foraging habitat.

No maternity roosts or winter hibernacula were located in areas potentially affected by O&M (bat use patterns suggest they are present in the larger vicinity). Thirty-two night roosts were identified, many within or adjacent to Don Pedro Project campgrounds. However, roosting at campground facilities persisted throughout the 2012 bat study, suggesting that in general, disturbance to night roosts is limited or absent, and is unlikely to result in abandonment by bats.

One night roost was observed to have evidence of human activity: a small cinderblock structure near the A2 restroom in the Blue Oaks campground. This structure is used by pallid bats as a night roost, and was found to have burn marks on the interior walls of the structure and broken glass on the floor. Although this structure was used as a pallid bat night roost for the study duration, the direct nature of the disturbance to this structure suggests that continued or future disturbances occurring at night could lead to a reduction of use by bats or abandonment.

3.7.3 Proposed Resource Measures

3.7.3.1 Bald Eagle Management Plan

- The Districts propose to develop and implement a Bald Eagle Management Plan. A Draft Bald Eagle Management Plan is included as Appenidx E-2, and includes the following components:
- bald eagle surveys,
- protection of existing nests and access restrictions to prevent disturbance during bald eagle mating and rearing,
- consultation with the USFWS regarding any planned rodenticide use, and
- awareness training for employees for avoidance around known nests.

3.7.3.2 Pallid Bat Roost Protection

The Districts propose to develop and implement a Recreation Resource Management Plan (Appendix E-3). The Recreation Resource Management Plan includes management of public access to and use of the cinderblock structure near the A2 restroom in the Blue Oaks campground in order to protect what was documented as a night roost for pallid bats.

3.7.4 Unavoidable Adverse Impacts

The Don Pedro Project has no known unavoidable adverse effects on wildlife species.

3.8 Threatened and Endangered Species

This section addresses Threatened or Endangered species with the potential to occur in the Don Pedro Project vicinity. Species evaluated are listed under the federal ESA, the California Endangered Species Act (CESA), or both. Designated and proposed critical habitat for these species is also addressed. This section references certain species listed as Rare or Fully Protected under California law. Species not listed under the ESA or CESA, but afforded other special designations (e.g., by a federal or state agency), are referred to as "special-status species" and are addressed in sections 3.5, 3.6, and 3.7 of this Exhibit E.

Threatened and Endangered species investigations began by identifying the species with the potential to occur in the Don Pedro Project vicinity. A list of ESA-listed species for the 7.5-minute USGS topographic quadrangles (Chinese Camp, La Grange, Moccasin, Penon Blanco Peak, Sonora, and Standard), which include the area within the Don Pedro Project Boundary, was generated via the on-line request service available at the USFWS's website (USFWS 2013). Following removal of species that do not occur in the vicinity (based on elevation or habitat requirements), 15 species remained, four listed as Endangered and 11 as Threatened:

- ESA Endangered:
  - Hartweg's golden sunburst (*Pseudobahia bahiifolia*),
  - Hairy Orcutt grass (*Orcuttia pilosa*),
  - Greene's tuctoria (*Tuctoria greenei*), and
  - San Joaquin kit fox (*Vulpes macrotis mutica*).
- ESA Threatened:
  - Succulent owl's-clover (*Castilleja campestris* ssp. *succulenta*),
  - Hoover's spurge (*Chamaesyce hooveri*),
  - Colusa grass (*Neostapfia colusana*),
  - Chinese Camp brodiaea (*Brodiaea pallida*),
  - Layne's ragwort (*Packera layneae*),
  - California vervain (*Verbena californica*),
  - Valley elderberry longhorn beetle (VELB) (*Desmocerus californicus dimorphus*),
  - Vernal pool fairy shrimp (*Branchinecta lynchi*),
  - California tiger salamander (CTS), Central Valley Distinct Population Segment (DPS) (*Ambystoma californiense*),
  - California red-legged frog (CRLF) (*Rana draytonii*), and
  - Steelhead, California Central Valley DPS (*Oncorhynchus mykiss irideus*)[27].

The CDFW list of State and Federally Listed Endangered and Threatened Animals of California was reviewed to identify CESA-listed animals potentially occurring in the Don Pedro Project vicinity. The list includes 157 fish and wildlife species, of which 55 are listed under both the ESA and CESA, 71 are listed only under the ESA, and 31 are listed only under the CESA. The Districts also reviewed the State of California, CDFW List of State Fully Protected Animals. The list includes 37 fish and wildlife species. The California Natural Diversity Database (CNDDB) was reviewed for ESA and CESA plant species occurrences (TID/MID 2013a).

Based on review of habitat requirements and known distributions, 12 species (nine plants, two birds, and one amphibian) were identified that could occur in the vicinity of the Don Pedro Project and are protected under the CESA or listed as rare or fully protected under California law:

- CESA Endangered:
  - Succulent owl's-clover,
  - Hartweg's golden sunburst,

[27] Central Valley steelhead are addressed in sections 3.5 and 4.0 of this Exhibit E.

- Colusa grass,
- Hairy orcutt grass,
- Chinese Camp brodiaea,
- Delta button-celery (*Eryngium recemosum*), and
- Bald eagle (*Haliaeetus leucocephalus*)[28].

▪ CESA Threatened:

- California vervain, and
- California tiger salamander (CTS), Central Valley DPS.

▪ State Rare:

- Layne's ragwort, and
- Greene's tuctoria,

▪ State Fully Protected:

- Golden eagle (*Aguila chrysaetos*)[28].

3.8.1 Species Removed from Consideration

In addition to the ESA-listed species initially considered by the Districts (see previous section), FERC's SD2 identified the following ESA-listed wildlife species to be addressed in FERC's environmental analysis for the Project:

- Riparian brush rabbit (*Sylvilagus bachmani riparius*),
- Riparian wood rat (*Neotoma fuscipes riparia*),
- Least Bell's vireo (*Vireo bellii pusillus*), and
- Conservancy fairy shrimp (*Branchinecta conservatio*).

In addition to being ESA-listed, the riparian brush rabbit is also listed as Endangered under the CESA. These four species and their critical habitats (when designated) have not been reported to occur within 5 miles of the Don Pedro Project Boundary, nor within Tuolumne County (CDFW 2013). As a result, these species were removed from further consideration. Habitat within the Don Pedro Project Boundary does not appear to be suitable for any of these species. The closest designated critical habitat for Conservancy fairy shrimp is over 10 miles from the Don Pedro Project Boundary, and no vernal pool habitats, which are required by Conservancy fairy shrimp, were found during extensive field studies conducted within the Don Pedro Project Boundary (Eng et. al 1990). Riparian brush rabbit, riparian wood rat, and least Bell's vireo each require riparian shrub habitats. Field studies conducted by the Districts documented that these habitats are uncommon within the Don Pedro Project Boundary.

[28] Bald eagle and golden eagle are addressed in Section 3.7 of this Exhibit E.

3.8.2 ESA- and CESA-listed Plants

Of the 10 ESA- or CESA-listed plants identified above, only two species, Layne's ragwort and California vervain, have been documented to occur within the Don Pedro Project vicinity. CDFW (2013) reported occurrences of these species within 1 mile of the Don Pedro Project Boundary.

The potential for the other eight ESA- or CESA-listed plant species to occur in the Don Pedro Project vicinity is low. Based on life history information gathered through the literature search and on-the-ground observations made during floristic surveys, seven of the 10 species require conditions that are not present in the study area, including:

- Vernal pools, the habitat of Hoover's spurge, succulent owl's clover, Colusa grass, Greene's tuctoria, and hairy Orcutt grass.
- Mima mounds, on which Hartweg's golden sunburst has been found to grow almost exclusively.
- Clay or silty soils in seasonally flooded plains and swales, which are the habitats of Delta button-celery.
- Vernal swales, the habitat of Chinese Camp brodiaea.

Because these plant species are not present in the Don Pedro Project vicinity, they are not addressed in this FLA.

In 2012, botanical surveys for ESA- and CESA-listed plants were conducted within and adjacent to the Project Boundary, following survey protocols developed in consultation with relicensing participants (TID/MID 2013a). Field studies were conducted in locations within the Don Pedro Project Boundary where there was the potential for resource effects, i.e., all Don Pedro Project facilities, recreation areas, and high-use dispersed recreation areas as identified during study plan consultation. The study area extended outside of the Don Pedro Project Boundary as needed to survey the full extent of plant occurrences, up to 300 ft outside the boundary within high-use recreation areas or the BLM's Red Hills Area of Critical Environmental Concern (ACEC), and where necessary to document the full extent of each ESA- or CESA-listed plant occurrence, up to 0.25 miles outside the Don Pedro Project Boundary. The study area assessed during surveys was approximately 3,870 ac.

Surveys were floristic in nature and followed the botanical survey protocol section of CDFW's *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (CDFG 2009). As detailed in the FERC-approved study plan, surveys were conducted using a random meander technique, with additional focus in high quality habitat or other areas with a higher probability of supporting ESA- or CESA-listed plants. Additional detail on survey methodology is provided in Section 3.6 of this Exhibit E.

During these surveys, 25 occurrences of Layne's ragwort and two occurrences of California vervain were documented, all of which were found on federal lands administered by the BLM within the Red Hills ACEC. No other ESA- or CESA-listed plants were found on lands potentially affected by operation and maintenance (O&M) or recreational use.

3.8.2.1 Layne's Ragwort

3.8.2.1.1 Regulatory Status

On October 18, 1996, the USFWS listed Layne's ragwort as threatened under the federal ESA (61 FR 54346). No critical habitat has been designated for this species. A 5-year review was initiated by the USFWS for this species in March 2009 (USFWS 2012a). The USFWS issued a Recovery Plan for Gabbro Soil Plants of the Central Sierra Nevada, which included Layne's ragwort, among other species (USFWS 2002a). Layne's ragwort is not listed under CESA or listed as a sensitive species by the BLM, but is on the CDFW list of state rare species, under the Native Species Plant Protection Act of 1977 (USFWS 2012a).

3.8.2.1.2 Habitat Requirements

Layne's ragwort is a perennial herb that grows within dry pine or oak woodlands (USFWS 2012c) in open, disturbed rocky areas on gabbro and serpentine soils between 660 ft and 3,280 ft elevation (Baldwin 2012, CNPS 2012). The species is also occasionally found along streams. CNPS reports rapid urbanization as the primary threat to Layne's ragwort, along with clearing, grazing, road construction, and fire suppression (CNPS 2012).

3.8.2.1.3 Occurrence and Habitat within the Don Pedro Project Boundary

During botanical surveys, 25 occurrences of Layne's ragwort were recorded within or adjacent to the Don Pedro Project Boundary. Occurrences ranged from five to 250 plants, with a total estimated area of 2.9 ac. The majority of Layne's ragwort was located in gray pine (*Pinus sabiniana*) woodlands, with wedgeleaf ceanothus (*Ceanothus cuneatus*), toyon (*Heteromeles arbutifolia*), chamise (*Adenostoma fasciculatum*), and common manzanita (*Arctostaphylos manzanita*) as common subdominants. Four of the occurrences were found in chaparral, dominated by wedgeleaf ceanothus, hollyleaf redberry (*Rhamnus ilicifolia*), and toyon. Special-status plants commonly co-occurred with Layne's ragwort, including Red Hills onion (*Allium tuolumnense*), Red Hills soaproot (*Chlorogalum grandiflorum*), tripod buckwheat (*Eriogonum tripodum*), Congdon's lomatium (*Lomatium congdonii*), and shaggy-haired lupine (*Lupinus spectabilis*). Three Layne's ragwort occurrences were recorded at Kanaka Point, near a day-use area off Jacksonville Road. There are multiple footpaths throughout the area, including one that runs within a few feet of two occurrences.

3.8.2.2 California Vervain

3.8.2.2.1 Regulatory Status

On September 14, 1998, the USFWS listed California vervain as threatened under the ESA (Federal Register 63:49002). No critical habitat has been designated for this species. The USFWS is currently developing a Recovery Plan for California vervain. In December 2007, a 5-

year review of the species by the USFWS recommended no change in designation. California vervain is also listed as threatened under CESA, but is not listed as a sensitive species by the BLM (USFWS 2012a).

3.8.2.2.2 Habitat Requirements

California vervain is a perennial herb that is found along small intermittent or perennial streams (CDFG 2005), usually within serpentinite, cismontane woodlands in valley and foothill grasslands between 853 ft and 1,312 ft elevation. It is occasionally found in non-wetland areas (Calflora 2012). This species is only known to grow in the Red Hills of California (CNPS 2012). The USFWS identifies recreational activities such as gold mining, mountain biking, and hiking as threats to California vervain. In addition, hydrological fluctuations also affect the species (USFWS 2012c).

3.8.2.2.3 Occurrence and Habitat within the Don Pedro Project Boundary

Two occurrences of California vervain were recorded within the study area during botanical surveys: one in Poor Man's Gulch and one in Six Bit Gulch. Both occur on public lands administered by the BLM within the Red Hills ACEC. During the surveys, the occurrence in Poor Man's Gulch consisted of over 200 individuals occupying approximately 0.2 ac. The occurrence in Six Bit Gulch consisted of two individuals occupying approximately 4 ft^2. Both were located within riparian zones dominated by arroyo willow (*Salix lasiolepis*), sedges (*Carex sp.*), white broadiaea (*Triteleia hycinthina*), and baltic rush (*Juncus balticus*).

3.8.3 ESA and CESA-listed Invertebrates

3.8.3.1 Valley Elderberry Longhorn Beetle

3.8.3.1.1 Regulatory Status

On August 8, 1980, the USFWS listed VELB as threatened under the ESA (Federal Register 45:52803). VELB is not listed as threatened or endangered under CESA, nor formally listed as a sensitive species by BLM, nor considered a Species of Special Concern by the CDFW. Critical habitat has been designated for the species, including the American River Parkway and Sacramento Zones (USFWS 1980). The Don Pedro Project is outside of the critical habitat zones, but falls within the potential range of the beetle.

The USFWS issued a VELB Recovery Plan on August 28, 1984. On February 14, 2007, the USFWS completed a 5-year review, which resulted in the recommendation that VELB be de-listed (USFWS 2012b). In October 2012, the USFWS began the process of reviewing the delisting proposal (USFWS 2012c).

Delisting is being assessed because of evidence that VELB may be widespread and less threatened than it was when initially listed. There are currently over 200 recorded occurrences of VELB, where there had been only 10 at the time of listing. Also, the destruction of riparian areas has slowed, and recovery efforts have led to the restoration and replanting of riparian areas, including plantings of elderberry (USFWS 2012c).

3.8.3.1.2 Life History and Habitat Requirements

The VELB is dependent on its host plant, elderberry (*Sambucus* spp.), which is a common component of riparian corridors and adjacent upland areas in the Central Valley, for all of its life stages (i.e., egg, larva, and adult). VELB primarily occurs within the riparian corridor but can occur infrequently in non-riparian scrub habitats adjacent to the corridor, and less commonly in annual grasslands and live oak woodlands. VELB appear to be capable of limited dispersal and prefer to remain within contiguous patches of high quality riparian habitat.

The VELB life cycle takes one or two years to complete. Eggs are laid on elderberry leaves or bark and hatch within two days. The larvae live within the stems of the plants feeding on the pith for one to two years. Adults emerge from the stems through holes made by larvae prior to pupation. Adults generally emerge from late March through June and are short-lived (USFWS 2009). The exit holes created by larvae prior to pupation are often the only evidence of VELB presence.

3.8.3.1.3 Occurrence and Habitat Within the Don Pedro Project Boundary

In 2012, the Districts conducted a data review for known occurrences of VELB, botanical surveys for elderberry plants, and stem inspections for beetle exit holes on elderberry plants within the Don Pedro Project Boundary (TID/MID 2013b). Surveys for elderberry plants followed CDFW's *Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities* (CDFG 2009). The study included all areas potentially subject to O&M activities, including all facilities and recreation sites, dispersed recreation areas on Don Pedro Reservoir, and 10 drainages within the Don Pedro Project Boundary that were also designated for wetland studies.

During surveys, 73 elderberry plant occurrences were recorded. VELB boreholes were observed at 14 of the elderberry occurrences, ranging from two to 43 exit holes (Table 3.8-1). Of the 14 elderberry plants with exit holes, only two were found in riparian areas; the majority were in partially disturbed habitat near roads or developed recreation areas.

Table 3.8-1. Elderberry plants with observed VELB exit holes.

Site Location	Riparian Yes|No	Stem Count[1]	Number of Exit Holes	Recent Yes|No	Land Ownership
Moccasin Point Recreation Area	No	15	15	No	MID/TID
Moccasin Point Recreation Area	No	13	7	No	MID/TID
Moccasin Point Recreation Area	Yes	10	43	Yes	MID/TID
Moccasin Point Recreation Area	Yes	1	2	No	Public - BLM
Below dam	No	1	8	No	MID/TID
Sewage pond across	No	1	5	No	MID/TID

Site Location	Riparian Yes|No	Stem Count[1]	Number of Exit Holes	Recent Yes|No	Land Ownership
from Blue Oaks Recreation Area					
Hatch Creek	No	1	10	No	MID/TID
Jacksonville Road	No	1	6	No	Public – BLM
Jacksonville Road	No	1	3	No	Public - BLM
Jacksonville Road	No	1	2	No	MID/TID
Jacksonville-Harney Road	No	1	2	No	Public - BLM
Moccasin transmission line	No	n/a	19	No	MID/TID
Rogers Creek Arm	No	18	8	No	MID/TID
Rogers Creek Arm	No	7	9	No	MID/TID

[1] Stems one inch or greater at the base.

3.8.3.2 Vernal Pool Fairy Shrimp

3.8.3.2.1 Regulatory Status

On September 19, 1994, vernal pool fairy shrimp were listed as Threatened under the ESA (59 FR 48136-48153). Critical habitat for vernal pool fairy shrimp, along with other vernal pool species, was originally designated in a final rule on August 6, 2003. A revised final rule for critical habitat, with unit designations by species, was published on February 10, 2006, with 35 critical habitat units for vernal pool fairy shrimp totaling 597,821 ac (USFWS 2006a). Of these, critical habitat unit VERFS21B is the closest to the Don Pedro Project, at approximately 2.6 miles from the edge of the Don Pedro Project Boundary.

The USFWS issued a draft Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon in October 2004; the recovery plan was finalized on December 15, 2005 (USFWS 2005a). A five-year status review for vernal pool fairy shrimp and other species was initiated on May 25, 2011 (USFWS 2011).

3.8.3.2.2 Life History and Habitat Requirements

Vernal pool fairy shrimp occur mostly in vernal pools, but may also occur in natural and artificial seasonal wetland habitats, such as alkali pools, ephemeral drainages, stock ponds, roadside ditches, vernal swales, and rock outcrop pools (NatureServe 2009). Vernal pool fairy shrimp occupy a variety of different vernal pool habitats, from small, clear, sandstone rock pools to large, turbid, alkaline, grassland valley floor pools (Eng et al. 1990, Helm 1998). Although vernal pool fairy shrimp have been collected from large vernal pools, including one exceeding 25 ac in area (Eriksen and Belk 1999), the species tends to occur primarily in smaller pools (Platenkamp 1998), and it is most frequently found in pools measuring less than 0.05 ac (Gallagher 1996, Helm 1998). The vernal pool fairy shrimp typically occurs at elevations from 30 to 4,000 ft (Eng et al. 1990), although the species has been found at two sites in the Los Padres National Forest at an elevation of 5,600 ft. The vernal pool fairy shrimp has been collected at water temperatures as low as 4.5°C (Eriksen and Belk 1999) and has not been found in water with temperatures above about 23°C (Helm 1998, Eriksen and Belk 1999). The species is typically found in pools with low to moderate amounts of salinity or total dissolved solids (Collie and Lathrop 1976, Keeley 1984, Syrdahl 1993). Because vernal pools are mostly rain-fed, they usually have low nutrient levels and often have dramatic daily fluctuations in pH, dissolved oxygen, and carbon dioxide (Keeley and Zedler 1998).

3.8.3.2.3 Occurrence and Habitat Within the Don Pedro Project Boundary

Most of the known occurrences of vernal pool fairy shrimp are in the Central Valley and Coast Ranges of California, with disjunct populations in San Luis Obispo County, Santa Barbara County, and Riverside County (Eng et al. 1990, Erickson and Belk 1999). The CNDDB includes a record of one occurrence within the Sonora quad, which is adjacent to the Don Pedro Project quads (CDFW 2013). The Districts engaged in detailed terrestrial resource studies in 2012, during which no vernal pools, or vernal pool plants that might indicate their presence, were located.

3.8.4 ESA and CESA-listed Vertebrates

3.8.4.1 California Tiger Salamander

3.8.4.1.1 Regulatory Status

On August 4, 2004, the Central California DPS of CTS was listed as Threatened under the ESA (69 FR 47212). Critical habitat was designated for the Central California Population DPS on August 23, 2005, (70 FR 79380), including an area approximately 1 mile southwest of the Don Pedro Project Boundary in Stanislaus County.

3.8.4.1.2 Life History and Habitat Requirements

CTS breeding habitat is generally associated with shallow, seasonal (i.e., continuously flooded for a minimum of 10-12 consecutive weeks), or semi-permanent pools and ponds that fill during heavy winter rains, or in permanent ponds (Alvarez 2004b). Adult CTS spend little time at breeding sites before returning to upland habitats. CTS populations generally do not persist where fish, American bullfrog, or predacious insects are well established. Breeding occurs mainly from December through February after rains fill pools and ponds. Eggs are laid singly or in small clusters, often attached to submerged stems and leaves, and hatch in two to four weeks. Larvae transform in about four months (Behler and King 1979) as water recedes in late spring or summer, but larvae may overwinter in permanent ponds (Alvarez 2004a). CTS may not breed at all in drought years when ponds fail to fill. CTS live in vacant or mammal-occupied burrows (e.g., California ground squirrel, *Otospermophilus beecheyi*, and valley pocket gopher, *Thomomys bottae*) (Trenham 2001), or occasionally other underground retreats, throughout most of the year in grassland, savannah, or open woodland habitats.

According to the Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the CTS (USFWS 2003), the criteria for CTS breeding habitat include the presence of standing water for a period sufficient for larvae to achieve metamorphosis. Breeding generally occurs between December and February. Larvae may metamorphose in as little as 10-12 weeks, although typically not until May to July (Laabs et al. 2001). Natural vernal pools, stock ponds, drainage ditches, and pools in low-gradient streams are potential habitats. Permanent ponds may be suitable, but not if predatory fish are established. The presence of American bullfrog (*Lithobates* [*Rana*] *catesbeianus*), introduced crayfish, and predacious insects may also decrease site suitability. Suitable upland habitats are equally important to the occurrence of CTS.

3.8.4.1.3 Occurrence and Habitat within the Don Pedro Project Boundary

There are five known historical CTS occurrences within 5 miles of the Don Pedro Project Boundary. The most recent of these was documented in 2007, approximately 0.4 miles from Don Pedro Reservoir (CDFW 2013). No CTS were observed during site assessments performed as part of 2012 surveys, nor were there any incidental sightings of CTS during other relicensing studies.

Site assessments and habitat characterizations were performed for CTS in the Don Pedro Project vicinity, which consisted of a review of historical data, identification of potential habitats using aerial photography and National Wetlands Inventory digital maps (USFWS 1987), and site evaluations (TID/MID 2013c). As specified in the FERC-approved study plan, the study area consisted of all suitable aquatic habitats within the Don Pedro Project Boundary and lands within 1.24 miles of the boundary, consistent with USFWS requirements. The study locations varied from large streams with substantial overhanging vegetation to manmade agricultural or water treatment ponds with no cover and limited vegetation. Ponds and streams within the Don Pedro Project vicinity are located in a mix of oak pastureland and pine savannah with shrubs, grasses, and forbs adjacent to the aquatic habitat. The diversity of study locations was representative of the Don Pedro Project Area as a whole. Small burrows were present at many sites.

Potential CTS breeding habitat (standing water for at least 10 weeks during the breeding season) was documented at or near 247 habitat sites within the study area. Many of the aerially assessed sites that held water for at least 10 weeks appeared to have suitable upland dispersal habitat nearby. Following aerial assessment, field surveys were conducted to verify habitat conditions and collect additional information at potential breeding sites within the Don Pedro Project Boundary and representative breeding locations on publicly accessible lands within 1.24 miles of the boundary. Field surveys revealed that the majority of these sites were perennial streams that were unsuitable because of high gradient or a lack of upland habitat suitable for dispersal. Within the Don Pedro Project Boundary, 38 field-assessed sites were characterized as potentially suitable for CTS breeding, 29 of which were considered more favorable to CTS breeding due to the presence of small burrows and upland habitat suitable for dispersal.

Based on their proximity to Don Pedro Project facilities or Don Pedro Reservoir, 20 sites were identified as having the potential to be affected by O&M activities. Of these 20 sites, two sites did not meet the 10-week criterion. Lack of emergent or overhanging vegetation or the presence of aquatic predators diminishes the potential suitability of most of the sites. Several pools in the spillway channel could not be accessed in the field due to safety concerns, making it impossible to determine whether CTS predators, such as fish and American bullfrog, were present. Table

3.8-2 summarizes the sites that are potentially affected by O&M activities, and describes elements important to CTS breeding habitat.

Table 3.8-2. Summary of CTS breeding sites potentially affected by O&M (TID/MID 2013c).

Site Number	Habitat Description	Area (acres)	Ownership	Meets 10-Week Criterion	Fish Known to Occur at Don Pedro Project Site
F31	Stream in Moccasin Point Recreation Area	0.39	MID/TID	N	None
F45	Sewage Treatment Pond near Fleming Meadows Recreation Area	1.51	MID/TID	Y	None
F46	Sewage Treatment Pond near Blue Oaks Recreation Area	1.53	MID/TID	Y	None
F47	Swimming lagoon at Fleming Meadows Recreation Area	2.16	MID/TID	Y	None
F49	Sewage Treatment Pond near Fleming Meadows Recreation Area	0.12	MID/TID	Y	None
F50	Sewage Treatment Pond near Blue Oaks Recreation Area	0.71	MID/TID	Y	None
F51	Sewage Treatment Pond near Moccasin Point Recreation Area	0.68	BLM	Y	None
F52	Sewage Treatment Pond near Moccasin Point Recreation Area	0.02	BLM	Y	None
F73	Stream in Moccasin Point Recreation Area	0.22	MID/TID	N	None
F77	Pool in spillway channel	0.14	MID/TID	Y	Not likely
F78	Pool in spillway channel	0.06	MID/TID	Y	Not likely
F80	Pool in spillway channel	1.61	MID/TID	Y	Not likely
F81	Pond at base of Gasburg Creek Dike, adjacent spillway channel.	0.88	MID/TID	Y	None
F82	Pool in spillway channel	0.33	MID/TID	Y	Not likely
F83	Pool in spillway channel	0.45	MID/TID	Y	Not likely
F85	Pool in spillway channel	0.33	MID/TID	Y	Not likely
F86	Pool in spillway channel	0.80	MID/TID	Y	Not likely
F87	Pool in spillway channel	0.32	MID/TID	Y	Not likely
F88	Pool in spillway channel	0.33	MID/TID	Unknown	Not likely
F89	Pool in spillway channel	0.06	BLM	Y	Not likely

3.8.4.2 California Red-Legged Frog

3.8.4.2.1 Regulatory Status

On May 23, 1996, the USFWS listed CRLF as threatened throughout its range (61 FR 25813 25833). The Final Recovery Plan for CRLF was issued on September 12, 2002 (67 FR 57830), and critical habitat was designated on March 13, 2001 (66 FR 14626), with additional critical habitat designated on April 13, 2006 (71 FR 19244), and revised on March 17, 2010 (75 FR 12816). No USFWS-designated Critical Habitat Units occur within 29 miles of the Don Pedro Project Boundary.

3.8.4.2.2 Life History and Habitat Requirements

CRLF is primarily associated with perennial ponds or pools and perennial or seasonal streams, where water remains for a minimum of 20 weeks beginning in the spring (i.e., sufficiently long for breeding to occur and larvae to complete development) (Jennings and Hayes 1994, USFWS 2006b). CRLF is also typically associated with low-gradient streams (Hayes and Jennings 1988), backwaters, and lentic habitat with emergent vegetation, although habitats lacking vegetation are sometimes used. Suitable CRLF breeding habitat is defined as:

> *Low-gradient fresh water bodies, including natural and manmade (e.g., stock) ponds, backwaters within streams and creeks, marshes, lagoons, and dune ponds….To be considered essential breeding habitat, the aquatic feature must have the capability to hold water for a minimum of 20 weeks in all but the driest of years* (USFWS 2010).

Locations with the highest densities of CRLF exhibit dense emergent or shoreline riparian vegetation closely associated with moderately deep (greater than 2.3 ft), still, or slow moving water. Plants that provide the most suitable structure are willows, cattails, and bulrushes at or close to the water level, which shade a substantial area of the water (Hayes and Jennings 1988). Another factor correlated with CRLF occurrence is the absence or near-absence of introduced predators such as American bullfrog and predatory fish, particularly mosquitofish and freshwater sunfishes, the latter of which feed on CRLF larvae at higher rates than do native predatory fish species (Hayes and Jennings 1988). The presence of non-native fish favors survival of bullfrogs over CRLF in streams (Hayes and Jennings 1988, Kruse and Francis 1977, Werner and McPeek 1994, Adams et al. 2003, Gilliland 2010). Hiding cover used to avoid predators may consist of emergent vegetation, undercut banks, and semi-submerged root wads (USFWS 2005b). Some habitats that are not suitable for breeding (e.g., shallow or short-seasonal wetlands, pools in intermittent streams, seeps, and springs) may constitute habitats for aestivation, shelter, foraging, predator avoidance, and juvenile dispersal.

Depending on elevation and climate, CRLF may breed from late November to late April. Egg masses are attached to emergent vegetation such as cattails or bulrush in natural ponds, stock ponds, marshes, or in deep pools and stream backwaters. Larvae typically metamorphose between July and September (Jennings and Hayes 1994).

Adult dispersal outside the breeding season may be directed upstream, downstream, or upslope of breeding habitat, and may be associated with foraging and pursuit of hiding cover or aestivation habitat. Telemetry and other detection methods indicate that CRLF use small mammal burrows, leaf litter, and other moist sites as much as 200 ft from riparian areas (Jennings and Hayes 1994, USFWS 2006b). Long-distance dispersal has been documented at distances of up to 1 mile but probably occurs only during wet periods (USFWS 2006b).

3.8.4.2.3 Occurrence and Habitat within the Don Pedro Project Boundary

No occurrences of CRLF have been recorded within 5 miles of the Don Pedro Project Boundary since 1984, and the USFWS's recovery plan for the species lists CRLF as extirpated from the Tuolumne River watershed (USFWS 2002b).

Site assessments and habitat characterizations were performed for CRLF in the Don Pedro Project vicinity, including a review of historical data, identification of potential habitats using aerial photography and National Wetlands Inventory digital maps (USFWS 1987), and site evaluations (TID/MID 2013d). As specified in the FERC-approved CRLF study plan, the study area for this effort consisted of all suitable aquatic habitats within the Don Pedro Project Boundary and lands within 1 mile of the boundary, consistent with USFWS requirements. Ponds and streams within the study area are located in a mix of oak pastureland and pine savannah with shrubs, grasses, and forbs adjacent to the aquatic habitat. The study locations varied from large streams with substantial overhanging vegetation to agricultural or water treatment ponds with no cover and limited vegetation. The diversity of study locations was representative of the Don Pedro Project area as a whole.

Initial assessment using aerial photography and National Wetlands Inventory digital maps determined that a total of 211 locations within the study area met the minimum criterion of 20 weeks of standing or slow-moving water during the CRLF breeding season. Many of the aerially assessed sites that met the 20-week criterion had some emergent and overhanging vegetation, but while these sites were located within the study area, they were not located within the Don Pedro Project Boundary, and were classified as marginal due to habitat type (e.g., human-made agricultural ponds) and the presence of bullfrogs.

Following aerial assessment, field surveys to verify habitat characterizations and collect additional information were performed at potential breeding sites within the Don Pedro Project Boundary, and representative breeding locations on publicly accessible lands within one mile of the boundary. Field surveys revealed that the majority of these sites provide marginal habitat due to a lack of emergent or overhanging vegetation or because of the presence of predators such as fish and bullfrogs. Of the field-assessed sites, 52 were characterized as potentially suitable CRLF breeding sites based on the minimum criterion, 10 of which were considered more favorable for CRLF breeding due to the presence of suitable vegetation and lack of predators. No CRLF were observed during this or other studies. Table 3.8-3 summarizes sites that are potentially affected by O&M activities, and describes elements important to CRLF breeding habitat.

Table 3.8-3. Summary of CRLF breeding sites potentially affected by O&M activities (TID/MID 2013d).

Site Number	Habitat Description	Area (acres)	Meets 20-Week Criterion	Notes
F31	Stream in Moccasin Point Recreation Area	0.39	N	No emergent vegetation present Blackberry overhanging.
F45	Sewage Treatment Pond near Fleming Meadows Recreation Area	1.51	Y	No emergent or overhanging vegetation present.
F46	Sewage Treatment Pond near Blue Oaks Recreation Area	1.53	Y	No emergent of overhanging vegetation present.
F47	Swimming lagoon at Fleming Meadows Recreation Area	2.16	Y	Pool lined with concrete. No vegetation present.
F49	Sewage Treatment Pond near Fleming Meadows Recreation Area	0.12	Y	Pond lined with concrete. No vegetation present.
F50	Sewage Treatment Pond near Blue Oaks Recreation Area	0.71	Y	Pond lined with concrete. No vegetation present.

Site Number	Habitat Description	Area (acres)	Meets 20-Week Criterion	Notes
F51	Sewage Treatment Pond near Moccasin Point Recreation Area	0.68	Y	Emergent vegetation limited. No overhanging vegetation.
F52	Sewage Treatment Pond near Moccasin Point Recreation Area	0.02	Y	Pond lined with concrete. Vegetation consisted of sparse forbs.
F73	Stream in Moccasin Point Recreation Area	0.22	N	Emergent vegetation: curled dock, cleavers, aster, grasses, and submerged rushes. Oak and toyon overhanging.
F77	Pool in spillway channel	0.14	Y	Emergent vegetation: cattail, monkey flower, bulrush, and primrose. No overhanging vegetation present.
F78	Pool in spillway channel	0.06	Y	Emergent vegetation: cattail, bulrush, primrose, and fern. No overhanging vegetation.
F80	Pool in spillway channel	1.61	Y	Emergent vegetation: cattail and some sedges. Sparse buckeye overhanging.
F81*	Pond at base of Gasburg Creek Dike, adjacent spillway channel.	0.88	Unknown	Emergent vegetation: primrose and bulrush. Blue oak overhanging.
F82	Pool in spillway channel	0.33	Y	Emergent vegetation present. Willows overhanging.
F83	Pool in spillway channel	0.45	Y	Emergent vegetation present. Willows overhanging.
F85	Pool in spillway channel	0.33	Y	Emergent vegetation present. Willows and shrubs overhanging.
F86	Pool in spillway channel	0.80	Y	Emergent vegetation present. Willows overhanging.
F87	Pool in spillway channel	0.32	Y	Emergent vegetation present. Oaks and willows overhanging.
F88	Pool in spillway channel	0.33	Unknown	Emergent and aquatic vegetation present. Shrubs overhanging.
F89	Pool in spillway channel	0.06	Y	No emergent or overhanging vegetation present.

* Sites considered to be more favorable for CRLF breeding due to the presence of suitable vegetation and lack of predators.

3.8.4.3 San Joaquin Kit Fox

3.8.4.3.1 Regulatory Status

The San Joaquin kit fox was originally listed as endangered in 1967 under the Endangered Species Preservation Act (32 FR 4001). It is currently ESA-listed as an endangered species. The Final Recovery Plan for Upland Species of the San Joaquin Valley, including San Joaquin kit fox, was issued on September 30, 1998 (Williams et. al. 1998). A five-year review was completed for the species in February 2010, and no change to listing status was recommended.

3.8.4.3.2 Life History and Habitat Requirements

San Joaquin kit foxes mate in winter and have between four and seven young in February or March. They use multiple underground dens throughout the year, sometimes using pipes or culverts as den sites in addition to burrows. Their primary prey is usually the most abundant nocturnal rodent or lagomorph in their area. They also feed opportunistically on carrion, birds, reptiles, insects, and fruits (NatureServe 2009).

San Joaquin kit foxes are reported to use a wide range of habitats, including alkali sink, valley grassland, and foothill woodlands (NatureServe 2009), at times in proximity to agriculture and grazing lands (Bell 1994). Kit foxes prefer loose-textured soils (Grinnell et al. 1937, Hall 1946, Egoscue 1962, Morrell 1972) but are found on virtually every soil type. Dens appear to be scarce in areas with shallow soils (OFarrell and Gilbertson 1979, OFarrell et al. 1980), high water tables (McCue et al. 1981), or impenetrable hardpan layers (Morrell 1972). However, kit foxes will occupy soils with high clay content, such as those in the Altamont Pass area in Alameda County, where they modify burrows excavated by other animals (Orloff et al. 1986).

3.8.4.3.3 Occurrence and Habitat within the Don Pedro Project Boundary

The CNDDB includes a single record of a San Joaquin kit fox within the general vicinity of the Don Pedro Project Boundary, approximately 2.1 mi southwest of the boundary. The record is from 1972-1973, in an area that is currently an Off-Highway Vehicle recreation development (CDFW 2013). No occurrences of San Joaquin kit fox have been recorded within 5 miles of the Don Pedro Project Boundary since 1973 (CDFW 2013). No kit fox sightings or large burrows were documented during the Districts' extensive terrestrial surveys conducted during 2012, but nearby occurrence records indicate that the presence of kit foxes cannot be ruled out.

3.8.5 Resource Effects

Page 37 of FERC's SD2 identifies the following issues related to Threatened and Endangered species:

- *Effects of project operation, including water level fluctuations, ground-disturbing activities, and maintenance on plants and wildlife species listed as threatened or endangered under the Endangered Species Act (ESA).*[29]
- *Effects of maintenance and use of project recreation facilities by recreationists on species listed as threatened or endangered under the ESA.*
- *Effects of project operation and maintenance on designated critical habitat under the ESA.*[30]

[29] (Footnote from FERC's SD2) Species cited by Districts as Threatened or Endangered under the ESA occurring in the Don Pedro Project area and surrounding lands include the Hartweg's golden sunburst, Hairy Orcutt grass, Greene's tuctoria, San Joaquin kit fox, succulent owl's-clover, Hoover's spurge, Colusa grass, Chinese Camp brodiaea, Layne's ragwort, Red Hills vervain, Valley elderberry longhorn beetle, vernal pool fairy shrimp, California tiger salamander (Central Valley DPS), California red-legged frog, and the steelhead (California Central Valley DPS)). Additional species cited during scoping as Threatened or Endangered under the ESA occurring in the Don Pedro Project Area or surrounding lands include the riparian brush rabbit, the riparian wood rat, the Least Bell's vireo, and conservancy fairy shrimp.

- *Effects of vegetation clearing for project maintenance on species listed as threatened or endangered under the ESA.*

3.8.5.1 Effects of the Proposed Action

The Proposed Action would have no direct or indirect adverse effects on the ESA-and CESA-listed species addressed in this FLA. The Proposed Action, i.e., relicensing of existing hydropower operations at Don Pedro Dam along with proposed resource enhancements (see Section 3.8.6, below), would have no effect on reservoir water surface elevations, recreational use, or maintenance activities, and as a result no adverse effect on listed species or their potential habitats.

Electric power is generated at the Don Pedro Hydroelectric Project using flows released for other purposes. Irrigation, municipal, and industrial water deliveries are pre-scheduled based on forecasted demands and actual projected inflow and then released through the powerhouse up to its hydraulic capacity. These releases are shaped during periods of peak electrical demand, when consistent with water supply requirements and subject to irrigation infrastructure constraints, to release more flow during on-peak rather than off-peak hours. However, such minor variability in flow releases immediately downstream of Don Pedro Dam as the result of hydroelectric operations has no significant influence on water surface elevation or other conditions in Don Pedro Reservoir. Reservoir levels reflect operations related to diversions and releases made in association with unrelated and non-interdependent actions, e.g., providing water for irrigation and municipal and industrial uses, as well as flood management in accordance with ACOE guidelines. Hydroelectric generation at the Don Pedro Hydroelectric Project cannot adversely impact ESA-listed species, because environmental variability in the reservoir is not linked to power production and, absent power production at the Don Pedro Project, the operations, including recreation, would remain as they are under existing conditions, i.e., driven by uses other than hydropower production.

3.8.5.2 Resource Effects of Don Pedro Project O&M Actions

3.8.5.2.1 Description of O&M Actions

All actions described and evaluated below are related to the Don Pedro Project's primary purposes (water supply for irrigation and M&I uses and water management for flood control). These actions are unrelated to the Proposed Action, which would not contribute in any way to adverse effects on ESA-listed species.

Facilities and Road Maintenance

As part of operating the Don Pedro Project to achieve its primary purposes, the Districts maintain developed facilities and roads using a combination of mechanical mowing and periodic use of pre-emergent herbicides to manage vegetation. Areas maintained by the Districts are typically

[30] (Footnote from FERC's SD2) Species cited by Districts with designated critical habitat occurring in the project area and surrounding lands include the Hairy Orcutt grass, Greene's tuctoria, Succulent owl's-clover, Hoover's spurge, Colusa grass, vernal pool fairy shrimp, California tiger salamander (Central Valley DPS), and steelhead (California Valley DPS).

managed in proportion to their use. Developed facilities and associated roads are managed with pre-emergent herbicides annually after the first fall rain, usually in November. Similarly, the perimeters of wastewater treatment facilities are sprayed annually, using herbicides labeled for aquatic use when appropriate, to manage vegetation or aquatic weeds and algae. Mechanical removal of aquatic weeds is also conducted when growth is excessive. Main access road shoulders are mechanically mowed or treated with herbicides. In contrast, unpaved roads leading to Don Pedro Dam from the main road are rarely used, and no formal management is conducted. Some roads may be treated for specific uses, e.g., a small access road leading to La Grange Dam is typically unmanaged but was mowed in 2012 to allow access for water quality monitoring. All herbicide use is conducted by licensed applicators in accordance with label requirements.

Recreation Area Maintenance

The Districts' three developed recreation areas are managed to control vegetation and the associated risk of fire. High-use sections of each recreation area are subject to mechanical mowing and trimming on a frequent basis, and pads, road edges, firebreaks, and the immediate areas around restrooms and DPRA facilities are sprayed with pre-emergent and/or post-emergent herbicides annually after the first rains. All herbicide use is conducted by licensed applicators in accordance with label requirements. Additionally, the Districts may engage in ground squirrel control via two methods:

(1) Burrow blasting: This poison-free management approach involves injection of nearly pure oxygen and a small amount of propane into the squirrel burrow. Once a correct amount of oxygen and gas is injected, the source of the gas is shut off and the gas in the burrow is ignited. This method was used in 2012 and 2013 within the Don Pedro Project Boundary.

(2) Targeted use of pelleted rodent bait in developed recreation areas. The last such application occurred during the 2009–2010 season. The Districts will notify the USFWS of any rodenticide use and locations of application on an annual basis. All rodenticide use is conducted by licensed applicators in accordance with label requirements.

The Districts have a Prescribed Burn Program that allows the use of prescribed burns for vegetation management. The Prescribed Burn Program includes limitations on the timing and frequency of burns, depending on weather conditions, to minimize fire risk and the potential for damage to adjacent habitats. The Districts use prescribed burning on a limited basis as a management tool. The last burn conducted under the program occurred in 2009, but the Districts will continue to use prescribed burns as conditions permit.

Woody Debris Management

Article 52 of the existing FERC license requires the implementation of the Districts' Log and Debris Removal Plan. Under the Plan, the Districts collect and remove debris at Don Pedro Dam and from other areas in the reservoir as needed. Debris is collected in boom rafts, piled in un-vegetated areas below the high-water mark along the reservoir's edge, and burned during fall and winter.

3.8.5.2.2 Effects Analysis for O&M Actions

The following sections provide an assessment of the potential effects of O&M activities conducted to support the Don Pedro Project's primary purposes (water supply and flood control) on each ESA-/CESA-listed species addressed in this FLA. Effects discussed in the following sections are unrelated to the Proposed Action for the reasons described above.

Layne's Ragwort and California Vervain

Potential stressors and disturbances to Layne's ragwort and California vervain include terrestrial recreation, cattle grazing, noxious weeds, vegetation management, and road maintenance. Small portions of several Layne's ragwort occurrences are located below the normal maximum water surface elevation of the reservoir. These plants are not currently adversely affected by variation in water surface elevation related to the Don Pedro Project's primary purposes of water supply and flood control.

Three occurrences of Layne's ragwort and one occurrence of California vervain were found near recreation sites, but no occurrences were found adjacent to roads or other facilities. Recreation activities, particularly equestrian trail riding, take place in the vicinity of several occurrences of Layne's ragwort and California vervain in Poor Man's Gulch. A cleared trail runs close by Layne's ragwort occurrence 631. Equestrians ride into the area from upstream of the Don Pedro Project. Very few recreationists appear to access the gulches from the reservoir shoreline. On Kanaka Point, recreationists access the area via a free day-use parking lot, and there is evidence of a walking trail in the vicinity of all Layne's ragwort surveyed in the area. In addition, distaff thistle (*Carthamus creticus*) was observed within 250 ft of a Layne's ragwort occurrence. Distaff thistle is a noxious weed that spreads quickly and can form dense stands, which can displace native plants (DiTomaso and Healy 2007). Because no occurrences of Layne's ragwort or California vervain are located near roads or other facilities, O&M activities are unlikely to affect these two plant species.

California Red-Legged Frog and California Tiger Salamander

CRLF are not known to occur within the Don Pedro Project boundary. No occurrences have been documented within a 5-mile radius of the Don Pedro Project, and the species is reported to be extirpated from the Tuolumne River watershed. Because the species is not believed to occur within the boundary, there is little to no potential for facilities and road maintenance, recreation, recreation area maintenance, and woody debris management to have an adverse effect on CRLF.

CTS are not known to occur within the Don Pedro Project Boundary, but are reported to occur in the Don Pedro Project vicinity. CTS breeding habitat is present within the Don Pedro Project boundary, but it is considered to be of marginal quality. As a result, adverse effects on CTS resulting from facilities and road maintenance, recreation, or recreation area maintenance are unlikely.

CRLF and CTS breeding habitat was documented at seven sites located at recreational facilities, i.e., one constructed swimming lagoon and six sewage treatment ponds. Each of these sites is lined with either concrete or gravel and has little or no surrounding upland vegetation. Although these sites all hold water for at least 10 weeks during the CTS breeding season and 20 weeks during the CRLF breeding season, they are considered to be marginal habitat due to their lack of overhanging and emergent vegetation and lack of suitable adjacent upland habitat. Therefore, they are unlikely to support CRLF or CTS. No potential CRLF or CTS breeding habitat was documented adjacent to roads or other facilities.

Ten of the sites that met the minimum criteria for both CTS and CRLF breeding habitats are located within or adjacent to the Don Pedro Dam spillway channel. However, flow has only been passed through the spillway once since Project construction (i.e., during the 1997 flood). The rare use of the spillway makes potential adverse effects on any CTS or CRLF, if they were present, highly unlikely.

Valley Elderberry Longhorn Beetle

VELB host plants (i.e., elderberry) and evidence of VELB were documented within the Don Pedro Project Boundary. Most elderberry shrubs are located on shorelines or hillsides that are not affected by the Don Pedro Project. The elderberry plants located in developed recreation areas and adjacent to facilities were vigorous at the time of the 2012 surveys, showing no signs of stress.

Elderberry occurrences 47 and 307 are located near the normal maximum water surface elevation of Don Pedro Reservoir. Under existing conditions, these plants are not adversely affected by variation in water surface elevation related to the Don Pedro Project's primary purposes of water supply and flood control.

Two elderberry occurrences are located near a sewage pond, where vegetation management activities are conducted. Six occurrences at Moccasin Point and one occurrence at Blue Oaks Recreation Area are located near roads and campsites, and nine occurrences at Kanaka Point, Harney Road, Hatch Creek, Shawmut Road, and Rogers Creek Arm are potentially subject to trampling caused by day-use recreation, particularly during summer months.

Under existing conditions, elderberry found near roads and recreation areas showed no signs of stress from human disturbance. Therefore, under existing conditions, road maintenance, recreation facilities maintenance, and woody debris management are expected to have no significant adverse effects on elderberry, and as a result should have no effects on VELB. Disturbance by recreational users is possible, as stated above, but because elderberry found near roads and recreation areas showed no signs of stress from human disturbance under existing conditions, it is reasonable to assume that disturbance is likely to be limited in the future.

San Joaquin Kit Fox

San Joaquin kit fox are not reported to occur within the Don Pedro Project Boundary, and during extensive terrestrial field surveys conducted in 2012 no kit foxes were sited and no large burrows were documented. However, nearby occurrence records indicate that kit foxes have the potential to be present within the boundary. The Districts do not engage in predator control that could affect San Joaquin kit fox, and no habitat conversions are proposed that would alter potential San Joaquin kit fox habitat within the Action Area. As a result, adverse effects on any kit foxes that might at times occupy the area within the Project Boundary are unlikely.

Vernal Pool Fairy Shrimp

Vernal pool fairy shrimp are not reported to occur within the Don Pedro Project Boundary, and no vernal pools or plant species indicating the presence of vernal pools were documented during the Districts' extensive terrestrial resources field surveys conducted in 2012. Given the absence of the vernal pool fairy shrimp and its habitat, there will be no adverse effects on the species associated with any O&M or recreation activities.

3.8.6 Proposed Resource Measures

The Districts include a Draft Vegetation Management Plan (Appendix E-1) with this license application. The Draft Vegetation Management Plan incorporates measures to manage ESA-listed plant species occurrences within the Project Boundary, including control of noxious weeds, protection of special status plants, and employee training. In addition, the Districts propose to follow USFWS Conservation Guidelines pertaining to the VELB for the management of elderberry within the Don Pedro Project Boundary (USFWS 1999). These enhancement measures are expected to benefit ESA- and CESA-listed plant species by limiting noxious weed distributions and providing protection of VELB habitat.

3.8.7 Unavoidable Adverse Impacts

The Don Pedro Project has no unavoidable adverse effects on ESA- and CESA-listed species.

3.9 Recreation, Land Use, and Shoreline Management

3.9.1 Existing Environment

3.9.1.1 Recreation in the Don Pedro Project Vicinity

The Don Pedro Project, located on the Tuolumne River in Tuolumne County, California, provides diverse and substantial recreation opportunities, including house boating, pleasure boating, fishing, swimming, water skiing, picnicking, hiking, and camping at either developed or remote sites. Numerous recreational opportunities are also available in the area surrounding the Don Pedro Project as well. Federally managed lands along the Tuolumne River along and above the Don Pedro Reservoir, including the BLM's Area of Critical Environmental Concern (ACEC), the Stanislaus National Forest, and Yosemite National Park, provide extensive opportunities for many popular recreational activities, including hiking, camping, fishing, and high-gradient whitewater boating in an undisturbed natural setting. Downstream of La Grange Diversion Dam, owned by the Districts and located about two miles below Don Pedro Dam, the lower Tuolumne River provides opportunities for fishing, swimming, and low gradient or flat-water boating in a rural/urban setting with agriculture and gravel mining along much of the river corridor.

3.9.1.1.1 Overview of Regional Recreation Demand

The California State Parks (2008) California Outdoor Recreation Planning Program (CORP) identifies trends and challenges in providing recreation opportunities to Californians. Trends identified by the 2008 CORP include:

- increasing population densities in urbanized areas,
- demographic shifts in California such as:
  - increased ethnic and cultural diversity,
  - estimated doubling of Californians aged 55 to 75 by the year 2030, and
  - increasing income inequality.
- increasing rates of obesity combined with a decrease in children actively recreating outdoors,
- increased high-tech-related recreation, such as geocaching,
- decline in participation of some traditional outdoor activities such as hunting and fishing,
- increasing use by Californians of their state's local park and recreation areas due to a combination of the economic downturn, the rise in home foreclosures, and fluctuating gasoline prices, and
- continued interest in the pursuit of adventure activities (e.g., mountain biking, scuba diving, kite surfing, and wilderness backpacking) and high-risk activities (e.g., rock climbing, bungee jumping, and hang gliding).

A critical component of the 2008 CORP is to determine the current attitudes, opinions, and beliefs of Californians regarding their experiences using outdoor recreation areas, facilities, and programs. This is achieved through the administration of the Public Opinions and Attitudes in Outdoor Recreational (POAOR) Survey (California State Parks 2009). The survey was conducted in 2007 and differed from previous surveys by including surveys for both adult and youth populations. Similar to previous CORP reports, responses from Hispanic and non-Hispanic adult residents were compared in order to identify any differences in recreation uses and needs between these two groups.

To understand latent demand, Californians were asked to identify which activities they would like to participate in more often. A list of the activities with the highest latent demand for each of these subgroups is found in Tables 3.9-1 through 3.9-3.

Table 3.9-1. Activities with highest latent demand – adult survey.

Ranking	Activity	Ranking	Activity
1	Walking for fitness or pleasure	9	Attending outdoor cultural events
2	Camping in developed sites	10	Off-highway vehicle use
3	Bicycling on paved surfaces	11	Driving for pleasure, sightseeing
4	Day hiking on trails	12	Swimming in a pool
5	Picnicking in picnic areas	13	Wildlife viewing
6	Beach activities	14	Outdoor photography

Ranking	Activity	Ranking	Activity
7	Visiting outdoor nature museums	15	Swimming in freshwater lakes, rivers
8	Visiting historic or cultural sites	--	--

Source: California State Parks, Public Opinions and Attitudes on Outdoor Recreation in California, 2009, p. 38

Table 3.9-2. Activities with highest latent demand – youth survey.

Ranking	Activity	Ranking	Activity
1	Horseback riding	9	Surfing, boogie boarding
2	Sledding, ice and snow play	10	Waterskiing or wakeboarding
3	Snowboarding	11	Swimming in oceans, lakes, rivers and streams
4	Swimming in a pool	12	Archery
5	Jet skis or wave runners	13	Camping
6	Rock climbing	14	Attending outdoor events
7	Beach activities	15	Paddle sports
8	Off-road vehicle use	--	--

Source: California State Parks, Public Opinions and Attitudes on Outdoor Recreation in California, 2009, pp.112-114

Table 3.9-3. Activities with highest latent demand – Hispanic adults.

Ranking	Activity	Ranking	Activity
1	Bicycling on paved surfaces	9	Attending outdoor cultural events
2	Walking for fitness or pleasure	10	Off-highway vehicle use
3	Day hiking on trails	11	Driving for pleasure, sightseeing
4	Picnicking in picnic areas	12	Swimming in a pool
5	Visiting outdoor nature museums	13	Wildlife viewing
6	Camping in developed sites	14	Outdoor photography
7	Beach activities	15	Swimming in freshwater lakes, rivers
8	Visiting historical or cultural sites	--	--

Source: California State Parks, Public Opinions and Attitudes on Outdoor Recreation in California, 2009, pp.86-87

There are four primary categories of outdoor recreation areas in the 2008 CORP. These are (1) highly developed park and recreation areas, (2) developed nature-oriented park and recreation areas, (3) historical or cultural buildings, sites and areas, and (4) natural or undeveloped areas. Californians visit all four types of outdoor recreation areas, with the most popular being highly developed parks and recreation areas.

The broader geographic area beyond the Project vicinity currently provides opportunities for visitors to participate in many of the outdoor activities that have high latent demand. These opportunities include:

- camping in developed sites,
- day hiking on established trails,
- picnicking in picnic areas,
- beach activities,
- wildlife viewing,
- outdoor photography,
- swimming in freshwater lakes, rivers,

- jet skiing or wave runner use,
- waterskiing or wakeboarding, and
- paddle sports (canoeing, kayaking, row boating).

3.9.1.1.2 Upper Tuolumne River Recreation Opportunities

Yosemite National Park and Stanislaus National Forest are prominent features of the watershed above the Don Pedro Project. The Tuolumne Meadows area within Yosemite National Park provides easily accessible recreational opportunities for people of all ages and abilities, and many individuals, families, and groups establish traditional ties with the area. The National Park Service (NPS) and other organizations promote the river and adjacent meadows as a focus of nature interpretation and education in the Sierra Nevada. The Pacific Crest Trail, one of eight National Scenic Trails, generally follows the river corridor in this segment of the trail.

In 1984, Congress designated portions of the upper Tuolumne River as Wild and Scenic. A total of 54 miles of the Tuolumne River within Yosemite National Park have been designated as Wild and Scenic. These sections include the Dana Fork and Lyell Fork at the headwaters of the river; a scenic segment through Tuolumne Meadows; a wild segment from the Grand Canyon of the Tuolumne River to the inlet of Hetch Hetchy Reservoir; a scenic segment from one mile west of O'Shaughnessy Dam; and the remaining five mile wild segment through Poopenaut Valley to the park boundary. Approximately 13 river miles of the Hetch Hetchy Reservoir were not included in the 1984 Wild and Scenic River designation and thus are not included within the Tuolumne Wild and Scenic River corridor.

The remaining segments of the Wild and Scenic Tuolumne River are under the administration of the USFS and the BLM. Approximately six miles below the O'Shaughnessy Dam, the Tuolumne River leaves Yosemite National Park and enters the Stanislaus National Forest. The Stanislaus National Forest encompasses 898,099 ac on the western slope of the Sierra Nevada between Lake Tahoe and Yosemite National Park. There are three wilderness areas within the Stanislaus National Forest: Carson-Iceberg, Emigrant, and Mokelumne. The forest offers a full range of year-round recreation opportunities including wildlife viewing, hiking, fishing, camping, picnicking, and off-road vehicle use (USDA undated).

There are a variety of developed and undeveloped camping areas along the upper Tuolumne River upstream of the Project Boundary. Campsites are utilized by hikers, whitewater boaters, anglers, and other recreational users. The most commonly used camping areas along the upper Tuolumne are the Tuolumne Meadows located within Yosemite National Park and Hetch Hetchy Reservoir. Camping at Hetch Hetchy is undeveloped camping, and a wilderness permit is required (NPS 2010).

In all, portions of the Tuolumne River designated as Wild & Scenic include stretches of the river extending 83 miles upstream of the Don Pedro Project Boundary. No specific reaches of the Tuolumne River within the FERC Project Boundary were designated by Congress as Wild or Scenic. However, when establishing an approximate location for the wild and/or scenic reaches, the USFS' description of the wild and scenic corridor overlapped with the 1966 authorized FERC Project Boundary for a distance of about one mile. This USFS description is contrary to the 1984 designating act which states "[n]othing in this section is intended or shall be construed to affect any rights, obligations, privileges, or benefits granted under any prior authority of law including chapter 4 of the Act of December 19, 1913, commonly referred to as the Raker Act (38 Stat. 242) *and including any agreement or administrative ruling entered into or made effective before the enactment of this paragraph."* [emphasis added]. (Public Law 98-425)

Camping

Within the Stanislaus National Forest, there are 12 riverside campsites and three USFS campgrounds. Motorhomes and vehicles with trailers are not recommended in many of the campgrounds along the upper Tuolumne River, as the access roads can be steep and rutted and electric and sewer hookups are not available in many of the dispersed camping areas (2009 Great Outdoor Recreation Pages [GORP] - Tuolumne River). A summary of the camping areas and amenities is provided in Table 3.9-4.

Table 3.9-4. Upper Tuolumne Campgrounds.

Developed Campgrounds
Tuolumne Meadows Campground (Yosemite National Park) - located on the Tioga Road, northeast of Yosemite Valley at an elevation of 8,600 ft. Open July through late September, offering 304 tent campsites, seven group campsites, and four horse campsites. Fees for campgrounds are: $20/night for each campsite (maximum six people per site); $40/night for the group campsite (13 to 30 people per site); and $25/night for the horse sites (maximum six horses and six people per site). Additional amenities include a dump station and general store.
Glen Aulin Campground (Yosemite National Park) - located along the Tuolumne River approximately one mile upriver from the Grand Canyon of the Tuolumne at an elevation of approximately 7,800 ft. Open July through September (snowmelt permitting); reservations and NPS wilderness permits required; tent cabins and traditional tent campsites available by lottery through High Sierra Camps.
Hetch Hetchy Campground (Yosemite National Park) - located along the Tuolumne River immediately downriver from the Hetch Hetchy Reservoir. Open year round (snowmelt permitting); reservations and NPS wilderness permits required; trailers, vehicles over 25 ft long, and RVs and other vehicles over eight ft wide are not allowed on Hetch Hetchy Road. No boating or swimming permitted at Hetch Hetchy Reservoir.
South Fork Campground (Stanislaus National Forest) - located near the confluence of the South and Main Forks of the Tuolumne River at an elevation of 1,500 ft. Approximately one mile upstream from the Lumsden Campground. The facility offers eight campsites with two vault toilets, stoves, and tables. Most sites are on the river or have river access. There is no running water, no use fee, and is not recommended for trailers / RV campers.
Lumsden Campground (Stanislaus National Forest) - located on the Tuolumne River one mile from South Fork Campground, within the Tuolumne-Lumsden Recreation Area off of Lumsden Road and Highway 120 at an elevation of 1,500 ft. The facility offers eleven campsites along the river with four vault toilets, stoves, and tables. There is no running water, no use fee, and is not recommended for trailers / RV campers.
Lumsden Bridge Campground (Stanislaus National Forest) - located on the Tuolumne River next to Lumsden Campground, within the Tuolumne-Lumsden Recreation Area off of Lumsden Road and Highway 120 at an elevation of 1,500 ft. The facility offers nine campsites along the river with two vault toilets, stoves, and tables. There is no running water, no use fee, and is not recommended for trailers / RV campers.
Undeveloped Camping[1]
Tin Can Cabin - located 3.5 miles downriver from Lumsden Campground on the Tuolumne River.
Clavey - located 5.5 miles downriver from Lumsden Campground on the Tuolumne River.
Powerhouse - located 7.6 miles downriver from Lumsden Campground on the Tuolumne River.
Grapevine - located 8.0 miles downriver from Lumsden Campground on the Tuolumne River.
Indian Creek - located 8.3 miles downriver from Lumsden Campground on the Tuolumne River.
Wheelbarrow - located 8.8 miles downriver from Lumsden Campground on the Tuolumne River.
Baseline - located 8.9 miles downriver from Lumsden Campground on the Tuolumne River.

Developed Campgrounds
Driftwood Paradise - located 11.4 downriver from Lumsden Campground on the Tuolumne River.
Cabin - located 12.8 miles downriver from Lumsden Campground on the Tuolumne River.
Big Creek - located 13.0 miles downriver from Lumsden Campground on the Tuolumne River.
Mohican - located 14.1 miles downriver from Lumsden Campground on the Tuolumne River.
North Fork - located 15.0 miles downriver from Lumsden Campground on the Tuolumne River.

[1] All undeveloped camping managed by Stanislaus National Forest.
Source: GORP 2009 - Tuolumne River, NPS 2010

Whitewater Boating/Rafting

In addition to camping along the Tuolumne, whitewater boating/rafting occurs upstream of the Project Boundary. All of the whitewater boating reaches identified in Table 3.9-5 provide opportunities for both kayaks and rafts. The upper Tuolumne River whitewater rafting season generally runs from April through August. The area along the upper Tuolumne from Cherry Creek to Don Pedro Project Boundary is commonly referred to as the Main Tuolumne. Most of the 27 mile Main Tuolumne River reach is an advanced Class IV-V river, and many portions require USDA Forest Service permits (California Whitewater 2010). There are four commercial white water companies that operate regularly on the Main Tuolumne (All-Outdoors California Whitewater Rafting, ARTA River Trips, O.A.R.S. California Whitewater Rafting, and Sierra Mac River Rafting Trips).

Table 3.9-5. Known whitewater boating runs on the Tuolumne River upstream of the Project area.

Whitewater Run	Length (miles)	Gradient (feet per mile)	Flow Range (cfs)	Optimum Flow Range (cfs)	Whitewater Classification
Upper Tuolumne (Meral’s Pool to Ward’s Ferry)	18.0	40	600-10,000	3,000	IV-V (600-4000) IV+ (4000-8000) V-V+ (8000+)
Cherry Creek (Cherry Creek just below bridge to Meral’s Pool)	9.0	110	600-2,000	1,500	V (600-1500) V+ (1500-2000)
Clavey River (Upper Bridge to Lower Bridge)	8.5	n/a	n/a	n/a	V+
South Fork of Tuolumne (Highway 120 to Rainbow Pool Picnic Area)	7.0	n/a	n/a	n/a	IV-V

Source: California Whitewater 2010

Fishing

Fishing is also a popular recreational activity along the upper Tuolumne River. There are a variety of access points along this reach. The sections listed below outline some of the main fishing areas along the upper Tuolumne, as well as the season, bag limit, and special regulations pursuant to the CDFW (CDFG 2010a).

- Lyell Fork of the Tuolumne in Yosemite National Park:
  - Season: Last Saturday in April through November 15,
  - Bag limit: five, and

- Special regulations: Brook trout minimum 10 inches. No fishing from piers or bridges. Use of live bait prohibited.

▪ Dana Fork of the Tuolumne in Yosemite National Park:

- Season: Last Saturday in April through November 15,
- Bag limit: five, and
- Special regulations: Brook trout minimum 10 inches. No fishing from piers or bridges. Use of live bait prohibited.

▪ Grand Canyon of the Tuolumne in Yosemite National Park:

- Meadows or from Hetch Hetchy Campgrounds,
- Season: Last Saturday in April through November 15,
- Bag limit: five, and
- Special regulations: Brook trout minimum 10 inches. Use of live bait prohibited.

▪ Hetch Hetchy Reservoir:

- Season: Year round,
- Bag limit: five, and
- Special regulations: Use of live bait prohibited. No boating or swimming permitted.

▪ O'Shaughnessy Dam to Early Intake Diversion Dam (Cherry Creek Confluence) in Yosemite National Park and Stanislaus National Forest:

- Season: Last Saturday in April through November 15,
- Bag limit: two, and
- Special regulations: Minimum length 12 inches. Only artificial lures with barbless hooks may be used.

▪ Early Intake Diversion Dam (Cherry Creek Confluence) to South Fork Tuolumne confluence in Stanislaus National Forest:

- Season: Last Saturday in April through November 15,
- Bag limit: five, and
- Special regulations: Minimum length 12 inches. Only artificial lures with barbless hooks may be used.

▪ South Fork Tuolumne confluence to Clavey River confluence in Stanislaus National Forest:

- Season: Last Saturday in April through November 15,
- Bag limit: two, and
- Special regulations: Minimum length 12 inches. Only artificial lures with barbless hooks may be used.

▪ Clavey River confluence to North Fork Tuolumne confluence in Stanislaus National Forest:

- Season: Last Saturday in April through November 15,
- Bag limit: five, and
- Special regulations: Minimum length 10 inches. Only artificial lures with barbless hooks may be used.

▪ North Fork Tuolumne confluence to Don Pedro Reservoir:

- Season: Last Saturday in April through November 15,
- Bag limit: five, and
- Special regulations: Minimum length 10 inches. Only artificial lures with barbless hooks may be used.

3.9.1.1.3 Recreation Opportunities Downstream of the Don Pedro Project

Downstream of the Don Pedro Project, the Tuolumne River continues through rural farmland, gravel mining areas, and urban landscapes before joining with the San Joaquin River. The main focus of recreational activity downstream of the Don Pedro Project area takes place at Turlock Lake and Modesto Reservoir, followed by fishing and boating on the lower Tuolumne River.

There are eight publicly available means of access to the lower Tuolumne River from Old La Grange Bridge at RM 50.5 to Shiloh Bridge at RM 3:

- Old La Grange Bridge (RM 50.5),
- Basso Bridge (RM 47.5),
- Turlock Lake SRA (RM 42),
- Riverwalk Park in Waterford (RM 31),
- Fox Grove (RM 26.1),
- Legion Park (RM 17.6),
- Riverdale Park in West Modesto (12.3), and
- Shiloh Bridge Fishing Access Site (RM 3).

Camping

Turlock Lake SRA is located in eastern Stanislaus County, approximately seven miles from Don Pedro Reservoir and provides the only developed camping facilities along the lower Tuolumne River corridor. The Turlock Lake SRA is open year-round and provides for water-oriented outdoor activities. The recreation area features the lake with its 26 miles of shoreline and access to the Tuolumne River. Picnicking, day-use, and boat launch ramps are offered at the lake. A campground and boat launch are located on the Tuolumne River within the SRA. Views of the surrounding savannas and some of the cattle ranches and orchards nearby are available at several lookout points. From Lake Road, which separates the campground from the day use area, the river and sloughs, and miles of dredger tailing piles, the by-product of a half century of mining, can be viewed (California State Parks 2013).

Each of the 66 campsites at the campground has a stove, table and food locker; piped drinking water is also available within one hundred feet of each campsite. Hot showers and restrooms with flush toilets are available within the campsite area. Although no trailer hookups are available, trailers up to 27 ft can be accommodated in the campsites.

Modesto Reservoir Regional Park is located a few miles east of the town of Waterford off California State Highway 132. This regional park offers 3,240 ac of land and 2,800 ac of reservoir for recreation and camping. Facilities include approximately 150 full hook-up campsites, undeveloped camping areas, marina, concessions, restrooms, picnic shelter, barbeques, picnic tables, archery range, and radio-control glider airplane field.

Campsites at the Modesto Reservoir Regional Park are available on a "first-come, first-served basis." Recreation opportunities include swimming, fishing, boating, water/jet skiing, bird watching, waterfowl hunting (with permit during specific times of year), archery, and radio-control airplane flying.

Boating

The Tuolumne River from La Grange to the San Joaquin River, a 50-mile river reach, has a mild to low gradient, resulting in flat and swift water boating opportunities for floating in kayaks, rafts, and inner tubes. The steeper gradients (approximately five-six feet per mile) are in the upstream portion from Old La Grange Bridge (RM 50.5) to Turlock Lake SRA (RM 42). Downstream of RM 32, gradients are less than two feet per mile.

Fishing

The lower Tuolumne River provides fishing opportunities, with special regulations for trout and salmon fishing. From La Grange Diversion Dam to the mouth of the San Joaquin River, no trout or salmon may be taken from the Tuolumne. Turlock Lake is stocked with trout, black bass, crappie, bluegill and catfish. Modesto Reservoir also offers fishing opportunities. Anglers fish from boats on these reservoirs or from the shoreline, as well as along the lower Tuolumne River. Table 3.9-6 summarizes the fishing regulations on the lower Tuolumne River from La Grange Diversion Dam to the mouth of the San Joaquin River. Fishing access is restricted from October 16 through December 31 due to the salmon run (Stanislaus County 2010).

Table 3.9-6. Summary of fishing regulations for Tuolumne River downstream of Don Pedro Project area.

Fish Type	Open Season	Bag Limit	Special Regulations
Tuolumne River			
Trout	1/1 - 10/31	0	Only artificial lures with barbless hooks may be used.
Black Bass	1/1 - 10/31	5	N/A
Striped Bass	1/1 - 10/31	2	Minimum length 18 in.
Salmon	1/1 -- 10/31	0	Only artificial lures with barbless hooks may be used.

Fish Type	Open Season	Bag Limit	Special Regulations
Turlock Lake			
Trout	All year	5	N/A
Black Bass	All year	5	Minimum length 12 in.
Striped Bass	All year	2	Minimum length 18 in.
Crappie	All year	25	N/A
Bluegill	All year	25	N/A
Catfish	All year	No limit	N/A

Source: CDFG 2010a.

3.9.1.2 Recreation within the Project Boundary

Primary access to the Don Pedro Reservoir is by California State Highways 120 and 49 and Jacksonville Road from the north; Kelly-Grade, Marshes Flat Road, and Blanchard Road from the east; California State Highway 132 from the southeast; Bonds Flat Road from the south; and County Road J-59 from the southwest. The public has access from the three developed recreation areas described above and a number of minor roads outside the main recreation areas.

The Don Pedro Reservoir has a normal maximum surface area of slightly less than 13,000 ac at a reservoir elevation of 830 ft, and the Project Boundary encompasses a total of approximately 18,370 ac. The Project Boundary extends from below the Don Pedro Dam at RM 53.8 to RM 80.8. The total shoreline length is approximately 160 miles, including islands.

Primary recreation activities at Don Pedro Reservoir include fishing; boating and other water based activities; hiking, biking, and general trail use; picnicking; camping; and activities at dispersed recreation areas. Developed recreation areas account for under 10 percent of the reservoir shoreline leaving over 90 percent of the Don Pedro shoreline undeveloped and in its natural state. This undeveloped shoreline allows for dispersed boat-in camping along the majority of the reservoir, as well as fishing, boating, and other day use opportunities discussed in more detail below.

3.9.1.2.1 Don Pedro Project Recreation Facilities

There are three developed recreation facilities on Don Pedro Reservoir: Moccasin Point Recreation Area, Blue Oaks Recreation Area, and Fleming Meadows Recreation Area (Figure 3.9-1).

Developed recreation facilities are maintained and operated by the DPRA with oversight by the Don Pedro Board of Control. Together, the three developed recreation areas include 559 campsites of various types, three boat launch facilities with a total of 14 launch lanes, three designated picnic areas with a total of 43 picnic sites, two full-service marinas, a houseboat dock and repair yard, five fish cleaning stations, and one swimming lagoon (TID/MID 2013a). In addition, there are 749 single vehicle parking spaces, 566 vehicle and trailer parking spaces, and 56 boat trailer-only parking spaces.

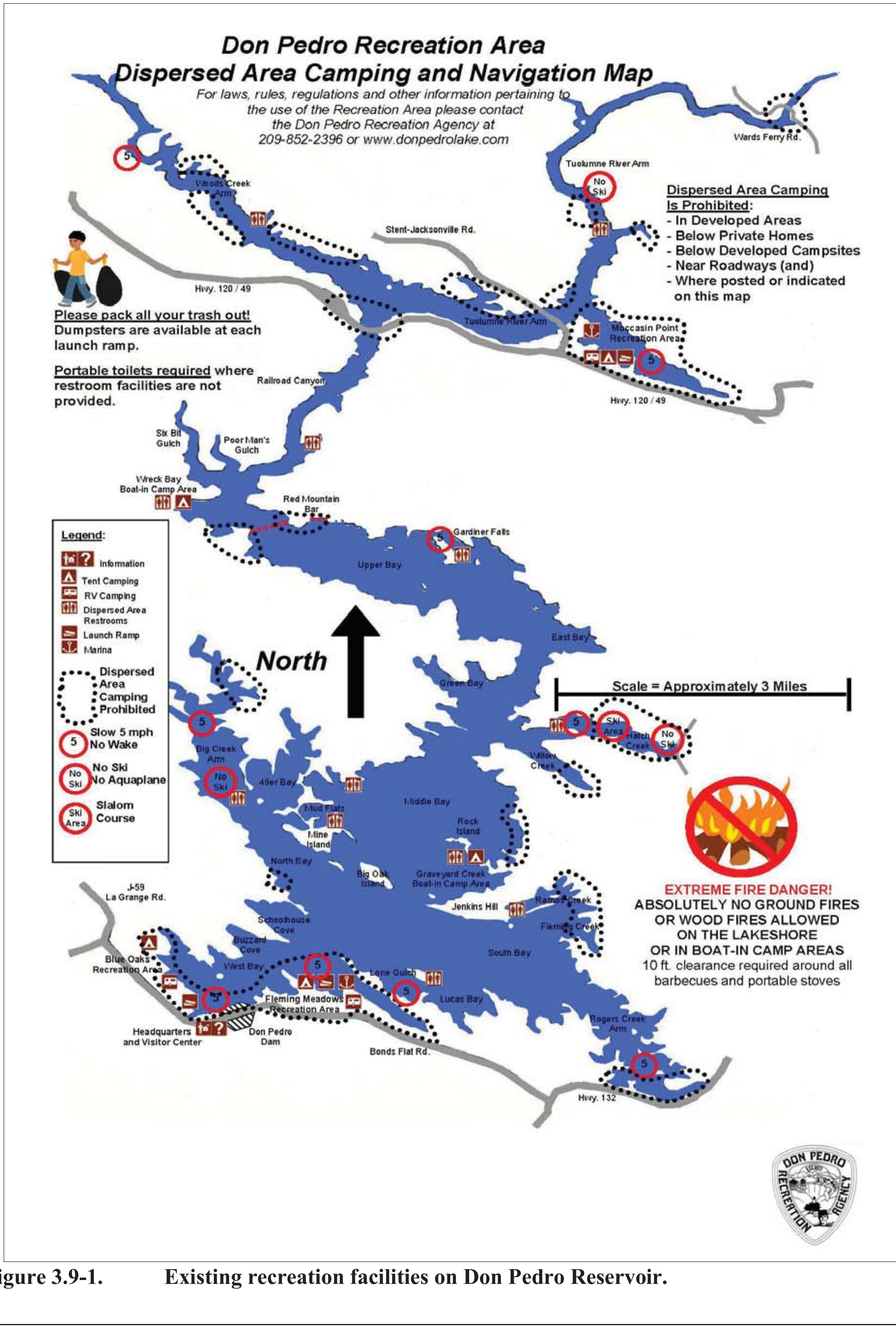

Figure 3.9-1. Existing recreation facilities on Don Pedro Reservoir.

Table 3.9-7 summarizes the amenities offered at the three developed recreation facilities. The three facilities are discussed in detail below.

Table 3.9-7. Summary of recreation facilities and other on-site amenities at developed recreation areas on Don Pedro Reservoir.

Amenities	Moccasin Point RA	Blue Oaks RA	Fleming Meadows RA
Don Pedro Project Recreation Facilities			
Camping Units - Total	96	195	267
With water and electric hookups	18	34	90
Picnic Areas –Total	2	1	2
Group Picnic Sites	1	1	1
Boat Launch Ramp	1	1	1
Fish Cleaning Stations	1	1	1
Comfort Stations - Total	8	11	14
With hot showers	3	5	5
Additional On-Site Recreation Amenities			
Concession Store	Yes	No	Yes
Swimming Lagoon	No	No	Yes
Volleyball / Softball Area	No	No	Yes
Marina	Yes	No	Yes
Amphitheatre	No	No	Yes
Houseboat Mooring	Yes	No	Yes
Boat Rentals	Yes	No	Yes
Houseboat Rentals	Yes	No	Yes
Boat Repair Yard	No	Yes	No
Gas and Oil	Yes	No	Yes
Sewage Dump Station	Yes	Yes	Yes

Source: TID/MID 2013a.

Fleming Meadows Recreation Area

The Fleming Meadows Recreation Area, located just east of the Don Pedro Dam, is comprised of 267 campsites, one boat launching facility, a sewage station, trading post, swimming lagoon, picnic area, amphitheater, softball and volleyball area, and two marinas—one with a full range of services, and one specifically for mooring private houseboats. There are also five designated parking lots located throughout the recreation area as well as a parking lot specific to the marina. Fleming Meadows has the highest use of the three recreation areas at the Don Pedro Project (TID/MID 2013a).

The Fleming Meadows Recreation Area has Americans with Disabilities Act (ADA)-accessible restrooms which include enlarged, ADA-accessible stalls. At least one sink in each restroom is height adjusted for ADA-accessible use. The urinals at the Fleming Meadows Launch Ramp and swimming lagoon are adapted to individual use urinals. The ramp access to ADA-accessible restrooms is designed for ADA-accessibility and meets grade and surface guidelines. ADA-accessible parking spaces have been designated at the boat launch ramp, main parking lot, and at all ADA-accessible restroom facilities (TID/MID 2013a). Amenities at Fleming Meadows Recreation Area are depicted in Figure 3.9-2.

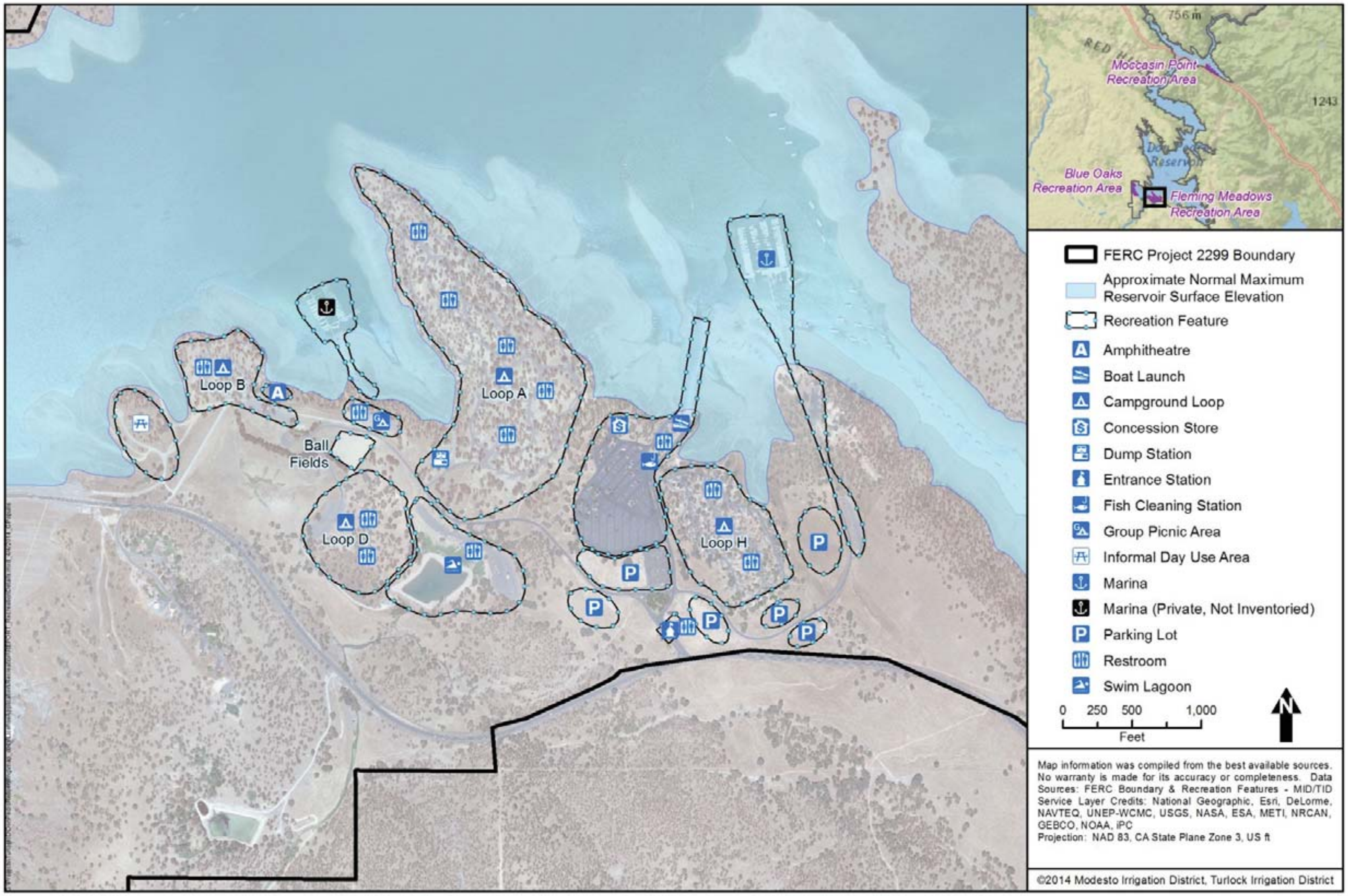

Figure 3.9-2. Fleming Meadows Recreation Area amenities.

Blue Oaks Recreation Area

The Blue Oaks Recreation Area, located just north of the emergency spillway section of the dam, includes 195 campsites, two RV full hookup sites, 34 RV partial hookup sites (four of which are ADA-accessible), and one boat launching facility. Additional amenities include a sewage dump station, a waste water treatment facility, boat repair yard, and a group picnic area. There are also three designated parking lots located throughout the recreation area, as well as a parking lot specific to the group picnic shelter (TID/MID 2013a).

The Blue Oaks Recreation Area also contains the Shoreline Trail hiking route, which is comprised of 3.5 miles of scenic hiking and mountain biking trails. The trail route starts at the Blue Oaks Group Area vista point and follows the shoreline of the Don Pedro Reservoir to Buzzard Point. The trail traverses wildflower displays in the spring, passes large quartz outcroppings, and offers unique vistas of Don Pedro Reservoir and the Sierra Nevada range. The trail is popular for viewing wildlife and birds such as bald eagles, ospreys, red-tailed hawks, and great blue herons (National Geographic Society 2009).

Restrooms contain ADA-accessible stalls, and a sink in each restroom is height-adjusted for ADA-accessible use. In addition, the shower restrooms at the Blue Oaks Recreation Area campground has one ADA-accessible shower station in each facility, and ADA-accessible parking spaces at all restroom facilities (TID/MID 2013a). Amenities at Blue Oaks Recreation Area are depicted in Figure 3.9-3.

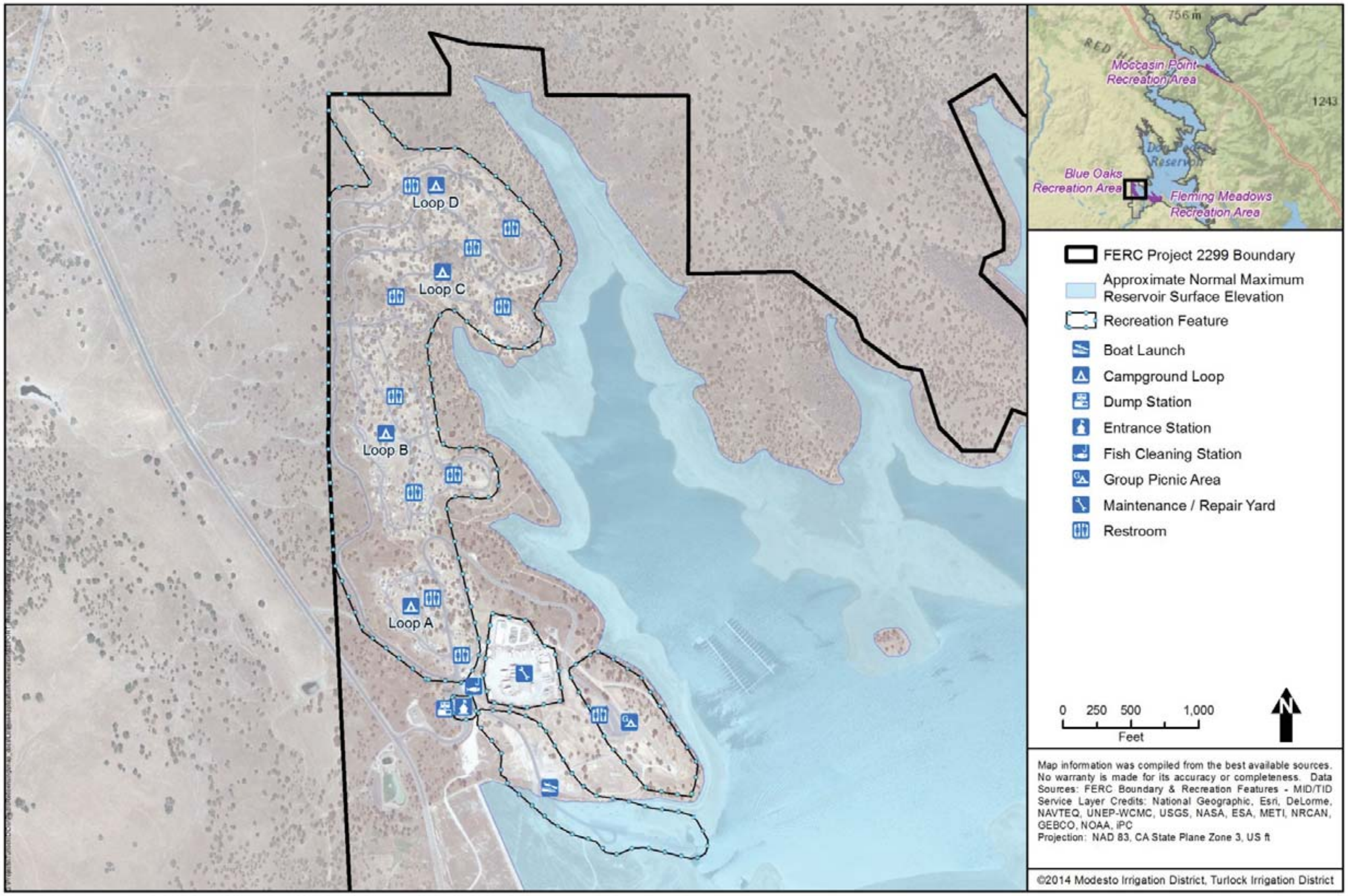

Figure 3.9-3. Blue Oaks Recreation Area amenities.

Moccasin Point Recreation Area

The Moccasin Point Recreation Area, located near the upper end of the Don Pedro Reservoir, is comprised of 96 campsites, 18 RV hookup sites, and one boat launching facility. Additional amenities include a marina, a sewage dump station, a waste water treatment facility, and two picnic areas. There are also five designated parking lots located within the recreation area (TID/MID 2013a).

ADA-compliant restrooms are installed at Moccasin Point Launch Ramp. One sink in each restroom is height-adjusted for ADA-accessible use. In addition, ADA-accessible parking spaces have been designated at these restrooms as well as at the launch ramp area (TID/MID 2013a). Amenities at Moccasin Point Recreation Area are depicted in Figure 3.9-4.

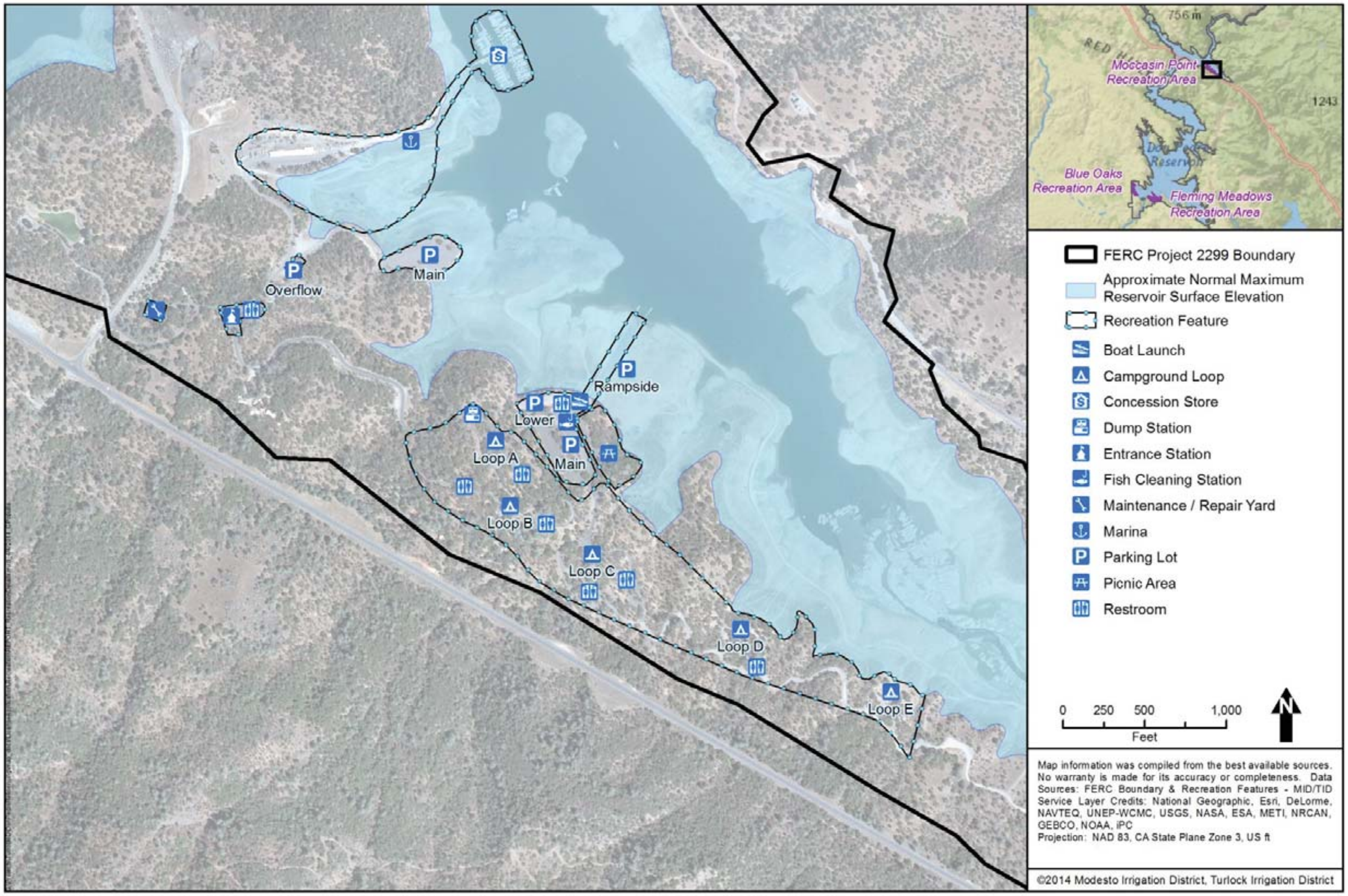

Figure 3.9-4. Moccasin Point Recreation Area amenities.

3.9.1.2.2 Recreational Use at the Don Pedro Project

The most popular recreational activities at the Don Pedro Project include fishing, boating, and camping. Other activities include water based activities; hiking, biking, and general trail use; picnicking; and activities at dispersed recreation areas. These activities are discussed below.

Fishing

Don Pedro Reservoir supports year-round fishing and offers abundant populations of rainbow, brown, and brook trout; largemouth, smallmouth, spotted, and black bass; kokanee, silver, and resident Chinook salmon; black and white crappie; bluegill and perch; channel, white, and black bullhead catfish; and green sunfish for anglers. Day use visitors have access to fishing opportunities both along the shoreline and via boating access. The many forks of the reservoir also afford the opportunity for isolated and quiet settings for fishing. DPRA, in conjunction with the Tuolumne County Sheriff's Office, enforces five mph no-wake boating and/or no-ski zones in the upper reaches of many of these forks to provide conditions suitable for fishing.

CDFW stocks trout and the DPRA stocks Florida-strain largemouth bass in the reservoir annually (DPRA 2010). The CDFW's Moccasin Creek Fish Hatchery typically stocks the reservoir with a variety of trout species every two to four weeks during the fall and winter months (CDFG 2010b).

Don Pedro Reservoir requires that all individuals fishing on the lake follow all regulations as set forth by the CDFW and all anglers must have a current California fishing license. The CDFW has a special silver (Coho) salmon regulation in California. The regulation prohibits keeping any silver salmon; any silver salmon hooked must be released back into the waters in which it was caught.

Don Pedro Reservoir is also a site for frequent bass fishing tournaments. For example, in 2010, 30 different organizations held 45 fishing tournaments at Don Pedro Reservoir. Table 3.9-8 summarizes the 2010 fishing tournament schedule.

Table 3.9-8. 2010 fishing tournament schedule for Don Pedro Lake.

Date	Day of Week	Organization	Launch Location
1/2/10	Saturday	Won Bass	Fleming Meadows
1/30/10	Saturday	LB Bass Club	Blue Oaks
2/6/10	Saturday	Won Bass	Fleming Meadows
2/12/10	Friday	California Bass Champs	Fleming Meadows
3/6/10	Saturday	Sonora Bass Anglers	N/A
3/6/10	Saturday	Diablo Valley Hawg Hunters	N/A
3/6/10	Saturday	American Bass	Fleming Meadows
3/6/10 3/7/10	Saturday Sunday	CA Landscape Contractors Trout Tournament	N/A
3/13/10	Saturday	Future Pro Tour	Fleming Meadows
3/13/10	Saturday	Tri Valley Bassmasters	N/A
3/14/10	Sunday	Fresno Bass	Fleming Meadows
3/20/10	Saturday	Won Bass	Fleming Meadows
3/20/10 3/21/10	Saturday Sunday	Kerman Bass Club	Fleming Meadows
3/21/10	Sunday	CA Bass Federation	Fleming Meadows

Date	Day of Week	Organization	Launch Location
3/27/10 3/28/10	Saturday Sunday	Sierra Bass Club	Blue Oaks
3/28/10	Sunday	Kings River Bass Club	Blue Oaks
3/28/10	Sunday	Fresno Bass	Fleming Meadows
4/10/10	Saturday	Angler's Choice	Fleming Meadows
4/10/10	Saturday	Modesto Elk's Lodge #1282	Fleming Meadows
4/10/10	Saturday	Manteca Bassin Cuddies	N/A
4/17/10	Saturday	100% Bass	Fleming Meadows
4/17/10 4/18/10	Saturday Sunday	Wasco Bass Club	Fleming Meadows
4/24/10	Saturday	King Salmon Derby	Blue Oaks
4/24/10	Saturday	Northern California Bass Federation	Fleming Meadows
4/25/10	Sunday	100% Bass	Fleming Meadows
5/1/10	Saturday	American Bass	Fleming Meadows
5/8/10	Saturday	Angler's Choice	Fleming Meadows
5/8/10 5/9/10	Saturday Sunday	Taft Bass	Fleming Meadows
5/15/10	Saturday	Bethel Assembly of God	Fleming Meadows
5/22/10	Saturday	Won Bass	Fleming Meadows
5/22/10	Saturday	Kerman Bass Club	Fleming Meadows
6/6/10	Sunday	Angler's Choice	Fleming Meadows
6/12/10	Saturday	Sacramento Bass Trackers	N/A
6/12/10 6/13/10	Saturday Sunday	Modesto Ambassadors Night Classic	Fleming Meadows
6/26/10 6/27/10	Saturday Sunday	U.S. Angler's Choice Night Tournament	Fleming Meadows
7/17/10	Saturday	Christian Bass League	N/A
7/17/10	Saturday	Riverbank Bass Anglers	N/A
8/7/10	Saturday	Point Seekers Bass Club	N/A
9/11/10	Saturday	Mid Valley Bass Club	N/A
10/9/10	Saturday	Jigs Bait and Tackle	Fleming Meadows
10/9/10	Saturday	Contra Costa Bass Club	N/A
10/16/10	Saturday	Christian Bass League	N/A
11/13/10	Saturday	US Angler's Choice	Fleming Meadows
12/5/10	Sunday	Riverbank Bass Anglers	N/A
12/11/10	Saturday	Won Bass	Fleming Meadows

Source: DPRA 2010.

Boating and Water Based Activities

The Don Pedro Reservoir covers 12,960 ac at normal maximum water surface elevation, and offers extensive open water for motor boating. There are also enough coves and sheltered areas to enjoy boat-tow activities. The Don Pedro Reservoir also provides a ski slalom course in the Hatch Creek Arm. Water based activities on the reservoir include water skiing and wake boarding, boat fishing, jet skiing, canoeing, flat water kayaking, windsurfing, sailing, and whitewater rafting and kayaking take-out areas. In 2007, 24 percent of the total gate receipts from recreation facilities were a result of boating use, and approximately 3,500 rafting take-outs occurred at the Reservoir (DPRA 2008). Licensed concessionaires provide 80 small vessel boat rentals and 378 small vessel moorings for reservoir visitors.

Whitewater rafting and kayaking are popular on the Wild and Scenic Tuolumne River above the Don Pedro Project Boundary. Boater put-in occurs primarily at Meral's Pool (RM 96) and recreational boating use is managed by the USFS. The Ward's Ferry Bridge, located near RM 78.5 towards the upstream end of the Don Pedro Reservoir, is used as a take-out location by whitewater boaters who run the whitewater reach. Most use occurs from April through August. While use levels are highly dependent on flow, an estimated 4,225 boaters used the Ward's Ferry Bridge as a site of river egress annually for the period 2003-2012 (USDA 2013). USFS estimates that two-thirds of these boaters were customers of commercial rafting companies and one-third were private boaters (USDA 2013). A whitewater boating take-out improvement feasibility study was conducted in 2012 by the Districts. The study is discussed further below.

Houseboating is also a popular activity at the Don Pedro Reservoir, and many boats anchor in the coves and arms of the lake for overnight camping or day use / swimming activities. Between the two marinas, there are 40 houseboats available for rent from the authorized concessionaires, and there exists 257 total moorings available for privately owned houseboats.

Camping

Moccasin Point Recreation Area, Blue Oaks Recreation Area, and Fleming Meadows Recreation Area offer a combined total of 558 camping units for recreational use with 142 offering water and electric hookups. Additionally, dispersed camping is allowed on most of the remaining lands, subject to the DPRA's published Rules and Regulations. None of the dispersed shoreline areas have developed camping spaces, and overnight camping is prohibited in some of these shoreline areas. Figure 3.9-5 shows locations where dispersed recreation most frequently occurs along the Don Pedro Reservoir.

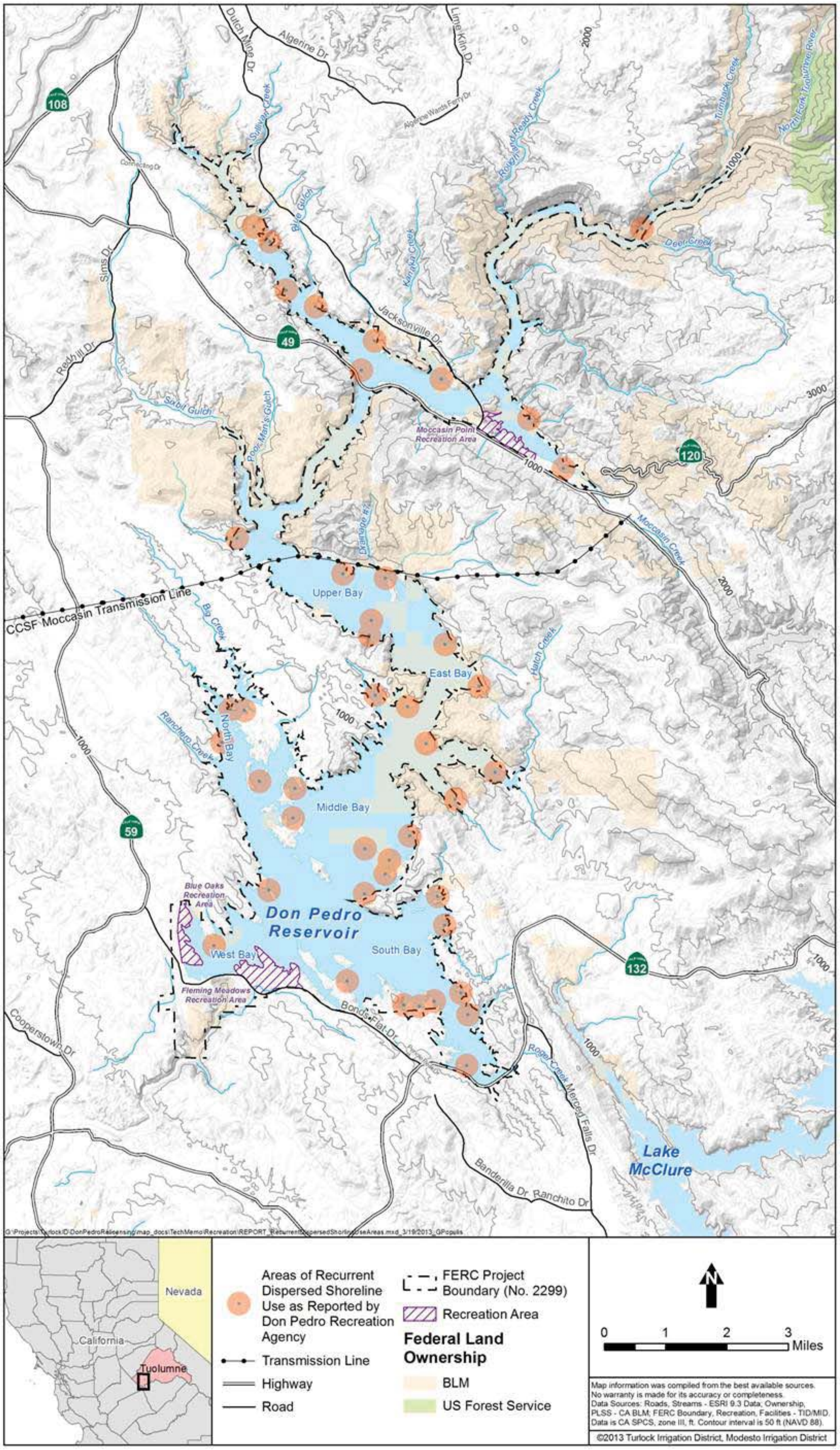

Figure 3.9-5. Dispersed recreation areas at the Don Pedro Project.

Hiking, Biking, and General Trail Use

There are several hiking and biking trails that are within or partially within the Project Boundary. Red Hills is a region of 7,100 ac of public land located just south of the historic town of Chinese Camp and immediately east, west, and northwest of the Railroad Canyon and Woods Creek Arm of Don Pedro Reservoir. Common visitor activities include hiking, horseback riding, wildflower viewing, birding, mountain biking, and some limited hunting (BLM 2009). The trail system in Red Hills totals approximately 17.3 miles. Scenic biking and hiking is available on the Shoreline Trail hiking route at Blue Oaks Recreation Area.

Picnicking

Picnicking is a popular activity within the Project Boundary. Picnic areas and group picnic sites are present at Moccasin Point Recreation Area, Blue Oaks Recreation Area, and Fleming Meadows Recreation Area.

Dispersed Recreation Opportunities

Dispersed recreation is allowed on most of the Don Pedro Project lands except within developed areas, below private homes, below developed campsites, near roadways, and where posted. None of the dispersed shoreline areas have developed camping spaces, and overnight camping is prohibited in some of these shoreline areas. These areas are subject to the DPRA's published Rules and Regulations (provided as Appendix H-4 of Exhibit H). DPRA routinely patrols and maintains these shoreline areas. An inventory and evaluation of potential use impacts to recurrent dispersed recreation locations was conducted in 2012 as part of Recreation Facility Condition and Public Accessibility Assessment, and Recreation Use Assessment. The study is discussed further below.

Boating, fishing, camping and wildlife viewing are popular for those who boat into these dispersed areas.

3.9.1.3 Recreation Studies Conducted as Part of Relicensing

The Districts conducted three recreational studies in 2012 and 2013 in support of relicensing: the Recreation Facility Condition and Public Accessibility Assessment, and Recreation Use Assessment (RR-01), Whitewater Boating Take-Out Improvement Feasibility Study (RR-02), and Lower Tuolumne River Lowest Boatable Flow Study (RR-03). These studies are discussed in further detail below.

3.9.1.3.1 Recreation Facility Condition and Public Accessibility Assessment, and Recreation Use Assessment

The Districts conducted the Recreation Facility Condition and Public Accessibility Assessment, and Recreation Use Assessment (RR-01) in 2012 (TID/MID 2013a). The goal of the study was to provide information about the need for maintenance or enhancement of existing recreation facilities to support current and future demand for public recreation at the Don Pedro Project. The objectives of the study were to:

- assess the condition of existing developed recreation facilities, including dispersed use areas,
- estimate present capacity of recreation facilities to support present and future demand for public recreation (i.e., facility carrying capacity),
- describe the preferences, attitudes, and characteristics of the recreation users,
- collect information about current recreation activities and future demand for activities, and
- undertake a creel survey in coordination with Study Plan W&AR-17, Reservoir Fish Population Study.

The study methods consisted of five steps: (1) conduct an inventory and evaluation of the recreation facilities for condition, ADA-compliance, and use impacts; (2) identify recreation uses and visitor attitudes, beliefs, and preferences at recreation resource areas; (3) estimate the current recreation use at recreation resource areas; (4) identify future use and demand opportunities; and (5) analyze the data collected and prepare a report.

Based on study results, existing facilities meet current recreation demand and are generally in good condition (TID/MID 2013a). Use levels projected through 2050 at each of the three recreational areas are not expected to exceed the capacity of the campgrounds, picnic areas, or parking areas, except for the Fleming Meadows houseboat marina parking facility and the Moccasin Point marina parking facilities and group picnic parking facilities. The congestion anticipated at these three parking facilities is expected to be mitigated by the use of overflow parking. Most survey respondents reported that facilities were acceptable or they did not have an opinion (TID/MID 2013a). Similarly, most respondents had no clear desire for specific improvements to recreation facilities.

Survey results indicated the most frequently identified activities of day-use respondents surveyed at Fleming Meadows, Blue Oaks, and Moccasin Point recreational areas are recreational activities common to the area and to the Central Valley Region. The primary recreational activities varied between day-use respondents and overnight respondents (Table 3.9-9).

Table 3.9-9. Primary day-use and overnight-use recreation activities at Fleming Meadows, Blue Oaks, and Moccasin Point.

Recreation Area	Day-Use	Overnight Use
Fleming Meadows	Fishing (44.9%) Boating (14.1%) Swimming (10.3%)	Camping (36.4%) Houseboating (20.2%) Fishing, boating, and relaxing (7%)
Blue Oaks	Fishing (75.8%) Watersports (7.6%) Boating (6.1%)	Camping (38.4%) Boating (11%) Houseboating (8.2%) Fishing (6.8%) Relaxing (5.5%)

Recreation Area	Day-Use	Overnight Use
Moccasin Point	Fishing (39.5%) Boating (18.6%) Picnicking and Relaxing (9.3%)	Camping (39%) Fishing (18.6%) Houseboating (11.9%)

Recreation users generally view Fleming Meadows, Blue Oaks, and Moccasin Point Recreation Areas as relatively unique recreation experiences offering easy access, natural conditions, great staff and facilities, good fishing, and less congestion than comparable recreation facilities in central California. Users also did not perceive any adverse effects on recreation experiences as a result of reservoir water levels. Overall, demand is being met for a wide range of outdoor recreation activities typical of reservoirs in central California.

As a component of the Recreation Facility Condition and Public Accessibility Assessment, and Recreation Use Assessment, recurrent dispersed recreation use locations along the Don Pedro Reservoir shoreline outside of the developed recreation facilities and within the Project Boundary were documented in 2012. A total of 23 discrete locations showing signs of recurrent dispersed shoreline recreation use were documented within the Project Boundary. Of the 23 recurrent dispersed recreation sites, the majority of the sites (70% or 16 sites) showed "low" impact; five sites (22%) showed "moderate" impact; and two sites showed "high" impact. The "low" impact sites either showed no signs of use impact or only a few signs with minimal scope. At the "moderate" impact sites, one to three signs of impact were typically observed with at least a few signs of litter and toilet paper, but also some unauthorized tree cutting, large areas of bare/compacted ground and/or user-created trails. At the "high" impact sites, four signs of use impact were observed, but most were significant or widespread impacts such as toilet paper (more than 5 occurrences); large areas of bare/compacted ground with trampled vegetation; user-created trails to satellite areas; and/or a fire ring without adequate clearances.

3.9.1.3.2 Whitewater Boating Take-Out Improvement Feasibility Study

The Districts conducted the Whitewater Boating Take-Out Improvement Feasibility Study (RR-02) in 2012 and 2013. A study report was filed with FERC on January 17, 2013 as an attachment to the Initial Study Report (ISR) in the ILP relicensing process. In response to relicensing participant requests for additional take-out site analyses and recommendations in FERC's May 21, 2013 *Determination on Requests for Study Modifications and New Studies for the Don Pedro Hydroelectric Project*, the Districts amended the study report to include more details on the benefits and constraints associated with the Ward's Ferry Bridge take-out site and alternative river egress sites at Deer Creek and Deer Flats (Figure 3.9-6). A revised study report was filed on January 6, 2014.

The Ward's Ferry Bridge spans the Tuolumne River at RM 78.5 and is the downstream terminus of whitewater boating on the Tuolumne River. The Ward's Ferry Bridge is not a recreation destination in and of itself; it is the location where whitewater boaters and boats exit the river at the end of their excursion. The primary goal of the Districts' study was to assess if, from an engineering feasibility perspective, functional options exist to make improvements to the existing take-out at the Ward's Ferry Bridge site. The feasibility of alternative sites for providing boat take-out was also evaluated.

This study elicited knowledge on the use of the existing site, potential improvements, and alternative sites from a focus group meeting with guides and boaters familiar with the Tuolumne River and the existing take-out methods at the Ward's Ferry Bridge. Information from the site assessments and focus group meeting in April 2012, August 2013, and September 2013 was used to examine proposed alternative take-out locations and assess the technical feasibility of potential improvements. Characteristics of the existing take-out and alternative locations were assessed including proximity to the terminus of the whitewater run, proximity to improved roads, site topography and bank slope, and presence of sensitive resources. The operational goal of the whitewater boating take-out study at the Ward's Ferry location was to examine whether reasonable engineering options exist to improve the efficiency and safety of removing boats and boaters from the river at the end of the whitewater trip at this location.

The study concluded that based on site assessment and preliminary engineering, take-out improvements at and just upstream of the Ward's Ferry Bridge appear to be technically feasible at both the river right option and river left option, with river right somewhat superior because it offers slightly more space without either sidehill cutting on the land side or large retaining walls on the river side of the site. Therefore, the lowest cost option identified in the study, which also involves lower construction risk and met the study goal of improving the efficiency and safety of exiting the river and the site, was the river right option at Ward's Ferry Bridge.

The river right option provides an access road/ramp which allows one-way traffic. Protective side rails are incorporated into the mechanically stabilized earth wall once elevation 830 ft is reached. The road/ramp includes a turn-around suitable for truck and trailer combination and a 15-foot road clear width above the turn-around to accommodate both vehicle and pedestrian use. There are also provisions for a separate access trail to the river's edge to accommodate other users.

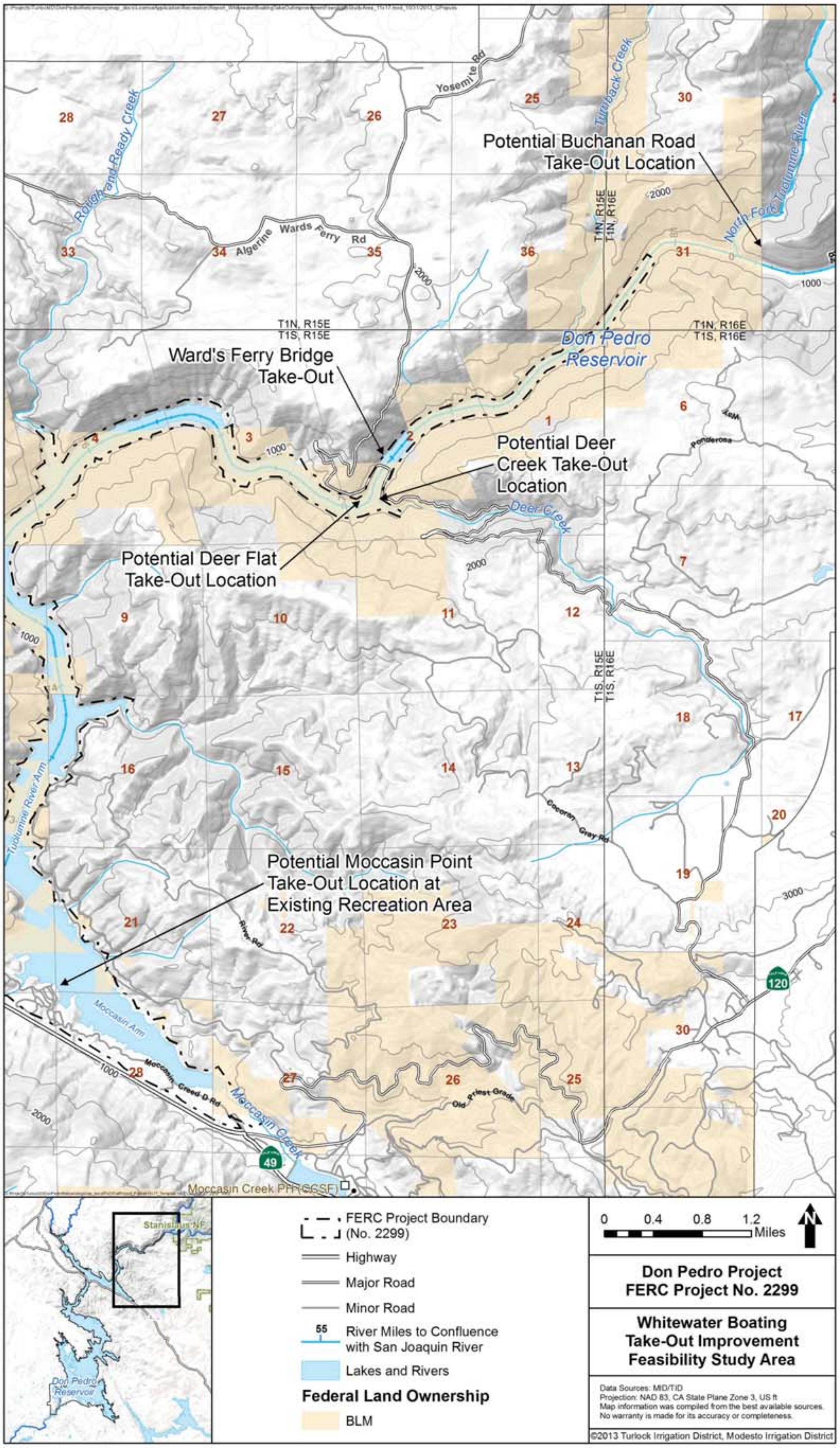

Figure 3.9-6. Potential upper Tuolumne River whitewater boating take-out locations.

3.9.1.3.3 Lower Tuolumne River Lowest Boatable Flow Study

The Districts conducted the Lower Tuolumne River Lowest Boatable Flow Study (RR-03) in 2012 and 2013 (TID/MID 2013c). The primary goal of the study was to determine if the minimum flows required under the current license provide boatable flows for non-motorized, recreational river boating in portions of the lower Tuolumne River where put-ins and take-outs are available. The study was designed to achieve the following objectives:

- determine whether the minimum flows provide for river boating in portions of the lower Tuolumne River,
- use existing recreation information, where possible, to assess river boating including gradient of river segments,
- determine the number of flow days by month at or above the minimum boatable flow for river boating opportunities under current operations,
- determine operational constraints, if any, of providing minimum flows for the river boating opportunities,
- identify and describe put-in and take-out locations for river boating between La Grange Dam and the confluence with the San Joaquin River,
- identify and describe the locations on the river where boaters encounter features of special interest, challenges, hazards, or difficulties, and
- evaluate the adequacy of flow information available to the public.

The 2012 river boating study effort was conducted in canoes, hard shell kayaks, inflatable kayaks, and a drift raft from May 30 to June 2, 2012, with flows ranging from 171 cfs to 256 cfs as recorded at the USGS Gage 11289650 Tuolumne River near La Grange, CA. The study team also assessed flow opportunistically throughout the study period by boating at flows ranging from 98 cfs to 132 cfs. One last event was boated September 29, 2012 at a flow of 101 cfs to 109 cfs. Flows recorded at the USGS' gage at Modesto at RM 16 were consistently greater than those at La Grange, consistent with other findings that the Tuolumne River is generally considered a "gaining" stream. Average daily accretions in the Lower Tuolumne range from 40 cfs to 200 cfs, with an annual average accretion of 218 cfs from water year 1970-1987 and 103 cfs from water year 1988-2010, resulting in a water year 1970-2010 average of 152 cfs (TID/MID 2013d).

In its May 21, 2013 *Determination on Requests for Study Modifications and New Studies for the Don Pedro Hydroelectric Project*, FERC staff recommended that the Lower Tuolumne River Lowest Boatable Flow study be modified to include a determination of the lowest boatable flow for: (1) hardshell kayaks, inflatable kayaks, and canoes and; (2) drift boat/rafts on each section of the lower Tuolumne River between Old La Grange Bridge (RM 51) and Riverdale Park (RM 12). FERC staff stated that the study should achieve the required five to eight boaters (with no financial connection to the Districts) for both groups of watercraft types for each section of the river, and participants should be notified at least six weeks in advance of conducting the study, with reminders at least three weeks and one week prior to the study. Prior volunteer participant data (not including the Districts' consultants) should be included as part of the data for the approved study.

The Districts conducted the FERC recommended second year study in 2013. Relicensing participants assisted in identifying segments of the river to be paddled and revisions to the survey instrument. The 2013 field studies were conducted August 17, August 24, September 7, and September 14, with flows ranging from approximately 125 cfs to 200 cfs as recorded at the USGS Gage 11289650 (La Grange gage). Participants used hardshell kayaks, inflatable kayaks, canoes, and drift boats/rafts. A revised study report was filed on January 6, 2014 with the USR.

Flows as low as 100 cfs as recorded at the USGS La Grange gage were determined to be boatable in the reach between Old La Grange Bridge and Turlock SRA in 2012. This segment has the highest gradient of the entire lower Tuolumne and provides the most interesting paddling. At flows in the 100 cfs range, one experienced boater in a kayak found the Old La Grange Bridge to Turlock SRA segment to be boatable, but also noted no attributes to entice toward boating at lower flows. Based on this very limited input (one boater) it would seem that 100 cfs is boatable and lower flows would not provide enjoyable boating in kayaks, or any other craft.

In 2013, a greater number of volunteers participated in the study, and results indicate 200 cfs and 175 cfs were equally judged boatable by an overwhelming majority of participants. More than half of the boaters who participated in the study reported that 150 cfs was boatable on the study reaches – Old LaGrange Bridge to Riverwalk Park in Waterford and Riverdale Park to Shiloh Bridge.

Study results and the level of volunteer participation in both 2012 and 2013 indicate that shallow draft canoes and kayaks are ideally suited for the boating opportunities on the lower Tuolumne. Very few drift boaters/rafters participated in the study, and of those who did participate, the majority reported the river unboatable at study flows of 175 cfs and lower.

La Grange gage data for the calendar years 1997[31] through 2012 reported flows were greater than or equal to 150 cfs 84 percent of the time. For the more popular boating season, flow was at or above 150 cfs 98% of the time in May, 60% of the time in June, 56% of the time in July, August, and September, and 94% if the time in October. Flows were at or above 175 cfs 76 percent of the time for the period 1997-2012. During the months of the typical boating season of May through October, flows were at or above 175 cfs 97 percent of the time in May and 56 percent of the time in July, August, and September. For the same period, the flow of 200 cfs is exceeded 88% of the time in April, 95% of the time in May, 56% of the time in June, July, August and September, 74% of the time in October, and 70% of the time in November. Only in dry years is a flow of 200 cfs rare, and this is at a time when all resource uses, including developmental uses, are being significantly affected. (TID/MID 2013c).

[31] The year 1997 was the first full calendar year following the implementation of the 1996 FERC order adopting new, higher minimum flows for the Don Pedro Project.

3.9.1.4 Land Use

The Don Pedro Project Boundary encompasses approximately 18,370 acres. The Districts own in fee title approximately 78 percent of the land within the Project Boundary, and the remaining 26 percent are federal lands. These lands are subject to the Districts' land use policies (see Appendix H-4 of Exhibit H), which strictly limit the use of lands outside the developed recreation areas. The Districts' land use policy is implemented through the DPRA and prohibits shoreline disturbances such as dredging, docks, moorings, piers, or developed improvement of any kind. DPRA rules prohibit all off-road vehicle use on lands, as well as motorized boat access over lands expect at designated boat launches. These rules and regulations are designed to protect and preserve the natural character and integrity of the Don Pedro Project area. Outside the Project Boundary, lands are a mix of lands administered by the BLM and private lands.

Upstream of the Project Boundary, the Tuolumne River is designated as a National Wild and Scenic River. Lands in this portion of the watershed are primarily publicly owned and managed, including Yosemite National Park, managed by the NPS, and Stanislaus National Forest, managed by the USFS. Immediately upstream of the Don Pedro Project, much of the land is managed by the BLM. Downstream of the Don Pedro Project, in the lower valley area of the Tuolumne River watershed, land is primarily privately owned and used for agriculture, grazing and rural residential purposes, or for denser residential, M&I purposes (Stanislaus County 2006).

3.9.1.5 Shoreline Management

The Don Pedro Reservoir has approximately 160 miles of shoreline including the numerous small islands within the lake. The Districts own approximately 122 miles of the shoreline while BLM administers the remaining 38 miles. Within the Project Boundary, the Districts and the BLM do not permit any commercial or residential shoreline development except at Moccasin Point, Blue Oaks, and Fleming Meadows Recreation Areas. In particular, the Districts' land use policy prohibits shoreline disturbances such as dredging, docks, moorings, piers, or developed improvement of any kind. Boat launching is only permitted at the designated launch ramps found in each of the three developed recreation areas.

Dispersed use (both day and overnight) of the majority of the undeveloped Don Pedro Reservoir shoreline is permitted. Use of some shoreline areas is restricted due to conditions such as on-shore hazards or the potential for nuisance activity to affect adjacent property owners.

3.9.2 Resource Effects

Based on study results, existing facilities appear to meet current recreation demand and are generally in good condition. Use levels projected through 2050 at each of the three recreation areas are not expected to exceed the capacity of the campgrounds, picnic areas, or parking areas, with a few exceptions as described previously in this section of Exhibit E.

Pages 37 and 38 of FERC's SD2 identified the following recreation and land-use related issues:

- *Effects of water levels in project reservoirs on recreation.*
- *Effects of project operations on public access to project waters, existing recreational opportunities, and future recreational opportunities within the project boundary.*
- *Effects of project operations on quality and availability of flow-dependent recreation opportunities, including whitewater boating, angling, and wading.*
- *Adequacy of existing recreation facilities (including accessible facilities) to meet current and future recreation demand.*
- *Effects of the project operations and maintenance on the condition and use of roads within the project area.*
- *Adequacy of existing Ward's Ferry Bridge whitewater boating takeout and restroom facility to meet current and future recreational demand.*

3.9.2.1 Effects of Water Levels in the Don Pedro Reservoir on Recreation

The Recreation Facility Condition and Public Accessibility Assessment, and Recreation Use Assessment conducted by the Districts in 2012 specifically addressed visitor preferences and expectations related to reservoir water level. Visitors were asked to indicate whether the level of the reservoir was a problem for a variety of different recreational activities. For both overnight and day-use visitors, the level of the reservoir was not perceived as a problem for different types of activities. The vast majority of visitors reported the reservoir level was either "not a problem" or selected "no opinion/not applicable" (TID/MID 2013a). The continuation of the current water level fluctuations under current water supply operations does not have an adverse effect on recreation at the Don Pedro Project.

3.9.2.2 Effects of Don Pedro Project Operations on Public Access to Waters, Existing Recreational Opportunities, and Future Recreational Opportunities within the Project Boundary.

Overall, demand is being met for a wide range of outdoor recreation activities typical of reservoirs in central California. The Recreation Facility Condition and Public Accessibility Assessment, and Recreation Use Assessment found that survey respondents rated the three developed Recreation Areas - Fleming Meadows, Blue Oaks, and Moccasin Point - as a unique recreational experience. Reasons contributing to the uniqueness were identified as easy access, natural conditions, great staff and facilities, good fishing, and less congestion than comparable recreation facilities in Central California. Access to existing recreational facilities was rated by survey respondents as in the acceptable range overall (TID/MID 2013a).

Survey respondents were also asked whether the existing facilities were acceptable, most respondents felt that facilities were acceptable or did not have an opinion (TID/MID 2013a). Similarly, most respondents had no clear desire for specific improvements to recreation facilities indicating that the existing Recreation Areas are providing opportunities for recreation activities identified in the California Outdoor Recreation Plan.

The public currently has access to the entire shoreline from the high-water line down and has vehicle access through a number of rural and unimproved roads outside the Recreation Areas. Access is currently viewed as acceptable by survey respondents. Access to Don Pedro Project waters and recreational opportunities is expected to remain the same.

3.9.2.3 Effects of Don Pedro Project Operations on Quality and Availability of Flow-dependent Recreation Opportunities, including Whitewater Boating, Angling, and Wading

Operations do not affect the flows available for whitewater boating, angling or wading in the reaches designated as Wild and Scenic upstream of the Don Pedro Project. Water level fluctuations of the reservoir, by definition, do not affect the Wild and Scenic reaches. The only use of the Don Pedro Project by whitewater boaters is as a location where boaters choose to exit the Tuolumne River, this being at the Ward's Ferry Bridge, a non-Don Pedro Project facility. The current river exit procedures are adequate to support the current level of whitewater use. Commercial and private boaters believe that improved take-out facilities at Ward's Ferry are warranted to efficiently get recreationists off the river and improve public safety on the bridge. The Districts' engineering study demonstrated that options exist to accommodate more efficient and safer exit along the river right side. Angling in the upper reaches of the reservoir is dependent on water levels. Higher water levels allow motorboat traffic access to and above Ward's Ferry Bridge; however, this creates conflict with whitewater excursionists. DPRA restricts motorboat use above Ward's Ferry Bridge to minimize this conflict.

Regarding water-dependent recreation in the lower Tuolumne River, boating, angling and wading occur from the La Grange powerhouse tailrace to the confluence with the San Joaquin River. All current minimum flows are supportive of angling, wading, and swimming. The results of the Lower Tuolumne River Lowest Boatable Flow Study Report indicate that 200 cfs and 175 cfs were equally judged boatable by an overwhelming majority of participants, and that More than half of the boaters who participated in the study reported that 150 cfs was boatable. La Grange gage data for the calendar years 1997 through 2012 reported flows were greater than or equal to 150 cfs 84 percent of the time. For the more popular boating season, flow was at or above 150 cfs 98 percent of the time in May, 60 percent of the time in June, 56 percent of the time in July, August, and September, and 94 percent if the time in October. Flows were at or above 175 cfs 76 percent of the time for the period 1997-2012. During the months of the typical boating season of May through October, flows were at or above 175 cfs 97 percent of the time in May and 56 percent of the time in July, August, and September. For the same period, the flow of 200 cfs is exceeded 88 percent of the time in April, 95 percent of the time in May, 56 percent of the time in June, July, August and September, 74% of the time in October, and 70% of the time in November. Only in dry years is a flow of 200 cfs rare, and this is at a time when all resource uses, including developmental uses, are being significantly affected. (TID/MID 2013c).

3.9.2.4 Adequacy of Existing Recreation Facilities (including accessible facilities) to Meet Current and Future Recreational Demand

The Districts conducted a Recreation Facility Condition and Public Accessibility Assessment, and Recreation Use Assessment (RR-01) in 2012. This study included a number of components including:

(1) Inventorying and evaluating the developed recreation facilities for condition, ADA compliance, and use impacts;
(2) Estimating current recreation use; and
(3) Identifying future use and demand opportunities.

Inventory and evaluation of developed recreation facilities (Fleming Meadows, Blue Oaks, and Moccasin Point recreation areas as well as 12 remote facilities where toilets are maintained) included four subtasks:

(1) A complete inventory of developed recreation facilities associated with the Don Pedro Project including campgrounds, boat launches, marinas, the swimming lagoon, picnic areas, signs, and interpretive displays;
(2) An assessment of the condition of each component (tables, fire rings, restrooms, walkways, parking areas, roads, etc.) of the developed recreation facilities;
(3) An assessment of whether each component complies with current ADA accessibility guidelines; and
(4) An assessment of the use impacts at each recreation facility.

The study team assessed the developed recreation facilities based on established criteria. Overall, existing facilities appeared to be in generally good condition with partial accessibility for persons with disabilities. Impact of recreation use varied by site between "low" and "high" impacts. Table 3.9-10 presents a summary of the inventory and evaluation of recreation facilities.

Table 3.9-10. Summary of inventory and evaluation of developed Don Pedro Project recreation facilities.

Facility	Facility Site Evaluation	Accessibility Assessment	Assessment of Recreation Use Impacts
Fleming Meadows	Excellent condition	Partially accessible[2]	Low[3]
Blue Oaks	Excellent condition	Partially accessible	High[4]
Moccasin Point	Good condition[1]	Partially accessible	High
Dispersed Developed Toilet Facilities	Good Condition	Not designed to be accessible	N/A

[1] "Good Condition" defined as requiring routine care/maintenance
[2] "Partially accessible" defined as some handicap facilities, but in disrepair or not up to current ADA/ABAAG standards (e.g., slopes too steep, docks inaccessible, etc.)
[3] "Low" defined as few, if any signs of use impact are observed at each site
[4] "High" Defined as extensive signs of use impact; widespread use with many impacts evident
Source: TID/MID 2013a

Additional details regarding the inventory and evaluation of developed recreation sites can be found in the RR-01 study report.

The study also estimated current recreation use and identified future use and demand opportunities. Data routinely collected by DPRA formed the basis of an estimate for the number of Visitor Days to the Don Pedro Project. Results of the observation and visitor survey were used to characterize participation in various activities. These surveys were conducted January 2012 through December 2012 at Fleming Meadows, Blue Oaks, and Moccasin Point. Additionally the study identified future use and demand opportunities (next 30 to 50 years) by assessing existing unmet demand, future recreation demand, and the regional uniqueness or significance of the Don Pedro Project for recreation. Overall, the results indicated that current demand is being met for a wide range of outdoor recreation activities typical of reservoirs in central California (TID/MID 2013a).

The study also characterized the capacity for future use through 2050 at the developed recreation sites. Use levels through 2050 at Fleming Meadows Recreation Area are not projected to exceed the capacity of the campgrounds, picnic areas, and parking areas (including boat launch, marina, and overflow lots), except for the houseboat marina parking facility experienced over 80 percent occupancy on the weekends in 2012. Weekend use of the marina parking facility is projected to exceed capacity by 2020 and overall use is projected to exceed capacity by 2040 as marina users seek to park as close to the marina as possible. Use of the Overflow Parking Lot is projected to remain below capacity through 2050 (TID/MID 2013a).

Similarly, use levels projected through 2050 at Moccasin Point Recreation Area are not projected to exceed the capacity of the campgrounds, picnic areas (including boat launch, marina, and overflow lots), except for the marina and group picnic parking facilities. The marina parking facility experienced over 100 percent occupancy on holidays and weekends in 2012, and overall use is projected to exceed capacity by 2020 as marina users seek to park as close to the marina as possible. Use of the entrance overflow and main lot overflow parking lots are projected to remain below capacity through 2050 (TID/MID 2013a).

Use levels through 2050 at Blue Oaks Recreation Area are not projected to exceed capacity of the campgrounds, picnic area, and parking areas (including boat launch and group picnic area parking).

Overall existing facilities appeared to be in generally good condition with partial accessibility for persons with disabilities. Current demand is being met for a wide range of outdoor recreation activities with the existing facilities and is consistent with recreation demands identified in the 2008 CORP (CORP 2008). Use levels through 2050 at the Don Pedro Project facilities are not expected to exceed the designed carrying capacity with the exception of the houseboat marina parking facility at Fleming Meadows and the marina parking facility at Moccasin Point Recreation Area. Both of these facilities have overflow parking lots that are expected to remain below capacity through 2050 (TID/MID 2013a).

Effective operation and maintenance (O&M) of existing and future recreation facilities are key elements of effective recreation resource management. The proposed Recreation Resource Management Plan (RRMP) describes the Districts' and DPRA's commitment to maintain a five-year budget plan that is updated annually which includes ongoing O&M commitments.

3.9.2.5 Effects of Don Pedro Project Operations and Maintenance on the Condition and Use of Roads within the Don Pedro Project Area

The Districts conducted an inventory and evaluation of roads at the existing recreational facilities under the Recreation Facility Condition and Public Accessibility Assessment, and Recreation Use Assessment (RR-01). Road conditions at the recreation areas ranged from fair to excellent with asphalt roads dominating road type. Table 3.9-11 summarizes evaluation of the road inventory at Fleming Meadows Recreation Area, Blue Oaks Recreation Area, and Moccasin Point Recreation Area.

Table 3.9-11. Summary of road evaluation at existing recreational facilities.

Site	Surface Material	Road Width (ft)	Circulation Type	Condition
Fleming Meadows Recreation Area				
Campground A	asphalt	12	1-way loop	Excellent[1]
Campground B	asphalt	12	1-way loop	Good[2]
Campground D	asphalt	20	2-way	Excellent
Campground H	asphalt	12	1-way loop	Good
Boat Launch	asphalt	20	2-way	Excellent
Swim Lagoon	asphalt	20	2-way	Excellent
Group Picnic Area	asphalt	20	2-way	Excellent
Marina	asphalt	20	2-way	Fair[3]
Informal Day Use Area	gravel	20	2-way in/out	Good
Blue Oaks Recreation Area				
Campground A	asphalt	12 / 20	1-way loop / 2-way	Excellent
Campground B	asphalt	12	1-way loop	Excellent
Campground C	asphalt	12	1-way loop	Excellent
Campground D	asphalt	12	1-way loop	Good
Campground B, C and D Access Road	asphalt	20	2-way	Excellent
Group Picnic Area	asphalt	22	2-way	Good
Moccasin Point Recreation Area				
Campground A	asphalt	12	1-way loop	Fair
Campground B	asphalt	12	1-way loop	Fair
Campground C	asphalt	12	1-way loop	Fair
Campground C Access Road	asphalt	24	2-way	Good
Campground D	gravel	12	1-way loop	Fair
Campground D Access Road	gravel	20	2-way	Good
Campground E	gravel	10	1-way loop	Fair
Boat Launch/Group Picnic Area	asphalt	20	2-way	Good
Boat Launch Overflow Parking Lot	asphalt	24	2-way	Good
Marina	asphalt	20	2-way	Good

[1] "Excellent" defined as rehabilitation required beyond 10 years
[2] "Good" defined as no rehabilitation required within the next 5-10 years
[3] "Fair" defined as rehabilitation required within 5 years
Source: TID/MID 2013a

Continued operations are not likely to negatively impact the condition of the roads aside from normal wear and tear. The majority of roads accessed by the public for recreational purposes are deemed to be in excellent condition and thus likely not require rehabilitation for at least 10 years (TID/MID 2013a). As stated above, the proposed RRMP describes the five-year budget plan that which includes ongoing O&M commitments for roads and other facilities.

3.9.2.6 Adequacy of Existing Ward's Ferry Bridge Whitewater Boating Takeout and Restroom Facility to Meet Current and Future Recreational Demand

Current and future demand for whitewater boating takeout and appurtenant visitor facilities such as restrooms at Ward's Ferry Bridge and its vicinity is driven mostly by available flow, which varies from year to year. The timing and amount of flows during the whitewater boating season (April – August) are established each spring by CCSF. The maximum number of whitewater boaters allowed on the river at any one time and during any one year is managed by the USFS via a private and commercial permitting system. Use data from the period 2003 to 2012 indicates that an annual average of 4,225 people annually used the take-out at Ward's Ferry Bridge during this period (USDA 2013).

The existing whitewater boating take-out is located just upstream of the Ward's Ferry Bridge at approximately RM 78.5. Remnant abutments from an old bridge are located at this site and the area was used as a laydown and construction access site during construction of the existing bridge in the early 1970s (Bechtel 1970). Under the terms of the current license, DPRA maintains a restroom on the shoulder of Ward's Ferry Road near the south end of the existing bridge, on river left. The 2012 Recreation Facility Condition and Public Accessibility Assessment, and Recreation Use Assessment study found the vault toilet to be in good condition and the parking areas along the road were found to be in fair condition. Commercial and private whitewater boaters use this site as a take-out at the end of trips on the Upper Tuolumne River. Its location is favorable due in part to proximity to the terminus of the whitewater run, downstream of all rapids and upstream of significant slackwater at most water levels (TID/MID 2013b).

During the relicensing process, relicensing participants expressed that the Ward's Ferry Bridge take-out location presents challenges to safe and efficient take-out due to topography, condition of the access trails, and the frequency of vandalism at the site. BLM, NPS, and other relicensing participants requested that the Districts research and identify potential improvements to whitewater boating take-out opportunities. In response to these requests, the Districts conducted a Whitewater Boating Take-Out Improvement Feasibility Study. The primary goal of the study was to assess the engineering feasibility of improving the existing take-out location at the Ward's Ferry Bridge (TID/MID 2013b).

The study concluded that based on site assessment and preliminary engineering, whitewater take-out improvements at Ward's Ferry Bridge appear to be technically feasible at the river right option and river left option. The Moccasin Point Recreation Area take-out was also identified as a viable option. Deer Creek and Deer Flats were not as feasible as the Ward's Ferry Bridge sites; and the potential Buchanan Road take-out was not favorable due to its location upstream of some of the whitewater rapids of the Upper Tuolumne River. The Ward's Ferry river right option was somewhat superior because it offered slightly more space without either sidehill cutting on the land side or large retaining walls on the river side of the site. River right was also the lowest cost option identified in the study.

3.9.3 Proposed Resource Measures

The Districts propose to develop and implement a Recreation Resource Management Plan (RRMP) to include the following components:

- The Recreation Facility Development Program is intended to help address existing and future recreation facility needs identified by upgrading existing facilities and constructing new facilities, where appropriate, based on regular monitoring of recreation use and trends. The program also defines the current capital construction-related plans of the Districts, identifies proposed recreation development projects and their estimated costs, and provides conceptual diagrams of the locations of anticipated improvements. The Recreation Facility Development Program addresses needs identified by relicensing recreation studies, including the current desire for improved river-egress for whitewater boaters at the Ward's Ferry Bridge location.
- The operation and maintenance (O&M) program describes of O&M of existing and future developed multi-purpose recreation areas, recreation areas with limited-facility infrastructure, and dispersed areas with no facility infrastructure. The Districts will continue to provide O&M as described in the RRMP, Section 4. The Districts and DPRA maintain a five-year budget plan that is updated annually (Attachment B to the RRMP). The current five-year recreation maintenance and operation budget projection for 2014-2018 averages $269,000 per year.
- The Recreation Monitoring Program component of the RRMP is designed to measure recreation use levels, recreation use impacts, visitor tolerances for impacts (crowding, conflict, use impacts, facility conditions, etc.) and management actions that may be used to address identified "impact problems." This program defines the Districts' role in collecting and analyzing recreation data, and proposes how the data might be used to guide planning related to recreation management and capital facility improvements over the term of the new license. As described in the RRMP Section 5, the Districts will collect recreation use data every year beginning in the year following FERC approval of the RRMP.
- Over the term of the new license, additional consultation may occur as necessary to ensure that the goal and objectives of the RRMP are being met and the proposed measures are implemented. Consultation activities conducted during the new license terms will include periodic reporting of recreation use and facility condition as described in the RRMP Section 6.

3.9.4 Unavoidable Adverse Impacts

There are no unavoidable adverse impacts on recreation resources.

Section 7.0 Literature Cited inserted here for ease of checking references in Sections 1.0 through 3.9 above.

7.0 LITERATURE CITED

Section 1.0: Introduction

California Energy Commission (CEC). 2011. Updated California Energy Demand Forecast 2011-2022. May 2011. CEC-200-2011-006-SD.

Department of Energy and Environmental Protection Agency. 2000. Carbon Dioxide Emissions from the Generation of Electric Power in the United States. 21pp. [Online] URL: http://tonto.eia.doe.gov/ftproot/environment/co2emiss00.pdf. (Accessed May 22, 2013.)

National Parks Service (NPS). 1982. The Nationwide Rivers Inventory. Available online at: A-M: http://www.nps.gov/ncrc/programs/rtca/nri/states/ca.html; N-Z: http://www.nps.gov/ncrc/programs/rtca/nri/states/ca2.html.

Stillwater Sciences. 2009. Lower Tuolumne River Instream Flow Studies – Final Study Plan. Prepared for Turlock Irrigation District and Modesto Irrigation District. [Online] URL: http://tuolumnerivertac.com.

_____. 2012. Lower Tuolumne River Instream Flow Study–Final Report. Prepared for Turlock Irrigation District and Modesto Irrigation District. [Online] URL: http://tuolumnerivertac.com.

_____. 2013. Pulse Flow Study Report. Prepared for Turlock Irrigation District and Modesto Irrigation District. [Online] URL: http://tuolumnerivertac.com.

Turlock Irrigation District and Modesto Irrigation District. 2013. Lower Tuolumne River Temperature Model Study Report (W&AR-16). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

U.S. Department of Agriculture (USDA). undated. Stanislaus National Forest - Recreation. [Online] URL: http://www.fs.usda.gov/recmain/stanislaus/recreation (Accessed November 1, 2013).

U.S. Department of Interior (USDOI), National Park Service. 1983. Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines in the Federal Register, September 29, 1983 (48FR44716). Department of the Interior, Washington, D.C.

Section 2.0: Proposed Action and Alternatives

No References Listed

Section 3.0: Environmental Analysis

Section 3.1: General Description of the Tuolumne River Basin and Don Pedro Project

DeLorme. 2003. Northern California Atlas and Gazetteer. Sixth Edition. DeLorme, Yarmouth, Maine.

National Park Service (NPS). 2010. Yosemite National Park Tuolumne River Plan / Tuolumne Meadows Plan Legislative Parameters. Original publication date unknown. U.S. Department of the Interior, National Park Service, Yosemite, California.

Stanislaus County . 2006. Stanislaus County General Plan. Stanislaus County Board of Supervisors, Modesto, California.

State of California, Employment Development Department. 2013. Major Employers in Tuolumne County. [Online] URL: http://www.labormarketinfo.edd.ca.gov/majorer/countymajorer.asp?CountyCode=000109 accessed March 26, 2013.

U.S. Department of Commerce, Census Bureau. 2013. North American Industry Classification System. [Online] URL: http://www.census.gov/eos/www/naics/. (Accessed September 10, 2013.)

U.S. Army Corps of Engineers (ACOE). 1972. Don Pedro Lake, Tuolumne River, California: Reservoir Regulation for Flood Control. Department of the Army, Sacramento, California.

Western Regional Climate Center. 2010. Historical Climatological data for Northern California. Western Regional Climate Center, Reno, Nevada. [Online] URL: http://www.wrcc.dri.edu/summary/ climsmnca.html. (Accessed August 2010.)

Section 3.2: Scope of Cumulative Effects Analysis

Federal Energy Regulatory Commission (FERC). 2008. Preparing Environmental Documents, Guidelines for Applicants, Contractors, and Staff. Office of Energy Projects Division of Hydropower Licensing, Washington, D.C.

_____. 2011. Scoping Document 2 for the Don Pedro Hydroelectric Project. Prepared by the Federal Energy Regulatory Commission, Office of Energy Projects, Washington, DC. July 25, 2011.

Section 3.3: Geology and Soils

Abrahamson, N.A. and W.J. Silva. 1997. Empirical response spectral attenuation relations for shallow crustal earthquakes: Seismological Research Letters, v. 68, no. 1, p. 94-127.

Bechtel Corporation. 1992. Don Pedro Dam Seismicity Update and Ground Motion Evaluation, Supplemental Information to 1991 Part 12 Report: Vol. 1, November 1992.

Bogen, N.L. 1985. Stratigraphic and sedimentologic evidence of a submarine island-arc volcano in the lower Mesozoic Penon Blanco and Jasper Point Formations: Geological Society of America Bulletin, v. 96, p. 1322-1331.

California Geological Survey (CGS). 2013. Map Sheet 49, Epicenters of and Areas Damaged by M>5 California Earthquakes, 1800-1999. [Online] URL: http://www.consrv.ca.gov/cgs/rghm/quakes/Pages/MS49.aspx

Clark, L.D. 1960. Foothills Fault System, western Sierra Nevada, California: Geological Society of America Bulletin, v. 71, p. 483-496.

_____. 1964. Stratigraphy and structure of a part of the western Sierran Nevada metamorphic belt: U.S. Geological Survey, Professional Paper 410, 70p.

Day, H.W., E.M. Moores, and A.C. Tuminas. 1985. Structure and tectonics of the northern Sierra Nevada: Geological Society of America Bulletin, v. 96, p. 436-450.

Don Pedro Recreation Agency (DPRA). 2001. Don Pedro Recreation Agency Rules & Regulations. Modesto, CA.

Hannah, J.L. and E.M. Moores. 1986. Age relations and depositional environment of Paleozoic strata, northern Sierra Nevada, California: Geological Society of America Bulletin, v. 97, p. 787-797.

Harden, D.R. 2004. California Geology: Pearson Education, Inc., Upper Saddle River, New Jersey 07458, 2nd Edition, 552p.

Hart, E.W., W.A. Bryant and T.C. Smith. 1984. Summary of Faults Evaluated, 1983 Area, Sierra Nevada Region. Department of Conservation, Division of Mines and Geology Open-File Report 84-52.

Harwood, D.S. 1988. Tectonism and metamorphism in the Northern Sierra Terrane, northern California, *in*, Ernst, W. G., ed., Metamorphism and Crustal Evolution of the Western United States: Englewood Cliffs, New Jersey, Prentice Hall, Inc., p. 764-788.

HDR Engineering and Geomatrix Consultants. 2000. Review of seismic sources and ground motions for Don Pedro Dam. Technical Memorandum prepared for Turlock Irrigation District., Turlock, CA.

Jennings, C.W. 1994. Fault activity map of California and adjacent Areas with locations and ages of recent volcanic eruptions: California Division of Mines and Geology, Geologic Data Map, No. 6, scale 1:750,000.

Kondolf, G.M. 1995. Geomorphological stream channel classification in aquatic habitat restoration: Uses and limitations. Aquatic Conservation: Marine and Freshwater Ecosystems 5: 127-141. Doi: 10.1002/aqc.3270050205.

McBain & Trush. 2004. Coarse sediment management plan for the lower Tuolumne River. Revised Final Report. Prepared by McBain and Trush, Arcata, California for Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation Districts, USFWS Anadromous Fish Restoration Program, and California Bay-Delta Authority.

Morgan, B.A. 1977. Geologic map of the Chinese Camp and Moccasin quadrangles, Tuolumne County, California: U.S. Geological Survey, Miscellaneous Field Studies, Map MF-840, scale 1:24,000.

Russell, C. 2013. Don Pedro Recreation Area Director. Personal communication with D. Malkin, Biologist, HDR. October 25, 2013.

Schweickert, R.A. and D.S. Cowan. 1975. Early Mesozoic tectonic evolution of the western Sierra Nevada, California: Geological Society of America Bulletin, v. 86, p. 1329-1336.

Sadigh, K., C.Y. Chang, J.A. Egan, F. Makdisi, and R.R. Youngs. 1997. Attenuation Relationships for shallow crustal earthquakes based on California strong motion data: Seismological Research Letters, v. 68, no. 1, p. 180-189.

Saleeby, J., W.D. Sharp, J. Schweickert, C. Merguerian, R. Kistler, O.Tobisch, and W.H. Wright, 1982, Age and tectonic significance of Paleozoic orthogneisses of Sierra Nevada Foothills Metamorphic Belt, California.

Tobisch, O.T., S.R. Paterson, S. Longiaru, and T. Bhattacharyya. 1987. Extent of the Nevadan orogeny, central Sierra Nevada, California: Geology, V. 15, p.132-135.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2011. Pre-Application Document. Don Pedro Project. FERC No. 2299. February 2011.

_____ 2013. Reservoir Temperature Model Study Report (W&AR-03). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

United States Geological Survey (USGS). 1984. CDMG Open-File Report 84-52. Western Region Geologic Publications. [Online] URL: http://geopubs.wr.usgs.gov/docs/wrgis/of-pre95.html#of84 (Accessed May 2010)

_____ 2013. Earthquake Hazards Program, [Online] URL: http://earthquake.usgs.gov/earthquakes/feed/v1.0/geojson.php

Wentworth, C.M. and M.D. Zoback. 1989. The style of later Cenozoic deformation at the eastern front of the California Coast Ranges: Tectonics, v. 8, p. 237-246.

Section 3.4: Water Resources

California Department of Public Health (CDPH). 2010. California Code of Regulations, Title 22, Division 4, Chapter 15, Domestic Water Quality and Monitoring Regulations.

Available online at: <http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Lawbook.aspx>.

California Department of Water Resources (CDWR). 2013. California Irrigation Management Information System (CIMIS) is a program in the Office of Water Use Efficiency (OWUE). [Online] URL: http://wwwcimis.water.ca.gov/cimis/frontMonthlyEToReport.do (Accessed October, 2013.)

Central Valley Regional Water Quality Control Board (CVRWQCB). 1998. The Water Quality Control Plan (Basin Plan) for the Sacramento River Basin and the San Joaquin River Basin. 4th ed. California Regional Water Quality Control Board, Central Valley Region. Revised in September 2009 with the Approved Amendments. Available online at: <http://www. waterboards.ca.gov/centralvalley/water_issues/basin_plans/>.

Eilers, J.M., P. Kanciruk, R.A. McCord, W.S. Overton, L. Hook, D.J. Blick, D.F. Brakke, P.E. Kellar, M.S. DeHaan, M.E. Silverstein, and D.H. Landers. 1987. Characteristics of Lakes in the Western United States. Volume II. Data Compendium for Selected Physical and Chemical Variables. EPA-600/3-86/054b, U.S. Environmental Protection Agency, Washington, D. C. January. 425 pp.

Hetch Hetchy Water and Power. 2006. Hetch Hetchy Restoration Study. Department of Water Resources, Department of Parks and Recreation.

Jayasundara, N. C., M. L. Deas, E. Sogutlugil, E. Miao, E. Limanto, A. Bale, Nd S. K. Tanaka. 2014. Tuolumne River flow and temperature model: without project assessment. Prepared by Watercourse Engineering, Inc., Davis, CA.

Marshack, J. 2008. A Compilation of Water Quality Goals. California Regional Water Quality Control Board, Central Valley Region, Rancho Cordova, California. Available online at: <http://www.swrcb.ca.gov/centralvalley/water_issues/water_quality_standards_limits/water_quality_goals/index.html>.

Office of Environmental Health Hazard Assessment (OEHHA). 2009. 2009 Update of California Sport Fish Advisories. California Environmental Protection Agency. Last updated March 18, 2009. URL: <www.oehha.ca.gov/fish/so_cal/index.html>.

PRISM Climate Group. 2006. United States Average Monthly or Annual Precipitation 1971 – 2000, <http://prism.oregonstate.edu>, Oregon State University, Created 12 Jun 2006.

State Water Resources Control Board (SWRCB). 2010. 2010 Integrated Report Clean Water Act Sections 303(d) and 305(b). Approved August 4, 2010. Board Resolution No. 2010-0040. Sacramento, California. Available online at: <http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml>

Turlock Irrigation District (TID). 2008. Turlock Groundwater Basin. Groundwater Management Plan. March 18.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2009. Don Pedro Reservoir Fish Mercury Study. Final Report. Prepared by Stillwater Sciences, Berkeley, California for Turlock Irrigation District and Modesto Irrigation District.

_____. 2011. Pre-Application Document. Don Pedro Project. FERC No. 2299. February 2011.

_____ 2013a. Water Quality Assessment Study Report (W&AR-01). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____ 2013b. Project Operations/Water Balance Model Study Report (W&AR-02). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____ 2013c. Reservoir Temperature Model Study Report (W&AR-03). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____ 2013d. Lower Tuolumne River Temperature Model Study Report (W&AR-16). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013e. Chinook Salmon Population Model Study Report (W&AR-06). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2014. *Oncorhynchus mykiss* Population Study Report (W&AR-10). April.

United States Environmental Protection Agency (EPA). 2000. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California. 40 CFR 131, pages 31682-31711. Federal Register May 18. Available online at: <http://www.epa.gov/fedrgstr/EPA-WATER/2000/ May/Day-18/w11106.pdf>.

_____ 2001. Water Quality Criterion for the Protection of Human Health: Methylmercury. Office of Science and Technology Office of Water. Washington, D.C. EPA-823-R-01-001. January 2001.

_____ 2003. Bacterial Water Quality Standards for Recreational Waters (Freshwater and Marine Waters). Office of Water Report No. EPA-823-R-03-008. June. Available online at: <http://www.epa.gov/waterscience/beaches/local/sum2.html>.

United States Geologic Survey (USGS). 2008. Water Resources Data - California, Water Year 2008: Volume 3 - Southern Central Valley Basins and the Great Basin from Walker River to Truckee River. Available online at: http://ca.water.usgs.gov/waterdata/.

_____ 2009. 1/3 Arc Second National Elevation Dataset, <http://seamless.usgs.gov>, USGS Earth Resources Observation & Science (EROS) Center, Sioux Falls, SD, Created 23 March 2009.

U.S. Army Corps of Engineers (ACOE). 1972. Don Pedro Lake, Tuolumne River, California: Reservoir Regulation for Flood Control. Department of the Army, Sacramento, California.

Wetzel, R.G. 1983. Limnology, 2"d Edition. Saunders College Publishing, Philadelphia, PA.

Western Regional Climate Center. 2006. Historical Climatological data for Northern California. Western Regional Climate Center, Reno, Nevada. [Online] URL: http://www.wrcc.dri.edu/summary/climsmnca.html. (Accessed September 2010.)

Section 3.5: Fish and Aquatic Resources

Barnett-Johnson, R., C.B. Grimes, C.F. Royer, and C.J. Donohoe. 2007. Identifying the contribution of wild and hatchery Chinook salmon (*Oncorhynchus tshawytscha*) to the ocean fishery using otolith microstructure as natural tags. Canadian Journal of Fisheries and Aquatic Sciences 64:1683-1692.

Beamesderfer, R.C.P., G. Kopp, and D. Demko. 2005. Review of the distribution, life history, and population dynamics of green sturgeon with reference to California's Central Valley. S.P. Cramer and Associates.

Bilby, R.E. and P.A. Bisson. 1998. Function and distribution of large woody debris. In River Ecology and Management. Naiman R.J. and R. E. Bilby (Eds.). New York, Springer, p. 324-346.

Bovee, K. D. 1982. A guide to stream habitat analysis using instream flow incremental methodology. Instream Flow Information Paper No. 12. Instream Flow Group. U.S. Fish and Wildlife Service, Fort Collins, Colorado. FWS/OBS- 82/26. 248 pp.

Brown, L. and P. B. Moyle. 2004. Native Fishes of the Sacramento-San Joaquin Drainage, California: a history of decline. Pages 75-98 in J. N. Rinne, R. M. Hughes, and B. Calamusso, editors. Historical Changes in Large River Fish Assemblages of the Americas. American Fisheries Society, Symposium 45, Bethesda, MD.

Bustard, D. R., and D. W. Narver. 1975. Aspects of the winter ecology of juvenile coho salmon (*Oncoryhnchus kisutch*) and steelhead trout (*Salmo gairdneri*). Journal of the Fisheries Research Board of Canada 32:667-680.

California Cooperative Oceanic Fisheries Investigations (CalCOFI). 2006. The State of the California Current, 2005-2006: Warm in the North, Cool in the South. CalCOFI Report, Vol. 47, 2006.

_____. 2007. The State of the California Current, 2006-2007: Regional and Local Processes Dominate. CalCOFI Report, Vol. 48, 2007.

California Invasive Plant Council (Cal-IPC). 2014. http://www.cal-ipc.org/ip/management/ipcw/pages/detailreport.cfm@usernumber=45&surveynumber=182.php.

California Department of Fish and Game (CDFG). 1946. Division of Fish and Game thirty-ninth biennial report for 1944-1946. California Department of Fish and Game.

California Department of Fish and Game and National Marine Fisheries Service (CDFG and NMFS). 2001. Final report of anadromous salmonid fish hatcheries in California. December. https://nrm.dfg.ca.gov/documents/ContextDocs.aspx?cat=Fisheries

California Department of Fish and Game and U. S. Fish and Wildlife Service (CDFG and USFWS). 2010. Hatchery and stocking program Environmental Impact Report/Environmental Impact Statement. Prepared for agencies by Jones and Stokes, Sacramento, California. [Online] URL: http://www.dfg.ca.gov/news/pubnotice/hatchery/. Accessed July 26, 2010.

California Department of Fish and Wildlife (CDFW). 2014. Striped bass biology (*Morone saxitilis*). http://www.dfg.ca.gov/fish/Resources/Striped_Bass/Biology.asp

Cohen, A. 2008. Potential Distribution of Zebra Mussels *(Dreissena polymorpha)* and Quagga Mussels *(Dreissena bugensis)* in California. Prepared for California Department of Fish and Game. Prepared by San Francisco Estuary Institute, Oakland, CA and Center for Research on Aquatic Bioinvasions, Richmond, CA.

Dill, W.A, and A.J. Cordone. 1997. History and status of introduced fishes in California, 1871-1996. California Department of Fish and Game Fish Bulletin 178. [Online] URL: http://www.escholarship.org/uc/item/5rm0h8qg#page-1. (Accessed August 2, 2010.).

Flagg, T., B. Berejikian, J. Colt, W. Dickhoff, L.W. Harrell, D.J. Maynard, C.E. Nash, M.S. Strom, R.N. Iwamoto, C.V.W. Mahnken. 2000. Ecological and behavioral impacts of artificial production strategies on the abundance of wild salmon populations. National Marine Fisheries Service. NOAA Technical Memorandum NMFS-NWFSC-41.

Ford, T. and L.R. Brown. 2001. Distribution and Abundance of Chinook Salmon and Resident Fishes of the Lower Tuolumne River, California. Fish Bulletin.

Ford, T., and S. Kirihara. 2010. Tuolumne River Oncorhynchus mykiss monitoring report. Prepared by Turlock Irrigation District/Modesto Irrigation District, California and Stillwater Sciences, Berkeley, California for Federal Energy Regulatory Commission, Washington, D.C.

Fry, D. H., Jr., and A. Petrovich, Jr. 1970. King salmon (*Oncorhynchus tshawytscha*) spawning stocks of the California Central Valley, 1953-1969. Anad. Fish. Admin. Rept. 70-11.

Garza, J.C., and D.E. Pearse. 2008. Population genetic structure of *Oncorhynchus mykiss* in the California Central Valley. Report to California Department of Fish and Game. Contract No. PO485303. University of California, Santa Cruz, and NOAA Southwest Fisheries Science Center, Santa Cruz, California.

Grant, J., and D. Kramer. 1990, Territory size as a predictor of the upper limit to population density of juvenile salmonids in streams: Canadian Journal Fisheries Aquatic Science, V. 47, No. 9, p. 1724–1737.

Houk, J.. 2002. Reservoir Biologist's Report, July 1, 2001 – June 30, 2002. Prepared for CDFW, Central Region, Fresno.

Houk, J. 2003. A summary and analysis of research data and assessment observations including electrofishing surveys, angler interview, habitat improvement projects and public relations conducted from July 1, 1998 – June 30, 2003 at New Melones, Don Pedro, McClure, Eastman, Hensley, Millerton, Pine Flat, Kaweah, Success, Isabella, Woolomes, San Luis, Bass Lake and Shaver Lake Reservoir. Prepared for CDFW, Central Region, Fresno.

Jackson, T. A. 2007. California Steelhead Report-Restoration Card: A Report to the Legislature California Department of Fish and Game. 46 p. plus appendices.

Jones, W.J., B.D. Quelvog, and G. Bernardi. 2002. Morphological and genetic analysis of the Red Hills roach (Cyprinidae: *Lavinia symmetricus*). Conservation Genetics 3:262-276. [Online] URL: http://bio.research.ucsc.edu/people/bernardi/Bernardi/Publications/2002RedHills.pdf. (Accessed July 21, 2010.).

Lee, D.P. 1999. Water Level Fluctuation Criteria for Black Bass in California Reservoirs. Reservoir Research Management Project: Informational Leaflet No. 12.

Lindley, S.T., R.S. Schick, E. Mora, P.B. Adams, J.J. Anderson, S. Greene, C. Hanson, B.P. May, D.R. McEwan, R.B. MacFarlane, C. Swanson, and J.G. Williams. 2007. Framework for assessing viability of threatened and endangered salmon and steelhead in the Sacramento- San Joaquin Basin. San Francisco Estuary and Watershed Science Volume 5, Issue 1 [February 2007], article 4.

McBain & Trush. 2000. Habitat restoration plan for the Lower Tuolumne River corridor, Final Report. Prepared by McBain and Trush, Arcata, California for the Tuolumne River Technical Advisory Committee with assistance from U.S. Fish and Wildlife Service Anadromous Fish Restoration Program.

_____. 2004. Coarse sediment management plan for the lower Tuolumne River. Revised Final Report. Prepared by McBain and Trush, Arcata, California for Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation Districts, USFWS Anadromous Fish Restoration Program, and California Bay-Delta Authority.

McBain & Trush and Stillwater Sciences. 2006. Lower Tuolumne River predation assessment final report. Prepared for the Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation districts, USFWS Anadromous Fish Restoration Program and California Bay-Delta Authority.

McEwan, D. 2001. Central Valley steelhead. *In* R. Brown, editor. Contributions to the biology of Central Valley salmonids, Volume 1. California Department of Fish and Game, Fish Bulletin 179. 43 pages.

McMillan, J. R., J. B. Dunham, G. H. Reeves, J. S. Mills, and C. E. Jordan. 2012. Individual condition and stream temperature influence early maturation of rainbow and steelhead trout, *Oncorhynchus mykiss*. Environmental Biology of Fishes 93:343–355.

Merced Irrigation District (Merced ID). 2012. Merced River Hydroelectric Project Final License Application. Merced Irrigation District, February 2012.

Mesick, C. 2009. The high risk of extinction for the natural fall-run Chinook salmon population in the Lower Tuolumne River due to insufficient instream flow releases. U.S. Fish and Wildlife Service, Exhibit No. FWS-50, to Proceeding of the Presiding Administrative Law Judge on Interim Measures for the Don Pedro Project.

Mesick, C.F. and D. Marston. 2007. Provisional Draft: Relationships between fall-run Chinook salmon recruitment to the major San Joaquin River tributaries and streamflow, Delta exports, the Head of the Old River Barrier, and tributary restoration projects from the early 1980s to 2003.

Mesick, C., J. McLain, D. Marston, and T. Heyne. 2008. Limiting factor analyses and recommended studies for fall-run Chinook salmon and rainbow trout in the Tuolumne River. Draft Report. Joint Report of the U.S. Fish and Wildlife Service (Anadromous Fish Restoration Program), National Marine Fisheries Service, Sacramento Office, and California Department of Fish and Game, Fresno Office. August 13, 2008.

Moyle, P.B. 1996. Potential Aquatic Diversity Management Areas. Ch. 57 In: Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options. Davis: University of California, Centers for Water and Wildland Resources, Davis, California.

_____. 2002. Inland Fishes of California. Revised and expanded. Berkeley: University of California Press. 502 pp.

Moyle, P. B., R. M. Yoshiyama, J. E. Williams, and E. D. Wikramanayake. 1995. Fish species of special concern of California, second edition. Prepared by Department of Wildlife and Fisheries Biology, University of California, Davis, for the State of California The Resources Agency, Department of Fish and Game, Inland Fisheries Division. Rancho Cordova, California.

Moyle P. B., R.M. Yoshiyama, and R.A. Knapp. 1996. Status of fish and fisheries. In Sierra Nevada Ecosystem Project: Final report to Congress, vol. II, Chap 33. Davis: University of California, Centers for Water and Wildland Resources.

Moyle, P.B., R. D. Baxter, T. Sommer, T. C. Foin, and S. A. Matern. 2004. Biology and population dynamics of Sacramento Splittail (*Pogonichthys macrolepidotus*) in the San Francisco Estuary: a review. San Francisco Estuary and Watershed Science [online serial] 2(2):1-47. http://repositories.cdlib.org/jmie/sfews/

National Marine Fisheries Service (NMFS) 2009. What Caused the Sacramento River Fall Chinook Stock Collapse? NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-447. July 2009.

Nielson, J.L., S.A. Pavey. T. Wiacek, and I. Williams. 2005. Genetics of Central Valley O. mykiss populations: drainage and watershed scale analysis. San Francisco Estuary and Watershed Science [online serial] 3.

Orr, B.K. 1997. Ecosystem health and salmon restoration: a broader perspective. Pages 575-580 in S.S.Y. Wang, editor. Environmental and coastal hydraulics: protecting the aquatic habitat. Volume 1: Proceedings of Theme B. Water for a changing global community. The 27th Congress of the International Association for Hydraulic Research. American Society of Civil Engineers, New York. [Online] URL: http://www.stillwatersci.com/resources/1997orrsalmon.pdf. (Accessed July 27, 2010.).

Pearse D. E., S. A. Hayes, M. H. Bond, C. V. Hanson, E. C. Anderson, and J. C. Garza. 2009. Over the Falls? Rapid Evolution of Ecotypic Differentiation in Steelhead/Rainbow Trout (*Oncorhynchus mykiss*). Journal of Heredity 100:515–525.

Robichaud, D. and K. English. 2013. Analysis of Tuolumne River Rotary Screw Trap Data to examine the relationship between river flow and survival rates for Chinook smolts migrating between Waterford and Grayson (2006-12). Prepared by LGL Limited, Sidney, BC, Canada for the Turlock Irrigation District and Modesto Irrigation District.

Rombough, P. 1985. Initial egg weight, time to maximum alevin wet weight, and optimal ponding times for Chinook salmon (*Oncorhynchus tshawytscha*). Can. J. Fish. Aquat. Sci. 42: 287–291.

Roper, B. and D. Scarnecchia. 1999. Emigration of age-0 chinook salmon (*Oncorhynchus tshawytscha*) smolts from the upper South Umpqua River basin, Oregon, U.S.A. Canadian Journal of Fisheries and Aquatic Sciences. 56: 939-46.

Satterthwaite, W. H., M. P. Beakes, E. M. Collins, D. R. Swank, J. E. Merz, R. G. Titus, S. M. Sogard, and M. Mangel. 2010. State-dependent life history models in a changing (and regulated) environment: steelhead in the California Central Valley. Evolutionary Applications 3:221-243.

Sloat, M. 2013. Born to Run? Integrating Individual Behavior, Physiology, and Life Histories in Partially Migratory Steelhead and Rainbow trout (*Oncorhynchus mykiss*). PhD dissertation, Oregon State University, Corvalis, OR. March. 148 pp.

Speed, T. 1993. Modeling and managing a salmon population. Pages 265-290 in V. Barnett, and K.F. Turkman, editors. Statistics for the Environment, John Wiley & Sons.

State Board of Fish Commissioners. 1904. Eighth Biennial Report. Prepared by the State Board of Fish Commissioners of the State of California, for the years 1903 – 1904.

Stillwater Sciences. 2003. Subject: Preliminary assessment of physical habitat and temperature suitability for steelhead based on 1995 IFIM Study Results for the lower Tuolumne River. Memorandum from N. Hume and P. Baker, Stillwater Sciences, Berkeley, California to T. Ford, Turlock and Modesto Irrigation Districts, September 24.

_____. 2009a. Don Pedro Reservoir Fish Mercury Study. Final Report for Turlock Irrigation District and Modesto Irrigation District.

_____. 2009b. March and July 2009 population size estimates of *Oncorhynchus mykiss* in the Lower Tuolumne River. Appendix G: Fish Observation Data. Prepared by Stillwater Sciences, Berkeley, California, for Turlock Irrigation District, Turlock, California, and Modesto Irrigation District, Modesto, California. November.

_____. 2010. 2010 Lower Tuolumne River Annual Report. Report 2010-5: 2010 Snorkel Report and Summary Update. Prepared by Stillwater Sciences, Berkeley, California, for Turlock Irrigation District, Turlock, California, and Modesto Irrigation District, Modesto, California. November.

_____. 2012a. Lower Tuolumne River Instream Flow Studies: Pulse Flow Study Report. Final. Prepared by Stillwater Sciences, Berkeley, California for Turlock Irrigation District and Modesto Irrigation District, California.

_____. 2012b. Tuolumne River 2011 *Oncorhynchus mykiss* monitoring summary report. Prepared by Stillwater Sciences, Berkeley, California for the Turlock Irrigation District and Modesto Irrigation District.

_____. 2012c. September 2011 population size estimates of Oncorhynchus mykiss in the Lower Tuolumne River. Prepared by Stillwater Sciences, Berkeley, California for the Turlock Irrigation District and the Modesto Irrigation Districts, California. March.

_____. 2013. Lower Tuolumne River Instream Flow Study. Final Report. Prepared by Stillwater Sciences, Davis, California for Turlock and Irrigation District and Modesto Irrigation District, California. April 2013.

_____. 2014. Lower Tuolumne River Instream Flow Study - Pacific lamprey and Sacramento splittail 1-D PHABSIM habitat assessment. Prepared by Stillwater Sciences, Davis, California for Turlock and Irrigation District and Modesto Irrigation District, California. April 2014.

Taylor, T.L., P.B. Moyle, and D.G. Price. 1982. Fishes of Clear Lake Basin. Univ. Calif. Publ. Zool. 115: 171-224.

Turlock Irrigation District (TID). 2011. La Grange Reservoir Backwater Analysis. Prepared by HDR Engineering, Inc. December.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 1992a. Lower Tuolumne River spawning gravel availability and superimposition report. Appendix 6 in Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 39 of the License for the Don Pedro Project, No. 2299 Vol. VIII. Prepared by EA Engineering, Science, and Technology, Lafayette, California.

_____. 1992b. Lower Tuolumne River spawning gravel studies report. Appendix 8 in Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 39 of the License for the Don Pedro Project, No. 2299. Vol. IV. Prepared by EA Engineering, Science, and Technology, Lafayette, California.

_____. 1992c. Report of Turlock Irrigation District and Modesto Irrigation District pursuant to Article 39 of the license for the Don Pedro Project. Turlock, California. 8 Volumes. April.

_____. 1997. 1996 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. 6 Volumes. March.

_____. 2001. Report 2000-6: Tuolumne River Chinook salmon fry and juvenile stranding report. Prepared by Noah Hume and Jennifer Vick of Stillwater Ecosystem, Watershed & Riverine Sciences, Berkeley, CA. March 2001.

_____. 2005. 2005 Ten Year Summary Report. Pursuant to Paragraph (G) of the 1996 FERC Order issued July 31, 1996. Don Pedro Project, No. 2299. April.

_____. 2007a. 2006 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 39 of the License for the Don Pedro Project, No. 2299. 2 Volumes. March.

______.2007b. Report 2006-7: Survival to emergence study report. Prepared by Peter Baker, Noah Hume, A.J. Keith, Neil Lassetre, and Frank Ligon, Stillwater Ecosystem, Watershed & Riverine Sciences, Berkeley, CA. March 2007.

______.2010a. Report 2009-3: 2009 seine report and summary update. Prepared by Prepared by Tim Ford, Turlock and Modesto Irrigation Districts and Steve Kirihara, Stillwater Sciences, Berkeley, CA. June 2009.

______.2010b. Report 2009-4: 2009 rotary screw trap report. Prepared by Michele L. Palmer and Chrissy L. Sonke, FISHBIO Environmental, LLC, Oakdale, CA. February 2010.

______.2010c. Report 2009-5: 2009 snorkel report and summary update. Prepared by Tim Ford, Turlock and Modesto Irrigation Districts and Steve Kirihara, Stillwater Sciences, Berkeley, CA. March 2010.

______. 2010d. Report 2009-2: Spawning survey summary update. Prepared by Tim Ford, Turlock and Modesto Irrigation Districts and Steve Kirihara, Stillwater Sciences, Berkeley, CA. March 2010.

______.2010e. Report 2009-8: 2009 counting weir report. Prepared by Ryan Cuthbert, Andrea Fuller, and Sunny Snider, FISHBIO Environmental, LLC, Oakdale, CA. February 2010.

______.2010f. Report 2009-7: Aquatic invertebrate monitoring and summary update. Prepared by Stillwater Sciences, Berkeley, CA. March 2010.

______. 2011a. Pre-Application Document. Don Pedro Project. FERC No. 2299. February 2011.

______. 2011b. Fall/Winter Migration Monitoring at the Tuolumne River Weir – 2010 Annual Report. Prepared by FishBio, Oakdale, CA.

______. 2011c. 2011 Lower Tuolumne River Annual Report. Report 2011-5, 2011 Snorkel Report and Summary Update.

______. 2012a. Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project No. 2299 - 2012 Lower Tuolumne River Annual Report,. March 2013.

______. 2012b. Fall/winter Migration Monitoring at the Tuolumne River Weir – 2011 Annual Report. Prepared by FishBio, Oakdale, CA.

______. 2013a. Don Pedro Fish Population Survey Study Report (W&AR-17). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

______. 2013b. Fish Assemblage and Population Between Don Pedro Dam and La Grange Dam Study Report (W&AR-13). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013c. Salmonid Population Information Integration and Synthesis Study Report (W&AR-05). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013d. Spawning Gravel in the Lower Tuolumne River Study Report (W&AR-04). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013e. Chinook Salmon Population Model Study Report (W&AR-06). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013f. Predation Study Report (W&AR-07). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013g. Salmonid Redd Mapping Study Report (W&AR-08). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013ih. Chinook Salmon Otolith Study Progress Report (W&AR-11), Section 2.4.11 of the Don Pedro Hydroelectric Project Initial Study Report. January 2013.

_____. 2013i. *Oncorhynchus mykiss* Habitat Survey Study Report (W&AR-12). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013j. Temperature Criteria Assessment Progress Report (W&AR-14). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013k. *Oncorhynchus mykiss* Scale and Age Determination Study Report (W&AR-20). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013l. Lower Tuolumne River Floodplain Hydraulic Assessment Study Plan (W&AR-21). September 2013.

_____. 2013m. Lower Tuolumne River Temperature Model Study Report (W&AR-16). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013n. Lower Tuolumne River Riparian Information and Synthesis Study Report (W&AR-19). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013o. Sturgeon Study Report (W&AR-18). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013p. Lower Tuolumne River Lowest Boatable Flow Study (RR-03). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2014. *Oncorhynchus mykiss* Population Study Report (W&AR-10). April 2014.

U.S. Department of Interior, Bureau of Land Management (USDOI BLM). 2009. Red Hills of Tuolumne County. U.S. Department of Interior, Bureau of Land Management Mother Lode Field Office, El Dorado Hills, California. [Online] URL: http://www.blm.gov/ca/st/en/fo/folsom/redhillshomepg1.html. (Accessed July 16, 2010.)

U.S. Fish and Wildlife Service (USFWS). 1995. The relationship between instream flow and physical habitat availability for Chinook salmon in the lower Tuolumne River, California. Prepared by USFWS, Ecological Services Division, Sacramento, California for Turlock Irrigation District and Modesto Irrigation District, California.

_____. 2008. Flow-overbank inundation relationship for potential fall-run Chinook salmon and steelhead/rainbow trout juvenile outmigration habitat in the Tuolumne River. U.S. Fish and Wildlife Service, Sacramento, CA.

U.S. Geological Survey (USGS). 1899. Water supply and irrigation papers. No. 19. Government Printing Office, Washington D.C.

Yoshiyama, R.M., E.R. Gerstung, F.W. Fisher, and P.B. Moyle. 1996. Historical and present distribution of Chinook salmon in the Central Valley drainage of California. Sierra Nevada Ecosystem Project: final report to Congress. In: University of California, Center for Water and Wildlife Resources, Davis. Assessments, commissioned reports, and background information. p 309-362. [Online] URL: http://www.sierraforestlegacy.org/Resources/Conservation/SierraNevadaWildlife/Chinook/CHYoshiyama-etal1996.pdf. (Accessed August 10, 2010.).

Zimmerman, C.E., G.W. Edwards, and K. Perry. 2008. Maternal Origin and Migratory History of *Oncorhynchus mykiss* captured on rivers of the Central Valley, California. California Department of Fish and Game.

_____. 2009. Maternal origin and migratory history of Oncorhynchus mykiss captured in rivers of the Central Valley, California. Final Report, Contract PO385300. Prepared for the California Department of Fish and Game.

Section 3.6: Botanical Resources

California Department of Fish and Game (CDFG). 2009. Protocols for Surveying and Evaluation Impacts to Special Status Native Plant Populations and Natural Communities.

_____. 2012. California Natural Diversity Database. Rarefind 4. Available online: <nrmsecure.dfg.ca.gov/cnddb/view/query.aspx>. Accessed February, 2012. Last updated February, 2012. California Department of Fish and Game, Sacramento, CA.

California Department of Food and Agriculture (CDFA). 2010. Pest Ratings of Noxious Weed Species and Noxious Weed Seed. Division of Plant Health and Pest Prevention Services. CDFA. Sacramento, CA.

_____. 2012. Encycloweedia: Data Sheets. Available online: <http://www.cdfa.ca.gov/phpps/ipc/weedinfo/winfo_table-commname.htm> Accessed June 21, 2012. CDFA. Sacramento, CA.

California Native Plant Society (CNPS). 2012. Inventory of Rare and Endangered Plants of California. Available online: <cnps.web.aplus.net/cgi-bin/inv/inventory.cgi>. Accessed February, 2012. Last updated February, 2012. California Native Plant Society, Sacramento, CA.

California Wetlands Monitoring Workgroup (CWMW). 2012. California Rapid Assessment Method (CRAM) for Wetlands and Riparian Areas, Version 6.0. 95 pp.

Jepson Flora Project, eds. 2013. *Jepson eFlora*. Available online: http://ucjeps.berkeley.edu/IJM.html. Accessed on June 3, 2013.

United States Department of Agriculture (USDA), Forest Service (USFS). 2009. Remote Sensing Lab, Ecosystem Planning. Vegetation Classification: CalVeg Zones and Alliances – Vegetation Descriptions. Available online: < http://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347192 >. Accessed 2010. Last updated March 12, 2009. USDA, Forest Service. Sacramento, CA.

United States Department of the Interior, Bureau of Land Management (BLM). 2012. Special-status Plants. Available online: <http://www.blm.gov/ca/st/en/prog/ssp.html>. Last updated: September, 2012.

United States Department of the Interior, Fish and Wildlife Service (USFWS). 1987. National Wetland Inventory Mapping. USFWS Region 1, Portland, OR.

Western Regional Climate Center. 2013. Cooperative Climatological Data Summaries. Available online: http://www.wrcc.dri.edu/climatedata/climsum/. Accessed on June 5, 2013.

Section 3.7: Wildlife Resources

Ashton, D.T., A.J. Lind, and K.E. Schlick. 1997. Western Pond Turtle (*Clemmys marmorata*). Natural History. USDA Forest Service, Pacific Southwest Research Station, Arcata, California. Available online: <http://www.krisweb.com/biblio/gen_usfs_ashtonetal_1997_turtle.pdf>. Accessed July 2010.

Bureau of Land Management (BLM). 1980. Fisheries Inventory of Sierra Foothill Streams on Public Land in 1979 and 1980. U.S. Department of Interior, Bureau of Land Management Mother Lode Field Office, El Dorado Hills, California.

_____. 2006. California-BLM sensitive species list, updated September 2006. U.S. Department of the Interior, Bureau of Land Management Mother Lode Field office, El Dorado Hills, California. Available online: < http://www.blm.gov/>. Accessed July 2010.

California Department of Fish and Game (CDFG). 2000. The Status of Rare, Threatened, and Endangered Animals and Plants of California. Habitat Conservation Planning Branch. Sacramento, CA.

_____. 2008. California Wildlife Habitat Relationship system. Version 8.2 personal computer. California Interagency Wildlife Task Group. CDFG Sacramento, California.

California Department of Fish and Wildlife (CDFW). 2012. California Natural Diversity Database (CNDDB). RareFind Version . Available <onlinehttps://nrm.dfg.ca.gov/myaccount/login.aspx?ReturnUrl=%2fcnddb%2fview%2fquery.aspx>. Accessed August 7 , 2012. . California Department of Fish and Game, Biogeographic Data Branch. Sacramento, CA.

_____. 2013a. California Natural Diversity Database. Rarefind 4. Available online: < nrmsecure.dfg.ca.gov/cnddb/view/query.aspx>. Accessed May 2013.

_____. 2013b. Golden eagles in the state of California. Available online: <http://www.dfg.ca.gov/wildlife/nongame/raptors/goldeneagle/>. Accessed October 2013.

_____. 2013c. Swainson's Hawks in California. Available online: <http://www.dfg.ca.gov/wildlife/nongame/raptors/swha/>. Accessed May 2013.

Cranston, Peggy. 2012. Wildlife Biologist. Bureau of Land Management (BLM). Personal communication with Susan Imholt, wildlife biologist, HDR. March 9, 2012.

_____. 2013. Wildlife Biologist. Bureau of Land Management (BLM). 2013. Personal communication with Justin Tortosa, Senior Wildlife Biologist, HDR. June 13, 2013.

deBecker, S. and A. Sweet. 2005. Crosswalk between WHR and California vegetation classifications. Pages 21-39 *in*: K.E. Mayer and W.F. Laudenslayer, eds. 1988. A Guide to Wildlife Habitats of California. Update from 1988. The Resources Agency, Department of Forestry and Fire Protection, Sacramento, California. Available online: <http://www.dfg.ca.gov/biogeodata/cwhr/pdfs/XCalVeg.pdf>. Accessed August 2010.

ECORP Consulting, Inc. 2005. Draft results of the 2004 (Year 1) amphibian monitoring program for foothill yellow-legged frog and mountain yellow-legged frog. El Dorado Hydroelectric Project (FERC Project No. 184). Report to El Dorado Irrigation District. May 18, 2005.

Holland, D.C. 1991. A synopsis of the ecology and status of the western pond turtle (*Clemmys marmorata*) in 1991. Prepared for USFWS, National Ecology Research Center, San Simeon Field Station.

Holt, D.L. 1988. Nest site characteristics of the western pond turtle, *Clemmys marmorata*, at Fern Ridge Reservoir, in west central Oregon. M.S. thesis, Oregon State University.

International Union for the Conservation of Nature (IUCN). 2013. IUCN Red List of Threatened Species – *Rana muscosa*. Available online: <http://www.iucnredlist.org/details/19177/0>. Accessed October 2013.

Jackman, R.E., and J.M. Jenkins. 2004. Protocol for evaluating bald eagle habitat and populations in California. Prepared for U.S. Fish and Wildlife Service. Sacramento, CA.

Jennings, M. R., and M. P. Hayes. 1994. Amphibian and reptile species of special concern in California. Final Report to the California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, CA. 225 pp.

Jurek, R.M. 1988. Five-year Status Report, Bald Eagle. California Department of Fish and Game Nongame Bird and Mammal Section. Sacramento, CA.

Moyle, P.B. 1973. Effect of introduced bullfrogs, *Rana catesbeiana*, on the native frogs of the San Joaquin Valley, California. Copeia 1973:18-22.

NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available online: <http://www.natureserve.org/explorer>. Accessed April 2010.

Pagel, J.E., D.M. Whittington, and G.T. Allen. 2010. Interim golden eagle inventory and monitoring protocols; and other recommendations. U.S. Fish and Wildlife Service, Carlsbad, CA and Arlington, VA.

Randall, P.J. 1997. Distribution and ecology of fish and frogs in tributaries to the South Fork Yuba River. M.S. thesis, University of California, Davis.

Seltenrich, C. P. and A. C. Pool. 2002. A standardized approach for habitat assessments and visual encounter surveys for the foothill yellow-legged frog (*Rana boylii*). Pacific Gas and Electric Company. Available online: <http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&ved=0CDsQFjAA&url=http%3A%2F%2Fwww.canvamphibs.com%2Fpdf%2FFYLFMethods052002.pdf&ei=UlopUMWdJ4e9yQGZ3oC4Bw&usg=AFQjCNG9Uhw4ApBy_O9WOrpiJAXWqS1bzA>. Accessed February 2012.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2011. Pre-Application Document. Don Pedro Project. FERC No. 2299. February 2011.

_____. 2013a. Special-Status Amphibians and Aquatic Reptiles Study Report (TR-06). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013b. Bald Eagle Study Report (TR-10). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013c. Special-Status Bats Study Report (TR-09). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

United States Department of Agriculture, Forest Service. 2009. Vegetation Descriptions - Central Valley Ecological Province - CALVEG ZONE 5. U.S. Department of Agriculture, Forest Service. Available online: <http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_045936.pdf>. Accessed February 2011.)

United States Fish and Wildlife Service (USFWS). 2007. National bald eagle management guidelines. Available online: <http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BaldEagle/NationalBaldEagleManagementGuidelines.pdf>.

Van Wagner, T. 1996. Selected life history and ecological aspects of a population of foothill yellow-legged frogs (*Rana boylii*) from Clear Creek, Nevada City, California. M.S. thesis, California State University Chico. 143 pp.

Western Bat Working Group (WBWG). 2005a. Species accounts pallid bat (*Antrozous pallidus*). Prepared by Rick Sherwin, updated by Daniela A. Rambaldini. Available online: <http://www.wbwg.org/speciesinfo/species_accounts/vespertilonidae/anpa.pdf> Accessed June 2013.

_____. 2005b. Species accounts Townend's big-eared bat (*Corynorhinus townsendii*). Prepared by Rick Sherwin, updated by Antoinette Piaggio. Available online: <http://www.wbwg.org/speciesinfo/species_accounts/vespertilonidae/coto.pdf> Accessed June 2013.

_____. 2005c. Species accounts spotted bat (*Euderma maculatum*). Prepared by Bob Luce, updated by Carol Chambers and Michael Herder. Available online: <http://www.wbwg.org/speciesinfo/species_accounts/vespertilonidae/euma.pdf> Accessed June 2013.

_____. 2005d. Species accounts western mastiff bat (*Eumops perotis*). Prepared by Elizabeth D. Pierson, updated by Melissa S. Siders. Available online: <http://www.wbwg.org/speciesinfo/species_accounts/molossidae/eupe.pdf> Accessed June 2013.

_____. 2005e. Species accounts western red bat (*Lasiurus blossevilli*). Prepared by Betsy C. Bolster. Available online: <http://www.wbwg.org/speciesinfo/species_accounts/vespertilonidae/labl.pdf> Accessed June 2013.

_____. 2005f. Species accounts long-eared myotis (Myotis evotis). Prepared by M. A. Bogan, E. W. Valdez, and K.W. Navo. Available online: <http://www.wbwg.org/speciesinfo/species_accounts/vespertilonidae/myev.pdf> Accessed June 2013.

_____. 2005g. Species accounts Yuma myotis (*Myotis yumanensis*). Prepared by M. A. Bogan, E. W. Valdez, and K. W. Navo. Available online: <http://www.wbwg.org/speciesinfo/species_accounts/vespertilonidae/myyu.pdf> Accessed June 2013.

Woodbridge, B. 1998. Swainson's Hawk (*Buteo swainsoni*). *In*: The Riparian Bird Conservation Plan: a strategy for reversing the decline of riparian-associated birds in California. California Partners in Flight. Available online: <http://www.prbo.org/calpif/htmldocs/riparian_v-2.html>. Accessed October 2013.

Section 3.8: Threatened and Endangered Species

Adams, M.J., C.A. Pearl, and R.B. Bury. 2003. Indirect facilitation of an anuran invasion by nonnative fishes. Ecology Letters 6:343-351.

Alvarez, J.A. 2004a. Use of Artificial Egg Laying Substrate to Detect California Tiger Salamanders (*Ambystoma californiense*). Herpetological Review 35:45-46.

_____. 2004b. Overwintering California Tiger Salamander (*Ambystoma californiense*) Larvae. Herpetological Review 35:344.

Baldwin, B. 2012. The Jepson Manual: Vascular Plants of California. University of California Press, Berkeley, CA.

Behler, J.L., and F.W. King. 1979. The Audubon Society field guide to North American reptiles and amphibians. Alfred A. Knopf, New York. 719 pp.

Bell, H. 1994. Analysis of habitat characteristics of San Joaquin kit fox in its northern range. Master’s thesis, California State University, Hayward.

California Department of Fish and Game (CDFG). 2005. The Status of Rare, Threatened, and Endangered Plants and Animals of California: 2000-2004.

_____. 2009. Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities. Sacramento, CA.

California Department of Fish and Wildlife (CDFW). 2013. Biogeographic Data Branch. California Natural Diversity Database (CNDDB). Available online: < http://www.dfg.ca.gov/biogeodata/cnddb/mapsanddata.asp>. Accessed October 17, 2013. California Department of Fish and Game, Sacramento, CA.

Calflora. 2012. Information on California Plants for Education, Research and Conservation: The California Database. Available online: <http://www.calflora.org/>. Accessed May 21, 2013.

California Native Plant Society (CNPS). 2012. Inventory of Rare and Endangered Plants online edition. (v8). Available online: <http://www.rareplants.cnps.org/advanced.html>. Accessed May 21, 2013. California Native Plant Society. Sacramento, CA.

Collie, N. and E.W. Lathrop. 1976. Chemical characteristics of the standing water of a vernal pool on the Santa Rosa plateau, Riverside County, California.

DiTomaso, J.M. and E.A. Healy. 2007. Weeds of California and Other Western States. 2 vols. University of California. Agriculture and Natural Resources.

Egoscue, H. J. 1962. Ecology and life history of the kit fox in Tooele Conty, Utah. Ecology 43:481-497.

Eng, L., D. Belk, and C.H. Eriksen. 1990. California Anostraca: distribution, habitat, and status. Journal of Crustacean Biology 10: 247-277.

Eriksen, C.H, and D. Belk. 1999. Fairy shrimps of California's puddles, pools, and Playas. Mad River Press, Rureka, California.

Gallagher, S.P. 1996. Seasonal occurrence and habitat characteristics of some vernal pool branchiopoda in northern California, U.S.A. Journal of Crustacean Biology.

Gilliland, K. L. 2010. The presence of *Micropterus salmoides* (largemouth bass) Influences the populations of *Rana draytonii* (California red-legged Frog) and *Pseudacris regilla* (Pacific treefrog) in two Ponds in Santa Barbara County, California. Masters thesis, California State Polytechnic State University, San Luis Obispo.

Grinnell, J., J. S. Dixon, and J. M. Linsdale. 1937. Fur-bearing mammals of California. 2 Vols. Univ. California Press, Berkeley. 777pp.

Hall, E. R. 1946. Mammals of Nevada. Univ. California Press, Berkeley. xi +710 pp.

Hayes, M.P. and M.R. Jennings. 1988. Habitat correlates of distribution of the California red-legged frog (*Rana aurora draytonii*) and the foothill yellow-legged frog (*Rana boylii*): Implications for management. Pages 144-158. In: R.C. Szaro, K.E. Severson, and D.R. Patton (technical coordinators), Proceedings of the symposium on the management of amphibians, reptiles, and small mammals in North America. United States Department of Agriculture, Forest Service, General Technical Report (RM-166):1-458.

Helm, B.P. 1998. Biogeography of eight large branchiopods endemic to California. California Native Plant Society.

Jennings, M.R. and M.P. Hayes. 1994. Amphibian and reptile species of special concern in California. Final report submitted to the CDFG, Inland Fisheries Division, Rancho Cordova, CA, under contract number 8023.

Keeley, J.E. 1984. Photosynthetic characteristics of certain vernal pool species. Institute of Ecology University of California, Davis; Davis, California.

Keeley, J.E. and P.H. Zedler. 1998. Characterization and global distribution of vernal pools. California Native Plant Society.

Kruse, K.C. & Francis, M.G. 1977. A predation deterrent in larvae of the bullfrog, *Rana catesbeiana*. Trans. American Fisheries Society 106:248–252.

Laabs, D.M., M.L. Allaback, and S.G. Orloff. 2001. Pond and Stream Breeding Amphibians. Chapter 5. Pages 193 – 229 In: J.E. Vollmar (ed.) . Wildlife and Rare Plant Ecology of Eastern Merced County's Vernal Pool Grasslands, Merced County. UC Development Office, Merced, CA.

McCue, P., T. Kato, M. L. Sauls, T. P. O'Farrell. 1981. Inventory of San Joaquin kit fox on land proposed as Phase II, Kesterson Reservoir, Merced County, California. Topical Report EGG 1183-2426, EG&G, Santa Barbara Operations, U.S. Department of Energy, Goleta, California.

Morrell, S. 1972. Life history of the San Joaquin kit fox. Calif. Fish and Game. 58:162-174.

NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life. Version 6.1. Nature Serve, Arlington Virgina. [Online] URL: http://www.natureserve.org/explorer. (Accessed October 9, 2013.)

O'Farrell, T. P. and L. Gibertson. 1979. Ecological life history of the desert kit fox in the Mojave Desert of southern California (draft final report). U.S. Bureau of Land Manage., Riverside, CA. 96 pages. (CA-060-CT8-55 and CA-060-CT7-2779)

O'Farrell, T. P., T. T. Kato, P. M. McCue, and M. L. Sauls. 1980. Inventory of San Joaquin kit fox on BLM lands in southern and southwestern San Joaquin Valley. U.S. Department of Energy Topical Report, EG&G/EM Santa Barbara Operations Report No. EGG 1183-2400. 74 pages.

Orloff, S., F. Hall, and L. Spiegel. 1986. Distribution and habitat requirements of the San Joaquin kit fox in the northern extreme of their range. Trans. West. Sect. Wildl. Soc. 22:60-70.

Platenkamp, G.A. 1998. Patterns of vernal pool biodiversity at Beale Air Force Base. California Native Plant Society.

Syrdahl, R.L. 1993. Distribution patterns of some key macro-invertebrates in a series of vernal pools at Vina Plains Preserve in Tehama County, California. University of California, Chico, California.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2013a. ESA- and CESA-Listed Plants Study Report (TR-02). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013b. ESA-Listed Wildlife - Valley Elderberry Longhorn Beetle Study Report (TR-05). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013c. ESA-List Amphibians - California Tiger Salamander Study Report (TR-08). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013d. ESA-Listed Amphibians – California Red-Legged Frog Study Report (TR-07). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

Trenham, P.C. 2001. Terrestrial Habitat Use by Adult California Tiger Salamanders. Journal of Herpetology 35:343-346.

U.S. Fish and Wildlife Service (USFWS). 1980. Listing the Valley Elderberry Longhorn Beetle as a Threatened Species with Critical Habitat. 50 CFR Part 17. Federal Register Vol. 45, No. 155. Rules and Regulations. Available online: <http://ecos.fws.gov/docs/federal_register/fr449.pdf>. Accessed on August 6, 2013. USFWS, Sacramento, CA.

_____. 1984. Valley Elderberry Longhorn Beetle Recovery Plan. U.S. Fish and Wildlife Service. Portland, Oregon. [Online] URL: http://ecos.fws.gov/docs/recovery_plan/840628.pdf. (Accessed August 23, 2010).

_____. 1987. National Wetland Inventory (NWI) maps. US Department of the Interior, USFWS, Region 1. Portland, OR.

_____. 1996. Determination of endangered status for Four Plants and Threatened Status for One Plant From the Central Sierran Foothills of California. Federal Register 61: 54346.

_____. 1999. Conservation Guidelines for Valley Elderberry Longhorn Beetle, Sacramento, CA. Available online: <http://www.fws.gov/sfbaydelta/documents/velb_conservation.pdf>. Accessed May 21, 2013.

_____. 2002a. Recovery Plan for Gabbro Soil Plants of the Central Nevada Foothills. Portland, OR.

_____. 2002b. Recovery Plan for the California Red-legged Frog (*Rana aurora draytonii*). U.S. Fish and Wildlife Service, Portland, Oregon..

_____. 2003. Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander. October 2003. USFWS, Sacramento Fish and Wildlife Office, Region 8. 8 pp. Available online: www.fws.gov/sacramento/es/documents/cts_survey_protocol.pdf.

_____. 2005a. Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon. Available online: <http://www.fws.gov/sacramento/ed/recovery_plans/vp_recovery_plan_links.htm>

_____. 2005b. Revised guidance on site assessments and field surveys for California red-legged frog. August 2005.

_____. 2006a. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Four Vernal Pool Crustaceans and Eleven Vernal Pool Plants. 71 FR 7118-7316. Available online: <htto://www.gpo.gov/fdsys/pklg/FR-2006-02-10/pdf/06-1080.pdf#page=1.>

_____. 2006b. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the California Red-Legged Frog, and Special Rule Exemption Associated With Final Listing for Existing Routine Ranching Activities.

_____. 2009. Sacramento Fish and Wildlife Office Species Account: Valley Elderberry Longhorn Beetle. Available online: <http://www.fws.gov/sacramento/es/animal_spp_acct/valley_elderberry_longhorn_beetl.htm>.

_____. 2010. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the California Red-Legged Frog. Federal Register Vol. 75, No. 51, Page 12816 - 12959.

_____. 2011. Endangered and Threatened Wildlife and Plants; 5-Year Reviews of Species in California, Nevada, and the Klamath Basin of Oregon. 76 FR 30377-30382. Available online: < http://www.gpo.gov/fdsys/pkg/FR-2011-05-25/pdf/2011-12861.pdf>.

_____. 2012a. Endangered Plant Species Accounts. <http://www.fws.gov/sacramento/es_species/Accounts/Plants/es_speciesaccounts_plants.htm>. Accessed July 25, 2012. United States Fish and Wildlife Service, Sacramento, CA.

_____. 2012b. Service Seeks Information on Proposal to Remove Endangered Species Act Protection for the Valley Elderberry Longhorn Beetle. U.S. Fish and Wildlife Service, Sacramento, California. October 2012. Available online:

<http://www.fws.gov/sacramento/outreach/2012/10-1/outreach_newsroom_2012-10-1.htm>.

_____. 2012c. Sacramento Fish and Wildlife Office Endangered Plant Species Accounts. <http://www.fws.gov/sacramento/es_species/Accounts/Plants/es_species-accounts_plants.htm>. Accessed July 25, 2012. United States Fish and Wildlife Service, Sacramento, CA.

_____. 2013. Species Lists. Available online: <http://www.fws.gov/sacramento/es/spp_list.htm>. Accessed October 23, 2013. United States Fish and Wildlife Service, Sacramento, CA.

Werner, E.E. & McPeek, M.A. 1994. Direct and indirect effects of predators on two anuran species along an environmental gradient. Ecology, 75, 1368–1382.

Williams, D.F., E. Cypher, P. Kelly, K., Miller, N. Norvell, S. Phillips, C. D. Johnson, and G.W. Colliver. 1998. Recovery Plan for Upland Species of the San Joaquin Valley, California. US Fish and Wildlife Service, Portland, OR.

Section 3.9: Recreation, Land Use, and Shoreline Management

Bechtel Corporation. 1970. New Don Pedro Project, Relocated County Road and Bridges, Ward's Ferry Bridge, Location and Vicinity Map. Drawing No 7352-3-00. Bechtel Corporation, San Francisco.

Bureau of Land Management (BLM). 2009. The Red Hills of Tuolumne County. [Online] URL: http://www.blm.gov/ca/st/en/fo/folsom/redhillshomepg1.html/. (Accessed September 2010.)

California Department of Fish and Game (CDFG). 2010a. California Freshwater Sport Fishing Regulations. [Online] URL: http://www.dfg.ca.gov/regulations/FreshFish/. (Accessed September 2010.)

_____. 2010b Schedule for fish stocking. California Department of Fish and Game website. [Online] URL: http://www.dfg.ca.gov/fish/Hatcheries/FishPlanting/Central.asp. (Accessed September 2010.)

California State Parks. 2008. 2008 California Outdoor Recreation Plan (CORP). Available online: <http://www.parks.ca.gov/pages/795/files/2009-2014 percent20corp.pdf> (Accessed Oct. 8, 2009).

_____. 2009. Turlock Lake State Recreation Area. Available online: <http://www.parks.ca.gov/?page_id=555> (Accessed Oct. 23, 2013).

_____. 2013. Off-Highway Motor Vehicle Recreation. Available online: <http://ohv.parks.ca.gov/> (Accessed Nov. 15, 2009).

California Whitewater. 2010. Guide to Rafting and Kayaking. [Online] URL: http://www.californiawhitewater.com/. (Accessed September 2010.)

Don Pedro Recreation Agency (DPRA). 2008. 2008 Davis-Grunsky Recreation Data. Unpublished data summary from Don Pedro Recreation Agency.

_____. 2010. Don Pedro Lake Website, fish stocking information. [Online] URL: http://donpedrolake.com/RecreationArea/Fishing/index.htm. (Accessed September 2010.)

Great Outdoor Recreation Pages (GORP). 2009. Tuolumne River. [Online] URL: http://www.gorp.com/parks-guide/travel-ta-tuolumne-river-california-sidwcmdev_068904.html. (Accessed September 2010.)

National Geographic Society. 2009. Shoreline Trail, Don Pedro Lake. [Online] URL: http://www.sierranevadageotourism.org/content/shoreline-trail,-don-pedro-lake-/sie174E88C8707B7D03B. (Accessed September 2010.)

National Park Service (NPS). 2010. Yosemite National Park Tuolumne River Plan. National Park Service. [Online] URL: http://www.nps.gov/yose/parkmgmt/trp.htm. (Accessed July 16, 2010.)

Stanislaus County. 2006. Stanislaus County General Plan. Stanislaus County Board of Supervisors, Modesto, California.

_____. 2010. River and Fishing Accesses. [Online] URL: http://www.co.stanislaus.ca.us/ER/Parks/pdf/RiverFishingAccesses.pdf. (Accessed September 2010.)

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2013a. Recreation Facility and Public Accessibility Assessment, and Recreation use Assessment Study Report (RR-01), Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013b. Whitewater Boating Take Out Improvement Feasibility Study Report (RR-02). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013c. Lower Tuolumne River Boatable Flow Study Report (RR-03). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013d. Project Operations/Water Balance Model Study Report (W&AR-02). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

U.S. Department of Agriculture (USDA). 2013. 1977-2012 Tuolumne Wild & Scenic River Use. (Summary data provided to the Districts January 31, 2013)

_____. Undated. Stanislaus National Forest. [Online] URL: http://www.fs.usda.gov/main/stanislaus/home. (Accessed September 2013).

Section 3.10: Aesthetic Resources

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2013a. Visual Quality Study Report (RR-04). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013b. Recreation Facility and Public Accessibility Assessment, and Recreation use Assessment Study Report (RR-01), Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

Section 3.11: Cultural Resources

Annear, M. L., H. C. Florcken, and Dr. H. Baker. 1950. *Section One of A Brief History of Stanislaus County, A Source Book for Secondary Schools*. Modesto, California: Stanislaus County Department, of Schools.

Arnold, J. F., M. R. Walsh, and S. E. Hollimon. 2004. The Archaeology of California. *Journal of Archaeological Research* 12(1):1-73.

Barnes, Dwight H. 1987. *The Greening of Paradise Valley, Where the Land Owns the Water and the Power. The First 100 Years of the Modesto Irrigation District*. Modesto Irrigation District, Modesto, California.

Baumhoff, M. A., and J. S. Byrne. 1959. Desert Side-notched Points as a Time Marker in California. *Reports of the University of California Archaeological Survey* 48:32-65.

Beard, Franklin. 1988. *Gold Fields to Grazing Fields.* Southern Mines Press, La Grange, California.

Bennyhoff, J. A. 1956. *An Appraisal of the Archaeological Resources of Yosemite National Park*. Reports of the University of California Archaeological Survey 34.

Bennyhoff, J. A., and R. F. Heizer. 1958. Cross-dating Great Basin Sites by California Shell Beads. In *Current Views on Great Basin Archaeology*, 42:60-92. University of California Archaeological Survey Reports.

Bennyhoff, J. A., and R. E. Hughes. 1987. *Shell Bead and Ornament Exchange Networks between California and the Western Great Basin*. Anthropological Papers of the American Museum of Natural History 64(2). American Museum of Natural History, New York.

Bettinger, R. L., and R. E. Taylor. 1974. Suggested Revisions in Archaeological Sequences in the Great Basin and the Interior of Southern California. *Nevada Archaeological Survey Research* Papers 5:1-26.

Branch, L.C. 1881. *History of Stanislaus County, California, with Illustrations Descriptive of its Scenery, Farms, Residences, Public Buildings, Factories, Hotels, Business H*

California Department of Parks and Recreation (CDPR). 1976. California Inventory of Historic Resources. On file, Central California Information Center, Turlock, California.

_____. 1996. California State Historic Landmarks. On file, Central California Information Center, Turlock, California.

Chartkoff, Joseph L., and K. K. Chartkoff. 1984. The Archaeology of California, Stanford University Press, Stanford.

Clark, Wm. C. 1970. Gold Districts of California. California Division of Mines Bulletin No. 193. California Division of Mines and Geology, Sacramento.

Clewlow, C. W., Jr. 1967. Time and Space Relations of Some Great Basin Projectile Points. *University of California Archaeological Survey Reports* 70:141-149.

Coleman, Charles M. 1952. *PG. and E. of California: The Centennial History of Pacific Gas and Electric Company, 1852-1952.* McGraw-Hill, New York.

Davis, James T. 1961. Trade Routes and Economic Exchange Among the Indians of California. *Reports of the University of California Archaeological Survey* 54. Berkeley. (Reprinted 1963 in *Aboriginal California: Three Studies in Culture History*, edited by Robert F. Heizer. University of California Press, Berkeley.)

Deane, Dorothy Newell. 1960. *Sierra Railway*. Howell-North. Berkeley, California.

Elias, Sol P.1924. *Stories of Stanislaus*. Reprinted by the McHenry Museum, Modesto, California.

Elston, R. G., J. O. Davis, A. Leventhal, and C. Covington. 1977. *The Archaeology of the Tahoe Reach of the Truckee River*. On file, Northern Division of the Nevada Archeological Survey, University of Nevada, Reno.

Federal Energy Regulatory Commission (FERC) and Advisory Council on Historic Preservation (ACHP). 2002. Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects. Washington D.C.

Foster, J. W., and J. C. Bingham. 1978. *Archaeology in Solution: Testing Inundation's Effects at Folsom Reservoir, California.* Submitted to Southwest Cultural Resources Center, National Park Service, Sacramento.

Foster, J.W., J.C. Bingham, C. Carter, K. Cooley-Reynolds, and J.L. Kelly. 1977. *The Effects of Inundation on the Pedersen Site, CA-ELD-201, Folsom Lake, California.* Submitted to the National Park Service, Sacramento.

Gudde, E. G. 1975. *California Gold Camps.* University of California Press, Berkeley.

Hamilton, Fletcher. 1915. *Mines and Mineral Resources of Amador County, Calaveras County, Tuolumne County*. California State Mining Bureau, San Francisco.

Heckendorn, John, and W.A. Wilson. 1856. *Miners & Business Men's Directory*. Heckendorn & Wilson, Columbia. Reprinted 1976 by the Donald I. Segerstrom Memorial Fund, Publication No. 2. Tuolumne County Historical Society, Sonora.

Heizer, R. F. 1951. An Assessment of Certain Nevada, California, and Oregon Radiocarbon Dates. In *Radiocarbon Dating*, Edited by F. Johnson, pp. 23-25. Memoirs No. 8, Society for American Archaeology, Washington, D.C.

Heizer, R. F., and M. A. Baumhoff. 1961. Wagon Jack Shelter. In *The Archaeology of Two Sites at Eastgate, Churchill County, Nevada,* pp. 119-138. University of California Anthropological Records 20(4).

Heizer, R. F., and T. R. Hester. 1978. *Great Basin Projectile Points: Forms and Chronology.* Ballena Press Publications in Archaeology, Ethnology and History.

Henn, W.G., and E. Sundahl. 1986. *Shasta Lake Archaeological Sites Project: Study of the Effects of Reservoir Drawdown*. U.S. Government Printing Office.

Hohenthal, Helen A., and others. Edited by John Edwards Caswell. 1972. *Streams in a Thirsty Land, A History of the Turlock Region*. City of Turlock, Turlock, California.

Hoover, M.B., H.E. Rensch, E.G. Rensch, and W.N. Abeloe. 1990. *Historic Spots in California*, 4th ed., revised by D.E. Kyle. Stanford University Press, Stanford, California.

Hull, K. C. 2007. The Sierra Nevada: Archaeology in the Range of Light. In *California Prehistory: Colonization, Culture, and Complexity,* edited by T. L. Jones and K. A. Klar, pp. 177-190, AltaMira Press, New York.

Jackson, Thomas L. 1971. Appendix C: Determination 0of the Source of Artifactual Lithic Material. In *A Study of the Prehistory of the Tuolumne River Valley, California*, edited by M.J. Moratto, pp. 167-180. Papers No. 9, Treganza Anthropology Museum, San Francisco State College, San Francisco, California.

Jackson, R. J., T. Jackson, C. Miksicek, K. Roper, and D. Simons. 1994. *Framework for Archaeological Research and Management, National Forests of the North Central Sierra Nevada*. BioSystems Analysis, Inc., Sacramento, California. Submitted to and on file at the Eldorado National Forest, Placerville, California.

Jenkins, Olaf P. 1948. *Geologic Guidebook Along Highway 49—Sierran Gold Belt, Bulletin 141, The Mother Lode Country (Centennial Edition).* California Division of Mines, San Francisco.

JRP Historical Consulting Services and Caltrans. 2000 *Water Conveyance Systems in California: Historic Context Development and Evaluation Procedures.* Caltrans Environmental Program/Cultural Studies Office; Sacramento, California.

La Jeunesse, R. M., and J. H. Pryor. 1996. Skyrocket Appendices. California State University, Fresno.

Lenihan, Daniel J, Toni Carrell, Stephen Fosberg, Larry Murphy, Sandra Rayl and John Ware 1981. The Final Report of the National Reservoir Inundation Study – Volume 1. National Park Service Library, Denver, Colorado.

Levy, Richard. 1978. Eastern Miwok. In *California*, edited by Robert F. Heizer, pp. 398-413. Vol. 8, *Handbook of North American Indians*, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Meikle, Roy, V., Chief Engineer. 1927. General Right of Way Map Don Pedro Reservoir Site. Turlock Irrigation District and Modesto Irrigation District, Turlock, California. On file, Turlock Irrigation District, Turlock.

Meyer, Jack. 2008. Volume IIa: Project-wide Geoarchaeological Study and Archaeological Investigations at Four Prehistoric Sites: CA-TUO-2640, -2643, -4556, and -4559. *Prehistory of the Sonora Region, Archaeological and Geoarchaeological Investigations for Stage 1 of the East Sonora Bypass Project, State Route 108, Tuolumne County, California.* Prepared for the California Department of Transportation, District 6 – Fresno. Far Western Anthropological Research Group, Inc.

_____. 2011. Holocene Landscape Evolution and the Archaeological Record at Sonora. In *A New Frame of Reference: Prehistoric Culture Chronology and Ecology in the North-Central Sierra Nevada,* edited by J. Rosenthal, pp. 67-80. Publication No. 16, Center for Archaeological Research at Davis, Davis, California.

Meyer, Jack, D. Bieling, S. Stewart, and C. Caputo. 2005. *Geoarchaeological Investigations and Archaeological Data Recovery at Four Prehistoric Sites (CA-TUO-2640, -2643, -4556, -4559) for the East Sonora Bypass Project (Stage 1) Tuolumne County, California*. Anthropological Studies Center, Sonoma State University, Rohnert Park, CA. Prepared for the California Department of Transportation, Stockton.

Meyer, Jack, and G. Dalldorf. 2004. *Geoarchaeological Investigations for State 2 of the East Sonora Bypass Project, State Route 108, Tuolumne County, California*. Anthropological Studies Center, Sonoma State University, Rohnert Park, CA. Prepared for the California Department of Transportation, Stockton.

Milliken, R., W. Bloomer, S. Stratton, J. Nelson, D. Furlong, D. C. Young, E. Wohlgemuth, J. Costello, P. Mikkelsen, T. Carpenter, and D. Jones. 1997. *The Taylors Bar Site (CA-CAL-1180/H): Archaeological and Ethnohistoric Investigations in Calaveras County, California.* Far Western Anthropological Research Group, Inc., Davis. Report submitted to and on file at Calaveras County Water District, San Andreas.

Moratto, M.J. 1971. A Study of Prehistory in the Tuolumne River Valley, California. Treganza Anthropology Museum Papers, Number 9. San Francisco State University.

_____. 1972. Study of Prehistory on the Southern Sierra Foothills, California. Unpublished Ph.D dissertation, Department of Anthropology, University of Oregon.

_____. 1984. California Archaeology. Academic Press, Orlando, Florida.

_____. 1999. Cultural Chronology, 1: Regional Context. In *Archaeological Synthesis and Research Design: Yosemite National Park, California*, Yosemite Research Center Publications in Anthropology No. 21, edited by K. L. Hull and M. J. Moratto, pp. 65-120, Submitted to USDI National Park Service, Contract No. 1443 CX80094 012. Copies available from INFOTEC Research, Inc., Fresno.

_____. 2002. Culture History of the New Melones Reservoir Area, Calaveras and Tuolumne Counties, California. In *Essays in California Archaeology: A Memorial to Franklin Fenenga*, edited by W. J. Wallace and F. A. Riddell. pp. 25-54. Contributions of the University of California Archaeological Research Facility, Berkeley.

Moratto, M. J., T. F. King, and W. B. Woolfenden. 1978. Archaeology and California's Climate. *The Journal of California Anthropology* 5(2):147-161.

Moratto, M.J., L.H. Shoup, and J.D. Tordoff. 1988. Culture Change in the Central Sierra Nevada, 8000 B.C.-A.D. 1950. Final Report of the New Melones Archaeological Project, edited by M.J. Moratto, 9:1-626. U.S. National Park Service and National Technical Information Service, Washington, D.C. (Also available from Coyote Press.)

National Park Service (NPS). 1983. Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines in the Federal Register, September 29, 1983 (48FR44716). Department of the Interior, Washington, D.C.

_____. 1995 *How to Apply the National Register Criteria for Evaluation.* National Register Bulletin. Department of the Interior, Washington, D.C.

Parker, P.L., and Thomas F.K. 1998. Guidelines for evaluating and documenting Traditional Cultural Properties. Revised. National Register Bulletin 38. U.S. Department of the Interior, National Park Service, National Register, History, and Education Division, Washington, D.C.

Paterson, Alan M. 1989. *Land, Water and Power, A History of the Turlock Irrigation District 1887-1987*. The Arthur H. Clark Company, Glendale, California.

Peak. A.S. and H. Crew. 1990. Cultural Resource Studies North Fork Stanislaus River Hydroelectric Development Project, Vol. II: An Archaeological Data Recovery Project at CA-Cal-S342, Clarks Flat, Calaveras County, California. Northern California Power Agency, Roseville, California.

Ragir, S. 1972. The Early Horizon in Central California Prehistory. *Contributions of the University of California Archaeological Research* Facility 15. Berkeley.

Rose, Al. 1970. *Map of Don Pedro Lake, California*. With hand written notations as to proposed names for geographical locations. Al—Rose Publications, Modesto, California. On file, Turlock Irrigation District, Turlock.

Rosenthal, J. S. 2008. *Prehistory of the Sonora Region, Archaeological and Geoarchaeological Investigations for Stage 1 of the East Sonora Bypass Project, State Route 108, Tuolumne County, California.* Far Western Anthropological Research Group, Inc., Davis, CA. Prepared for the California Department of Transportation, Central California Cultural Resources Branch, Fresno.

_____. 2011a. Projectile Point Typology and Chronology in the North-Central Sierra In *A New Frame of Reference: Prehistoric Culture Chronology and Ecology in the North-Central Sierra Nevada*, edited by J. S. Rosenthal, pp. 17-36. Publication No. 16, Center for Archaeological Research at Davis, Davis, California.

_____. 2011b. Building a New chronological Framework for the West-Central Sierra Nevada In *A New Frame of Reference: Prehistoric Culture Chronology and Ecology in the North-Central Sierra Nevada*, edited by J. S. Rosenthal, pp. 37-66. Publication No. 16, Center for Archaeological Research at Davis, Davis, California.

Rosenthal, Jeffrey (ed.). 2011. *A New Frame of Reference: Prehistoric Culture Chronology and Ecology in the North-Central Sierra Nevada.* Center for Archaeological Research at Davis Publication 16, University of California, Davis.

Rosenthal, J. S., J. King, K. R. McGuire, S. A. Waechter, J. Berg, and L. Leach-Palm. 2008. *Prehistory of the Sonora Region: Archaeological and Geoarchaeological Investigations for State I of the East Sonora Bypass Project, State Route 108, Tuolumne County, California. Volume IIb: Data Recovery Excavations at CA-TUO-2195/H, -4513, -4514, -4523, -4524, -4525, and Additional Analysis of TUO-2642.* Far Western Anthropological Research Group, Inc., Davis, CA. Prepared for the California Department of Transportation, Central California Cultural Resources Branch, Fresno.

Rosenthal, J. S., and K. McGuire. 2004. M*iddle Holocene Adaptations in the Central Sierra Nevada Foothills: Data Recovery Excavations at the Black Creek Site, CA-CAL-789.* Far Western Anthropological Research Group, Inc., Davis, California. Submitted to

California Department of Transportation, District 6, Fresno. On file, Central California Information Center, California State University, Stanislaus.

Rosenthal, J.S., and J. Meyer. 2004. Bodie Hills Obsidian Hydration Rates. In *Middle Holocene Adaptations in the Central Sierra Nevada Foothills: Data Recovery Excavations at the Black Creek Site, CA-CAL-789*. Far Western Anthropological Research Group, Inc., Davis, California. Submitted to California Department of Transportation, District 06, Fresno. On file, Central California Information Center, California State University, Stanislaus.

Rosenthal, J. S., G. G. White, and M. Q. Sutton. 2007. The Central Valley: A View from the Catbird's Seat. In *California Prehistory: Colonization, Culture, and Complexity*, edited by T. L. Jones and K. A. Klar, pp. 147-163, AltaMira Press, New York.

Stoddard, S. E., and David A. Fredrickson 1978. *Supplementary Investigations into the Effects of Freshwater Immersion on Cultural Resources of the Lake Mendocino Reservoir Basin, Mendocino County, California*. Submitted to the U.S. Army Corps of Engineers.

Thomas, David H. 1970. Archaeology's Operational Imperative: Great Basin Projectile Points as a Test Case. *University of California Archaeological Survey Annual Report* 12:27-60.

_____. 1981. How to Classify Projectile Points from Monitor Valley, Nevada. *Journal of Great Basin and California Anthropology* 3(1):7-43.

Tinkham, George H. 1921. History of Stanislaus County, California. Volume I. Historic Record Company, Los Angeles.

Tuolumne County Historical Society. 2013. Tuolumne County Railroad Transportation. Online document, http://www.tchistory.org/TCHISTORY/railroads.htm, accessed February 28, 2013.

Turlock Irrigation District (TID). 1975. Don Pedro Lake Place Names. List on file, Turlock Irrigation District, Turlock.

_____. 2013. TID Overview. Website, http://www.tid.org/about-tid/tid-overview, accessed July 30, 2013.

Turlock Irrigation District (TID) vs. Allen Zanker et al. 2006. Court of Appeal of California, Fifth District. Court Opinion. June 26, 2006.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2014a. Draft Historical Properties Study Report (CR-01). Prepared by HDR and Far Western Anthropological Research Group, with contributions from Foothill Research, Inc. and Applied EarthWorks, Inc. April.

_____. 2014b. Draft Native American Traditional Cultural Properties Study Report (CR-02). Prepared by Applied EarthWorks, Inc. April 2014.

Union Democrat, edited by J.A. Van Harlingen & Co. 1909. *Tuolumne County, California*. Issued by the *Union Democrat*, Sonora, California. Republished 1995 by the Tuolumne County Historical Society, Sonora. `

U.S. Department of Interior, National Park Service (NPS). 1983. Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines in the Federal Register, September 29, 1983 (48FR44716). Department of the Interior, Washington, D.C.

Wagner, Jack R. 1980. *Gold Mines of California*. Howell-North Books, San Diego, California.

Ware, J.A. 1989. *Archaeological Inundation Studies: Manual for Reservoir Managers.* Prepared for the U.S. Army Corps of Engineers, Washington D. C.

Whitaker, A., and J. Rosenthal. 2009. *Addendum Archaeological Survey and Phase II Evaluation for the East Sonora Bypass Stage II Project, Tuolumne County, California*. Far Western Anthropological Research Group, Inc., Davis, CA. Prepared for the California Department of Transportation, Central California Cultural Resources Branch, Fresno.

_____. 2010. *9,000 Years of Prehistory at the Poppy Hills Site: Data Recovery Report for CA-TUO-2797/H*. Prepared for the California Department of Transportation, Central California Cultural Resources Branch, Fresno, California. Far Western Anthropological Research Group, Inc., Davis, California.

Wirth Environmental Associates. 1985. *Mokelumne River Project, Cultural Resources Evaluation Program*. Report prepared for Pacific Gas and Electric, San Francisco. On file, Central California Information Center, California State University, Stanislaus.

Section 3.12: Socioeconomic Resources

California Chapter of the American Society of Farm Managers and Rural Appraisers. 2012. 2012 Trends in Agricultural Land & Lease Values.

Federal Energy Regulatory Commission (FERC). 2013. Market Oversight, California Annual Average Bilateral Prices. [Online] URL: http://www.ferc.gov/market-oversight/mkt-electric/california/2013/08-2013-elec-ca-archive.pdf. (Accessed April 17, 2013.)

Modesto Irrigation District (MID). 2013. Information provided by Jimi Netniss, MID, to Duane Paul, CardnoENTRIX, on April 16, 2013.

Turlock Irrigation District (TID). 2013. Information provided by Nancy J. Folly, TID, to Duane Paul, CardnoENTRIX, on April 17, 2013.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2013. Project Operations/Water Balance Model Study Report (W&AR-02). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2014. Socioeconomics Study Report (W&AR-15). April 2014.

Section 4.0: Cumulative Effects of the Proposed Action

Araki, H., B. Cooper and M. S. Blouin. 2007. Genetic effects of captive breeding cause a rapid, cumulative fitness decline in the wild. Science 318:100-103.

Baker, P. F., T. P. Speed, and F. K. Ligon. 1995. Estimating the influence of temperature on the survival of Chinook salmon smolts (Oncorhynchus tshawytscha) Migrating through the Sacramento-San Joaquin River Delta of California. Canadian Journal of Fisheries and Aquatic Science 52:855-863.

Barnett-Johnson, R., C. B. Grimes, C. F. Royer, and C. J. Donohoe. 2007. Identifying the contribution of wild and hatchery Chinook salmon (Oncorhynchus tshawytscha) to the ocean fishery using otolith microstructure as natural tags. Canadian Journal of Fisheries and Aquatic Sciences 64:1683-1692.

Berejikian, B. A., and M. J. Ford. 2004. Review of Relative Fitness of Hatchery and Natural Salmon. NOAA Technical Memorandum NMFS-NWFSC-61. December 2004. Seattle, Washington.

Boydstun, L.B. 2001. Ocean Salmon Fishery Management. Fish Bulletin No. 179, vol. 2, 2001, pp. 183-196.

Brown, L.R. 1996. Aquatic biology of the San Joaquin-Tulare basins, California: analysis of available data through 1992. Water-Supply Paper No. 2471. U. S. Geological Survey, Denver, Colorado.

Brown, L. R., and T. Ford. 2002. Effects of flow on the fish communities of a regulated California river: implications for managing native fishes. River Research and Applications 18:331-342.

Brown, L.R., and P.B. Moyle. 1993. Distribution, Ecology, and Status of the Fishes of the San Joaquin River Drainage. California Fish and Game: Conservation of Wildlife through Education, Volume 79, summer1993, Number 3, Page 96.

Brown, C.B., and E.M. Thorp. 1947. Reservoir sedimentation in the Sacramento–San Joaquin drainage basins, California, Special Report 10, Soil Conservation Service, Sedimentation Section, Office of Research, Washington, D.C.

Brown, L. R., J. K. Thompson, K. Higgins, and L. V. Lucas. 2007. Population density, biomass, and age-class structure of the invasive clam Corbicula fluminea in rivers of the lower San Joaquin River watershed, California. Western North American Naturalist 67: 572–586.

Brunell, M., G. M. Litton, J. C. Monroe & ICF International. 2010. Effects of the Head of Old River Barrier on flow and water quality in the San Joaquin River and Stockton Deep Water Ship Channel. Report to the Department of Water Resources.

Buttars, B. 2011. Central Valley Salmon and Steelhead Marking/Coded-wire Tagging Program 2012 Marking Season. Pacific States Marine Fisheries Commission. Redd Bluff, California.

Cain, J. R., R. P. Walkling, S. Beamish, E. Cheng, E. Cutter, and M. Wickland. 2003. San Joaquin Basin Ecological Flow Analysis. Prepared for the Bay-Delta Authority by the Natural Heritage Institute, Berkeley, California. August 2003.

California Cooperative Oceanic Fisheries Investigations (CalCOFI). 2006. The State of the California Current, 2005-2006: Warm in the North, Cool in the South. CalCOFI Report, Vol. 47, 2006.

California Energy Commission (CEC). 2011. Updated California Energy Demand Forecast 2011-2022. May 2011. CEC-200-2011-006-SD.

_____. 2007. The State of the California Current, 2006-2007: Regional and Local Processes Dominate. CalCOFI Report, Vol. 48, 2007.

California Department of Fish and Game (CDFG). 1990. Central Valley Salmon and Steelhead Restoration and Enhancement Plan. Sacramento, California. April 1990. 115 pages.

_____. 1993. Restoring Central Valley Streams: A Plan for Action. Sacramento, California. November 1993. 129 pages.

_____. 1996. Steelhead restoration and management plan for California. California Department of Fish and Game, Sacramento, California.

_____. 2011. Freshwater Sport Fishing Regulations. March 1, 2011 - February 29, 2012.

California Department of Fish and Wildlife (CDFW). 2012. California Hatchery Review Project. Appendix VIII. Mokelumne River Hatchery Steelhead Program Report. June. Available at http://cahatcheryreview.com/wp-content/uploads/2012/08/Mokelumne%20Steelhead%20Program%20Report%20June%202012.pdf

_____. 2013. Status of Fisheries Report. An Update through 2011. Report to the California Fish and Game Commission as directed by the Marine Life Management Act of 1998. Prepared by California Department of Fish and Wildlife Marine Region, January 2013.

_____. 2014. Fishing for Black Bass. [Online] URL: http://www.dfg.ca.gov/fish/Resources/ (Accessed April 23, 2014).

California Department of Water Resources (CDWR). 1994. San Joaquin River tributaries spawning gravel assessment: Stanislaus, Tuolumne, Merced rivers. Draft memorandum prepared by the Department of Water Resources, Northern District for the California Department of Fish and Game. Contract number DWR 165037.

_____. 2013. California Data Exchange Center. On-line Database. http://cdec.water.ca.gov/cdecapp/resapp/getResGraphsMain.action. (Accessed March 2014.)

California Department of Water Resources (CDWR), U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and National Marine Fisheries Service. 2013. Environmental Impact Report/ Environmental Impact Statement for the Bay Delta Conservation Plan. Administrative Draft. March. (ICF 00674.12.) Prepared by ICF International, Sacramento, CA.

California Environmental Protection Agency (CEPA). 2006. Climate Action Team Report to Governor Schwarzenegger and the Legislature, March 2006, 107 pages.

California Regional Water Quality Control Board (CRWQCB). 2006. Executive Officer's Report 26/27 October 2006. California Regional Water Quality Control Board, Central Valley Region, USA.

California State Lands Commission (CSLC). 2012. Final Environmental Impact Report (EIR) for the San Francisco Bay and Delta Sand Mining Project. Project Clearinghouse Number 2007072036, CSLC EIR NO. 742.

City and County of San Francisco (CCSF). 2006. Tuolumne River System and HHWP Fact sheet. San Francisco, California.

Clark K., M. Bowen, R. Mayfield, K. Zehfuss, J. Taplin, C. Hanson. 2009. Quantification of pre-screen loss of juvenile steelhead in Clifton Court Forebay. Department of Water Resources, the California Natural Resources Agency.

Cohen, A. N., and J. T. Carlton. 1995. Non-indigenous aquatic species in a United States estuary: a case study of the biological invasions of the San Francisco Bay and Delta. Prepared for U. S. Fish and Wildlife Service, Washington, D. C. and The National Sea Grant College Program, Connecticut Sea Grant.

Dill, W. A. and A. J. Cordone. 1997. History and status of introduced fishes in California, 1871-1996. California Department of Fish and Game Fish Bulletin 178. [Online] URL: http://www.escholarship.org/uc/item/5rm0h8qg#page-1. (Accessed August 2, 2010.).

Dubrovsky, N. M., C. R. Kratzer, L. R. Brown, J. M. Gronberg, and K. R. Burow. 1998. Water Quality in the San Joaquin-Tulare Basins, California, 1992-95. U.S. Geological Survey, Sacramento, California. [Online] URL: http://pubs.usgs.gov/circ/circ1159/circ1159.pdf.

Durand, J. 2008. Delta foodweb conceptual model. Delta Regional Ecosystem Restoration Implementation Plan. Sacramento, California. http://www.science.calwater.ca.gov/pdf/drerip/DRERIP_food_web_conceptual_model_final_120208.pdf

Evans, A. F., D. D. Roby, K. Collis, B. M. Cramer, J. A. Sheggeby, L. J. Adrean, D. S. Battaglia, and D. E. Lyons. 2011. Recovery of coded wire tags at a Caspian tern colony in San Francisco Bay: A technique to evaluate impacts of avian predation on juvenile salmonids. North America Journal of Fisheries Management 31:79-87.

Fausch, K. D. 1993. Experimental analysis of microhabitat selection by juvenile steelhead (Oncorhynchus mykiss) and coho salmon (O. kisutch) in a British Columbia stream. Canadian Journal of Fisheries and Aquatic Sciences 50: 1198–1207.

Federal Energy Regulatory Commission (FERC). 1996. Order Amending License and Dismissing Rehearing Request, California. FERC Project No. 2299-024, FERC, Office of Hydropower Licensing, Washington, D.C.

_____. 2008. Preparing Environmental Documents, Guidelines for Applicants, Contractors, and Staff. Office of Energy Projects Division of Hydropower Licensing, Washington, D.C.

Feyrer, F, T. R. Sommer, and W. Harrell. 2006. Importance of flood dynamics versus intrinsic physical habitat in structuring fish communities: evidence from two adjacent engineered floodplains on the Sacramento River, California. North American Journal of Fisheries Management 26:408-417.

Flagg, T., B. Berejikian, J. Colt, W. Dickhoff, L. W. Harrell, D. J. Maynard, C. E. Nash, M. S. Strom, R. N. Iwamoto, C. V. W. Mahnken. 2000. Ecological and behavioral impacts of artificial production strategies on the abundance of wild salmon populations. National Marine Fisheries Service. NOAA Technical Memorandum NMFS-NWFSC-41.

Ford, T., and L. R. Brown. 2001. Distribution and abundance of Chinook salmon and resident fishes of the lower Tuolumne River, California. Pages 253-303 in R.L. Brown, editor. Contributions to the biology of Central Valley salmonids. Fish Bulletin 179: Volume 2. California Department of Fish and Game, Sacramento.

Galloway, D.L., and Riley, F.S., 1999, San Joaquin Valley, California—Largest human alteration of the Earth's surface: *in* Land Subsidence in the United States, Galloway, D.L., Jones, D.R., and Ingebritsen, S.E., eds., U.S. Geological Survey Circular 1182, pp. 23-34.

Garza, J. C., and D. E. Pearse. 2008. Population genetic structure of Oncorhynchus mykiss in the California Central Valley. Report to California Department of Fish and Game. Contract No. PO485303. University of California, Santa Cruz, and NOAA Southwest Fisheries Science Center, Santa Cruz, California.

Gingras, M. 1997. Mark/recapture experiments at Clifton Court Forebay to estimate prescreening loss to juvenile fishes: 1976-1993. Interagency Ecological Program for the San Francisco Bay/Delta Estuary. Technical Report. http://198.31.87.66/pdf/MarkRecaptureCliftonCourt.pdf

Grant, G. E., J. C. Schmidt, and S. L. Lewis. 2003. A geological framework for interpreting downstream effects of dams on rivers. Pages 209–225 in J. E. O'Connor and G. E. Grant, editors. A peculiar river: geology, geomorphology, and hydrology of the Deschutes River, Oregon. Water Science and Application Series No. 7. American Geophysical Union, Washington, D.C.

Hallock, R. J., R. F. Elwell, and D. H. Fry, Jr. 1970. Migrations of adult king salmon Oncorhynchus tshawytscha in the San Joaquin Delta as demonstrated by the use of sonic tags. State of California, The Resources Agency, Department of Fish and Game. Fish Bulletin 151.

Hansen, J. A., J. C. A. Marr, J. Lipton, D. Cacela, and H. L. Bergman. 1999. Differences in neurobehavioral responses of Chinook salmon (Oncorhynchus tshawytscha) and rainbow trout (Oncorhynchus mykiss) exposed to copper and cobalt: behavioral avoidance. Environmental Toxicology and Chemistry 18(9):1972-1978.

HDR. 2012. Don Pedro Reservoir Bathymetric Study Report. Prepared for Turlock Irrigation District and Modesto Irrigation District. October 2012.

Herren, J. R. and S. S. Kawasaki. 2001. Inventory of Water Diversions in Four Geographic Areas in California's Central Valley. In R. L. Brown, (ed.), Contributions to Biology of Central Valley Salmonids, Vol. 2. CDFG Fish Bulletin 179: 343–355.

Higgins, T., and D. L. Dupras. 1993. Mineral land classification of Stanislaus County, California, California Department of Conservation, Division of Mines and Geology. 174 pages.

ICF International. 2010. Effects of the Head of Old River Barrier on Flow and Water Quality in the San Joaquin River and Stockton Deep Water Ship Channel. ICF 01111.07, Sacramento, CA. Prepared for Department of Water Resources, Sacramento, CA.

ICF Jones & Stokes. 2010. Hatchery and Stocking Program Environmental Impact Report/Environmental Impact Statement. Final. January. (ICF J&S 00264.08) (SCH #2008082025). Sacramento, CA. Prepared for the California Department of Fish and Game and U.S. Fish and Wildlife Service, Sacramento, CA.

Imre, I., J. W. A. Grant, and E. R. Keeley. 2002. The effect of visual isolation on territory size and population density of juvenile rainbow trout (Oncorhynchus mykiss). Canadian Journal of Fisheries and Aquatic Sciences, 59:303-309.

ISAB (Independent Scientific Advisory Board). 2003. Review of salmon and steelhead supplementation. June 4, 2003. Independent Scientific Advisory Board for the Northwest Power Planning Council, the National Marine Fisheries Service, and the Columbia River Basin Indian Tribes, Portland, Oregon.

Jackson, T. A. 2007. California Steelhead Report-Restoration Card: a Report to the Legislature California Department of Fish and Game. 46 pages plus appendices.

Jayasundara, N. C., M. L. Deas, E. Sogutlugil, E. Miao, E. Limanto, A. Bale, Nd S. K. Tanaka. 2014. Tuolumne River flow and temperature model: without project assessment. Prepared by Watercourse Engineering, Inc., Davis, CA.

Johnson, R., P. K. Weber, J. D. Wikert, M. L. Workman, R. B. MacFarlane, M. J. Grove and A. K. Schmitt. 2011. Managed metapopulations: do salmon hatchery 'sources' lead to in-river 'sinks' in conservation? PLoS ONE 7(2):e28880.

Joint Hatchery Review Committee (JHRC). 2001. Final Report on Anadromous Salmonid Fish Hatcheries in California. December 3, 2001. California Department of Fish and Game and National Marine Fisheries Service, Southwest Region.

Katibah, E. F. 1984. A brief history of the riparian forests in the central valley of California. in: Warner, R.E.; Hendrix, K.M., editors. California riparian systems: ecology conservation and productive management. Berkeley, CA: University of California Press; 23-29.

Kelley, R. L. 1989. Battling the inland sea: floods, public policy, and the Sacramento Valley, 1985-1986. University of California Press, Berkeley.

Kuminoff, N. and D.A. Sumner. 2001. What drives farmland conversion: farm returns versus urban factors? Presentation at American Agricultural Economics Association Annual Meeting, August 5-8, Chicago, IL.

Kimmerer, W., L. Brown, S. Culberson, P. Moyle, M. Nobriga, and J. Thompson. 2008. Aquatic ecosystems. Pages 55-72 in M. Healey, M. Dettinger, and R. Norgaard, editors. The State of Bay-Delta Science 2008. CALFED Science Program, Sacramento, California.

Kohler, S. 2006. Aggregate Availability in California. Department of Conservation, California Geological Survey.

Kondolf, G. M. 1995. Geomorphological stream channel classification in aquatic habitat restoration: Uses and limitations. Aquatic Conservation: Marine and Freshwater Ecosystems 5: 127-141. Doi: 10.1002/aqc.3270050205.

Koschmann, A. H., and M. H. Bergendahl. 1968. Principal Gold-Producing Districts of the United States, USGS Professional Paper 610.

Kostow, K. E. 2004. Differences in juvenile phenotypes and survival between hatchery stocks and a natural population provide evidence for modified selection due to captive breeding. Canadian Journal of Fisheries and Aquatic Sciences 61:577-589.

Kuivala K. and C. Foe. 1995. Concentrations, transport, and biological effects of dormant spray pesticides in the San Francisco Estuary, California. Environmental Toxicology and Chemistry 14:1141-1150.

Laird, A. 2005. Gasburg Creek fine sediment reduction and habitat restoration project, La Grange, Stanislaus County, California. Prepared by River Planner, Arcata, California for Turlock Irrigation District, Turlock, California and California Department of Fish and Game, Region 1, Fresno, California.

Lindley, S. T., R. S. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. R. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2007. Framework for assessing viability of threatened and endangered salmon and steelhead in the Sacramento- San Joaquin Basin. San Francisco Estuary and Watershed Science Volume 5, Issue 1 [February 2007], article 4.

Lund, J., E. Hanak, W. Fleenor, R. Howitt, J. Mount, and P. Moyle. 2007. Envisioning futures for the Sacramento–San Joaquin Delta. Public Policy Institute of California, San Francisco. February 2007.

Mather, M. E. 1998. The role of context-specific predation in understanding patterns exhibited by anadromous salmon. Canadian Journal of Fisheries and Aquatic Sciences 55(Supplement 1):232-246.

McBain & Trush. 2000. Habitat restoration plan for the lower Tuolumne River corridor. Prepared for Tuolumne River Technical Advisory Committee (TRTAC) by McBain and Trush, Arcata, with assistance from U. S. Fish and Wildlife Service Anadromous Fish restoration Program (AFRP).

McBain & Trush, Inc. (eds.), 2002. San Joaquin River Restoration Study Background Report. Prepared for Friant Water Users Authority, Lindsay, California, and Natural Resources Defense Council, San Francisco, California.

_____. 2004. Coarse sediment management plan for the lower Tuolumne River. Revised Final Report. Prepared by McBain and Trush, Arcata, California for Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation Districts, USFWS Anadromous Fish Restoration Program, and California Bay-Delta Authority.

_____. 2007. Gasburg Creek fine sediment reduction project: summary of project accomplishments. Final Technical Memorandum. Prepared by McBain & Trush, Arcata, California for W. Fryer, Turlock Irrigation District, Turlock, California.

_____. 2008. Monitoring the impacts on the Tuolumne River from Peaslee Creek erosion and runoff events of January 2008. Prepared by McBain and Trush, Arcata, California for T. Ford, Aquatic Biologist, Turlock Irrigation District, Turlock, California.

McBain & Trush and Stillwater Sciences. 2006. Lower Tuolumne River predation assessment final report. Prepared for the Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation districts, USFWS Anadromous Fish Restoration Program and California Bay-Delta Authority.

McEwan, D., and T. A. Jackson. 1996. Steelhead restoration and management plan for California. Management Report. California Department of Fish and Game, Inland Fisheries Division, Sacramento, California.

Mesick, C. 2001. The effects of San Joaquin River flows and Delta export rates during October on the number of adult San Joaquin Chinook salmon that stray. Pages 139-162 in R.L. Brown, editor. Contributions to the biology of Central Valley salmonids, California Department of Fish and Game, Fish Bulletin 179.

Mesick, C. F. and D. Marston. 2007. Provisional Draft: Relationships between fall-run Chinook salmon recruitment to the major San Joaquin River tributaries and streamflow, Delta exports, the Head of the Old River Barrier, and tributary restoration projects from the early 1980s to 2003.

Mesick, C., J. McLain, D. Marston, and T. Heyne. 2008. Limiting factor analyses and recommended studies for fall-run Chinook salmon and rainbow trout in the Tuolumne River. Draft Report. Joint Report of the U.S. Fish and Wildlife Service (Anadromous Fish Restoration Program), National Marine Fisheries Service, Sacramento Office, and California Department of Fish and Game, Fresno Office. August 13, 2008.

Merced Irrigation District (MID). 2012. Merced River Hydroelectric Project Final License Application. Merced Irrigation District Merced Irrigation District, February 2012.

Mintier Harnish Planning Consultants, Planning Partners, Morton & Pitalo, Dowling Associates, Economic Planning Systems, Mead & Hunt, EDAW/AECOM, and Amy Skewes-Cox Environmental Planning. 2009

Moore, J., and R. Shlemon. 2008. Levee system fragility. Pages 103-120 in M. C. Healey, M.D. Dettinger, and R.B. Norgaard, editors. The State of Bay-Delta Science, 2008. CALFED Science Program, Sacramento, California. http://www.science.calwater.ca.gov/publications/sbds.html

Mount J. and S. Purdy. 2010. Confluence: a natural and human history of the Tuolumne River watershed. Department of Geology and Center for Watershed Sciences, University of California, Davis, version 1.0, 189 pages.

Moyle, P. B. 2002. Inland fishes of California, revised and expanded. University of California Press, Berkeley, California.

Moyle, P. B., P. K. Crain, and K. Whitener. 2007. Patterns in the Use of a Restored California Floodplain by Native and Alien Fishes. San Francisco Estuary and Watershed Science, 5(3). Retrieved from: http://www.escholarship.org/uc/item/6fq2f838.

Myrick, C. A., and J. J. Cech, Jr. 2001. Temperature effects on Chinook salmon and steelhead: a review focusing on California's Central Valley populations. Bay-Delta Modeling Forum Technical Publication 01-1.

Naiman, R. J., H. Decamps, and M. E. McClain. 2005. Riparia: ecology, conservation, and management of streamside communities. Academic Press, New York, New York.

Newcomb, J., and L. Pierce. 2010. Low Dissolved oxygen levels in the Stockton deep water shipping channel: adverse effects on salmon and steelhead and potential beneficial effects of raising dissolved oxygen levels with the aeration facility. Bay-Delta Office, Department of Water Resources.

Newman, K. B. and D. G. Hankin. 2004. Statistical Procedures for Detecting the CVPIA natural Chinook salmon Production Doubling Goal and Determining Sustainability of Production Increases. USFWS, May 2004.

National Marine Fisheries Service and California Department of Fish and Game (NMFS and CDFG). 2001. Final report of anadromous salmonid fish hatcheries in California. December. https://nrm.dfg.ca.gov/documents/ContextDocs.aspx?cat=Fisheries

National Marine Fisheries Service (NMFS). 2009. Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead. Sacramento Protected Resources Division. October 2009.

NPS (National Park Service). 2006. Tuolumne Wild and Scenic River Outstandingly Remarkable Values Draft Report. National Park Service. Available online at: http://www.nps.gov/yose/parkmgmt/ upload/2006%20DRAFT%20ORV%20REPORT_Final-2.pdf.

Orr, B. K. 1997. Ecosystem health and salmon restoration: a broader perspective. Pages 575-580 in S.S.Y. Wang, editor. Environmental and coastal hydraulics: protecting the aquatic habitat. Volume 1: Proceedings of Theme B. Water for a changing global community. The 27th Congress of the International Association for Hydraulic Research. American

Society of Civil Engineers, New York. [Online] URL: http://www.stillwatersci.com/resources/1997orrsalmon.pdf. (Accessed July 27, 2010.).

Pearcy, W.G. 1992. Ocean Ecology of North Pacific Salmonids. University of Washington, Seattle.

Pacific Fishery Management Council (PFMC). 2013. Review of 2012 Ocean Salmon Fisheries. February 2013. 7700 NE Ambassador Place, Portland, OR 97220-1384.

Pacific Watershed Associates (PWA). 2004. Subject: Gasburg Creek sediment control plan and cost estimate. Memorandum from W. Weaver, PhD, Pacific Watershed Associates, Arcata, California to C. Braudrick, Stillwater Sciences, Berkeley, California. 12 March 2004.

Reid, L.M., and T. Dunne. 1996. Rapid evaluation of sediment budgets. Catena Verlag, GMBH, Reiskirchen, Germany.

Robichaud, D. and K. English. 2013. Analysis of Tuolumne River rotary screw trap data to examine the relationship between river flow and survival rates for smolts migrating between Waterford and Grayson (2006–2012). Attachment C in Chinook Salmon Population Model Study – Draft Report prepared by Stillwater Sciences. 23 p.

Scholz, N. L., N. Truelove, B. L. French, B. A. Berejikian, T. P. Quinn, E. Casillas, and T. K. Collier. 2000. Diazinon disrupts antipredator and homing behaviors in Chinook salmon (Oncorhynchus tshawytscha). Canadian Journal of Fisheries and Aquatic Sciences 57:1911-1918.

Scordino, J. 2010. West Coast Pinniped Program Investigations on California Sea Lion and Pacific Harbor Seal Impacts on Salmonids and Other Fishery Resources. Pacific States Marine Fisheries Commission. Portland, OR.

San Francisco Public Utilities Commission (SFPUC). 2007. Program Environmental Impact Report for the SFPUC Water System Improvement Program. San Francisco Public Utilities Commission, San Francisco, California.

San Joaquin River Restoration Program (SJRRP). 2011. Program Environmental Impact Report. Draft April 2011.

Snyder, N.P., D.M. Rubin, C.N. Alpers, J.R. Childs, J.A. Curtis, L.E. Flint, and S.A. Wright. 2004. Estimating accumulation rates and physical properties of sediment behind a dam: Englebright Lake, Yuba River, northern California. Water Resource Research 40.

Speed, T. 1993. Modeling and managing a salmon population. Pages 265-290 in V. Barnett, and K. F. Turkman, editors. Statistics for the Environment, John Wiley & Sons.

Stanislaus County. 2006. Stanislaus County General Plan. Stanislaus County Board of Supervisors, Modesto, California.

Stillwater Sciences. 2001. Merced River Restoration Baseline Studies: Volume II: Geomorphic and Riparian Vegetation Investigations Report. Final Report. Berkeley, CA.

_____. 2002. Subject: Results of summer 2001 snorkel surveys of fine sediment deposits in the Lower Tuolumne River. Technical Memorandum from M. Trso and N. Hume, Stillwater Sciences, Berkeley, California to McBain and Trush, Arcata, California. 5 January 2002.

_____. 2004. Gasburg Creek sediment source analysis. Technical Report. Prepared for the Tuolumne River Technical Advisory Committee.

_____. 2006. Subject: 2002–2003 fine sediment monitoring results for Lower Dominici Creek. Technical Memorandum from N. Lassettre, W. Swaney, and N. Hume, Stillwater Sciences, Berkeley, California to W. Fryer. 16 November 2006.

_____. 2012a. Lower Tuolumne River Instream Flow Studies: Pulse Flow Study Report. Final. Prepared by Stillwater Sciences, Berkeley, California for Turlock Irrigation District and Modesto Irrigation District, California.

_____. 2012b. Tuolumne River 2011 Oncorhynchus mykiss monitoring summary report. Prepared by Stillwater Sciences, Berkeley, California for the Turlock Irrigation District and Modesto Irrigation District.

Stillwater Sciences and McBain & Trush. 2006. Lower Tuolumne River Predation Assessment Final Report. Prepared for the Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation Districts, USFWS Anadromous Fish Restoration Program, and the California Bay-Delta Authority. Prepared by Stillwater Sciences, Berkeley, CA, and McBain & Trush, Inc., Arcata, CA. June.

Sommer, T .R., M. L. Nobriga, W. C. Harrell, W. Batham, and W. J. Kimmerer. 2001. Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Science 58:325–333.

Sommer, T. R., W. C. Harrell, and M. L. Nobriga. 2005. Habitat use and stranding risk of juvenile Chinook salmon on a seasonal floodplain. North American Journal of Fisheries Management 25:1493-1504.

State Board of Fish Commissioners. 1904. Eighth Biennial Report. Prepared by the State Board of Fish Commissioners of the State of California, for the years 1903 – 1904.

SWRCB (California State Water Resources Control Board). 2010. Final 2010 Integrated Report CWA Section 303(d) List / 305(b) Report. Available: <http://www.waterboards.ca.gov/water_issues/programs/tmdl/2010state_ir_reports/category5_report.shtml>.

Thompson, K. 1961. Riparian forests of the Sacramento Valley, California. Annals of the Association of American Geographers 51: 294–315.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 1992. Report of Turlock Irrigation District and Modesto Irrigation District pursuant to Article 39 of the license for the Don Pedro Project. Turlock, California. 8 Volumes. April.

_____. 1997. 1996 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. 6 Volumes. March.

_____. 2000. 1999 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. 2 Volumes. March.

_____. 2001. 2000 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. 2 Volumes. March.

_____. 2005. 2005 Ten Year Summary Report. Pursuant to Paragraph (G) of the 1996 FERC Order issued July 31, 1996. Don Pedro Project, No. 2299. April.

_____. 2007. 2006 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. March.

_____. 2007. 2006 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. March.

_____. 2010. 2009 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. March.

_____. 2011. Pre-Application Document. Don Pedro Project. FERC No. 2299. February 2011.

_____. 2012. 2011 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. March.

_____. 2013a. Project Operations/Water Balance Model Study Report (W&AR-02). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013b. Lower Tuolumne River Riparian Information and Synthesis Study Report (W&AR-19). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013c. Salmonid Population Information Integration and Synthesis Study Report (W&AR-05). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013d. Fish Assemblage and Population Between Don Pedro Dam and La Grange Dam Study Report (W&AR-13). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013e. *Oncorhynchus mykiss* Habitat Survey Study Report (W&AR-12). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013f. Spawning Gravel in the Lower Tuolumne River Study Report (W&AR-04). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013g. Predation Study Report (W&AR-07). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013h. Water Quality Assessment Study Report (W&AR-01). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013i. Reservoir Temperature Model Study Report (W&AR-03). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013j. Lower Tuolumne River Temperature Model Study Report (W&AR-16). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013k. Tuolumne River Chinook Salmon Population Model Study Report (W&AR-06). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2014. In-River Diurnal Temperature Variation Study Report. April 2014.

Tierney, K. B., D. H. Baldwin, T. J. Hara, P. S. Ross, N. L. Scholz, C. J. Kennedy. 2010. Olfactory Toxicity in Fishes. Aquatic Toxicology, 96:2-26.

U.S. Bureau of Reclamation and California Department of Water Resources (USBR and CDWR). 2005. Draft Environmental Impact Statement/Environmental Impact Report South Delta Improvements Program. Prepared for the California Resources Agency, Sacramento, CA.

U.S. Bureau of Reclamation (USBR). 2008. Biological assessment on the continued long-term operations of the Central Valley Project and the State Water Project. U.S. Department of the Interior Bureau of Reclamation Mid-Pacific Region Sacramento, California. August.

_____. 2011. Central Valley Project Water Contractors 2011 Allocation. Available: <http://www.usbr.gov/mp/PA/water/CVP_Water_Contracts_with_2011_Allocation.pdf>.

USDA Forest Service (USFS). 2013. Rim Fire burned area report. Reference FSH 2509.13, September 2013.

U.S. Fish and Wildlife Service (USFWS). 2001. Final Restoration Plan for the Anadromous Fish Restoration Program: A Plan to Increase Natural Production of Anadromous Fish in the Central Valley of California. U.S. Fish and Wildlife Service, Anadromous Fish Restoration Program (U.S.). Core Group, 100 pages.

U.S. Geological Survey (USGS). 1999. Water Resources Data – California, Water Year 1999: Volume 3 – Southern Central Valley Basins and the Great Basin from Walker River to Truckee River. Available online at: http://ca.water.usgs.gov/waterdata/.

Werner, I., S. Anderson, K. Larsen, and J. Oram. 2008. Chemical stressors conceptual model. Delta Regional Ecosystem Restoration Implementation Plan, Sacramento, California. http://www.science.calwater.ca.gov/pdf/drerip/DRERIP_chemical_stressors_conceptual_model_final_012808.pdf

Whipple A. A., R. M. Grossinger, D. Rankin, B. Stanford, and R. A. Askevold. 2012. Sacramento-San Joaquin Delta historical ecology investigation: exploring pattern and process. Prepared for the California Department of Fish And Game and Ecosystem Restoration Program. A report of SFEI-ASC's Historical Ecology Program, Publication #672, San Francisco Estuary Institute-Aquatic Science Center, Richmond, California.

Williams, J. G. 2006. Central Valley salmon: a perspective on Chinook and steelhead in the Central Valley of California. San Francisco Estuary and Watershed Science 4(3).

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher and P. B. Moyle. 2001. Historical distribution and abundance of chinook salmon in the Central Valley Drainage of California. California Department of Fish and Game, Fish Bulletin No. 179: 71-176.

Zimmerman, C. E., G. W. Edwards, and K. Perry. 2009. Maternal origin and migratory history of steelhead and rainbow trout captured in rivers of the Central Valley, California. Transactions of the American Fisheries Society 138(2):280–291.

Section 5.0: Developmental Analysis

EPA. 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards. EPA 910-B-03-002. Region 10 Office of Water, Seattle, WA.

EPA. 2011, October 11. USEPA's final approval letter and enclosure for California's 2010 303(d) List (http://www.swrcb.ca.gov/rwqcb5/water_issues/tmdl/impaired_waters_list/index.shtml)

Section 6.0: Conclusions

California Advisory Committee on Salmon and Steelhead Trout.1988. Restoring the balance: 1988 annual report. Sausalito, California.

California Department of Fish and Game (CDFG). 1990. Central Valley Salmon and Steelhead Restoration and Enhancement Plan. Sacramento, California. April 1990. 115 pages.

_____. 1993. Restoring Central Valley Streams: A Plan for Action. Sacramento, California. November 1993. 129 pages.

_____. 1996. Steelhead restoration and management plan for California. California Department of Fish and Game, Sacramento, California.

California Department of Parks and Recreation (CDPR). 1994. California Outdoor Recreation Plan (SCORP). Sacramento, California. April 1994.

_____. 1998. Public opinions and attitudes on outdoor recreation in California. Sacramento, California. March 1998.

California Department of Water Resources (CDWR). 1983. The California water plan: projected use and available water supplies to 2010. Bulleting 160-83. Sacramento, California. December 1983.

_____. 1994. San Joaquin River tributaries spawning gravel assessment: Stanislaus, Tuolumne, Merced rivers. Draft memorandum prepared by the Department of Water Resources, Northern District for the California Department of Fish and Game. Contract number DWR 165037.

_____. 2000. Final programmatic environmental impact statement/environmental impact report for the CALFED Bay-Delta Program. Sacramento, California. July 2000. CD Rom, including associated plans.

Federal Energy Regulatory Commission (FERC). 2013. List of Comprehensive Plans. Office of Energy Projects. Washington, D.C. 20426. http://www.ferc.gov/industries/hydropower/gen-info/licensing/complan.pdf

National Parks Service (NPS). 1982. The Nationwide Rivers Inventory. Available online at: A-M: http://www.nps.gov/ncrc/programs/rtca/nri/states/ca.html; N-Z: http://www.nps.gov/ncrc/programs/rtca/nri/states/ca2.html.

California State Water Resources Control Board (SWRCB). 1995. Water quality control plan report. Sacramento, California. Nine volumes.

_____. 1999. Water quality control plans and policies adopted as part of the State comprehensive plan. April 1999.

The Resources Agency. 1983. Department of Parks and Recreation. 1983. Recreation needs in California. Sacramento, California. March 1983.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2013. Recreation Facility and Public Accessibility Assessment, and Recreation use Assessment Study Report (RR-01), Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

U.S. Fish and Wildlife Service. Canadian Wildlife Service. 1986. North American waterfowl management plan. Department of the Interior. Environment Canada. May 1986.

U.S. Fish and Wildlife Service. 1990. Central Valley habitat joint venture implementation plan: a component of the North American waterfowl management plan. February 1990.

U.S. Fish and Wildlife Service. 2001. Final restoration plan for the anadromous fish restoration program. Department of the Interior, Sacramento, California. January 9, 2001.

DON PEDRO HYDROELECTRIC PROJECT
FERC NO. 2299

FINAL LICENSE APPLICATION

EXHIBIT E –ENVIRONMENTAL REPORT

SECTION 3.0 (3.10 to 3.12) THROUGH SECTION 8.0

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3.10 Aesthetic Resources

3.10.1 Existing Environment

The Don Pedro Project is located in western Tuolumne County on the Tuolumne River, about 40 miles east of the City of Modesto and 26 miles northeast of the City of Turlock, both in Stanislaus County. The Don Pedro Project is located in the Sierra foothills region, an area characterized by rolling hills, rural landscapes, native grasslands, and blue oak woodland.

The Don Pedro Project consists of Don Pedro Reservoir, Don Pedro Dam and spillway, Don Pedro powerhouse, and a number of other, primarily recreation-related, facilities. Don Pedro Reservoir has a normal maximum water surface elevation of 830 ft msl and extends about 24 miles upstream from the dam. At maximum water surface elevation, the reservoir has a surface area of 12,960 ac and 160 miles of shoreline, including islands. Don Pedro Dam is an earth-and-rockfill structure with a reinforced-concrete upstream face approximately 580 ft high, with a top elevation of 855 ft. The Don Pedro powerhouse, located at the base of Don Pedro Dam, is a semi-outdoor, above-ground concrete powerhouse.

Views of the Don Pedro Project Boundary are scenic due to the natural beauty of the Tuolumne River and Sierra foothills. Because residential and commercial development are not allowed within the Project Boundary, vegetation along the reservoir is generally well established and lands within the Project Boundary blend into the surrounding landscape. Figure 3.10-1 shows a typical spring reservoir view. However, Don Pedro Project facilities are structural elements that visually contrast with the surrounding rural or natural landscape, as described below.

Figure 3.10-1. View across Don Pedro Reservoir from the intersection of Grizzly Road and New Priest Grade Road (March 2012).

All facilities and lands within the Project Boundary are owned by TID and MID, with the exception of 4,802 ac of federal lands administered by the BLM. These federal lands are part of a larger land unit managed by the BLM in accordance with the Sierra Resource Management Plan (SRMP). The BLM has identified the lands within the Project Boundary as Visual Resource Management (VRM) areas in the SRMP. In the SRMP, the BLM described the following goals for these lands:

- protect and enhance the scenic and visual integrity of the characteristic landscape, and
- maintain the existing visual quality of the Lake Don Pedro/Highway 49 viewshed and the Red Hills ACEC.

In 2012, the Districts conducted a Visual Quality Study (TID/MID 2013a) to document current visual conditions of the Don Pedro Project as viewed from BLM lands during various times of the year and identify any adverse visual resource effects due to continued operation. The objectives of the study were to identify, map, and describe BLM inventories associated with Don Pedro Project facilities and features on land administered by BLM and document the Existing Visual Condition (EVC) of all facilities and features from associated viewsheds on land administered by BLM.

The study area included Don Pedro Reservoir and the Tuolumne River upstream to Ward's Ferry Bridge (Figure 3.10-2). The features and facilities listed below were assessed for visual quality. Greater detail regarding the delineation of the study area, basis of study site selection, and assessment methods used is included in the Visual Quality Study Report and associated appendices (TID/MID 2013a).

- Ward's Ferry Bridge,
- State Highway 49/120 Vista Point,
- Moccasin Point Recreation Area,
- State Highway 132,
- BLM dispersed use areas,
- Don Pedro Reservoir and Tuolumne River,
- Fleming Meadows Recreation Area,
- Don Pedro Dam and Powerhouse,
- DPRA Headquarters and Visitor's Center,
- Don Pedro Spillway, and
- Blue Oaks Recreation Area.

Don Pedro Reservoir is operated between elevations 690 ft and 830 ft msl, depending on hydrologic, precipitation, and water management factors. A zone of exposed soil with sparse and/or low growing vegetation is evident in the drawdown zone. As reservoir surface elevation declines and the drawdown zone expands, the visual effect is often one of strong visual contrast

(TID/MID 2013a). Where the slopes are steeper, sandy brown soils are exposed; and where slopes are gentler, grasses and low vegetation become established. In some locations the reservoir drawdown exposes large rocky areas that tend to match rocky areas above the high water mark and therefore present little visual contrast.

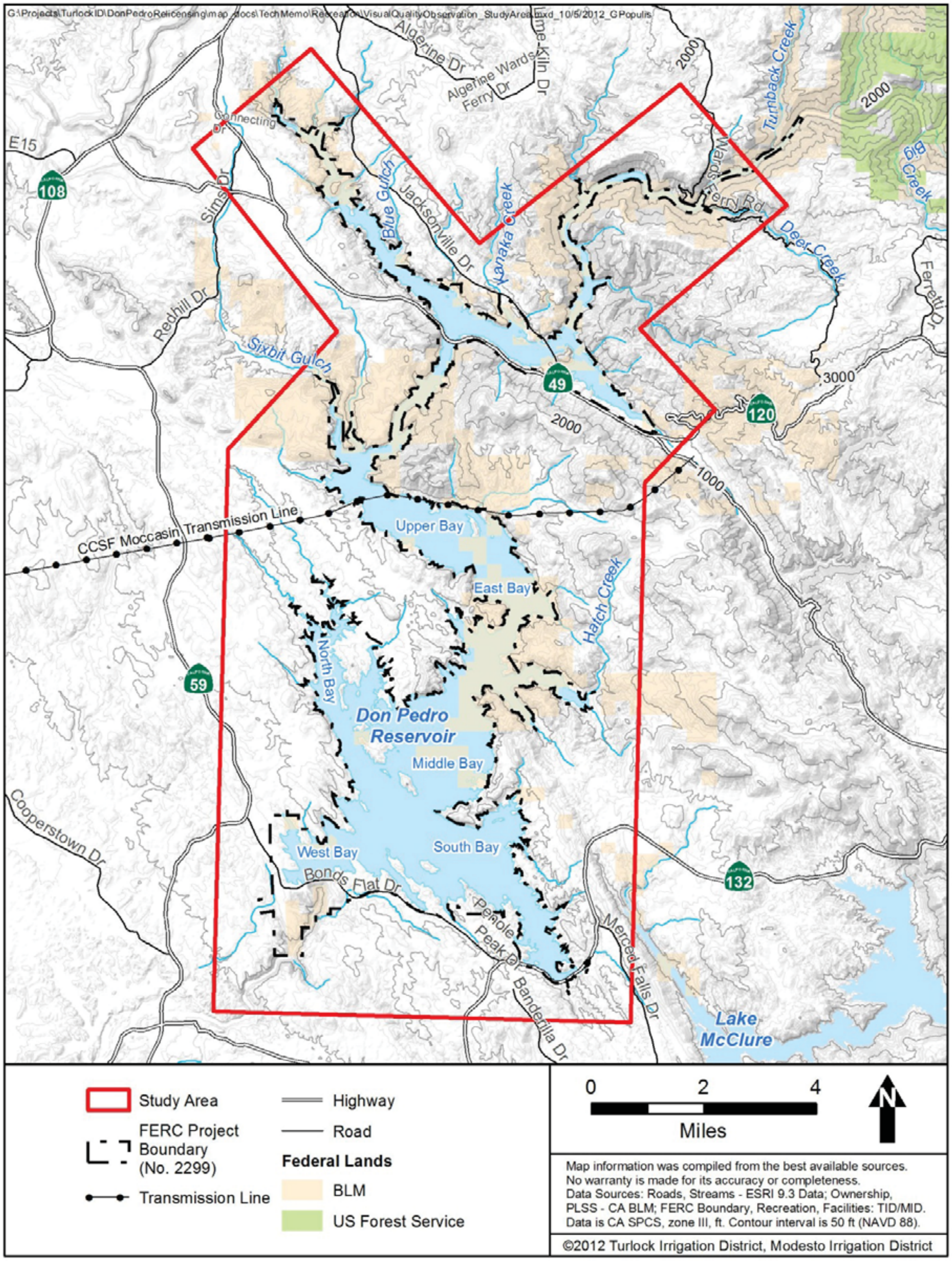

Figure 3.10-2. Visual Quality Study area.

3.10.1.1 Ward's Ferry Bridge

Ward's Ferry Bridge is located in a steep canyon in the upstream portion of the study area (Figure 3.10-3). A whitewater boating take-out, which is used primarily from April through September, is located just upstream of the bridge. Looking up- and down-river from Ward's Ferry Bridge, the effects of drawdown are evident on the steep slopes adjacent to the reservoir and present a strong visual contrast to the landscape outside the drawdown zone (TID/MID 2013a).

Figure 3.10-3. View from Ward's Ferry Bridge looking upriver (July 2012).

3.10.1.2 Moccasin Point Recreation Area

Moccasin Point Recreation Area is located south of the Jacksonville Road Bridge. No Key Observation Points (KOPs) were established in the campground because there are limited views of the reservoir and it is not located on BLM land (TID/MID 2013a). However, KOPs were selected in four locations associated with dispersed recreation areas located on BLM land where either the reservoir or Moccasin Point Recreation Area can be seen from BLM administered lands (Figure 3.10-4). Views of the reservoir from these locations are considered favorable.

Figure 3.10-4. View from the end of Grizzly Road of houseboats and Moccasin Point Recreation Area boat ramp (March 2012).

3.10.1.3 Highway 49/120 and Vista Point

Views from Highway 49/120 include Don Pedro Reservoir and BLM, District, and other private lands were recorded; Figure 3.10-5 depicts a sample view. The foreground is dominated by the reservoir, shoreline lands constitute the middle ground, and the background consists of steep foothill slopes. Hetch Hetchy pipeline can be seen to the east. This view of the reservoir is the one most often seen by people, i.e., typically those traveling to Yosemite National Park.

A few residences can be seen when looking across the reservoir. The colors and shapes of these present weak visual contrasts to the surrounding terrain (TID/MID 2013a). The Jacksonville Road Bridge can be seen to the south, which presents a moderate to strong contrast, depending on lighting.

During high water there is little to no visual contrast of the reservoir shoreline with the surrounding area. However, as reservoir water level decreases, the drawdown zone contrasts with the surrounding vegetation. This contrast, as seen from the Vista Point, was considered to be moderate when viewed in March and July 2012 (TID/MID 2013a).

Figure 3.10-5. View of Don Pedro Reservoir from Highway 49/120 Vista Point (July 2012).

3.10.1.4 State Highway 132

State Highway 132 runs east-west along the southern portion of the Don Pedro Project area, immediately adjacent to the Rogers Creek Arm of Don Pedro Reservoir. Although the reservoir can be seen along a short section (several hundred feet) of road, there are no views of facilities or recreation areas (TID/MID 2013a).

3.10.1.5 Fleming Meadows Recreation Area

The Fleming Meadows Recreation Area is located on a peninsula, with views of Don Pedro Reservoir, the dam and spillway, a marina, and three houseboat mooring areas. The strong visual contrast of the houseboat mooring areas and marina are typical of recreation management areas on reservoirs (Figure 3.10-6). The long-range views of the dam and spillway result in a weak visual contrast (TID/MID 2013a). When the reservoir is below full pool, the drawdown zone can be seen, resulting in a moderate visual contrast (TID/MID 2013a).

Figure 3.10-6. View from campsite A19 at Fleming Meadows Recreation Area looking east at Don Pedro Reservoir and houseboat marina (March 2012).

3.10.1.6 Don Pedro Dam

Don Pedro Dam can be viewed directly in the foreground from the DPRA Headquarters and Visitor's Center (Figure 3.10-7). The dam can also be viewed from the Blue Oaks Recreation Area. At both locations, the dam presents a strong visual contrast to the surrounding natural landscape (TID/MID 2013a). Because the BLM's Visual Resource Objective (VRO) maps were developed with the Don Pedro Dam present, the continued presence of the dam is consistent with BLM's objective of retaining the existing character of the landscape (TID/MID 2013a).

Figure 3.10-7. View east towards the Don Pedro Dam from DPRA Headquarters and Visitor's Center (March 2012).

3.10.1.7 Don Pedro Powerhouse

The Don Pedro powerhouse can be seen briefly when traveling east along Bonds Flat Road (Figure 3.10-8). Although the powerhouse presents a strong visual contrast to the surrounding landscape, it is located at the bottom of a valley, which makes it difficult to see from a moving vehicle. The powerhouse cannot be seen from the DPRA Headquarters and Visitor's Center or elsewhere along the reservoir (TID/MID 2013a). As with the dam, BLM's VRO maps were developed with the Don Pedro Powerhouse in place, and as a result the presence of the powerhouse is consistent with BLM's objective of retaining the existing character of the landscape (TID/MID 2013a).

Figure 3.10-8. View south of powerhouse from Bonds Flat Road. Picture is taken from the passenger window at the center of the dam road. The powerhouse is located at the bottom of the canyon and is in the middle ground (July 2012).

3.10.1.8 Don Pedro Recreation Agency Headquarters and Visitor's Center

The DPRA Headquarters and Visitor's Center are located adjacent to the dam, and include a viewing platform that provides views of the facilities. The dam provides a strong visual contrast to the surrounding natural landscape (TID/MID 2013a). A communications tower, water storage tank, and a DPRA maintenance building and yard are also visible from the viewing platform. These also present a strong contrast to the surrounding landscape. The Blue Oaks Recreation Area is visible from the viewing platform but presents only a moderate contrast, even when recreation use is heavy (TID/MID 2013a).

3.10.1.9 Don Pedro Spillway

The Don Pedro Spillway can be seen briefly by those traveling along Bonds Flat Road and from the Blue Oaks Recreation Area group picnic site (Figure 3.10-9). The spillway strongly contrasts with the surrounding landscape (TID/MID 2013a), but like the other facilities discussed above, its presence is consistent with BLM's objective of retaining the existing character of the landscape.

Figure 3.10-9. View east of Don Pedro Spillway from Bond Flats Road (March 2012).

3.10.1.10 Blue Oaks Recreation Area

The Blue Oaks Recreation Area is located partially on BLM land. Views from the area include the reservoir and campground in the foreground; the dam, DPRA Headquarters and Visitor's Center, a houseboat mooring area, undeveloped landscape, and rolling hills in the middle ground; and the foothills in the background. Figure 3.10-10 includes a sample view. When recreation sites are occupied, their visual contrast with the surrounding landscape is strong (TID/MID 2013a). The dam and houseboat area likewise present a strong visual contrast with the surrounding area (TID/MID 2013a). Again, because the BLM's VRO maps were developed with the Blue Oaks Recreation Area in place, the area's presence is consistent with BLM's objective of retaining the existing character of the landscape (TID/MID 2013a).

Figure 3.10-10. View from campsite D-19 at Blue Oaks Recreation Area looking east at Don Pedro Reservoir and Don Pedro Dam (July 2012).

3.10.1.11 Don Pedro Reservoir

Don Pedro Reservoir is a major visual asset to the landscape, as evidenced by development of residential property with views of the reservoir (TID/MID 2013a). The reservoir, with its complex shoreline and many bays and arms, looks like a natural lake when at full pool (TID/MID 2013a). Although at lower water surface elevations the drawdown zone presents a strong contrast to the surrounding landscape, public attitudes toward the drawdown zone are not necessarily negative (TID/MID 2013a); a sample low reservoir view is shown in Figure 3.10-11. Particularly during low water years, recreationists know the reservoir will be drawn down and understand the various demands for the water stored in the reservoir. This is supported by the results of the recreation use assessment, which show that over 70 percent of respondents surveyed did not view variation in reservoir water level as an impairment of the scenic quality of the area (TID/MID 2013b).

Figure 3.10-11. View depicting low reservoir elevation condition taken from the Blue Oaks Recreation Area looking east towards Don Pedro Reservoir (Photograph provided by DPRA).

3.10.2 Resource Effects

Page 38 of FERC's SD2 identifies the following potential Don Pedro Project effects:

- *Effects of project operations, maintenance activities, and project recreation use on aesthetic resources, including the reservoirs and downstream reach, within the project area.*

Views of the Don Pedro Project Boundary are scenic due to the natural beauty of the Tuolumne River and Sierra foothills. Because residential and commercial development are not allowed within the Project Boundary, vegetation along the reservoir is generally well established and lands within the Project Boundary provide scenic landscape vistas. The Proposed Action does not include changes in the current footprint of the existing powerhouse and switchyard or other facilities. Effects on aesthetic resources during the term of the new FERC license will be the same as those described above for existing conditions.

3.10.3 Proposed Resource Measures

There are no proposed measures related to aesthetic resources.

3.10.4 Unavoidable Adverse Impacts

There will continue to be visual contrasts associated with the Don Pedro Project, as described in the previous sections. These are an unavoidable consequence associated with a water storage project and its related facilities, including those developed for recreation. However, because BLM's VRO maps were developed with the Don Pedro Project facilities in place, the continued presence of these facilities, though at times presenting a visual contrast with surrounding natural areas, is consistent with the BLM's objective of retaining the existing character of the landscape (TID/MID 2013a).

3.11 Cultural Resources

The Districts have undertaken an extensive investigation of the cultural resources at the Don Pedro Project, including efforts to identify those cultural resources that may be affected by ongoing O&M activities. The studies undertaken to investigate cultural resources include the Historic Properties Study (CR-01), which focused on archaeological and built environment resources, and the Native American Traditional Cultural Properties Study (CR-02), which focused on TCPs. These investigations substantially added to the existing information provided in the Districts' PAD. Draft study reports have been distributed to the Cultural Resources Workgroup in order to inform consultation with state and federal agencies and the potentially affected Tribes regarding the results of these studies. These studies have supported the development of a draft Historic Properties Management Plan (HPMP) [32], which is included as Appendix E-4 to this Exhibit E.

3.11.1 Existing Environment

This section describes existing cultural resources associated with the Don Pedro Project. It is presented by the following six areas: (1) regulatory context, including Section 106 consultation; (2) APEs; (3) cultural history overview; (4) existing information; (5) results of the Historic Properties Study; and (6) results of the Native American TCP Study.

3.11.1.1 Regulatory Context

Section 106 of the National Historic Preservation Act (NHPA), requires FERC to take into account the effects of licensing on properties listed or eligible for listing in the National Register of Historic Places (NRHP) prior to issuance of a new license. Pursuant to the applicable regulations found at 36 CFR 800.16, an undertaking is defined as a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including those requiring a Federal permit, license or approval. In this case, the undertaking is FERC's consideration of issuing a new license for the Don Pedro Project. Potential effects that may be

[32] The draft HPMP contains sensitive information and is therefore being filed with FERC as a PRIVILEGED, non-public document.

associated with this undertaking include any Don Pedro Project-related effects associated with day-to-day operations and maintenance and any new construction activity proposed under the new license.

Historic properties are cultural resources listed or eligible for listing in the NRHP. Historic properties represent objects, structures, districts, traditional places, or archeological sites that can be either Native American or Euro-American in origin. In most cases, cultural resources less than 50 years old are not considered eligible for the NRHP. Cultural resources also must retain integrity (i.e., the ability to convey their significance) to qualify for listing in the NRHP. For example, dilapidated structures or heavily disturbed archeological sites may not retain enough integrity to relay information relative to the context in which the resource is considered to be important and, therefore, are not eligible for listing on the NRHP.

Section 106 also requires that FERC consult with the SHPO on any determinations of NRHP eligibility and findings of effect to historic properties, and allow the Advisory Council on Historic Preservation (ACHP) an opportunity to comment on any finding of adverse effects. If Native American properties have been identified, Section 106 also requires that FERC consult with interested Native American Tribes that might attach religious or cultural significance to such properties (i.e., TCPs).

On April 8, 2011, FERC designated the Districts as their non-federal representatives for purposes of consultation under Section 106 of the NHPA. As FERC's non-federal representatives, the Districts have consulted throughout the relicensing effort with BLM, potentially affected Tribes, and SHPO, including obtaining SHPO's concurrence on the Area of Potential Effects (APE). By letter dated January 9, 2012, SHPO concurred with the Districts proposed APE. Consultation efforts further included six meetings between the Districts, interested Tribes, BLM, and SHPO that focused on the collaborative development of study plans and preliminary study results. Representatives from five Tribes, BLM, NPS, SHPO and FERC participated in these meetings, although not all parties attended each meeting.

3.11.1.2 Area of Potential Effects

The study area investigated for the Historic Properties Study and the Native American TCP Study is the APE. As defined in the applicable regulations found at 36 CFR 800.16(d), the APE is "...the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historical properties, if any such properties exist." The APE for the Don Pedro Project relicensing study effort is defined as all lands within the FERC boundary that are (1) within 100 ft beyond the normal maximum water surface elevation (830 ft), (2) within designated Don Pedro Project facilities and formal recreation use areas, (3) within informal recreation use areas identified by the DPRA[33], (4) within the Red Hills ACEC, and (5) along the reservoir edges, including reservoir reaches that contain intermittent and perennial streams.

[33] The FERC approved Historic Properties Study Plan specified that if informal recreation areas were found to extend beyond the Don Pedro Project APE during the study, these areas would be surveyed at that time and the APE expanded to incorporate the informal recreation areas up to the FERC Project Boundary. No such areas have been identified to date.

3.11.1.3 Cultural History Overview

The Don Pedro Project area has a varied and rich history related to cultural resources. This discussion is presented in two parts: prehistory and post-European settlement, and is based on research conducted during the relicensing studies.

3.11.1.3.1 Prehistory and Archaeology

The broad outline of prehistoric California cultural chronology and culture history has been established primarily by observation of basic changes through time in artifact assemblages in areas in the vicinity of the Don Pedro Project. These include overviews of the central Sierra Nevada (cf., Arnold et al. 2004:41-43; Chartkoff and Chartkoff 1984:121-124, 162-165 [Table 4.9], 176-178; Hull 2007:184, Figure 12.4; Jackson et al. 1994; Moratto 1984: Chapters 5 and 7; 1999:Table 4.9; Rosenthal et al. 2007). A number of other culture-historical schemes have also been applied to various western-slope drainages over the last several decades (e.g., Bennyhoff 1956; Elston et al. 1977; Moratto 1972; Wirth Environmental Associates 1985). Many of these schemes link back to temporal divisions originally outlined in the traditional western Great Basin projectile point chronology (e.g., Baumhoff and Byrne 1959; Bettinger and Taylor 1974; Clewlow 1967; Heizer and Baumhoff 1961; Heizer and Hester 1978; Thomas 1970, 1981), and to a lesser extent the original Central Valley chronology (Bennyhoff and Heizer 1958; Bennyhoff and Hughes 1987; Heizer 1951; Ragir 1972).

Cultural chronologies/culture histories of particular relevance to the current APE include that developed for the new Don Pedro Project by Michael Moratto who conducted a study of the reservoir locality in 1970-1971 using students from San Francisco State College (Moratto 1984:311-312; papers in Moratto 1971). In addition to the Don Pedro Reservoir area, project localities in the north-central Sierras of particular interest include the New Melones Reservoir (Moratto 2002; Moratto et al. 1988), and the Sonora Locality (papers in Rosenthal ed. 2011). These are summarized below.

Don Pedro Reservoir Cultural Chronology/Culture History

During 1970 and 1971, M. Moratto and others conducted an archaeological survey and limited excavations at the site of the new Don Pedro Reservoir, recording 28 historic-era resources and 41 prehistoric sites or features (Moratto 1984:311-312; papers in Moratto 1971). The latter were mostly small middens, bedrock milling stations, a few cupule petroglyphs, and a single rock shelter. Moratto noted that many of the sites or features had been damaged or nearly destroyed by previous earth-moving operations, including dredging, tunneling, hydraulic mining, road construction, agricultural activities, and inundation by the La Grange and the original Don Pedro reservoirs in the 1890s and 1923, respectively.

Test excavations at seven of the prehistoric sites located by Moratto suggested that they dated to the last 1,500 years, and at least four of them to the last 500 years. Despite the lack of identified older components, Moratto surmised that there were probably older settlements along the inundated reaches of the Tuolumne River. The lithic materials at the seven Don Pedro sites were dominated by local cryptocrystalline silicate (CCS) toolstone, with smaller amounts of obsidian.

Some of the later sites also yielded steatite disc beads, ornaments, and vessels; small (presumably arrow) points; small obsidian flake tools; and the remains of circular, semi-subterranean houses. Moratto reported that numerous flake and core tools "occur throughout the sequence without noticeable temporal clustering" (1971:144). One site, CA-TUO-300, produced "heavy" projectile points, a "boatstone," and disc beads made of abalone shell. Two of the sites contained a total of at least 16 burials.

Moratto (1984:311-312) recognized two well-documented cultural phases at the Don Pedro locality. One dated to c. 500-300 years before present (B.P.)[34] and was considered an expression of the Mariposa Phase, representing Miwok prehistory. The other, dated at c. 1700-500 B.P., was correlated with the Crane Flat Phase, generally associated with the Yosemite area of the Sierra Nevada and often affiliated with Yokuts prehistory. Evidence for earlier occupation of the area suggested that humans were present from c. 5,000 B.P. on. These studies documented a long and intensive history of use of the Don Pedro Reservoir area by native people.

Jackson (1971) sourced 112 obsidian artifacts from five Don Pedro locality sites, representing one of the first attempts to systematically source prehistoric obsidian artifacts from the central Sierra. Bodie Hills was the primary source, followed by Casa Diablo, and Mount Hicks. One artifact was made from Mono Glass Mountain obsidian and one from Konocti glass.

New Melones Reservoir Cultural Chronology/Culture History

Over a period of 30 years, numerous survey efforts documented over 700 archaeological sites in a cultural resource study that has become known as the New Melones Archaeological Project[35]. These archaeological investigations were initiated for the construction of the New Melones Dam and Reservoir in the 1960s/1970s. The New Melones facilities are located less than 6 miles northwest of the Don Pedro Project area on the Stanislaus River. Testing and/or data recovery, conducted by several entities for the New Melones work, occurred at 34 historic and 68 prehistoric sites. A ten-volume final report was prepared covering the investigations, and a synthesis and summary of findings has also been prepared (Moratto et al. 1988).

Moratto (2002) has summarized the prehistoric chronology/culture history of the New Melones locality in a series of temporal and formal units (Moratto 2002:36, Figure 7; see also pp. 31-35, Figures 2-6 for locations of archaeological sites associated with each major time period). Peak and Crew (1990) defined the earliest signs of human occupancy at New Melones.

Between c. 9450 and 5450 B.P., stemmed series projectile points occur, joined after c. 5950 B.P. by Pinto and Humboldt Series points. The Clarks Flat Phase occurred from c. 9450 B.P. to c. 6950/6450 B.P., followed by the Stanislaus Phase (c. 6950/5950 B.P. to 6200 B.P.), and a terminal period of undesignated components (c. 6200-5450 B.P.). During Early Clarks Flat Subphase times (c. 9450-7950 B.P.), bipointed, foliate, and stemmed points occurred, along with scrapers, notched tools, and beaked gravers. Great Basin transverse points (i.e., "crescents")

[34] Years before present (B.P.) is a time scale used in archaeology, geology, and other scientific disciplines to specify when events in the past occurred. Because the "present" time changes, standard practice is to use the year 1950 as the arbitrary origin of the age scale (i.e., the present).

[35] See Moratto 2002 for a summary of Don Pedro Project history, and a bibliography of relevant resultant literature.

may be associated with this or possibly an earlier, undesignated phase. Several sites appear to have functioned as hunting camps. Low assemblage diversity and artifact densities suggest limited, temporary use of sites during this time period.

During the subsequent Late Clarks Flat Subphase, c. 7950-6950/6450 B.P., Early Clarks Flat flaked stone tool types continue with the addition of milling slabs, handstones, a variety of scrapers, and Western Stemmed Series points. The “Stanislaus Phase” is characterized by continuance of Late Clarks Flat artifact types, with the addition of Stanislaus Broad-Stemmed points, and abundant milling tools. Pinto and Humboldt Series points begin to appear after c. 5950 B.P. Increasing artifact densities and assemblage diversity occurs during the Late Clarks Flat through Stanislaus Phase sequence. This is thought to reflect diversification of economic pursuits, especially those resulting from expanding use of plant resources, and occupational intensification. Some New Melones sites contain poorly documented assemblages with Pinto and Humboldt Series points which appear unrelated to the Clarks Flat-Stanislaus continuum.

The period c. 5450-4750 B.P. witnessed the Texas Charley Phase, typified by the presence of Pinto and Humboldt points, large lanceolate bifaces, and distinctive scrapers. A hiatus in the New Melones archaeological records appears to have occurred after the Texas Charley Phase until c. 4450 B.P. when the Calaveras Phase commenced, marked by the presence of Pinto and Humboldt Series points and milling stones. For a period after the Calaveras Phase ended, c. 3950 B.P., the New Melones archaeological record is poorly known, with traces of minimal site occupancy noted.

Between c. 2950 B.P. and 1450 B.P., the Sierra Phase took place. Typical artifacts include Elko Series, Sierra Concave Base, and Sierra Side-Notched projectile points, bowl mortars, cylindrical pestles, and Olivella F and G Series beads (the Olivella bead types are based on Bennyhoff and Hughes 1987). This phase is marked by economic diversity, acorn use, large populations, intensive occupation, middens and structural remains, cemeteries, use of mortuary caves, abundant funerary artifacts, and signs of extensive material conveyance.

From c. 1450-950 B.P., the Redbud Phase occurred. Typical artifacts are Rosegate Series projectile points, and Olivella D, K, and M Series beads. After c. 950 B.P., other as yet undefined phases may have occurred until c. 650 B.P. Throughout this time, ephemeral site use by small populations engaged in minimal material conveyance seems to have occurred in the New Melones region. During the later part of this time, this may reflect unfavorable climatic conditions resulting from the Medieval Climatic Anomaly.

The Horseshoe Bend Phase, c. 600 B.P. to Anno Domini (A.D.) 1848 – the beginning of the gold rush – was marked by Stockton Serrated, Cottonwood Triangular, Desert Side-Notched, and Gunther Barbed projectile points, and Olivella E, K, and M Series beads. At this time, the New Melones region was occupied by large numbers of people, who intensively occupied the area. These were ancestral Sierra Miwok speakers who practiced an intensified acorn-based economy, and lived in year-round settlements.

Between A.D. 1848 and 1910, the Peoria Basin Phase is associated with historic Sierra Miwok village communities. Associated artifacts include glass trade beads and Desert Side-Notched and

Cottonwood Triangular points. During this period, the Sierra Miwok experienced severe depopulation from a variety of causes along with the effects of acculturation with introduced elements of Euro-American culture.

The Sonora Region Cultural Chronology/Culture History

The original cultural chronology/cultural history for the Sonora area, located roughly eight miles from the Don Pedro Reservoir, was developed during the New Melones Reservoir project (Moratto et al. 1988; Moratto 2002). The New Melones chronology, which was the first systematic attempt to organize the local archaeological record, distinguishes six major time periods. As described above, from youngest to oldest they include: Peoria Basin, Horseshoe Bend, Redbud, Sierra, Calaveras/Texas Charley, Stanislaus, and Clarks Flat, with temporal divisions between them occurring at 650 B.P., 1450 B.P., 2950 B.P., 5450 B.P., and 7950 B.P. Each of these breaks was thought to represent a significant transition in the archaeological record, distinguishable through changes in technology and land use.

Subsequent recent and ongoing research in the Sonora region of Tuolumne County by Far Western and Sonoma State University, directed by archaeologists Jeffrey Rosenthal and Jack Meyer (e.g., Meyer 2008, 2011; Meyer and Dalldorf 2004; Meyer et al. 2005; Rosenthal 2008; Rosenthal ed. 2011; Rosenthal et al. 2008; Whitaker and Rosenthal 2009) has resulted in development of a more inclusive regional cultural/chronology/culture history. This scheme was developed for the Sonora region based on a synthesis of chronological information from more than 100 excavated sites in the watersheds of the Mokelumne, Calaveras, Stanislaus, and Tuolumne rivers, including those excavated as part of the New Melones project (cf., papers in Rosenthal ed. 2011). Based on spatial and stratigraphic analyses of more than 200 radiocarbon dates, more than 4,000 source-specific obsidian hydration readings, slightly more than 875 projectile points, and close to 600 shell beads, five major time periods were defined, including the Early Archaic, Middle Archaic, Late Archaic, Recent Prehistoric I, and Recent Prehistoric II (Table 3.11-1).

Also identified were dominant projectile point styles and obsidian hydration brackets associated with each time period, facilitating interpretation of calendric ages of Bodie Hills hydration readings below 4,000 ft (1,219 meters) in elevation (Rosenthal 2011b:48, Table 16). This new chronology revises the one developed for New Melones, and provides a framework for timing of major prehistoric technological, subsistence, and land-use changes occurring in the central Sierra Nevada (cf., papers in Rosenthal ed. 2011).

Table 3.11-1. Archaeological chronology of the West-Central Sierra Nevada developed for the Sonora Region.

Period	Age Range (cal B.P.)[1]	Hydration Range (microns)[2]
Recent Prehistoric II	610-100	2.4-0.9
Recent Prehistoric I	1100-610	3.1-2.5
Late Archaic	3000-1100	4.7-3.2
Middle Archaic	7000-3000	6.8-4.8
Early Archaic	11,500-7000	8.6-6.9

[1] "cal" refers to calibrated. Uncorrected, or 'conventional' radiocarbon ages are calculated using an assumption that the concentration of naturally occurring radiocarbon in the atmosphere is constant. Calibration of these conventional ages to calendar years corrects for known minor variations over time in the concentration of atmospheric radiocarbon. This calibration

also corrects for an error in the estimate of 'half-life,' or the rate at which radiocarbon decays. While the half-life of radiocarbon is now known to be slightly longer than was estimated when the technique was invented, laboratories continue to report radiocarbon dates using the older, less accurate value, hence the term 'conventional.' Because of this, uncalibrated dates earlier than about 2000 years B.P. tend to be substantially 'younger' than calibrated dates.

[2] Bodie Hills Obsidian; applicable only below 4,000 ft (below snow line). From Rosenthal (2008), based on Rosenthal and Meyer (2004).

3.11.1.3.2 General Prehistoric Chronological Sequence

The general chronological sequences described in this section reflect the new regional chronology for the Sonora region that is based on the research conducted by Jeffrey Rosenthal and Jack Meyer (e.g., Meyer 2008, 2011; Meyer and Dalldorf 2004; Meyer et al. 2005; Rosenthal 2008; Rosenthal ed. 2011; Rosenthal et al. 2008; Whitaker and Rosenthal 2009), as described above.

Early Archaic (11,500-7000 cal B.P.)

Like most places in California, well-dated deposits from the Early Archaic are quite rare in the Sierra Nevada foothills. To date, they have been identified at Skyrocket (CA-CAL-629/630) in Salt Springs Valley and at Clark's Flat (CA-CAL-342), located upstream from New Melones Reservoir along the Stanislaus River. Both sites were observed in buried stratigraphic contexts. Artifacts included large numbers of Wide-stem and Large-stemmed dart points, as well as very small numbers of other notched and stemmed projectile points.

The Early Archaic stratum at the Skyrocket site contained hundreds of handstones and milling slabs, and a variety of cobble-core tools, large percussion-flaked "greenstone" bifaces, and comparatively high frequencies of obsidian from the Bodie Hills and Casa Diablo sources located east of the Sierra crest (La Jeunesse and Pryor 1996). Milling equipment was substantially less abundant at the Clark's Flat site. Plant macrofossil assemblages recovered from Skyrocket are dominated by gray pine and acorn nutshell, but include few if any small seeds or other spring- and summer-ripening plant foods (e.g., manzanita). This suggests that the site was primarily used during the fall and early winter when nuts were available. Plant remains were not sampled at Clarks Flat.

The large accumulation of ground stone in the early stratum at CA-CAL-629/630 probably represents sustained residential use or the residue of repeated seasonal occupations occurring over many millennia. This pattern of repeated or extended occupation suggests that Early Archaic land use in the western central Sierra was seasonally structured, and was not the wide-ranging, highly mobile lifestyle often believed to characterize the Early Archaic throughout the mountain west. This conclusion is further supported by the almost exclusive use of local toolstone for the manufacture of bifaces and projectile points at both Skyrocket and Clark's Flat.

Other sites with evidence of Early Archaic occupation include Taylor's Bar (CA-CAL-1180) on the Calaveras River. There, large stemmed points and an early Holocene radiocarbon date are reported from buried soil. This material was mixed with a substantial Late Holocene deposit (Milliken et al. 1997). In addition, the Poppy Hills site (CA-TUO-2797/H), located downslope from Sonora near Jamestown, produced Early Holocene radiocarbon dates and obsidian hydration readings from a buried soil mixed with Middle Archaic material (Whitaker and Rosenthal 2010).

Middle Archaic (7000-3000 cal B.P.)

The Middle Archaic has traditionally been the most misunderstood portion of the central Sierra Nevada archaeological record, with sites from this time period once thought to be quite rare in many foothill areas (e.g., Moratto et al. 1988). However, the apparent absence of this record can be attributed primarily to long-standing confusion over the timing of corner-notched dart points on the western slope. The common assumption has been that they date to only the last 3,000 years, and that either broad-stem points (e.g., Stanislaus Broad Stem), or Pinto and Humboldt Concave points, are diagnostic of this period (cf., Moratto 2002; Moratto et al. 1988; Peak and Crew 1990). However, recent excavations of several well-dated and stratified Middle Archaic sites clearly indicate that Corner-notched dart points were the predominant projectile point form used on the western slope of the north-central Sierra Nevada from about 7,000 to 1,100 years ago (Rosenthal 2011a; Rosenthal and McGuire 2004). Other stemmed and notched dart points also were used during the Middle Archaic, but in significantly lower numbers.

Like the Early Archaic, most known Middle Archaic deposits from the western Sierran slope have been identified in buried stratigraphic contexts. These often include large numbers of handstones and milling slabs, a variety of cobble-based pounding, chopping, and milling tools; and an occasional mortar and pestle (found only at the most intensively occupied sites). The earliest house structures identified so far on the western slope were present in a Middle Archaic stratum at the Edgemont Knoll site (CA-TUO-4559) at Sonora, associated with large subterranean storage pits (Meyer 2008).

A diverse assemblage of flaked, ground, and battered stone tools, along with comparatively high densities of dietary debris (i.e., plant remains and animal bone) suggests that the Edgemont site served as a primary residential encampment. Archaeobotanical remains, dominated by gray pine and acorn nutshell, reveal that the site was used primarily in the fall and winter, when large quantities of nuts were stored in underground granaries. The overwhelming abundance of nut crops at other Middle Archaic sites in the foothill woodlands suggests a similar season of occupation. In contrast, summer-ripening berries and other fruits are dominant in higher elevation sites located in the Lower Montane Forest.

These differences indicate a pattern of seasonal transhumance, with fall and winter villages placed below the snow line in the Blue Oak-Gray Pine Woodland, and summer camps situated in the conifer forest zone where annual roots, bulbs, seeds, and fruits were common during warmer months. Faunal assemblages from Middle Archaic sites are dominated by large mammal remains (e.g., deer), a pattern that continued throughout the remainder of the prehistoric sequence. The presence of atlatl weights and spurs in these deposits confirms that the dart and atlatl were the primary hunting implements. Soapstone "frying pans" and other vessels first appear in the local record during the Middle Archaic, along with various types of stone pendants, incised slate, and stone beads.

Late Archaic (3000-1100 cal B.P.)

Late Archaic sites are among the most common on the western slope, with many of these also occurring in buried stratigraphic contexts (Meyer 2011). Late Archaic lifeways, technologies, and subsistence patterns were quite similar to that of the previous Middle Archaic period, the primary difference being an increase in the use of obsidian. Handstones and milling slabs made up the vast majority of ground stone implements, and Corner-notched dart points were the most common projectile.

Various expedient, cobble-core tools, battered cobbles, and heavily used flake-based implements are common in Late Archaic foothill deposits. These heavy-duty tools were probably associated with the processing of pine nuts, the primary plant-food refuse present in Late Archaic foothill sites. Fall-ripening acorn nutshell also occurs regularly. Summer grass seeds and fruit and berry pits continue to be rare in foothill deposits, and common in higher elevation sites, indicating that seasonal mobility remained the primary strategy for overcoming spatial and seasonal differences in the availability of important plant foods.

This pattern of seasonal movements between the foothills and conifer forest is further supported by the distribution of different toolstones. Chert, only available in the western Sierra foothills below about 3,000 ft, is common at Archaic sites in the Lower Montane Forest up to about 6,000 ft. Above that elevation, flaked stone assemblages on the western slope are composed almost entirely of obsidian (>80%). This suggests groups using the upper elevations of the western Sierra traveled from the east side, where obsidian was the primary toolstone.

Recent Prehistoric I and II (1100-100 cal B.P.)

Moratto (2002; Moratto et al. 1978, 1988) pointed out that sites dating to the Recent Prehistoric I Period are under-represented in the foothills of the western Sierra Nevada, a pattern that continues to be apparent in subsequent studies (e.g., Rosenthal 2008). He suggested that pervasive drought in the Sierra Nevada may be responsible for wide-spread settlement disruption (Moratto 1984:338; 2002; Moratto et al. 1988). Subsequent research has shown that this period coincides with a region-wide interval of reduced precipitation and higher temperatures, the Medieval Climatic Anomaly.

During this period, among the most important changes in the archaeological record of the western slope is the introduction of the bow and arrow at about 1100 calibrated (cal) B.P., an innovation apparently borrowed from neighboring groups to the north or east. This shift in technology is clearly reflected by the dominance of Small-stemmed and Corner-notched arrow points in the earlier Recent Prehistoric I sites. It remains unclear whether bedrock mortars were first widely used during this period. Their common occurrence at Recent Prehistoric II sites in the Sonora vicinity suggests that they had become an important milling technology by 610 cal B.P. Unlike the earliest arrow points, bedrock mortar technology appears to have developed west of the Sierra Nevada, the center of distribution for these milling features.

Unfortunately, too few single-component Recent Prehistoric I assemblages exist to adequately describe the basic lifeways and subsistence patterns characterizing this period. For the Recent

Prehistoric II Period, however, numerous well-dated sites and components provide abundant evidence for changes in the nature of local subsistence economies. The dominance of acorn nutshell in these sites is among the most compelling evidence for acorn intensification in central California. Bedrock milling fixtures are established across the landscape, near well-developed residential middens, and as isolated features both above and below the oak zone. Subsistence remains in foothill sites include many more spring and summer grass seeds, and fruits and berry pits than were present in Archaic deposits. This indicates that occupation occurred for a longer part of the year, or that sites below the snow line were more regularly used to store warm-season resources for winter use.

There also appears to have been greater settlement differentiation during the Recent Prehistoric II Period. Residential sites often include house-depressions and other structural remains. Special-use localities consisting simply of bedrock milling features also occur. Summer use of higher elevations is also apparent. Many sites from this time period are found in the Lower Montane Forest, often containing high proportions of summer-ripening plant foods.

Like the Archaic, large mammal remains continue to make up a substantial portion of faunal assemblages from both high- and low-elevation sites. Similarly, the distribution of different east- and west-side toolstones indicates that regions above 6,000 ft remained primarily within the seasonal round of east-side people, probably targeting sheep and deer which congregate at high elevations during the summer. Many more specialized technologies are associated with the Recent Prehistoric II Period than were evident during the Archaic, including stone drills and bone awls.

The Desert Side-notched arrow point was first introduced on the western slope at about 610 cal B.P., clearly borrowed from Great Basin peoples to the east. Circular, perforated stone shaft-straighteners are also common in these sites, consistent with use of the bow and arrow. Imported shell beads from coastal California first appear in appreciable amounts in Recent Prehistoric II village sites, as do other rare items such as shell ornaments and bone whistles.

3.11.1.3.3 Ethnohistory

Ethnographically, the Don Pedro Project area lies within Central Sierra Miwok territory, located in the Sierra Nevada foothills and mountains spanning the upper drainages of the Stanislaus and Tuolumne Rivers. The Central Sierra Miwok group is considered a member of the Eastern Miwok, one of the two major divisions of the Miwokan subgroup of the Utian language family (Levy 1978). The Eastern Miwok peoples belonged to five separate linguistic and cultural groups each of which had distinct language and cultural characteristics (Levy 1978). Anthropologists have categorized the Eastern Miwok into language areas according to geographical location, which consist of (1) the Bay Miwok that occupied the eastern area of the Contra Costa County extending from Walnut Creek eastward to the Sacramento-San Joaquin delta; (2) the Plains Miwok, which inhabited the lower reaches of the Mokelumne and Calaveras river drainages; (3) the Northern Sierra Miwok that occupied foothills and mountains of the Mokelumne and Calaveras river drainages; (4) the Southern Sierra Miwok, which inhabited the foothill and mountain portions of the Merced and Chowchilla drainages; and (5) the Central Sierra Miwok mentioned above (Levy 1978).

These five groups were further designated as three distinct groups based on their phonological history and structural and lexical similarity (Levy 1978). Plains and Bay Miwok are both members of a distinct group, while the other three groups comprise a Sierra Miwok language group (Levy 1978). It has been suggested that Plains Miwok separated from the Sierra Miwok languages around 2,000 years ago (Levy 1978). Lexicostatistical chronology and language classification suggests that ancestral Miwok occupation of the Sierra Nevada and its foothills is probably a much more recent event compared to the central California delta region, since Sierra Miwok internal time depth is estimated at around 800 years (Levy 1978).

The main political unit of the Miwok was the tribelet, which was an independent and sovereign nation that had a defined and bounded territory designating its zone of control over natural resources. Among the Sierra Miwok, tribelets included political lineage localities that made up the permanent settlements with an average population estimate of around 25 persons, as well as several semi-permanent settlements and numerous seasonally occupied campsites that were used at various times throughout the seasonal round of gathering, hunting, and fishing activities (Levy 1978). Ethnographic literature points to the presence of a chief or an assembly house in the community at the capital or principal settlement (Levy 1978). The dominant form of house was a conical structure of bark slabs, supported by posts or frameworks.

The main foci of subsistence were the gathering of wild plant foods, especially acorn, and the hunting of mammals. The Sierra Miwok traveled to higher or lower elevation levels during various seasons of the year to obtain subsistence resources unavailable in the vicinity of their permanent settlements. The inhabitants occupying the Transition Zone forest moved to higher elevations during the summer months in pursuit of deer. Those in the foothill areas would occasionally visit the plains of the central valley to hunt antelope and tule elk, which are unavailable in the mountains. Gathering of plant foods varied seasonally, as greens were gathered in the spring and were used to supplement the diet of acorns stored since the previous fall. Seeds were gathered from May to August. Pine nuts were collected after August, when the land was burned. In the late fall and early winter, acorns were gathered (Levy 1978). Meat consumption was its greatest in the winter months when plant resources were limited to stored foods (Levy 1978).

Technological skills included basket making and production of ground stone items, such as mortars and pestles used in acorn processing. Lithic technology consisted of projectile points, knives, scrapers, and expedient tools like hammer stones and choppers made from various materials, such as chert and obsidian (Levy 1978).

The Eastern Miwok in the Sacramento-San Joaquin Valley were first contacted by Spanish explorers in the second part of the eighteenth century (Levy 1978). Since then, dramatic cultural changes developed, including the transformation of previously independent tribelets into unified militias resisting forced labor, forced missionization, and displacement that was intensified by epidemics and targeted violence against the Miwok by the Spanish, which killed many thousands of Miwok persons in the first half of the nineteenth century (Levy 1978).

During the 1840s, fur trappers, gold miners, and settlers arrived in large numbers and often hostile relations arose between these newcomers and Sierra Miwok. For a brief time, Southern

Sierra Miwok supplied labor for J.D. Savage's gold mining operations in the Big Oak Flat district, but as the number of non-indigenous miners increased in the region, large mining operations were shut down, and Miwok participation decreased (Levy 1978). Records indicate that at least 200 Miwok were killed by the miners during the years 1847 to 1860 (Levy 1978).

A period of confiscation of Indian lands began with the annexation of California by the U.S. (Levy 1978). Although treaties were signed by several members of the tribelets, they were never ratified by the U.S. Senate (Levy 1978). A few groups of Sierra Miwok were removed to the Fresno area but most of the Sierra Miwok population remained in rancherias scattered throughout the Sierra Nevada foothills (Levy 1978). Reliance on wage labor steadily increased and dependence on gathering and hunting diminished throughout the end of the nineteenth century and early twentieth century. Federally recognized Sierra Miwok Tribes in the vicinity of the Don Pedro Project area include the Chicken Ranch Rancheria of Jamestown, California and the Tuolumne Band of Me-Wuk Indians of Tuolumne, California.

3.11.1.3.4 General Historical Themes

Regional Mining History

Like every other county along California's Mother Lode, reaching from Mariposa in the south to Auburn in the north (Clark 1970:15), intensive non-Native settlement in Tuolumne County began with gold mining operations.

County folklore credits the initial discovery of gold in Tuolumne County to James Savage and Benjamin Wood and company in July of 1848, on what is now Woods Creek near its crossing with the Stockton Road (State Route 108). Although it is not known who first mined for gold in the region, evidence points to people of Hispanic origin. The diaries of Americans who arrived in the area in 1848 provide accounts of Mexicans from Sonora, Mexico, working the flats and streams for gold. Extensive placer mining was carried out during the early years of the Gold Rush in nearly all of the ravines and gulches in present-day Tuolumne County, to be followed by hydraulic and hard-rock or quartz mining. The results of these activities can still be seen in the drainages and on the hillsides in and around the Don Pedro Project vicinity.

Placer Mining

The richest deposits of retrievable gold in California were found in the Sierra Nevada foothill region. How the gold came to the foothills is an involved story of geological processes. Basically, granitic rock, quartz lodes, and the contact zones were washed and eroded, and naturally milled by flowing water which concentrated the native gold in former and present streams and gravel beds. It was this "free" or placer gold which attracted the Gold Rush miners. Placer mining was the initial extraction method used in Tuolumne County, already familiar to miners from Mexico, Central America, and South America, where placer mining began in the 1500s.

Placer mining was the most common technique used in the APE and vicinity along the Tuolumne River and its drainages, from the earliest years of the Gold Rush through the Depression era.

Most of the successful placer mines are now located beneath the waters of Don Pedro Reservoir, although some activity was carried on in the Jacksonville area until the New Don Pedro Dam was built in the late 1960s. Although placer mining was carried on all along the river, the most successful mines were located near Jacksonville and on the river bars along its length. Major placer mining activities on Moccasin Creek, Woods Creek, Sullivan Creek, and Kanaka Creek were identified above the present water line and were recorded during the Historic Properties Study (CR-01), while smaller operations were noted on Mine Island and on many drainages and gulches in the area.

Hydraulic Mining

After placer mining declined in the 1860s, hydraulic and quartz lode mining gave the region a more permanently based mining economy, one which continued—with cycles of expansion and contraction—through the 1930s and in some areas until the 1950s. Invented in California, hydraulic mining began in the 1850s when Anthony Chabot attached a wooden nozzle to a canvas hose and washed ancient river gravels. Over the next 20 years, miners improved upon Chabot's design, developing "the Little Giant," used for more than 100 years thereafter. The Little Giant, or monitor, required vast amounts of gravity-fed water at high head to spray on the Tertiary river gravels. Torrents of water would melt away boulders, trees, gravel, and dirt, all mixed with gold.

Although a simple and economic way of recovering rich nuggets deep in the gravels, hydraulic mining had numerous adverse effects downstream, where thousands of cubic yards of dirt and rocks were sent into the Central Valley. The tons of waste that entered the valley rivers caused the water level to rise, resulting in floods that destroyed crops, agricultural fields, and buildings. Hydraulic mining effectively ended in 1884, when Judge Sawyer of the United States Circuit Court granted an injunction making it illegal to discharge mining residue into rivers and streams. The 1893 Caminetti Act permitted hydraulic mining if debris-impounding dams were constructed, but the construction and maintenance of such dams was generally too expensive and not very successful and so the method was not widely used in Tuolumne County; it was successfully employed for many years, however, in nearby La Grange in Stanislaus County.

Hydraulic mining, with its dramatic landscapes and large open pits, never took hold in the Southern Mines[36], including those in Tuolumne County, to the degree it did in the Northern Mines of Placer, Nevada, Amador, and El Dorado counties. A small hydraulic pit has been identified near Moccasin and hydraulic mining was conducted at Hawkins Bar.

Hard-Rock Mining

Hard-rock (or quartz) mining began in Tuolumne County in the 1850s. Some of the earlier quartz mines continued to operate for many years: Carlin, Cherokee, Buchanan, Confidence, App, Soulsby, Dutch, and the Trio/Whiskey Hill mines. Hard-rock mining is a method of

[36] The term "Southern Mines" is commonly used in Gold Rush related literature and refers to those mining areas at the southern end of the Mother Lode gold belt. Conversely, the term "Northern Mines" is commonly used in Gold Rush related literature and refers to those mining areas at the northern end of the Mother Lode gold belt.

exploration that is largely subsurface but that leaves many remains on the landscape, including shafts, adits, haul roads, waste rock, prospects, surface vein workings, and tunnels.

The advent of the hard-rock mining boom of the late 1880s, which continued until most of the mills were shut down for World War I, was induced by a combination of advanced mining and milling technologies, primarily the invention of dynamite and the development of square-set timbering in the Comstock lode, the chlorination and cyanide ore refining processes, water or steam power drills, and water pumps and air power. Along with investment of foreign capital, these technologies provided for the resurgence of the mining industry in Tuolumne County and the foothills.

With the advent of hard-rock mining, mines that had closed throughout Tuolumne County were reopened during the late 1880s, often with new names and under new ownership. The larger mines were owned by corporations with abundant capital to invest in the construction of modern and larger stamp mills and recovery systems. The Eagle-Shawmut near Jacksonville (now beneath the waters of Don Pedro Reservoir) and the Harvard Mine near Jamestown were the largest of these, although hundreds of small and medium-sized mines were developed at Confidence, Soulsbyville, Jamestown, Stent, Quartz, Carters, Big Oak Flat, Groveland, Tuttletown, Sonora, and other locations. This boom continued for two decades, and by 1915, mining was still the major industry in the county (Hamilton 1915:136-166). Physical remains from that era include shafts and adits, stamp mills, haul roads, abandoned equipment, leach fields, powder magazines, mill tailings, ponds, waste rock dumps, workers' and superintendents' housing, and company offices.

The Eagle-Shawmut Mine, the Orcutt, Harriman, Mammoth, Republican, Tarantula, Wheeler, and other mines on the Mother Lode vein near Jacksonville were inundated by the new Don Pedro Reservoir in the late 1960s. Other hard-rock mining activities in the area included surface vein workings, prospecting, coyoting, and small adits and "gyppo" (independent operator) mines, some of which are above the present water line of the reservoir and were recorded during the relicensing studies (49 Mine, McCormick/Tuolumne River Mine, coyoting on Kanaka Creek, the surface vein workings on the Penrose property near Jacksonville, and others).

Gold Dredging

Bucket-line and dragline dredges, which are based on the large-scale processing of low-grade placer-bearing gravel, became important producers of placer gold in the early 20th century. . Although introduced into California in 1897, dredging did not become a viable method of mining in Tuolumne County until the 1930s, when dredges worked on and in the Stanislaus and the Tuolumne rivers, Moccasin Creek, and at Montezuma. "Doodlebug" dredges were used on the hillsides below Jamestown during the 1940s. Both forms of dredging have left characteristic scars on the landscape, although many dredger gravel bars are now under reservoirs, including Don Pedro. Dredge tailings on the Ferretti/Sandner Ranch near Moccasin on Moccasin Creek are the most visible remnants of this activity in the APE. Tailings from the extensive dredge mining near La Grange were used in the construction of the new Don Pedro Dam.

Tuolumne County Agricultural Development

While gold mining drove the study area's economy, agriculture was a necessary industry to supply the miners with food. Close behind the prospectors and miners came the agriculturalists, families from the eastern states and Europe who saw opportunities for stock-raising and truck-garden operations on the open grasslands. Following the decline of placer deposits in the Mother Lode after c. 1860, ranching and farming became more important to the foothill economy. Settlers established farms in the area where they grew hay, alfalfa, and wheat, and planted orchards. Most families practiced a mixed agricultural economy, raising cattle, sheep, hogs, and poultry and maintained vegetable gardens and orchards. As the mining economy declined, farming gained importance as a family enterprise which helped to establish more permanence and stability in the local society.

In Tuolumne County, agricultural pursuits were always critical as a supporting service and at times were the most important source of income; even so, agricultural development was not as great as conditions warranted, since the interest in the county was so heavily centered on mining. In the early years when animals provided much of the labor, massive production of hay and grasses was necessary to feed the cattle, oxen, and horses. In 1909 about 18,000 ac were devoted to "hay" (wheat, barley, and oats), since these could be grown without water or much attention. County grasslands were used for stock grazing. Hogs were among the first animals to be raised in the county. Though few ranchers developed hog operations, other animals, such as goats, llamas, sheep, dairy cows, chickens, and other poultry were raised on county ranches and farms.

Livestock grazing was the primary agricultural industry in the vicinity of the APE, and in Tuolumne County as a whole. In 1909 more than half of the cattle ranches in the county were located in or near the Don Pedro area (*Union Democrat* 1909:63). When the first Don Pedro dam was constructed in the 1920s, lands that were to be inundated were purchased from ranchers, including Rosasco, Rushing Land & Cattle Company, Rydberg, Randall, Fleming, Hammond, Donahue, Hughes, Bartlett, Kassabaum, and others (Meikle 1927). As noted by Bill Welch, who was born and raised in the area: "When the dams were built the water backed up over many of the old ranches and the settlers moved out. There were big families here and I often wondered how they all made a living—they had nice homes and big barns and buildings" (Beard 1988:87). Additional lands were purchased in the 1960s when the new Don Pedro Dam was constructed. By that time, many of the ranchers no longer lived on their grazing lands full time, but resided in La Grange, Merced Falls, Empire, Jamestown, Chinese Camp, and other nearby communities.

Transportation Development

Most of the major highways and corridors in California follow the routes of Indian trails (Davis 1961). Such routes in Tuolumne County include State Route 49 and likely include portions of State Route 120. Within Tuolumne County, the pattern of roads generally led to river fords, which later became ferries crossings, and then successive bridge crossings, many of which persist to this day. Stevens Bar was bridged in 1859 and Ward's Ferry in 1879. Other crossings were made at Central Ferry (replaced by Central Bridge in the late 1850s), Jacksonville Ferry, McLeans Ferry, and more. Most physical remains are no longer extant or are underwater in reservoirs, but the names of those crossings survive today as road names: Parrotts Ferry, O'Byrnes Ferry, Reynolds Ferry, Ward's Ferry, and Don Pedro Bar. Numerous avenues between towns, camps, wood mills, mines, ranches, and all the other human additions to the landscape were developed, especially during the period 1849-1900. With the advent of the automobile and other gasoline-powered vehicles, there grew a state-wide interest in transportation development.

Early Wagon Roads

Several early roads and routes traversed the APE and are depicted on historical maps, including the late 19th century General Land Office (GLO) plat maps and historic USGS topographic maps. These include Coulterville Road, Merced and Coulterville Road, Sonora to Jacksonville Road, Sonora to Big Oak Flat Road, Don Pedro Road, Marsh Flat Road, Chinese Camp and Jacksonville Road, Moccasin Road, Ward's Ferry Road, Moffitts Road, Knights Ferry and Don Pedro Bar Road, Road to Crawford's Ranch, Salumbo and French Bar Road, Crimea House Road, Chinese Camp to Stevens Bar Road, Morgans Bar Road, Indian Bar Road, Hatch Creek Road, and other smaller routes between ranches and settlements. Most of them were established in the 1850s, first as public roads, then as county roads, and some later as state highways. The Sonora to Big Oak Flat Road was accepted into the state highway system and later named State Route 120, while the Sonora to Coulterville Road became part of State Route 49.

With the construction of the old and new Don Pedro dams and reservoirs, several roads were inundated and their names and destinations altered. Old Don Pedro Road became Don Pedro Bar Road, the Chinese Camp to Jacksonville Road (c. 1900) was changed to Shawmut Road, Jacksonville Road was moved to the east and Jacksonville-Stent Road was abandoned, the road from Priest Grade along the northeast side of Moccasin Creek was named Grizzly Road and on the south side was named Moccasin Road; and the old Coulterville Road from La Grange was rerouted to cross the New Don Pedro Dam and renamed Bonds Flat Road. Several early roads were truncated and new turnarounds constructed, as on Kanaka Creek Road, old Highway 49 near Moccasin, Grizzly Road, and others. The old road along the northwest side of the river above Stevens Bar was inundated and a new River Road constructed to serve the mines along its route (Rose c. 1970; TID 1975).

Railroads

Although the first common-carrier railroad in California was in place by 1852, and the transcontinental rails of the Central and Union Pacific were laid by 1869, it was not until the end of the 19th century that Tuolumne County began to consider building a railroad. The first one in the county, the Sierra Railway, was incorporated in 1897 as a standard gauge railroad between the cities of Oakdale (on the Southern Pacific line) and Angels Camp in Calaveras County (Coleman 1952:165). The railway was completed to Jamestown that year, financed by Thomas S. Bullock, W. H. Crocker, and Prince Andre Poniatowski. When the railroad to Tuolumne was completed in 1901 to serve the financiers' mill there, it penetrated farther into the Sierra Nevada than any other railroad in California except the Central Pacific (Deane 1960:318). Six branches and secondary railroads were built that linked directly with the Sierra Railway in subsequent years, including the Atlas Branch, the Don Pedro Branch (or spur), the Hetch Hetchy Railroad, the Melones Branch, the Yosemite Short Line Railroad, and the Angels Camp Branch (Tuolumne County Historical Society 2013). Of these, the Don Pedro Branch, the Hetch Hetchy Railroad and the Yosemite Short Line Railroad ran through the APE. Though the railway was built to service the lumber industries and gold fields in the Sierras, the Sierra Railway was instrumental in the construction of several dams, for which most of the spurs and secondary railroads were built. The railroad was used during the 1920s construction of the Don Pedro Dam, the Melones Dam, and the O'Shaughnessy Dam. It also supported the construction of the Tri-Dam Project. During the Great Depression the railway went into receivership and emerged in 1937 as the Sierra Railroad. The last passenger train ran in 1955, after which the train hauled freight exclusively. The train complex in Jamestown was sold in 1982 to the State of California Parks and Recreation Department and became Railtown 1897 State Historic Park. Today the train still runs and offers passenger excursion rides along a portion of the old route.

Water and Power Development[37]

The earliest efforts to control water in Tuolumne County (and elsewhere in the Mother Lode region) were the ditches and flumes constructed originally to provide water for the miners working the rich gold-bearing gravels in the gold diggings. By 1853, within five years of the initial gold discovery, most easily retrievable gold had been recovered. Decreasing quantities of placer gold and the need for vast quantities of water to mine in new ways and areas spurred the development of large-scale water storage and conveyance systems.

Tuolumne County Water Company

From its organization in 1851 to its purchase by Pacific Gas and Electric (PG&E) in 1927, the Tuolumne County Water Company (TCWC) constructed dams, reservoirs, ditches, flumes, and watercourses, purchasing virtually every other ditch and flume company within its sphere of operations. Starting with small ditches built only to serve Columbia, TCWC's system expanded to provide water to the entire area between the Tuolumne and Stanislaus rivers. Over the ensuing years, the use of water controlled by the company shifted from placer mining to hard-rock mining, then to agriculture, and finally to domestic use, reflecting the changing economic pattern of Tuolumne County and the entire foothill region. One important early ditch of the TCWC, the Algerine Ditch, ran close to the APE, near Sullivan and Curtis Creeks. An extension of the ditch appears to have extended into the APE.

La Grange Hydraulic Mining Company

The town of La Grange, also known as French Bar, was one of the important mining camps on the Tuolumne River, established by a group of Frenchmen in the early 1850s. The wealth of the area was based upon the rich gravel bars along the river and associated terraces. A townsite was laid out in 1852 and by 1856 mining had proved so successful that La Grange (French for "the farm") became the Stanislaus County seat. It held that honor until 1862, when the county seat was moved to Knights Ferry. After the county seat was moved and the mining excitement had

[37] Much of the Tuolumne County Water Company history and La Grange Hydraulic Mining Company history is provided from Marvin and Francis 2012.

subsided, the town lost its former prestige and began to show signs of decline (Branch 1881:114, 116).

To help counter this decline, the La Grange Ditch was constructed from 1871 to 1872 for the La Grange Hydraulic Mining Company, headed by San Francisco attorney Edmund Green. The ditch was built to bring water from the Tuolumne River to the company's hydraulic mining operations north of La Grange, where gold was found in the rich auriferous gravels in surface diggings and in an old river channel. By the late 1880s the ditch system had fallen into poor condition (JRP and Caltrans 2000:40, 41, 45, 46, and 50). In the early 20th century the ditch was used for dredging operations and later the water rights were used to supply water for the town of La Grange. However, by the 1920s, following the construction of the old Don Pedro Dam, the La Grange Ditch, portions of which were inundated by the newly formed Don Pedro Reservoir, was abandoned for good (TID vs. Allen Zanker et al. 2006).

Turlock Irrigation District

The first irrigation system to be completed under the Wright Act was by TID, which was also the first public irrigation district to be established in California and one of only four in California today to deliver retail electric power (TID 2013). Its history has been written at length elsewhere (Annear et al. 1950; Elias 1924; Hohenthal et al. 1972; Paterson 1989; Tinkham 1921) and is only briefly summarized here. Although impetus for the development of irrigation systems within Stanislaus County began in the early 1870s, only one canal, the San Joaquin and King's River Canal on the west side of the county, was constructed during that decade (Elias 1924:203–204). The following decade saw the submission of the first irrigation bills in the California legislature, but no action was taken until the late 1880s.

In 1886, Turlock and Ceres farmers began proposing the formation of irrigation districts for the farmers of their regions, stating that "a new water code for equal distribution of water and water rights, under strict regulations, with no chance of monopoly, should be drawn up" (Hohenthal et al. 1972:61). The answer to their demands was provided by a young Modesto attorney, C. C. Wright, who had recently been elected to the State Assembly and chosen "for the express purpose of advocating some measure providing for the municipal control of water for irrigation" (Paterson 1989:53). In the spring of 1887 Wright drafted the Irrigation Districts Act, based largely on the draft of a law prepared the previous year by William Hammond Hall, State Engineer of California.

The Wright Act, approved in March 1887, provided "for the organization and government of irrigation districts and…for the acquisition of water and other property and for the distribution of water thereby for irrigation purposes." The act was designed to give "highest legal sanction to the permanent union of land and water, but at the same time to recognize every other existing right and equity." Patterned on the government of California counties, the district was to have an elected board and powers to assess and collect funds, with all district lands to be taxed (Hohenthal et al. 1972:62).

Within three months of passage of the Wright Act, on June 6, 1887, TID was formed, boundaries were fixed and officers elected. Initially, 176,210 ac (over 275 mi^2) were included in the district, which was all the irrigable land between the Tuolumne and Merced Rivers, from the foothills on the east to the San Joaquin River on the west. The first members of the board, W. L. Fulkerth, E. V. Cogswell, R. M. Williams, J. T. Dunn, and E. B. Clark, met in June of 1887. The TID offices were established in Turlock.

The Board soon located a water right for 225,000 inches near Wheaton's Dam on the Tuolumne River close to La Grange. George Manuel of Fresno, who was hired as district engineer, surveyed the dam site and canal routes and estimated costs for the system at $467,544.62. The Board called for an election to authorize issuance of $600,000 in bonds. The election was held in October of 1887 and only 12 of 188 votes cast opposed the sale. The first sale occurred in November, when Robert McHenry purchased $50,000 in bonds. The first contracts for construction were let in 1890.

Concerned with the prospect of lawsuits against the Wright Act, the TID Board commenced a writ of mandate before the State Supreme Court to compel the secretary of TID to sign certain bonds, which the secretary had refused to sign on the grounds that the Wright Act was unconstitutional and void. The decision, handed down on May 31, 1888, upheld the Wright Act in all respects and ordered the secretary to sign the bonds. TID then set about construction of the La Grange Diversion Dam, located about one-and-one-half miles above La Grange, near the site of the 1870s Wheaton Dam. Built as a joint undertaking by MID and TID, under an agreement made in August of 1890, the water rights were divided in proportion to the number of acres in the respective districts, giving TID 68.46 percent of the total and MID 31.54 percent of the total. The dam was completed by the Pacific Bridge Company in 1893 at a cost of $543,164. At the time of its completion, La Grange Diversion Dam was the highest overflow dam in the country and one of the largest in the world. Most of the design was done by Luther Wagoner, Engineer for MID. E. H. Barton, TID Engineer, supervised the construction.

The years following construction of the La Grange Diversion Dam were characterized by lawsuits, difficulties in selling bonds and making payroll, and deterioration of the canal system during delays. Finally, by 1902 all of the main canals west and some east of the main line of the Southern Pacific Railroad, a total length of 10 miles, were completed. With the La Grange Reservoir and the system on line, TID began to look for storage reservoirs. In 1910, bonds were passed for the construction of reservoirs downstream from the La Grange Diversion Dam in order to store more water from the Tuolumne River for irrigation.

That same year, TID formally began to consider producing electric power, with the intention of building hydroelectric plants at La Grange Diversion Dam and the Hickman Drop. By 1913, 17 dams and one levee were nearly completed, including the Owens (Turlock) Reservoir on the bluff south of the Tuolumne River on the old Morley Ranch (Paterson 1989:158-159). In 1915, TID and MID agreed to build a water-storage dam at the Don Pedro site. The following year, TID Chief Engineer Roy V. Meikle revived a proposal to build a power plant at Hickman Drop, though this plan was later abandoned.

By 1923, the old Don Pedro Dam and Reservoir had been completed and more than 55 miles of main and lateral canals had been lined with concrete to reduce seepage and avoid washouts. A decade later, another 50 miles of concreting had been completed, contributing to a 30 percent increase in canal capacity and reducing the average interval between irrigations from 30 or 35 days to 10 or 15 days (Paterson 1989:258-259). Additional canal improvements and lining were accomplished during the mid-1930s when TID received funding from the Public Works Administration (PWA) (Paterson 1989:271). Over the ensuing years the canals have been periodically upgraded to modern construction standards. In the late 1960s the new Don Pedro Dam was built by TID and MID downstream of the old Don Pedro Dam. Following completion of the new Don Pedro Dam the old dam quickly became inundated by the new Don Pedro Reservoir, which at full capacity holds over 2,000,000 AF of water.

Modesto Irrigation District

Much of MID's history has been closely entwined with that of TID since 1890, when they reached an agreement to construct the La Grange Diversion Dam. MID's history has been written about at length elsewhere (Annear et al. 1950; Barnes 1987; Elias 1924; Hohenthal 1972; Tinkham 1921) and is summarized briefly herein.

Almost immediately after the signing of the Wright Act in March 1887, the organizers of MID circulated a petition calling for formation of the District, presenting it to the Board of Supervisors on April 25. However, the plan was petitioned against. Numerous challenges and court cases led by farmer Christopher Columbus Baker and harness-maker William Tregea delayed the formation of the District for several years. In November of 1889, however, Justice Minor ruled in favor of the District's organization. The decision was immediately appealed by Tregea but was upheld by the California Supreme Court in March of 1891 (Barnes 1987:31).

By early 1894, following completion of the La Grange Diversion Dam, MID had a means of diverting water from the Tuolumne River but no canals to carry it. In April 1890, work began on a gravity-flow main canal running 25 miles through the foothills to the district. The canal was damaged in the floods of 1892 but quickly repaired, and the rest of the main canal contracts were awarded that year. By 1893 all the main canals were finished, but headworks and gates at the dam and lateral canals were not yet complete. A portion of the canal below the dam was declared unsafe and had to be rebuilt. Almost nothing happened in the district from 1896 through 1900, except for the natural deterioration of the canals.

On February 2, 1901, control of MID's Board of Directors was wrested from the anti-irrigationists in an election made contentious by the Board's refusal to act. A bond election held in January of 1902 was overwhelmingly approved by the voters and, with the refinancing bonds approved, the Board set about to raise its $71,000 share of the construction money. The bonds, approved in 1895, were purchased by rancher and president of the First National Bank of Modesto, Oramil McHenry, and work commenced under the direction of Engineer R. H. Goodwin.

Water first flowed through the main canal from the La Grange Diversion Dam to the district boundary and into Dry Creek at 7 a.m. on April 3, 1903. Irrigation formally began in 1904 when Oramil McHenry, George Covell, and T. H. Kewin received the first "official" water.

Irrigation forever altered the early dry-land wheat farming and cattle grazing within the district, as the large grain farms were broken up into smaller parcels and alfalfa became the dominant crop. Dairying also became a major factor in the region's agricultural economy, with grapevines and orchards close behind. Canning and packing plants were established, and in 1907 and 1908 special rail coaches traveled throughout the nation displaying the fruits grown in the MID and TID areas and carrying real estate agents promoting small farm and residential developments. By 1913 more than half of the tillable land in the district was under irrigation, and the amount of land provided with water had increased by 160 percent. Stanislaus County had become the 27th largest producer of crops and livestock in the nation and was second only to Los Angeles County in the pace of agricultural growth. By the beginning of the 1920s, alfalfa had given way to fruit, nut, and vine crops.

As the demand for water storage grew, MID decided to provide its own storage along its main canal below La Grange Diversion Dam. MID enlarged the Dallas and Warner lakes near Waterford, to cover 2,800 ac with a capacity of 27,700 AF. Now known as Modesto Reservoir, the original Dallas-Warner Reservoir was completed in 1912.

Within a decade the wooden flumes and trestles of the irrigation canals began to deteriorate and were replaced with concrete. In March 1914, the voters approved, by a seven-to-one vote, two bond issues totaling $610,000 as part of a policy to expand the irrigating facilities and supersede the temporary early construction with concrete. New headgates, weirs, and diversion points were constructed, and existing canal facilities were replaced and improved (Barnes 1987:55–56).

Evaporation and seepage along MID's canals and ditches accounted for a loss of 30 percent of the water, while weeds and tules clogged the canals and ground squirrels dug holes in the structures and caused additional integrity problems. Accordingly, MID's most important long-range water management program after completion of the La Grange Diversion Dam was the concerted effort to line with concrete or divert into underground pipelines all of its main canal, laterals, and ditches. By 1921, only one mile of the main canal had been lined, and by 1933, less than 25 miles of canals had been piped or concreted. The Work Progress Administration (WPA) improved additional sections of the canal during the Great Depression (mid-1930s to early 1940s). After World War II, however, MID began a 20-year program to line or pipe all of its main canal and laterals. By 1955, 93.7 miles of the total network had been improved. By 1960, 81 percent of the work had been completed. The Don Pedro Project was finished in the mid-1960s. Today, all 288 miles of the main canal, laterals, and drains are piped or lined with concrete (Barnes 1987:118).

In addition to these important long-range management measures to improve the infrastructure of the canal system, MID's largest projects include construction of the original Don Pedro Dam and Reservoir in 1923 and the new Don Pedro Dam and Reservoir in the late 1960s. Including the new Don Pedro Dam and Reservoir, numerous new facilities and improvements were completed in the latter half of the twentieth century. Following the merger with the Waterford Irrigation District in 1978, MID completed the New Hogan hydroelectric plant and the Coldwater Creek geothermal plant (in 1986) and the Modesto Regional Water Treatment Plant (in 1994). In 1997 MID expanded electric service to Oakdale, Ripon, and Escalon.

The New Don Pedro Project

The 1940s through the 1960s proved to be a critical period for TID and MID, as the Districts often had to defend their Tuolumne River water rights. To ensure that water requirements for TID and MID would be met "for all time," the Districts began planning for the new Don Pedro Dam and Reservoir, which would require a Federal Power Commission (FPC) license (Barnes 1987:124).

The first official report of plans to construct a new dam and reservoir dates to 1931, when the California Department of Water Resources (CDWR) discussed the feasibility of such a development. By that time, farmers and officials of the Districts were aware of the need for additional storage, especially as there had been only one year of "normal" rainfall since completion of the first Don Pedro Dam. In addition, about a decade later the ACOE looked to the Tuolumne for additional flood control, and the City of San Francisco began pressing to develop resources based upon the Raker Act. An agreement to proceed with the new dam and reservoir was reached by the three local agencies in November of 1943, and three months later the COE recommended the construction to Congress. Congress concurred with the recommendation in December 1944, and the next year the California Legislature authorized construction of a 1,200,000 AF reservoir (increased to 2,030,000 AF after aerial mapping). The CDWR issued rights in 1953, and by 1955 five potential dam sites had been identified by geologist Roger Rhoades. Two years later, after additional mapping and boring studies, the present location was selected.

The construction site was located in a V-shaped gorge, where terrain was rugged, access was difficult, and the river was violent. Access to much of the river was achieved by filling the old La Grange Ditch (1871), perched on the side of the hill. Later, John Goodier, vice-president and chief engineer of the Atkinson Company, the company contracted to build the dam, noted that it had been an interesting job for a contractor, with two diversion tunnels, a shaft, a powerhouse, a switchyard, a dam, and a spillway—all in one job.

Atkinson established its construction camp at what is now the Blue Oaks Campground, managed by the DPRA. Irrigation engineer, Charles Crawford, a 39-year employee of MID, was named as coordinator. The first order of work was to build a diversion tunnel and clear the dam site. The tunnel was completed and the river diverted on September 7, 1967; nine days later the first loads of dredge tailings were delivered. Following the dam completion, the diversion tunnel became part of the outlet works, draining the downstream portal located south of the powerhouse. On February 27, 1969, the first of the dam's clay core (of silty sand mixed with clay found near La Grange) was placed. For the next 15 months the dam rose 18 inches a day, raised with tailings dumped by earth movers nicknamed "belly dumps." The rigs operated around the clock from 8 a.m. Mondays to 8 p.m. Saturdays, stopping only for a half-hour lunch period on each shift. Two years after construction began, 500 men were working on construction and the development was 53 percent complete.

The last load of material was delivered May 28, 1970, with TID Chief Engineer Roy Meikle riding in the passenger seat (Barnes 1987:140–143). The new dam began storing water in November 1970 (Barnes 1987:146). Formal dedication ceremonies were held May 22, 1971, where San Francisco mayor Joseph Alioto addressed an audience of 3,000. The total cost of the development was $115,697,000 (Barnes 1987:148–150).

Tourism/Recreation

Provisioned by the local agricultural and livestock industries, inns, boarding house, hostelries, and restaurants were established in virtually every community, at crossroads, and at stopping places along the major roads in Tuolumne County. Although tourism was an early activity in the county (Bower Cave, Hetch Hetchy, and Table Mountain all drew visitors), the railroad from Stockton to Milton, completed in May 1871 (originally part of the Stockton & Copperopolis Railroad), greatly increased tourism. After the completion of the Sierra Railway, many locations in the county became destinations for vacationers who came to admire its natural wonders and cooler temperatures.

During the Don Pedro Project FPC hearings in 1962, Tuolumne County lobbied the Districts to incorporate boating and camping facilities into the new Don Pedro Project. The county felt it would benefit financially from the recreation tourism at the reservoir. The Districts maintained they did not have to provide public recreation services and did not want to add this aspect to their management operations. The FPC disagreed and included a recreation requirement in the Don Pedro Project license (Paterson 1989:344). This resulted in the creation of the Don Pedro Recreation Area in 1970, which incorporated all lands and water available for recreation use within the federally licensed Don Pedro Project (FERC Project Number 2299). Subsequently, three formal recreation areas were built around the reservoir in the early 1970s. These areas, Fleming Meadows Recreation Area, Blue Oaks Recreation Area, and Moccasin Point Recreation Area, continue to be operated and maintained today much as they were in the 1970s.

Settlement

The vicinity of the APE includes the locations of several historic-era towns and mining camps, often located on bars of the Tuolumne River or along its larger tributaries. Fire and weather destroyed many of the earliest settlements, and others were later razed before reservoir inundation[38] or abandoned (such as Poverty Hill #1, Curtisville, and Blanket Creek). The following sections provide details of the communities located within the APE. Most of these communities initially sprang up as a result of the Gold Rush, and represented either mining camps or supply centers that supported the surrounding mining communities.

<u>Jacksonville and Shawmut</u>

Jacksonville, located on the Tuolumne River near its confluence with Woods Creek, was named for Colonel Aldan Apollo Moore Jackson, for whom the town of Jackson in Amador County is also named. Jackson is believed to have discovered gold here in 1849 and opened a trading post. Later that year it was reported that there were about 40 people engaged in mining and storekeeping. By April of 1851 the community boasted 252 inhabitants, with a post office

[38] Including dozens of camps such as Melones or Pine Log Crossing on the Stanislaus River, every major mining center on the Tuolumne River from Brazoria Bar to Jacksonville to Don Pedro’s Bar to Rodgers Bar, and Junction Camp and Dutch Bar on Woods Creek.

established that October. According to Heckendorn and Wilson, in 1855 the river was being successfully worked in the months of August through November, at its lowest stage (Heckendorn and Wilson 1856:85). The rich placer deposits in the district reportedly produced $9 million in gold, while hard-rock mining (beginning in the late 1850s) produced more than $7.5 million (Clark 1970:77).

Jacksonville's population waned with the depletion of the easy gold, and it slumbered until reawakened by the hard-rock mining boom of the late 1880s. In 1909, with its location on the Mother Lode Vein and with quartz and gravel mining continuing on an extensive scale, the town was still providing goods and services to the surrounding mines and farms, with a couple of stores, a hotel, and some small farms (*The Union Democrat* 1909:84). Jacksonville was registered as State Historic Landmark No. 419, but all buildings were removed and the townsite was inundated by the waters of Don Pedro Reservoir when the new dam was built in the late 1960s (Gudde 1975:174).

Shawmut, named for the Shawmut Mine on Woods Creek, was located about two miles northwest of Jacksonville. The mine was the most important reason for the town's existence. The first hard-rock mine in the area was the Eagle on Blue Gulch, which started in the 1860s with a 10-stamp mill. After changing hands several times, in the 1890s it was consolidated with the Shawmut claim as the Eagle-Shawmut Mine, the most important in the Jacksonville Mining District and the largest in Tuolumne County in the early 1900s. After being closed for a short time, the mine was reopened in 1897 with a 40-stamp mill (increased to 100 stamps in 1901), with a power plant driven by water purchased from the Sierra and San Francisco Power Company (Hamilton 1915:146). Numerous extensive improvements were made over the ensuing years to the mine and mill, surrounded by Shawmut, a company town with boarding houses and cottages for workers and their families (Wagner 1980:56). The mine continued to operate successfully until shut down by World War II in 1942, by which time it was noted as one of the major mines along the Mother Lode, having many miles of workings (3,550 ft below bedrock), and the producer of huge tonnages of low-grade ore. Most of the extensive workings had been driven after the turn of the 19th century, resulting in a production of approximately $7.5 million in gold (Jenkins 1948:48). For over 50 years the Eagle-Shawmut had been the lifeblood of the district, which never recovered after the mine closure at the start of World War II. Today, what remains of the mine and mill site are under the waters of the Woods Creek Arm of Don Pedro Reservoir, and surface only during times of extreme low water (personal communication with Dave Jigour of DPRA).

<u>Tuolumne River Bars</u>

Many other settlements, in addition to the larger, more permanent communities of Jacksonville and Shawmut, sprang up along the river bars. Heckendorn and Wilson (1856:89) provided this description of the smaller bars and settlements along the Tuolumne River in the mid-1850s:

> *Stevens', Red Mountain, Hawkins', Indian, Texas, Morgan's, Don Pedro's, Rodgers' and many other Bars on the Tuolumne river, are all in Tuolumne County, and are places of considerable note. In 1850 they were the largest camps in the county—thousands of miners were engaged in attempting to turn the river, the bed of which they imagined*

> *contained millions in treasure; but few companies succeeded in diverting the channel from its course, and what few did were disappointed in its supposed richness. Some few companies [have] done well, but as a general thing the river turning that year was a failure—since then the mode of operating has been very different, and the bed of the stream in a number of places has paid well for the expense of fluming, which is the only mode by which it can be successfully worked. The River will furnish profitable employment for many years to come.*

In 1850, the river camps along the Tuolumne were among the largest in the county; few, however, enjoyed any great prosperity and all of them had disappeared by the beginning of the 20th century. Only Don Pedro Bar, Indian Bar, and Red Mountain Bar continued to exist, and those only until the construction of the first Don Pedro Dam in the early 1920s. Not even the bars themselves remain, for the river has changed its course several times since the 1850s and the bars are now located beneath the waters of the reservoir (Hoover et al. 1990:519).

Demographic History of the APE and Vicinity

The cultural resources which remain today in Tuolumne County gain much of their importance from the people who lived and worked there, and from those who designed or built or used the resources. Tuolumne County's structures, sites, objects, and buildings often bear more meaning or significance because of their association with a particular ethnic, religious, or social group that constructed it, lived in it, or was otherwise associated with it. This section provides a brief demographic history of the APE and vicinity, focusing primarily on the ethnic background of the Tuolumne County population.

Although there were other ethnic groups present in California prior to the Gold Rush, particularly Hispanic and Russian peoples, very few made it into what is now Tuolumne County. In the middle of the 19th century, the area was inhabited by several different Indian groups, *Californios*, a handful of Americans, and others. The *Californios* (one of the names for the people of Iberian descent who lived in California before the Gold Rush) were born in California, usually of Spanish, Mexican, and/or Indian parents. Another early group was composed of the 500 men from the eastern United States who came to California in 1846 with Colonel Jonathan D. Stevenson to become the first American regiment in the state. The Mexican-American War had begun and Stevenson's regiment, fought in Baja California but otherwise saw no action in the war, spending its latter part on the Stanislaus River. By 1849 their military tasks were finished and many stayed to become craftsmen, miners, and merchants, and were among the first Americans to settle and mine for gold in California.

Many different groups have lived in Tuolumne County, some of which are still reflected in local place-names like Chinese Camp, Chili Camp, and Kanaka Creek. The Anglos, or people of British extraction, composed an early majority of inhabitants, including the Cornish, with their important hard-rock mining skills, as well as the English, Irish, Welsh, and Scots. Other Europeans were also important to the early development of the county, and many of them stayed when the placer gold was depleted.

The Chinese were a particularly important ethnic group in the history of the Gold Rush as they offered a large labor force. The Chinese Exclusion Act of 1882 essentially ended Chinese immigration and forced many to return to their native land.

3.11.1.4 Existing Information and Need for Additional Information

To gather existing, relevant, and reasonably available information regarding cultural resources in the Don Pedro Project APE and vicinity, the Districts performed a records search in July 2010 at the Central California Information Center (CCIC) of the California Historical Resources Information System at California State University (CSU), Stanislaus in Turlock. In addition to identifying cultural resources, this research also served to obtain background information pertinent to understanding the archaeology, history, and ethnohistory of the Don Pedro Project vicinity and APE. The data gathering area included the FERC Project Boundary, which is much larger than the APE, plus an additional 0.25-mile buffer beyond, to identify previously recorded cultural resources and previous cultural studies that may require consideration.

The records search included reviews of cultural resources records and site location maps, historic GLO plats, NRHP, California Register of Historic Resources, Office of Historic Preservation Historic Property Directory, *California State Historic Landmarks* (CDPR 1996), *California Inventory of Historic Resources* (CDPR 1976), historic topographic maps, and the Caltrans Bridge Inventory.

The records search indicates that the Project Boundary contains numerous prehistoric- and historic-era properties and that some areas have been subject to previous cultural surveys (see Section 5.8 in the PAD). However, the research also revealed that many areas within the APE have not yet been surveyed for cultural resources and a portion of previously surveyed areas should be reexamined to meet current professional standards for identifying historic properties. A comprehensive field survey of the APE was conducted to accomplish this.

3.11.1.4.1 Summary of Record Search

Previous Cultural Studies

The above-described records search identified 62 previous cultural resource investigations within 0.25 miles of the APE, of which 32 fall within the APE, and were conducted prior to a variety of different undertakings, to include proposed water control/treatment facilities, utilities, housing developments, mining activities, road/highway construction, recreation facilities, and grazing leases. Two of the previous investigations are comprised of articles from The Quarterly of the Tuolumne Historical Society, and one is comprised of documentation of monuments and plaques of the E Clampus Vitus organization.

The previous investigations covered roughly 20 percent of the APE, though many of these studies were not completed to current (2010) professional standards. One of the largest studies in the APE (Moratto 1971) did not include a map of the area surveyed, thus it is unclear exactly what locations within the APE were included in this study.

Previously Recorded Archaeological Sites

The records searches identified 160 known archaeological sites previously documented within 0.25 miles of the Don Pedro Project APE, of which 104 fall within the APE. Of the 160 sites within 0.25 miles of the APE, one is protohistoric, one includes both prehistoric and protohistoric components, 12 have both prehistoric and historic-era cultural remains, three did not have any information on file and therefore are unknown as to their age, 65 are prehistoric in age, and 78 contain historic-era resources. The prehistoric components typically include flaked stone with and without bedrock milling stations, with both short term and long term occupation sites represented. The historic components are predominantly represented by refuse scatters and/or remains of habitation structures/buildings, and also include a number of mining relates sites. According to the Office of Historic Preservation's Archaeological Determinations of Eligibility list and the Directory of Properties in the Historic Property Data File on file at the CCIC, of the 160 sites recorded in the vicinity of the Don Pedro Project APE, nine have been evaluated as eligible for inclusion on the NRHP. The remaining 151 resources remain unevaluated for the NRHP.

Potential Historic-Period Cultural Resources

Historic period USGS topographic quadrangles and GLO plats were reviewed during the records search to identify locations of potential historic-era sites and features within the APE and within 0.25 miles of the APE. This resulted in the identification of well over 50 locations where unrecorded historic period sites or features may be present within the APE. These sites and features include potential roads and trails, the town site of Jacksonville, buildings, mines, ditches, the Hetch Hetchy Railroad/Yosemite Short Line Railroad, the Hetch Hetchy Aqueduct, and other features.

Historic period maps often provide a general idea of where sites may be located but are not necessarily accurate. Today's maps and mapping standards are not always translatable to the past and plots cannot be taken as exact. Because of the disparity between historic-period maps and modern maps, it is not known if physical attributes associated with the potential sites and features are accessible, or if the remains are actually within the APE. As well, the presence of cultural features on an historic map does not confirm that the features still exist. Many historic features, such as town sites, mines, roads, etc., often have continued use into present times that may obliterate any historic remains. As well, historic features can also disappear over time through natural erosion or other weathering processes. Based on the inventory of previously recorded cultural resources in the APE and the 0.25 mile study area, it appears that many of the historic features identified on the historic maps of the Don Pedro Project area have not been formally recorded as archaeological sites.

3.11.1.5 Results of Relicensing Studies

To assist FERC in identifying historic properties that may be affected by continued operation and maintenance of the Don Pedro Project under the new FERC license, the Districts conducted two cultural resources studies: the Historic Properties Study (TID/MID 2014a) and the Native American Traditional Cultural Properties (TCP) Study (TID/MID 2014b). The results of each of these studies are provided in the following sections and summarized in the table below (Table 3.11-2).

Table 3.11-2. Summary of results for the cultural resources relicensing studies.

Resource Type	NRHP Evaluation			Totals
	Ineligible	Unevaluated	Eligible	
Historic Properties Study				
Isolated Find	127	0	0	**127**
Archaeological Site[1]	130	75	29	**234**
Built Environment Resource[2]	33	3	1	**37**
Native American TCP Study				
TCP[3]	0	0	1	**1**
Totals	**290**	**78**	**31**	**399**

[1] This count includes two historic districts and one prehistoric district, the primary components of which are archaeological. All three districts have been evaluated as eligible for the NRHP.
[2] This count includes two historic districts comprised of built environment resources. Both districts are currently ineligible for the NRHP.
[3] The TCP identified is represented by a district.

3.11.1.5.1 Historic Properties Study

The Historic Properties Study focused on identifying archaeological and built environment resources within the APE. It included conducting a comprehensive and intensive field survey of the APE, which was completed between January 2012 and September 2012 in accordance with the Secretary of Interior's Standards and Guidelines for Identification (NPS 1983) and the BLM's Class III/intensive standards, per the BLM's 8100 manual series. Tribal monitors from the Tuolumne Band of Me-Wuk Indians and the Southern Sierra Miwuk Nation accompanied the field crew during the field survey.

Archaeological Resources

A total of 361 archaeological resources were identified as a result of the Historic Properties Study, including 127 isolated finds and 234 archaeological sites. Each of these resource groups are described below, including their NRHP evaluations.

Isolated Finds

A total of 127 isolated finds were located and documented within the APE as a result of the Historic Properties Study (see Attachment A for an isolate location map). Of the 127 isolated finds, 85 are prehistoric in affiliation and 42 are historic-era isolates. The prehistoric isolated finds are predominantly comprised of isolated flakes and groundstone tools, but also include flaked stone tools, cores, core tools, possible charm stones or atlatl weights, a bowl mortar fragment, and one milling station that is no longer in situ. The historic isolated finds include isolated occurrences of mining activity and isolated cairns/cadastrals, concrete features, rock alignments, earthen dams (likely modern), glass fragments, ceramic fragments, an earthen structure pad, a brick feature, and a tire.

As is usual for isolated finds, all 127 of these resources were evaluated as ineligible for inclusion on the NRHP.

Archaeological Sites

A total of 234 archaeological sites were identified within the APE as a result of the Historic Properties Study, of which at least 22 were previously documented during prior investigations and 212 were newly identified (see Attachment B for an archaeological site location map). As summarized in Section 2.2.2, there are a total of 97 previously recorded cultural resources within the APE, of which 19 archaeological sites were revisited and updated during the present field investigation[39]. Of the remaining 78 previously recorded resources, one is a built environment resource that is discussed in the following section (P-55-3913, the Red Mountain Bar Siphon) and 77 were not located in the field as they were likely either miss-mapped and are actually outside the APE or were inundated by the reservoir. Many of the historical features identified on historic maps of the APE were also located in the field and documented as archaeological sites; conversely, many were also not relocated due to inundation and because they have either eroded away over time or have been removed/covered by modern development.

Of the 234 archaeological sites identified, 129 contain historic-era deposits and features (two of these represent the Woods Creek Mining Landscape and the Kanaka Creek Mining Landscape), 76 represent prehistoric or Native American use (one of these represents the Tuolumne River Prehistoric Archaeological District) and 29 represent both prehistoric and historic-era occupations. The types of prehistoric sites represented in the APE include occupation sites, lithic quarry sites, small temporary task locations (lithic retooling, lithic reduction, subsistence procurement and processing, and hunting-related locals), districts/landscapes, and possibly other types of prehistoric or ethnographic occupation that could not be distinguished. Based on the artifact assemblages recorded during the study, the prehistoric or Native American occupation of the area appears to be focused on the Middle to Late Archaic periods through to the ethnographic or contact period (from roughly 7000 to 100 cal B.P., as provided above in Section 3.11.1.3.2). The historic sites observed represent the remains of a variety of historic-era land uses, primarily consisting of extensive mining, including two historic mining landscapes, utilities, homesteads, ranching/farming, transportation (roads, railroads), water control and conveyance features, and other unassociated historical remains. The historic occupation dates to as early as the late 1840s and as late as the 1960s.

As summarized in Table 3.11-3 below, 159 of the 234 archaeological sites identified within the APE were evaluated for the NRHP during the Historic Properties Study; 130 have been evaluated ineligible for inclusion in the NRHP and 29 have been evaluated as eligible for inclusion in the NRHP. The remaining 75 sites are unevaluated for the NRHP pending further work.

The remainder of this section provides more details of the archaeological sites. It is organized by site age – prehistoric, historic, and multi-component.

[39] Two of these previously recorded archaeological sites (P-55-1920 and P-55-1921) were merged to create one site during the present survey. As well, four of the other sites updated during the present survey (P-55-110, P-55-3876, P-55-5231, and P-55-7353) are comprised of linear sites, of which the segments previously recorded were located outside of the APE. Accordingly, these four sites were not counted as part of the 97 previously recorded cultural resources within the APE.

Table 3.11-3. Summary of NRHP evaluations for archaeological sites identified within the APE.

Age	Ineligible	Unevaluated	Eligible	Totals
Historic	98	23	8	**129**
Prehistoric	27	37	12	**76**
Multi-component	5	15	9	**29**
Totals	**130**	**75**	**29**	**234**

Prehistoric Resources

Of the 76 prehistoric sites identified within the APE, 12 are evaluated as eligible for inclusion on the NRHP, while 27 are evaluated as ineligible and 37 remain unevaluated pending further investigations (Table 3.11-4). The prehistoric sites have been grouped according to the following types:

(1) Lithic Scatter (26)

(2) Short-Term Habitation (14)

(3) Quarry (13)

(4) Long-Term Habitation (12)

(5) Milling Feature (6)

(6) Rock Shelter (2)

(7) Other (2)

(8) District (1)

Those sites included under the lithic scatter type include flaked stone debitage and/or flaked stone tools and contain no groundstone, milling features, or habitation features that might suggest more long term activity or a multi-task site. The lithic scatter sites may represent secondary lithic reduction and/or retooling locations and also locations related to hunting activities. Those sites grouped under the short-term habitation type include flaked and groundstone tools and debris and may include non-extensive bedrock milling stations (<10 mortar cups). It is assumed that these sites represent small temporary campsites that are occupied longer than the lithic scatters and thus are more complex and may represent multiple kinds of tasks being undertaken at them. Long-term habitation sites include those sites with prominent midden deposits and/or housepits or extensive (>10 mortar cups) milling features. These sites represent village sites that were occupied for much longer time periods than the short-term habitation sites, and generally represent an even greater variety of tasks and activities, with greater complexity of features and artifact types. The quarry type represents those sites with small to extensive quarries, where the primary activity appears to be focused on tool stone acquisition and usually includes moderate to heavy primary lithic reduction debris. The milling feature type includes those sites with an isolated milling feature or containing a non-extensive (<10 mortar cups) milling feature(s) with minimal associated debris. The rock shelter type represents those sites that contain a prominent rock shelter. As rock shelters are important sites that usually offer a great deal of information potential, it was important to identify these sites separately from the other site types, even when they contained other prominent features. The other type includes two sites that do not conform to the other categories. One is a possible tool cache and/or procurement location and one is a possible hunting blind. Finally, the district type represents one archaeological district, the Tuolumne River Prehistoric Archaeological District.

Historic Resources

Of the 129 historic sites identified within the APE, eight have been evaluated as eligible for inclusion on the NRHP, while 98 have been evaluated as ineligible and 23 remain unevaluated pending further investigations (Table 3.11-5). The historic sites have been grouped according to the following types:

(1) Transportation (51)

(2) Mining (40)

(3) Water Control/Hydroelectric (WCH) (20)

(4) Other (8)

(5) Utilities (5)

(6) Habitation (3)

(7) Trash Scatter (2)

The sites that fall within the transportation type include roads and railroads. Those within the mining type include placer mining and lode mining complexes and sites comprised of prospect pits, tailings, waste rock, shafts/adits, or other mining-related features. Additionally, two of the resources included under the mining type are historic landscapes that incorporate several sites as elements of the landscapes: Kanaka Creek Mining Landscape and Woods Creek Mining Landscape. Sites included under the water control/hydroelectric type are ditches, dams, reservoirs, and other features directly associated with water control and hydroelectric-related facilities. The other type covers those sites that do not conform to any of the other types, or whose type is unknown. The utilities type covers sites related to power transmission/distribution and/or communication facilities (telephone/telegraph lines and one radio tower) and includes sites comprised of utility poles and transmission line or radio tower footings. Sites that fall under the habitation type include those sites that represent primary residential locations. Finally, sites that are within the trash scatter type include those sites that are refuse scatters and represent primary or secondary discard, but are not associated with a primary residential location and have no features that represent an activity that would suggest association with one of the other types.

It is important to note that even though all of the sites have been assigned to one type, several of them may contain features or components that represent another type. For example, a mining complex under the mining type may also incorporate a habitation feature, transportation feature, and/or a water control feature. These sites are assigned to a particular type based on the primary activity/focus of the site, as determined by the number and type of components contained within the site.

Table 3.11-4. Summary of prehistoric sites.

Count	Temporary Site No.	Primary No./ Trinomial	Age	Type	Description	Land Owner	NRHP Eligibility[1]	
							Individual Eligibility	NRHP Eligibility as a Contributing or Non-Contributing Element to the Tuolumne River Prehistoric Archaeological District
1	FW-DP-003	--	Prehistoric	Lithic Scatter	Lithic Scatter. Age unknown.	TID/MID/ BLM	U	U
2	FW-DP-004	--	Prehistoric	Lithic Scatter	Lithic Scatter; three artifacts and ~20 flakes. Age unknown.	TID/MID/ BLM	U	U
3	FW-DP-005	--	Prehistoric	Lithic Scatter	Lithic Scatter: Small, moderately dense (up to three flakes per square meter) greenstone flake and artifact scatter of 23 items. Age unknown.	TID/MID/ BLM	U	U
4	FW-DP-006	--	Prehistoric	Lithic Scatter	Lithic Scatter small, sparse, greenstone flake scatter (eight flakes on the surface), shovel probe test uncovered four additional flakes. Age unknown.	TID/MID/ BLM	U	U
5	FW-DP-043	--	Prehistoric	Settlement	Habitation site; 40 cultural items were recorded and mapped. These consist of ten core tools, 14 handstones, two bifaces, one pestle, one perforator, two milling slabs, one cobble tool, one flake tool, two cores, and six flakes. Dates to Middle Archaic.	TID/MID	E	C
6	FW-DP-068	--	Prehistoric	Subsistence	BRM with one cup. Age unknown.	TID/MID/ BLM	I	NC
7	FW-DP-072	--	Prehistoric	Subsistence	Two BRMs ~50m apart. Age unknown.	TID/MID	I	NC
8	FW-DP-081	--	Prehistoric	Settlement	Occupation site with BRMs across from marina; eight bedrock milling features, a possible rockshelter, midden deposit, ground stone artifacts, and at least one flake. Age unknown.	TID/MID/ Private	E	C
9	FW-DP-086	--	Prehistoric	Short-term Habitation	Lithic scatter with three bifacial tools, two battered cobbles, one core, two handstones, one millingstone fragment, and one cobble tool. Age unknown.	TID/MID/ BLM	U	U
10	HDR-DP-001	--	Prehistoric	Milling Feature	A single milling station. Age unknown.	TID/MID	I	NC
11	HDR-DP-013	--	Prehistoric	Short-term Habitation	One milling station; lithic scatter (50+ flakes). Age unknown.	TID/MID	I	NC
12	HDR-DP-014	--	Prehistoric	Quarry	Lithic scatter (40+ flakes, one handstone, one biface); one quarry feature. Age unknown.	TID/MID	I	NC
13	HDR-DP-015	--	Prehistoric	Quarry	Quarry/assay location with lithic scatter (100+ flakes). Age unknown.	TID/MID	I	NC
14	HDR-DP-018	--	Prehistoric	Quarry	Quarry; lithic scatter (500+ flakes, one battered cobble, one scraper, and one milling slab); one milling station. Age unknown.	TID/MID	U	C
15	HDR-DP-021	--	Prehistoric	Quarry	Quarry/assay location; Lithic scatter (200+ flakes, 20+ assayed cobbles, one spokeshave). Age unknown.	TID/MID	I	NC
16	HDR-DP-024	--	Prehistoric	Long-term Habitation	Lithic scatter (65+ flakes, one core, one handstone, one abrader, one scraper, one chopper); three milling features with possible rock art; Looter's pile. Age unknown.	TID/MID	E	C
17	HDR-DP-026	--	Prehistoric	Long-term Habitation	Two loci: lithic scatter and tools (450+ flakes, 20+ FCR, five hanstones, three choppers, two Elko series projectile points, one modified flake, one scraper, one biface). Dates to Middle Archaic.	TID/MID	E	C
18	HDR-DP-027	--	Prehistoric	Other	Three features: two possible hunting blinds; one rock scatter. Age unknown.	TID/MID	U	U
19	HDR-DP-028	--	Prehistoric	Short-term Habitation	Three milling stations; lithic scatter (25+ flakes). Age unknown.	TID/MID	U	U
20	HDR-DP-032	--	Prehistoric	Short-term Habitation	Lithic scatter (300+ flakes, two handstones, one milling slab). Age unknown.	TID/MID	I	C
21	HDR-DP-033	--	Prehistoric	Lithic Scatter	Lithic scatter (10 flakes). Age unknown.	TID/MID	U	U
22	HDR-DP-034	--	Prehistoric	Short-term Habitation	Lithic scatter (30+ flakes and 1 handstone). Age unknown.	TID/MID	I	NC
23	HDR-DP-041	--	Prehistoric	Quarry	Quarry/assay location; Lithic scatter (100+ flakes, one core). Age unknown.	TID/MID	U	U
24	HDR-DP-043	--	Prehistoric	Lithic Scatter	Lithic scatter (12 flakes - two are utilized, one scraper, one core, one possible spokeshave). Age unknown.	TID/MID	U	U
25	HDR-DP-046	--	Prehistoric	Milling Feature	One milling station feature (four cups); lithic scatter (three flakes). Age unknown.	TID/MID	U	U
26	HDR-DP-047	--	Prehistoric	Milling Feature	One milling station feature (three cups); lithic scatter (two flakes). Age unknown.	TID/MID	U	U
27	HDR-DP-049	--	Prehistoric	Lithic Scatter	Lithic scatter (eight flakes, one core). Age unknown.	TID/MID	U	U
28	HDR-DP-050	--	Prehistoric	Quarry	One quarry feature; lithic scatter (500+ flakes). Age unknown.	TID/MID	I	NC

Count	Temporary Site No.	Primary No./ Trinomial	Age	Type	Description	Land Owner	NRHP Eligibility[1]	
							Individual Eligibility	NRHP Eligibility as a Contributing or Non-Contributing Element to the Tuolumne River Prehistoric Archaeological District
29	HDR-DP-054	--	Prehistoric	Quarry	One quarry feature; lithic scatter (27 flakes). Age unknown.	TID/MID	I	NC
30	HDR-DP-055	--	Prehistoric	Lithic Scatter	Lithic scatter (six flakes). Age unknown.	TID/MID	I	NC
31	HDR-DP-056	--	Prehistoric	Lithic Scatter	Lithic scatter (15 flakes). Age unknown.	TID/MID	I	NC
32	HDR-DP-057	--	Prehistoric	Quarry	One quarry feature; Lithic scatter (215+ flakes, one core). Age unknown.	TID/MID	I	NC
33	HDR-DP-058	--	Prehistoric	Lithic Scatter	Lithic scatter (50+ flakes). Age unknown.	TID/MID	U	U
34	HDR-DP-060	--	Prehistoric	Lithic Scatter	Lithic scatter (six flakes). Age unknown.	TID/MID	U	U
35	HDR-DP-061	--	Prehistoric	Long-term Habitation	Lithic scatter (two loci, 60+ flakes, one retouched flake, one scraper); midden; possible housepit. Age unknown.	TID/MID	U	U
36	HDR-DP-062	--	Prehistoric	Lithic Scatter	Lithic scatter (four flakes - one is a possible scrapper, one broken CCS cobble). Age unknown.	TID/MID	I	NC
37	HDR-DP-063	--	Prehistoric	Quarry	One milling station feature (three cups); quarried outcrop; lithic scatter (12 pieces of debitage). Age unknown.	TID/MID	U	U
38	HDR-DP-064	--	Prehistoric	Lithic Scatter	Lithic scatter (nine flakes). Age unknown.	TID/MID	I	NC
39	HDR-DP-065	--	Prehistoric	Lithic Scatter	Lithic scatter (100 flakes, one digging tool); a quarried CCS cobble with flake scars. Age unknown.	TID/MID	U	U
40	HDR-DP-066	--	Prehistoric	Short-term Habitation	Lithic scatter (25 flakes, two utilized flakes, two cores, one chopper, one scraper, two milling slabs, and two projectile points shown to the crew by local residents who collected them from the site the year before; Rosegate Series and Elko Series). Dates to Middle Archaic to Late Archaic.	TID/MID	U	C
41	HDR-DP-067	--	Prehistoric	Lithic Scatter	Lithic scatter (one flake, two assayed cobbles). Age unknown.	TID/MID	I	NC
42	HDR-DP-068	--	Prehistoric	Short-term Habitation	Lithic scatter (one portable mortar, three pieces of debitage). Age unknown.	TID/MID	I	NC
43	HDR-DP-069	--	Prehistoric	Quarry	Lithic scatter/assay location (four pieces of debitage). Age unknown.	TID/MID	I	NC
44	HDR-DP-071	--	Prehistoric	Lithic Scatter	Lithic scatter (one modified flake, one chopper, and two flakes). Age unknown.	TID/MID	I	NC
45	HDR-DP-073	--	Prehistoric	Lithic Scatter	Lithic scatter (one Elko Series projectile point, four cores, and seven flakes). Dates to Middle Archaic.	TID/MID	U	C
46	HDR-DP-074	--	Prehistoric	Long-term Habitation	Four bedrock milling station features; midden; lithic scatter (100+ flakes, three cores, three handstones, one milling slab, and one bifacially modified amethyst bottle glass fragment). Dates to Protohistoric age.	TID/MID	E	C
47	HDR-DP-075	--	Prehistoric	Lithic Scatter	Lithic scatter (two cores, one modified flake, and one biface). Age unknown.	TID/MID	I	NC
48	HDR-DP-076	--	Prehistoric	Quarry	Lithic scatter (100+ flakes, 50+ tools including choppers, hammerstones, edge modified cores, edge modified flakes, and cores); quarry (cobbles and outcrops across site). Age unknown.	TID/MID	E	C
49	HDR-DP-077	--	Prehistoric	Quarry	Lithic scatter (500+ flakes, 100+ tools, a sample was recorded including 25 edge modified flakes, nine bifaces, eight cores, five edge modified cores, four unifaces, three utilized flakes, four handstones, one scraper, one blade, one flake blank, and one chopper); quarry. Age unknown.	TID/MID	E	C
50	HDR-DP-095	--	Prehistoric	Long-term Habitation	One milling feature (12 cups); One handstone. Age unknown.	TID/MID	U	U
51	HDR-DP-106	--	Prehistoric	Long-term Habitation	Eight housepit features; nine milling station features; a possible water retention basin feature; a rock feature; a lithic scatter with four artifact scatters (100+ flakes, two edge modified flakes, one biface, one uniface, one cached pestle, several cores). Age unknown.	TID/MID	E	C
52	HDR-DP-107	--	Prehistoric	Lithic Scatter	Lithic scatter (150+, one biface). Age unknown.	TID/MID	I	NC
53	HDR-DP-109	--	Prehistoric	Short-term Habitation	Two milling station features (three cups total); lithic scatter (100+ flakes, one biface). Age unknown.	TID/MID	U	U
54	HDR-DP-110	--	Prehistoric	Lithic Scatter	Lithic scatter (14 flakes, one core/scraper). Age unknown.	TID/MID	I	NC
55	HDR-DP-112	--	Prehistoric	Lithic Scatter	Lithic scatter (two flakes, two modified flakes, one biface, one uniface). Age unknown..	TID/MID	I	NC
56	HDR-DP-113	--	Prehistoric	Long-term Habitation	Nine housepits with possible midden deposits; five milling stations; lithic scatter (50+ flakes, one uniface, one scraper, 100+ FCR, one bowl mortar fragment). Age unknown.	TID/MID	E	C
57	HDR-DP-115	--	Prehistoric	Quarry	Quarry feature; lithic scatter (200+ flakes, 30-60 cores). Age unknown.	TID/MID	I	C
58	HDR-DP-116	--	Prehistoric	Long-term Habitation	Five milling station features; lithic scatter (10+ flakes, one scraper). Age unknown.	TID/MID	U	U
59	HDR-DP-118	--	Prehistoric	Short-term Habitation	One milling station feature; lithic scatter (two loci, 190+ flakes, one biface). Age unknown.	TID/MID	U	U

Count	Temporary Site No.	Primary No./ Trinomial	Age	Type	Description	Land Owner	NRHP Eligibility[1] Individual Eligibility	NRHP Eligibility as a Contributing or Non-Contributing Element to the Tuolumne River Prehistoric Archaeological District
60	HDR-DP-127	--	Prehistoric	Long-term Habitation	Lithic scatter with possible midden deposits (215+ flakes, two loci, one artifact concentration, six bifaces, four edge modified flakes, two unifaces, one handstone, one hammerstone, one core, and one flake blade. Age unknown.	TID/MID	U	C
61	HDR-DP-128	--	Prehistoric	Short-term Habitation	Two bedrock milling station features (nine cups total); lithic scatter (two flakes, one handstone). Age unknown.	TID/MID	U	U
62	HDR-DP-131	--	Prehistoric	Other	Ten+ possible atlatl weights, some are cached. Age unknown.	TID/MID	E	C
63	HDR-DP-135	--	Prehistoric	Short-term Habitation	Lithic scatter (two concentrations, eight flakes, one Elko Corner-notched projectile point, one bowl mortar fragment). Dates to Middle to Late Archaic age.	TID/MID	U	C
64	HDR-DP-137	--	Prehistoric	Lithic Scatter	Lithic scatter (5 flakes). Age unknown.	TID/MID	I	NC
65	HDR-DP-140	P-55-1331/ CA-TUO-306	Prehistoric	Long-term Habitation	Eight bedrock milling stations. Age unknown.	TID/MID	U	C
66	HDR-DP-141	--	Prehistoric	Lithic Scatter	Lithic scatter (eight flakes). Age unknown.	TID/MID	U	U
67	HDR-DP-145	--	Prehistoric	Lithic Scatter	Lithic scatter (70+ flakes, two bifaces, one flake tool, and one Elko Corner-notched point). Dates to Middle Archaic age.	TID/MID	U	C
68	HDR-DP-147	--	Prehistoric	Lithic Scatter	Lithic scatter (four flakes). Age unknown.	TID/MID	U	U
69	HDR-DP-151	--	Prehistoric	Long-term Habitation	Three milling station features; lithic scatter (100+ flakes, two handstones, one biface, two cores, two cached pestles, two cobble tools, one flake tool). Age unknown.	TID/MID	U	C
70	HDR-DP-155	--	Prehistoric	Short-term Habitation	Lithic scatter (four flakes, four handstones). Age unknown.	TID/MID	U	U
71	HDR-DP-158	--	Prehistoric	Short-term Habitation	Three groundstone artifacts and one flake tool. Age unknown.	TID/MID	I	NC
72	HDR-DP-164	P-55-1925/ CA-TUO-915	Prehistoric	Lithic Scatter	Lithic scatter (two flakes, one core). Previously identified milling station with 14+ mortar cups was not observed and likely inundated during current recordation. Age unknown.	TID/MID	U	U
73	HDR-DP-186	--	Prehistoric	Short-term Habitation	Lithic scatter (three handstones, two pestles, one millings slab, one flake). Age unknown.	TID/MID	U	U
74	HDR-DP-192	P-55-1363/ CA-TUO-340	Prehistoric	Rock Shelter	One rock shelter, midden, two bedrock milling stations; Lithic scatter (30+ flakes, 60+ cobble tools, 40+ groundstone tools). Age unknown.	TID/MID	E	C
75	HDR-DP-195	--	Prehistoric	Milling Feature	One milling station feature (one mortar cup) and one handstone. Age unknown.	TID/MID	U	U
76	HDR-DP-196	--	Prehistoric	District	Tuolumne River Prehistoric Archaeological District. Elements of the district are comprised of all prehistoric archaeological site components documented in the APE. Dates from 11,500 cal B.P. to the mid-19th Century.	TID/MID/ BLM	E	N/A

[1] NRHP Eligibility Evaluations: E = Eligible; I = Ineligible; U = Unevaluated; C = Contributing Element; NC = Non-Contributing Element; N/A = Not Applicable (this resource is the Tuolumne River Prehistoric Archaeological District and is not an element of the district).

Table 3.11-5. Summary of historic sites.

Count	Temporary Site No.	Primary No./ Trinomial	Age	Type[1]	Description	Land Owner	NRHP Eligibility[2]		
							Individual Eligibility	NRHP Eligibility as a Contributing or Non-Contributing Element to the Kanaka Creek Mining Landscape	NRHP Eligibility as a Contributing or Non-Contributing Element to the Woods Creek Mining Landscape
1	FW-DP-002/25/79	--	Historic	Utilities	Remnants of a former above-ground utility line. Dates to late 19th/early 20th century.	TID/MID/BLM	I	N/A	N/A
2	FW-DP-010	--	Historic	WCH	Ditch near Taco House site, two segments. Dates to c. 1850s-1950s.	TID/MID/BLM	I	N/A	N/A
3	FW-DP-011/012	--	Historic	WCH	Two parallel square-shaped ditches on Raggio parcel. Dates to c. 1930s.	TID/MID/BLM	I	N/A	N/A
4	FW-DP-013	--	Historic	Transportation	Road to Ferretti property near Moccasin Creek. Dates to late 19th/early 20th century.	TID/MID/BLM	I	N/A	N/A
5	FW-DP-016	--	Historic	Transportation	Old Sonora to Big Oak Flat Road; 690 feet road segment. Dates to c. 1850s-1970s.	TID/MID/BLM	I	N/A	N/A
6	FW-DP-020	--	Historic	WCH	Placer mining ditch with stacked rock support along Moccasin Creek. Dates to c. 1850s to early 20th century.	TID/MID/BLM	I	N/A	N/A
7	FW-DP-021	--	Historic	Mining	Temporary camp with three features: square rock alignment, fire ring, prospect pit. Historic age unknown.	TID/MID/BLM	U	N/A	N/A
8	FW-DP-022	--	Historic	Mining	Mining - Dredge Area with several tailings piles. Dates to c. 1935-1942.	TID/MID/BLM	I	N/A	N/A
9	FW-DP-024	--	Historic	Transportation	Jacksonville to Big Oak Flat Road. Dates to c. 1850s-1930s.	TID/MID/BLM	I	N/A	N/A
10	FW-DP-026	--	Historic	WCH	Ditch West of Steven's Bar, approximately 150 in length. Dates to c. 1850s-early 20th century.	TID/MID	I	N/A	N/A
11	FW-DP-030/031	--	Historic	Mining	Hard rock mining complex, two loci with four collapsed adits each, four features. Dates to c. 1850s-early 20th century.	TID/MID/BLM	U	N/A	N/A
12	FW-DP-032	--	Historic	Other	Bulldozed structure and leveled area (possible structure location), no artifacts/features. Dates to c. 1960s-1970s or later.	TID/MID/BLM	I	N/A	N/A
13	FW-DP-033	--	Historic	WCH	Ditch, ~470 feet long, near Jacksonville. Dates to c. 1850s-early 20th century.	TID/MID/BLM	I	N/A	N/A
14	FW-DP-034/035/036/063	--	Historic	Transportation	Jacksonville area roads: three road segments, one trail; one rock wall. Dates to c. late-19th /early-20th century.	TID/MID/BLM	I	N/A	N/A
15	FW-DP-037/038	--	Historic	Transportation	Don Pedro and Indian Bar Road. Dates to c. 1850s-1970.	TID/MID/BLM	I	N/A	N/A
16	FW-DP-039	--	Historic	Transportation	Road, 290 feet long. Unknown Historic age (pre-1971).	TID/MID	I	N/A	N/A
17	FW-DP-040	--	Historic	Transportation	Road, 360 feet long. Unknown historic age (pre-1971).	TID/MID/BLM	I	N/A	N/A
18	FW-DP-041	--	Historic	Transportation	Road; two segments, 210 and 2,495 feet long. Unknown historic age (pre-1971).	TID/MID/BLM	I	N/A	N/A
19	FW-DP-042	--	Historic	WCH	Ditch (Brown Adit area). Dates to c. 1850s-early 20th century.	TID/MID/BLM	I	N/A	N/A
20	FW-DP-046	P-55-3227/ CA-TUO-2253H	Historic	WCH	Brown Adit site, originally recorded in 1989 by Napton and Greathouse, four new features (adit, shop building foundations, concrete platform, waste rock pile). Dates to c. 1920s-1945.	TID/MID/BLM	E	N/A	N/A
21	FW-DP-047/048/051/052	--	Historic	Transportation	Road (Railroad Canyon); four segments. Dates to c. 1850s-early 20th century.	TID/MID/BLM	I	N/A	N/A
22	FW-DP-050	--	Historic	Mining	Clio Mine; 14 features. Dates to c. 1870s-c. 1942.	TID/MID/BLM/Private	E	N/A	N/A
23	FW-DP-053	--	Historic	Mining	Kanaka Creek mining landscape (District); several features including roads, ditches, coyote holes (adits), numerous randomly stacked tailings piles, pits, and channels in Kanaka Creek. There are sixe elements (FW-DP-54, FW-DP-57, FW-DP-58, FW-DP-59, FW-DP-80, FW-DP-99); Dates to c. 1850s- c. 1930s. A prehistoric component within the District is not considered an element of the District as it is not affiliated with the time period or theme of the District.	TID/MID/BLM/Private	E	N/A	N/A
24	FW-DP-054	--	Historic	WCH	Ditch above Kanaka Creek Cabin, 195 feet long. Dates to c. 1850s-c. 1930s.	TID/MID/Private	I	NC	N/A
25	FW-DP-055	--	Historic	Mining	Hard Rock mining site; four features (one pit, three linear prospects). Dates to c. 1880-post 1945.	TID/MID/BLM	I	N/A	N/A

Count	Temporary Site No.	Primary No./ Trinomial	Age	Type[1]	Description	Land Owner	NRHP Eligibility[2]		
							Individual Eligibility	NRHP Eligibility as a Contributing or Non-Contributing Element to the Kanaka Creek Mining Landscape	NRHP Eligibility as a Contributing or Non-Contributing Element to the Woods Creek Mining Landscape
26	FW-DP-056	--	Historic	WCH	Ditch (west of Stevens Bar) ~60 feet long, four features. Dates to c. 1850s-early 20th century.	TID/MID/BLM	I	N/A	N/A
27	FW-DP-058	--	Historic	WCH	Two ditches with reservoir in Kanaka Creek Landscape; five features - ditch segment, earthen berm, ditch, dam breach, linear rock pile. Dates to c. 1850s to c. 1930s.	TID/MID/BLM	I	C	N/A
28	FW-DP-059	--	Historic	Transportation	470 foot earthen road (along Kanaka Creek). Dates to c. 1850s to c. 1930s.	TID/MID/BLM	I	NC	N/A
29	FW-DP-061	--	Historic	WCH	Two Ditch segments, 90 feet and 106 feet. Dates to c. 1850s to c. 1880s.	TID/MID/BLM	I	N/A	N/A
30	FW-DP-064	--	Historic	WCH	Ditch 1,366 feet long. Dates to c. 1869.	TID/MID/BLM	I	N/A	N/A
31	FW-DP-065	--	Historic	Mining	Woods Creek placering mining complex with habitation area; seven features: hand stacked rock wall, linear stacked rock wall, tailings piles, placer mining gulch, tailings piles, hand-stacked waste rock, tailing piles. Dates to c. 1850s-1880s.	TID/MID/BLM	U	N/A	C
32	FW-DP-066	--	Historic	WCH	One Ditch (above FW-DP-65) 970-feet, six features incl. stacked rock feature. Dates to c. 1850-1880s.	TID/MID/BLM	I	N/A	C
33	FW-DP-069	--	Historic	Mining	Placering area at mouth of Sullivan Creek; six features (channel, pit, tailings, mining cuts with associated tailings, channel, and fire ring). Dates to c. 1848-1880s.	TID/MID/BLM	U	N/A	N/A
34	FW-DP-070/071	--	Historic	Mining	Woods Creek Mining Landscape (includes FW-DP-65; FW-DP-66; FW-DP-87; FW-DP-88; FW-DP-89; FW-DP-91; FW-DP-94; FW-DP-95; FW-DP-96; FW-DP-97; FW-DP-98; ISO-FW-DP-09; ISO-FW-DP-13; ISO-FW-DP-33). Dates to c. 1850-1880s.	TID/MID/BLM/Private	E	N/A	N/A
35	FW-DP-073	P-55-3877/ CA-TUO-2893H	Historic	Transportation	Ward's Ferry Road; two segments and three new features (stacked rock retaining wall, two board-formed reinforced concrete abutments) recorded as part of this update. The stone bridge abutments of old Ward's Ferry Bridge were recorded as a separate site. Dates to c. 1875-1930s.	TID/MID/BLM	U	N/A	N/A
36	FW-DP-074	--	Historic	Transportation	Ward's Ferry Bridge Abutments (two stone abutments on either side of the Tuolumne River). Dates to c. 1875.	TID/MID	I	N/A	N/A
37	FW-DP-075	--	Historic	Transportation	Old River Road, 1,935 feet long, one stacked rock feature. Dates to c. 1914.	TID/MID/BLM	I	N/A	N/A
38	FW-DP-076	--	Historic	Mining	McCormick River Mine; five features: stacked rock walls, collapsed adit, drainage pipe, gate post, wooden lean-to (possibly modern). Dates to post 1914 to c. 1930s.	TID/MID/BLM/Private	U	N/A	N/A
39	FW-DP-077	--	Historic	Transportation	Road, inaccessible by foot; 0.5 miles long. Age unknown.	TID/MID/Private	I	N/A	N/A
40	FW-DP-080	--	Historic	Transportation	Road adjacent to Cabin near Kanaka Creek (FW-DP-57); 150 foot segment in the APE. Dates to late-19th to early-20th century.	TID/MID/Private	I	NC	N/A
41	FW-DP-082	--	Historic	Transportation	Earthen road on Mine Island; approximately 150 feet in length. Dates to late 19th/early 20th century.	TID/MID/BLM	I	N/A	N/A
42	FW-DP-083	--	Historic	WCH	Earthen bermed ditch on Mine Island. Dates to late 19th/early 20th century.	TID/MID/BLM	I	N/A	N/A
43	FW-DP-084	--	Historic	Transportation	Earthen road on Mine Island, approximately 1,882 feet in length. Unknown Historic age.	TID/MID/BLM	I	N/A	N/A
44	FW-DP-087	--	Historic	WCH	Ditch with rock-work along Woods Creek, two linear segments. Dates to c. 1850s to 1880s.	TID/MID	I	N/A	C
45	FW-DP-088	--	Historic	WCH	Earthen bermed ditch along Woods Creek. Dates to c. 1850s to 1880s.	TID/MID	I	N/A	C
46	FW-DP-089	--	Historic	Transportation	Road above Woods and Slate creeks. Dates to c. 1850s-early 20th century.	TID/MID/Private	I	N/A	C
47	FW-DP-091	--	Historic	WCH	Ditch along Woods Creek; two discontinuous segments (A and B), segment A contains a stacked-rock retaining wall (Feature 1). Dates to c. 1850s-1880s.	TID/MID	I	N/A	C
48	FW-DP-092	--	Historic	Habitation	Raggio Parcel across from Taco House; rectangular rock foundation, concrete structure pads, a cased well, and two ditches (FW-DP-11/12). Dates to c. late 19th-century to c. 1930s.	TID/MID/BLM	U	N/A	N/A
49	FW-DP-093	--	Historic	Transportation	Earlier alignment of Grizzly Road/Highway 120; paved and measures approximately 25 feet wide and 1,710 feet long. Dates between c. 1934 and c. late 1960s/early 1970s.	TID/MID/Private	I	N/A	N/A

Count	Temporary Site No.	Primary No./ Trinomial	Age	Type[1]	Description	Land Owner	NRHP Eligibility[2]		
							Individual Eligibility	NRHP Eligibility as a Contributing or Non-Contributing Element to the Kanaka Creek Mining Landscape	NRHP Eligibility as a Contributing or Non-Contributing Element to the Woods Creek Mining Landscape
50	FW-DP-094	--	Historic	Mining	Woods Creek placer mining complex; three distinct areas of mining resources (loci H, I, and J) that include placer tailings piles, mining cuts, and a mining claim. Dates to c. 1850s-1880s.	TID/MID/BLM/Private	U	N/A	C
51	FW-DP-095	--	Historic	Mining	Woods Creek placer mining complex with habitation areas, three loci (F, G, and K), 13 features recorded (more located). Dates to c. 1850s-1880s.	TID/MID/Private	E	N/A	C
52	FW-DP-096	--	Historic	Mining	Woods Creek placer mining complex, remnants of placer mining activities along a terrace above Woods Creek; three loci (C, D, and E) and three hand-stacked waste rock features (feature 1a, 1b and 2); single "black" glass bottle base fragment Dates to c. 1850s-1880s.	TID/MID/Private	U	N/A	C
53	FW-DP-097	--	Historic	Mining	Woods Creek placer mining complex including hand-stacked rock walls and placering piles; three loci (L, M, and N), three features (dry-stacked rock wall dam, hand-stacked waste rock feature, prospect pit), no artifacts. Dates to c. 1850s-1880s.	TID/MID/BLM	U	N/A	C
54	FW-DP-098	--	Historic	Mining	Woods Creek placer mining complex with possible structure flat/tent pad (feature 1). Dates to c. 1850s-1880s.	TID/MID/BLM	U	N/A	C
55	FW-DP-100	--	Historic	Transportation	Road segment along Willow Creek. Dates to c. pre-1944.	TID/MID/BLM	U	N/A	N/A
56	FW-DP-109	P-55-3876/ CA-TUO-2892H	Historic	Transportation	Pedestrian/animal trail with rock retaining walls. Dates to 1851.	BLM	U	N/A	N/A
57	HDR-DP-002	--	Historic	Transportation	A historic road segment. Dates between the late 19th century and the 1960s.	TID/MID	I	N/A	N/A
58	HDR-DP-004	--	Historic	Transportation	Four historic dirt road segments. Dates to pre-1944.	TID/MID	I	N/A	N/A
59	HDR-DP-005	--	Historic	Mining	Two tailings piles; A pile of waste rock; Two features comprised of multiple placer scrapes; Artifact Concentration of historic metal. Dates to after the turn of the century.	TID/MID	I	N/A	N/A
60	HDR-DP-007	--	Historic	Other	Two features: a concrete pad; wooden beam; debris scatter. Dates to the early modern period (c. late 1960s or later).	TID/MID	I	N/A	N/A
61	HDR-DP-012	--	Historic	Transportation	Two historic road segments; two metal items; two quartz crystals (natural). Dates to c. 1890s.	TID/MID	I	N/A	N/A
62	HDR-DP-016	--	Historic	Mining	Nine mining features: four back dirt/tailings piles; three placer scar features; two ditches. Dates to post 1930.	TID/MID	I	N/A	N/A
63	HDR-DP-017	--	Historic	Mining	Two features: Three-four bulldozer scrapes, and backdirt pile. Age unknown.	TID/MID	I	N/A	N/A
64	HDR-DP-020	--	Historic	Mining	One feature comprised of about four tailings piles. Age unknown.	TID/MID	I	N/A	N/A
65	HDR-DP-022	--	Historic	Other	Two concrete foundations. Dates to c. late 1960s.	TID/MID	I	N/A	N/A
66	HDR-DP-023	--	Historic	Other	Nine features: one feature of concrete footings, three bulldozer scrapers, two rock cairns, two prospect pits, a benchmark. Dates to c. late 1960s.	TID/MID	I	N/A	N/A
67	HDR-DP-025	--	Historic	Transportation	A historic road segment. Dates to c. 1940 - 1960s	TID/MID	I	N/A	N/A
68	HDR-DP-030	--	Historic	Transportation	Old Highway 132. Two segments of a historic road; four features: a borrow scrape, two culvert, and earthen dam. Dates between the 1870s and early 1970s.	TID/MID	I	N/A	N/A
69	HDR-DP-035	--	Historic	Habitation	Historic homestead site of the Haskell family: two pits (possible cellar features), a rock alignment, and sparse trash scatter. Dates between 1880s and 1910s.	TID/MID	U	N/A	N/A
70	HDR-DP-051	--	Historic	Other	Windmill remains. Dates to c. 1960.	TID/MID	I	N/A	N/A
71	HDR-DP-052	--	Historic	Other	Windmill/well remains. Dates to c. 1960.	TID/MID	I	N/A	N/A
72	HDR-DP-072	--	Historic	Transportation	Road segment. Dates to c. 1960.	TID/MID	I	N/A	N/A
73	HDR-DP-079	--	Historic	Utilities	A segment of a utility pole line, with 17 pole remnants. Age unknown.	TID/MID	I	N/A	N/A
74	HDR-DP-081	--	Historic	Mining	Three features: a road/ditch, a placer scrape, an earthen dam. Age unknown.	TID/MID	I	N/A	N/A
75	HDR-DP-083	--	Historic	Transportation	Ten segments of an old alignment of Highway 49; five features: three flattened terraces, a debris pile, a stacked rock wall; one glass fragment and a few ceramic fragments. Dates between the 1850s and 1970s.	TID/MID/ BLM	I	N/A	N/A

Count	Temporary Site No.	Primary No./ Trinomial	Age	Type[1]	Description	Land Owner	NRHP Eligibility[2]		
							Individual Eligibility	NRHP Eligibility as a Contributing or Non-Contributing Element to the Kanaka Creek Mining Landscape	NRHP Eligibility as a Contributing or Non-Contributing Element to the Woods Creek Mining Landscape
76	HDR-DP-084	--	Historic	Mining	Five waste rock/tailings piles. Age unknown.	TID/MID	I	N/A	N/A
77	HDR-DP-085	--	Historic	Mining	Mining complex with eight features (rock piles, a large pit with a rock alignment, placer scars), a metal pipe and tin can fragment. Age unknown.	TID/MID	I	N/A	N/A
78	HDR-DP-086	--	Historic	Mining	20 features: nine scrapes (possible tent platforms), three ditch segments, three pits, two features comprised of pipes sticking out of the ground, one road segment, one excavated area, and one rock pile; waste rock/placer tailings; limited associated debris. Dates between the late 19th Century and 1940.	TID/MID	E	N/A	N/A
79	HDR-DP-087	P-55-1913/ CA-TUO-903H	Historic	Habitation	Ten features: a dug-out house structure, a modern landmark shrine, one rock wall, one rock alignment, a structural foundation, remnants of a corral, an improved spring, a structural depression, a spring box, and a ditch segment; moderate trash scatter. Dates from 1870s to 1930s-1940s.	TID/MID	E	N/A	N/A
80	HDR-DP-090	--	Historic	Other	Two metal pipes. Dates to the late 1960s.	TID/MID	I	N/A	N/A
81	HDR-DP-094	--	Historic	Transportation	Don Pedro Road with two culverts, rock retaining wall; concrete pad; post; bulldozer scrape. Dates to early 1900s.	TID/MID	I	N/A	N/A
82	HDR-DP-096	--	Historic	Utilities	One feature: radio tower foundation. Dates to c. 1960.	TID/MID	I	N/A	N/A
83	HDR-DP-100	--	Historic	Mining	Six tailings/waste rock piles and a rock cairn. Dates to c. 1880s - 1890s	TID/MID	I	N/A	N/A
84	HDR-DP-101	P-55-1346/ CA-TUO-321H	Historic	Mining	Mining complex with waste rock/tailings, two level areas, a trench, a depression, a road trace, a standing stone structure, and three pieces of metal. Dates between the 1880s and 1890s.	TID/MID	U	N/A	N/A
85	HDR-DP-102	--	Historic	Mining	Four waste rock/tailings concentrations; one metal artifact; two historic fence posts. Dates between 1880s and 1940s.	TID/MID	I	N/A	N/A
86	HDR-DP-103	P-55-110/ CA-TUO-2007H	Historic	Transportation	Four segments of the Hetch Hetchy Railroad; three features (two culverts, one road), two railroad ties. Dates between 1916/1917 and 1949.	TID/MID	I	N/A	N/A
87	HDR-DP-104	--	Historic	Mining	Six distinct concentrations of waste rock, a cut utility pole and two beer cans. Dates to c. 1900.	TID/MID	I	N/A	N/A
88	HDR-DP-108	--	Historic	Mining	Four features: one hearth, one cairn, two waste rock/tailings concentrations. Age unknown.	TID/MID	I	N/A	N/A
89	HDR-DP-111	--	Historic	Transportation	One historic road segment. Dates to c. 1940 - 1960s	TID/MID	I	N/A	N/A
90	HDR-DP-114	P-55-7353/ CA-TUO-4795H	Historic	Transportation	Segment of the Don Pedro Spur of the Sierra Railway (one railroad spike, no features or other artifacts). Dates to c. 1921-1923.	TID/MID	I	N/A	N/A
91	HDR-DP-117	P-55-5231	Historic	Transportation	One historic road segment. Dates from the mid-1800s.	TID/MID/BLM	I	N/A	N/A
92	HDR-DP-120	--	Historic	Transportation	Three historic road segments. Dates from the mid-1800s.	TID/MID	I	N/A	N/A
93	HDR-DP-122	--	Historic	Mining	Four features: one earthen dam with rock retaining wall, one prospect pit, one rock alignment, two prospect trenches; trash scatter. Dates from the mid-1800s to the early 1900s.	TID/MID	U	N/A	N/A
94	HDR-DP-124	--	Historic	Mining	Six prospect pits; one water control feature; waste rock. Age unknown.	TID/MID	I	N/A	N/A
95	HDR-DP-125	--	Historic	Transportation	One historic road segment, "road to coulterville". Dates to pre-1875 through late 1870s.	TID/MID	I	N/A	N/A
96	HDR-DP-126	--	Historic	Mining	Three prospect trench features, one prospect pit; waste rock. Age unknown.	TID/MID	U	N/A	N/A
97	HDR-DP-129	--	Historic	Transportation	Two segments of Morgan's Bar Road. Dates to mid to late 1800s.	TID/MID	I	N/A	N/A
98	HDR-DP-133	--	Historic	Mining	Nine tailings piles. Age unknown.	TID/MID	U	N/A	N/A
99	HDR-DP-136	--	Historic	Transportation	One historic road segment with bulldozer scrapes/push piles. Age unknown.	TID/MID	I	N/A	N/A
100	HDR-DP-138	--	Historic	Transportation	Two historic road segments. Age unknown.	TID/MID	I	N/A	N/A
101	HDR-DP-143	--	Historic	Transportation	One historic road segment. Dates from the mid to late 1800s.	TID/MID	I	N/A	N/A

Count	Temporary Site No.	Primary No./ Trinomial	Age	Type[1]	Description	Land Owner	NRHP Eligibility[2]		
							Individual Eligibility	NRHP Eligibility as a Contributing or Non-Contributing Element to the Kanaka Creek Mining Landscape	NRHP Eligibility as a Contributing or Non-Contributing Element to the Woods Creek Mining Landscape
102	HDR-DP-144	P-55-3175/ CA-TUO-2201H	Historic	WCH	A historic pipeline with 13 access point features. Dates between the 1870s to the present.	TID/MID	I	N/A	N/A
103	HDR-DP-146	--	Historic	Transportation	One road segment. Dates to late 1960s/early 1970s.	TID/MID	I	N/A	N/A
104	HDR-DP-148	--	Historic	Trash Scatter	Three can dumps (over 1,500 tin cans and other refuse) associated with the construction of the Hetch Hetchy Project. Dates between the late 1920s and early 1930s.	TID/MID	U	N/A	N/A
105	HDR-DP-149	P-55-1887/ CA-TUO-877H	Historic	Mining	Three mine shafts, one pit, and one linear cut. Age unknown.	TID/MID	I	N/A	N/A
106	HDR-DP-150	--	Historic	Transportation	Two segments of a historic road. Dates to c. 1850 - 1920s	TID/MID	I	N/A	N/A
107	HDR-DP-152	--	Historic	Utilities	Seven cut utility poles. Dates from 1923-early 1960s.	TID/MID/BLM	I	N/A	N/A
108	HDR-DP-153	--	Historic	Transportation	One historic road segment; three railroad ties and a metal can. Dates to the mid-1920s to the 1930s.	TID/MID	I	N/A	N/A
109	HDR-DP-154	--	Historic	Transportation	Two segments of a historic road; likely remnants of the Brown Adit Tramway. May date to mid 1870s, certainly 1920s-1960s.	TID/MID/BLM	I	N/A	N/A
110	HDR-DP-156	--	Historic	Transportation	One historic road segment. May be associated with HDR-DP-154 and date to c. 1920s.	TID/MID	I	N/A	N/A
111	HDR-DP-157	--	Historic	Trash Scatter	Possible remnants of a tramway associated with the construction of the Red Mountain Bar Siphon. One feature: an iron wheel encased in concrete; metal debris. Dates between the late 1920s and early 1930s.	TID/MID	I	N/A	N/A
112	HDR-DP-160	--	Historic	Transportation	One historic road alignment. Age unknown.	TID/MID	I	N/A	N/A
113	HDR-DP-161	--	Historic	Transportation	Seven segments of an historic road. Dates to c. 1890s	TID/MID	I	N/A	N/A
114	HDR-DP-165	--	Historic	Transportation	One historic road segment. Dates to c. 1905	TID/MID	I	N/A	N/A
115	HDR-DP-170	--	Historic	Other	One historic rock wall. Age unknown.	TID/MID	U	N/A	N/A
116	HDR-DP-171	--	Historic	Mining	A collapsed mine entrance; an adit; two concrete structures; trash scatter. Dates to the 1880s through the mid 1940s.	TID/MID	U	N/A	N/A
117	HDR-DP-173	--	Historic	Mining	Two features: one prospect pit, one prospect trench. Age unknown.	TID/MID	I	N/A	N/A
118	HDR-DP-174	--	Historic	WCH	One segment of a historic ditch. Age unknown.	TID/MID	I	N/A	N/A
119	HDR-DP-175	--	Historic	Transportation	One historic road segment, a metal pipe and a railroad spike. Dates to c. 1900 - c. 1942.	TID/MID	I	N/A	N/A
120	HDR-DP-178	--	Historic	Utilities	Four utility pole posts. Age unknown.	TID/MID	I	N/A	N/A
121	HDR-DP-179	--	Historic	Mining	One concrete foundation; one quartz tailing pile, one road segment, one adit. Dates from the 1880s to 1947.	TID/MID	U	N/A	N/A
122	HDR-DP-180	--	Historic	Mining	One historic road segment; three prospect trenches, three mine shafts/adits. Age unknown.	TID/MID	I	N/A	N/A
123	HDR-DP-181	--	Historic	Transportation	Two segments of a historic road, two rock features, and a railroad tie timber. Dates to c. 1895 - 1905.	TID/MID	I	N/A	N/A
124	HDR-DP-182	--	Historic	Transportation	Three historic road segments; dumped car. Dates to c. 1905 and c. 1970.	TID/MID	I	N/A	N/A
125	HDR-DP-183	--	Historic	Mining	13 mining-related features. Age unknown.	TID/MID	I	N/A	N/A
126	HDR-DP-187	--	Historic	Mining	One mining trench; one tailings pile. Age unknown.	TID/MID	I	N/A	N/A
127	HDR-DP-188	--	Historic	Mining	Two features: one trench, one tailings pile. Age unknown.	TID/MID	I	N/A	N/A
128	HDR-DP-193	--	Historic	WCH	Pedro Adit - portal for the Foothill Tunnel of the Hetch Hetchy Project. Remains include concrete foundations, waste rock pile, adit entrance, two road segments, utility pole stub, possible tent platform, trench, possible powder house, and limited debris. Dates between the 1920s and 1930s.	TID/MID	E	N/A	N/A

Count	Temporary Site No.	Primary No./ Trinomial	Age	Type[1]	Description	Land Owner	NRHP Eligibility[2]		
							Individual Eligibility	NRHP Eligibility as a Contributing or Non-Contributing Element to the Kanaka Creek Mining Landscape	NRHP Eligibility as a Contributing or Non-Contributing Element to the Woods Creek Mining Landscape
129	HDR-DP-197	--	Historic	Transportation	Gravel access road that was used during the construction of the Foothill Tunnel of the Hetch Hetchy Project. The road is now used as access for maintenance and inspections of the Foothill Tunnel, Pedro Adit, the Red Mountain Bar Syphon, and a transmission line. Dates from the 1920s to the 1930s.	TID/MID	U	N/A	N/A

[1] Types: WCH = Water Control / Hydroelectric.
[2] NRHP Eligibility Evaluations: E = Eligible; I = Ineligible; U = Unevaluated; C = Contributing Element; NC = Non-Contributing Element; N/A = Not Applicable (i.e., not an element of the landscape).
[3] In addition to those resources identified herein as elements to this landscape, the following resources are also elements of this landscape: FW-DP-57, a standing cabin (recorded as a built environment resource), FW-DP-99, a multi-component site addressed below, and ISO-FW-DP-9, ISO-FW-DP-13, and ISO-FW-DP-33 (recorded as isolated finds).

Multi-Component Resources

Of the 29 multi-component sites identified within the APE, nine have been evaluated as eligible for inclusion on the NRHP, while five have been evaluated as ineligible and 15 remain unevaluated pending further investigations (Table 3.11-6). The 29 prehistoric and historic components represented by the multi-component sites fall within the following historic and prehistoric types, which are the same as those described in the above sections, with the exception of the farming/ranching type that represents those historic components associated with farming/ranch activities:

Historic Types:

(1) Transportation (2)

(2) Mining (9)

(3) WCH (1)

(4) Utilities (3)

(5) Other (3)

(6) Habitation (8)

(7) Trash Scatter (1)

(8) Farming/Ranching (2)

Prehistoric Types:

(1) Lithic Scatter (4)

(2) Short-Term Habitation (9)

(3) Long-Term Habitation (10)

(4) Quarry (1)

(5) Milling Feature (3)

(6) Other (2)

Built Environment Resources

A total of 37 built environment resources were identified and recorded within the APE as a result of the Historic Properties Study (Table 3.11-7). These resources have been grouped into eight categories[40]:

(1) Don Pedro Project Dam System Resources (15)

(2) TID and MID Transmission Lines (2)

(3) Don Pedro Project Dam Construction-Related Resources (1)

(4) Don Pedro Project Operations Support Resources (8)

(5) Don Pedro Project Recreation-Related Resources (4)

(6) Don Pedro Project Historic District (1)

(7) Don Pedro Recreation Agency Historic District (1)

(8) Other Non-Don Pedro Project resources (5)

[40] The resources within the following categories are Don Pedro Project-related facilities, the operations and maintenance of which is licensed by FERC: Don Pedro Project Dam System Resources, Don Pedro Project Dam Construction-Related Resources, Don Pedro Project Operations Support Resources, Don Pedro Project Recreation-Related Resources, Don Pedro Project Historic District, and Don Pedro Recreation Agency Historic District. The resources in the other built environment categories are non-Don Pedro Project related resources, thus the operation and maintenance of these facilities does not fall under the Don Pedro Project FERC license.

Table 3.11-6. Summary of multi-component sites.

Count	Temporary Site No.	Primary No./ Trinomial	Age	Type[1]	Description	Land Owner	NRHP Eligibility[2]	
							Individual Eligibility	NRHP Eligibility as a Contributing or Non-Contributing Element to the Tuolumne River Prehistoric Archaeological District
1	FW-DP-017	P-55-6021	Multi-component	P: Long-term Habitation H: Habitation	Habitation site - Taco House Site with Human remains; eight features: two possible house pit features associated with the prehistoric/protohistoric component, and six features associated with the historic-era component. Historic dates to c. 1930s. Age unknown. However, glass beads indicate a protohistoric component.	TID/MID/BLM	E	C
2	FW-DP-018	--	Multi-component	P: Long-term Habitation H: Mining	Habitation site with human remains and a historic artifact scatter; two loci, two features, ~three BRMs, 22 artifacts; previously recorded but no trinomial. Age unknown. Historic dates to late 19th to mid-20th century.	TID/MID/BLM	E	C
3	FW-DP-078	P-55-1351/ CA-TUO-326	Multi-component	P: Long-term Habitation H: Habitation	Habitation site excavated by Moratto; Feature 1 is a quartz bedrock outcrop with three cupules, 12 artifacts. Dates to Protohistoric. Historic age dates to c. 1848 to c. 1914.	TID/MID/BLM	E	C
4	FW-DP-085	--	Multi-component	P: Short-term Habitation H: Mining	Multi-component site on Mine Island; Historic: (nine features) collection of mining-related archaeological resources: tailings piles, prospecting pits, surface vein workings, an adit, and a stock dam; Prehistoric: scatter of flaked and ground stone artifacts and debitage. Historic age dates to late 19th-early 20th century. Age unknown.	TID/MID/BLM	U	U
5	FW-DP-099	--	Multi-component	P: Milling Station H: Mining	Kanaka Creek placer and hard rock mining complex; BRMs with groundstone; two loci - A:linear tailings piles, sluicing channels, drainage trenches, pits, and randomly stacked tailings piles; B:two mortar cups; additional features 1-4; (three adits, one cut); no historic artifacts; three prehistoric artifacts (pestle, handstone end frag, pestle). Age unknown. Historic age dates to c. 1880s-1930s.	TID/MID/BLM	U	N/A
6	HDR-DP-006	P-55-1902/ CA-TUO-892	Multi-component	P: Quarry H: Habitation	Historic habitation location with two structural remnants (structure pads) and associated refuse (glass, ceramics, metal, one cut animal bone); a placer mining complex (two prospect pits, one area of placer scrapes, one ditch, and one excavated area) with limited debris (two pieces of metal and one piece of animal bone); an extensive lithic scatter with two quarry features (1,500+ flakes, one concentration, four scrapers, two bifaces, two cores, one quartz crystal, one milling slab, one utilized flake). Age unknown. Historic age dates between 1850 and 1960 and may represent either multiple periods of occupation of consistent occupation.	TID/MID	U	C
7	HDR-DP-009	--	Multi-component	P: Other H: Other	Two historic rock features; single prehistoric lithic flake. Prehistoric age unknown. Historic c. late 19th/early 20th century	TID/MID	I	NC
8	HDR-DP-019	--	Multi-component	P: Short-term Habitation H: Mining	Historic: 11 mining features and two metal artifacts. Prehistoric: milling station; lithic scatter (270+ flakes, one pestle, one core, one handstone). Prehistoric age unknown. Historic component dates to c. late 19th/early 20th Century.	TID/MID	U	U
9	HDR-DP-029	P-55-1920, P-55-1921, CA-TUO-910/H, CA-TUO-911/H	Multi-component	P: Long-term Habitation H: Habitation	Two loci; two features: a historic rock alignment and prehistoric milling station, seven depressions that are previous archaeological excavation units, historic refuse scatter including residential discard and structural debris (two historic artifact concentrations), lithic scatter (700+ flakes, 40+ lithic tools, 50-100 fire cracked rock). Prehistoric component dates to Late Archaic period based on previously identified point types (Desert Side-notched and Rosegate Series) and historic age dates to c. 1870 to c. 1900s.	TID/MID	E	C
10	HDR-DP-031	P-55-1923/ CA-TUO-913	Multi-component	P: Short-term Habitation H: Other	Five features: three modern depressions with backdirt piles, two historic bulldozer scrapes; lithic scatter (300+ flakes, two handstones). Prehistoric age is between 550 A.D. (1400 BP) and 1450 A.D. (500 BP) and historic age dates to between the 1930s and 1950s.	TID/MID	I	NC
11	HDR-DP-039	--	Multi-component	P: Short-term Habitation H: Habitation	Prehistoric lithic scatter (two flakes, one scraper) and milling station and four historic features (rock foundations for a residential structure and three rock alignments) and historic refuse. Age unknown. Historic component dates to late 19th Century/early 20th Century.	TID/MID	U	U
12	HDR-DP-042	--	Multi-component	P: Lithic Scatter H: Habitation	Five historic features: three pits and two rock foundations, limited historic trash scatter, lithic scatter (<ten flakes, four cores, one spokeshave, one gouge, two possible digging tools, one hammerstone). Unknown Prehistoric age and historic age c. 1890s to c. 1900s.	TID/MID	U	U
13	HDR-DP-045	--	Multi-component	P: Lithic ScatterH: Utilities	Lithic scatter (250+ flakes, two choppers, one modified flake, one utilized flake); transmission line tower foundations. Unknown Prehistoric age and historic age 1921-1923.	TID/MID	U	U

Count	Temporary Site No.	Primary No./ Trinomial	Age	Type[1]	Description	Land Owner	NRHP Eligibility[2]	
							Individual Eligibility	NRHP Eligibility as a Contributing or Non-Contributing Element to the Tuolumne River Prehistoric Archaeological District
14	HDR-DP-053	--	Multi-component	P: Short-term Habitation H: Utilities	Transmission tower foundation; Lithic scatter (one pestle, one retouched flake, and three flakes). Unknown Prehistoric age and historic age 1921-1923.	TID/MID	U	U
15	HDR-DP-070	--	Multi-component	P: Short-term Habitation H: Mining	Historic component: three bulldozer scars, one bulldozer mound, one rock pile. Prehistoric component: lithic scatter (two flakes, two chunks of CCS with flake scars, one milling slab). Unknown Prehistoric and Historic age.	TID/MID	I	NC
16	HDR-DP-078	--	Multi-component	P: Lithic Scatter H: Transportation	Historic road segment; Lithic scatter (10+ flakes, one modified flake). Age unknown. Historic age between 1944 and 1962.	TID/MID	I	NC
17	HDR-DP-092	--	Multi-component	P: Long-term Habitation H: Utilities	15 prehistoric housepits; eight milling stations; three possible midden areas; lithic scatter (one artifact concentration, 350+ flakes, four bifaces, three modified flakes, one handstone, one uniface); one historic transmission line tower; limited historic trash scatter. Unknown Prehistoric age and historic age 1921-1923.	TID/MID	E	C
18	HDR-DP-093	--	Multi-component	P: Other H: Other	One feature with prehistoric and historic petroglyphs (three panels). Age unknown. Historic component dates to 1887.	TID/MID	I	NC
19	HDR-DP-098	--	Multi-component	P: Long-term Habitation H: Transportation	One segment of a historic road and four metal pipe fragments; one milling station (12 cups and two possible cups), two flakes, one possible handstone. Age unknown. Historic component dates between the 1920s and 1950s.	TID/MID	U	U
20	HDR-DP-099	--	Multi-component	P: Long-term Habitation H: Ranching / Farming	Two historic features: a concrete trough, one historic road segment, two prehistoric milling station features; three historic metal artifacts; lithic scatter (16 flakes, one core, one uniface). Unknown Prehistoric age and historic age possibly as early as the 1890s with continued use through the present.	TID/MID	U	U
21	HDR-DP-119	P-55-1360/ CA-TUO-336/H	Multi-component	P: Long-term Habitation H: Habitation	Prehistoric component: thousands of flakes, thousands of fire cracked rocks (FCR), several milling stations, midden deposits, numerous lithic tools, possible hearth features, possible remnant housepits, a cluster of quartz boulders that may represent a grave marker, and human remains. Historic component: sparsely scattered refuse (ceramics, metal, and glass), two rock alignments that appear to be property boundaries, and a depression of unknown function. Prehistoric component dates from the Middle to Late Archaic and ethnographic periods. Historic component dates to late 19th Century/early 20th Century.	TID/MID/ BLM	E	C
22	HDR-DP-130	--	Multi-component	P: Long-term Habitation H: Mining	One bedrock milling station feature; three prospect trenches; sparse trash scatter (glass, metal, ceramics); lithic scatter (six flakes, one handstone); one historic road segment. Age unknown. Historic component dates to the 1890s.	TID/MID	U	U
23	HDR-DP-134	--	Multi-component	P: Short-term Habitation H: Mining	One earthen dam feature; one dug-out feature; one ditch; one rock wall; one ditch/trail; three placer mining areas; lithic scatter (50+ flakes, one core, one flake tool, one handstone, one concentration). Unknown Prehistoric and Historic ages.	TID/MID	U	U
24	HDR-DP-139	--	Multi-component	P: Lithic Scatter H: Trash Scatter	Lithic scatter (10+ flakes, one core, one biface, one handstone); historic trash scatter (bottle glass, ceramics, and a nail). Age unknown.. Historic component dates to late 19th Century/early 20th Century.	TID/MID	U	U
25	HDR-DP-142	P-55-1384/ CA-TUO-361	Multi-component	P: Milling Feature H: Ranching / Farming	One historic fence segment; two milling stations (five cups) and three pestles. Unknown Prehistoric and Historic ages.	TID/MID	U	U
26	HDR-DP-162	P-55-1927/ CA-TUO-917	Multi-component	P: Short-term Habitation H: WCH	Two milling station features; two concrete footings; lithic scatter (25+ flakes, two cobble tools, one Elko Corner-notched point; historic trash scatter (bottle glass, a ceramic, and a square metal nut). Prehistoric component dates to Middle Archaic in age. Historic component dates to 1860s-1950s.	TID/MID	U	C
27	HDR-DP-189	--	Multi-component	P: Long-term Habitation H: Mining	Seven bedrock milling stations; Lithic scatter (two concentrations, 150+ groundstone tools - mostly fragmented, one battered cobble, and one core); Historic adit and two rock piles. Prehistoric age unknown. Historic age 1902.	TID/MID	E	C

Count	Temporary Site No.	Primary No./ Trinomial	Age	Type[1]	Description	Land Owner	NRHP Eligibility[2]	
							Individual Eligibility	NRHP Eligibility as a Contributing or Non-Contributing Element to the Tuolumne River Prehistoric Archaeological District
28	HDR-DP-198	P-55-1928/ CA-TUO-918/H	Multi-component	P: Short-term Habitation H: Habitation	Only part of the historic component was observed and recorded during the present survey. This part included a fenceline, one piece of glass, a modern water system, an orchard area, and a few other fruit/nut trees. Previous recordation noted the following: A prehistoric lithic scatter with six+ flakes and one handstone; a historic ranching complex with 12 standing structures, two wells and associated water systems, a former structure location, a recent trash pit, many exotic fruit, nut, and other trees and vegetation, roads, fences, ranching machinery, and other associated remains. Prehistoric age unknown. Historic component dates from the 1860s to the present.	TID/MID	E	U
29	HDR-DP-250	--	Multi-component	P: Millling Feature H: Mining	Extensive placer mining area with 17 historic features (four trenches or sluicing channels, two structural depressions, one stone foundation, one stone oven, one road trace, one culvert, one rock pile/cairn, one rock alignment, a waste rock pile, a collapsed adit, one stacked rock pile, a reservoir, and one feature comprised of rock dams) and limited associated trash (one automobile and automobile parts date to a later period than the rest of the historic component). The prehistoric component is an isolated milling station (three mortar cups). Historic component dates to two periods: 1848 to 1850s and 1950s to 1960s. Prehistoric age is unknown.	TID/MID/ BLM	E	NC

1 Types: P = Prehistoric; H = Historic; WCH = Water Control / Hydroelectric.
2 NRHP Eligibility Evaluations: E = Eligible; I = Ineligible; U = Unevaluated; Only the prehistoric components of these multi-component sites are considered district elements.

Of the 37 built environment resources documented within the APE, all but four are less than 50 years of age. Of these four resources that are older than 50, one has been evaluated as eligible for inclusion on the NRHP and three remain unevaluated regarding their eligibility for inclusion on the NRHP pending further work (one of these is also an element to a NRHP eligible historic landscape that is discussed with the archaeological resources above). Of the remaining 33 built environment resources, all were constructed less than 50 years ago, e.g., 1968–1972. None of these 33 resources are considered to be exceptionally significant (NRHP Criterion Consideration G), as would be required of resources less than 50 years of age to be considered eligible for inclusion on the NRHP. Subsequently, these 33 resources are evaluated as not eligible for listing on the NRHP. However, when these resources do become 50 years of age, reassessment of their eligibility for inclusion on the NRHP will likely find several of these resources eligible for inclusion on the NRHP (Table 3.11-8), assuming their current level of integrity remains intact. Table 3.11-8 provides a summary of all 37 built environment resources, their NRHP eligibility evaluations, and potential future NRHP eligibility evaluations, if applicable. As two of the resources not yet 50 years of age are historic districts that incorporate several of the other resources as elements, the table below also identifies which elements of the two districts will potentially be evaluated in the future as contributing and non-contributing elements to the districts once the districts reach 50 years of age.

Table 3.11-7. Summary of built environment resources identified within the APE.

Building/Structure (Field Designation)	Date	Engineering Style/Type	Designer
Don Pedro Project Dam System Resources			
Don Pedro Dam (FR-1)	1970	Earth and Rock Fill	Bechtel
Gated Dam Spillway (HDR-1a)	1969	None	Bechtel
Un-gated Dam Spillway (HDR-1b)	1969	None	Bechtel
Dike A (HDR-2a)	1969-1970	Earth and cobble fill	Bechtel
Dike B (HDR-2b)	1969-1970	Earth and cobble fill	Bechtel
Dike C (HDR-2c)	1969-1970	Earth and cobble fill	Bechtel
Gasburg Creek Dike (HDR-2d)	1970	Earth and cobble fill	Bechtel
Powerhouse (FR-2)	1968-1970	Industrial	Bechtel
Switchyard (FR-3a)	1971	Industrial	Bechtel
Power Intake and Tunnel (FR-4)	1968-1970	None	Bechtel
Outlet Works/Diversion Tunnel (FR-5)	1968	None	Bechtel
Unit 1 Substation (HDR-3)	1970	None	Bechtel
Unit 2 Substation (HDR-4)	Circa 1972	None	Bechtel
Cable Hoist Building/Inclined Gate Track (HDR-5)	1969-1971	Utilitarian	Bechtel
Reservoir (FR-6)	1970	None	Bechtel
TID and MID Transmission Lines			
TID (east) Transmission Line (FR-3b)	1970 to 1971	Steel lattice towers	Bechtel
MID (west) Transmission Line (FR-3c)	1970 to 1971	Steel lattice towers	Bechtel
Don Pedro Project Dam Construction-Related Resources			
Guy F. Atkinson Company construction camp powder house (HDR-6)	1967-1968	Utilitarian	Bechtel
Don Pedro Project Operations Support Resources			
Dam Storage Yard Warehouse (HDR-8)	1971	Butler style building	Bechtel
Riley Ridge Microwave Building and Tower (1 building and attached tower), and second tower built in 1986 (HDR-9)	1970–1971; 1986	Contemporary	Unknown; Possibly James W.B. Shade-Turlock
Riley Ridge Employee Housing House 1 (HDR-10a)	1970–1971	Contemporary	James W.B. Shade-Turlock
Riley Ridge Employee Housing House 2 (HDR-10b)	1970–1971	Contemporary	James W.B. Shade-Turlock
Riley Ridge Employee Housing House 3 (HDR-10c)	1970–1971	Contemporary	James W.B. Shade-Turlock
Riley Ridge Employee Housing House 4 (HDR-10d)	1972	Contemporary	James W.B. Shade-Turlock
Riley Ridge Employee Housing House 5 (HDR-10e)	1972	Contemporary	James W.B. Shade-Turlock
Riley Ridge Water Tank (HDR-11)	1971	Utilitarian	National Tank Manufacturing Company of Los Angeles

Building/Structure (Field Designation)	Date	Engineering Style/Type	Designer
Don Pedro Project Recreation-Related Resources			
Headquarters and Visitor Center (HDR-12)	1972	Pole	Caywood, Nopp, Takata, Hansen, and Ward of Sacramento
Moccasin Point Recreation Area (HDR 13)	1971-1972	Designed Landscape	Clair A. Hill & Associates/Caywood, Nopp, Takata, Hansen, and Ward of Sacramento
Blue Oaks Recreation Area (HDR-14)	1971-1972	Designed Landscape	Clair A. Hill & Associates/Caywood, Nopp, Takata, Hansen, and Ward of Sacramento
Fleming Meadows Recreation Area (HDR 15)	1971-1972	Designed Landscape	Clair A. Hill & Associates/Caywood, Nopp, Takata, Hansen, and Ward of Sacramento
Don Pedro Project Historic District			
Don Pedro Project Historic District	1968-1972	Industrial/Utilitarian/ Contemporary	Bechtel, James W.B. Shade, and National Tank Manufacturing Company
Don Pedro Recreation Agency Historic District			
Don Pedro Recreation Agency Historic District	1971-1972	Pole/Designed Landscape	Clair A. Hill & Associates/Caywood, Nopp, Takata, Hansen, and Ward of Sacramento
Other Non-Don Pedro Project resources			
Kanaka Creek cabin (FW-DP-57)	1930s-1950s	Vernacular	Unknown
La Grange Ditch (FW-DP-08)	1872	Vernacular water conveyance structure	Augustus Bowie
Red Mountain Bar Siphon (P-55-3913/CA-TUO-2928H)	1923	Engineered water conveyance structure	Marsden Manson and Michael Maurice O'Shaughnessy
Moccasin Creek stone building (HDR-DP-101/P-55-1346/CA-TUO-321H)	1890s	Vernacular rubble construction	Unknown
Hetch Hetchy Moccasin-Newark Transmission Line (HDR-16)	1969	Steel lattice towers	Unknown

Table 3.11-8. Summary of NRHP evaluations for built environment resources identified within the APE.[1]

Building/Structure (Field Designation)	NRHP Eligibility	Potential Future NRHP Eligibility of Resources Not Yet 50 Years of Age	Potential Future NRHP Eligibility as a Contributing or Non-Contributing Element of the Don Pedro Project Historic District	Potential Future NRHP Eligibility as a Contributing or Non-Contributing Element of the Don Pedro Recreation Agency Historic District
Don Pedro Project Dam System Resources				
Don Pedro Dam (FR-1)	Ineligible	Eligible	Contributing Element	N/A
Gated Dam Spillway (HDR-1a)	Ineligible	Eligible	Contributing Element	N/A
Un-gated Dam Spillway (HDR-1b)	Ineligible	Eligible	Contributing Element	N/A

Building/Structure (Field Designation)	NRHP Eligibility	Potential Future NRHP Eligibility of Resources Not Yet 50 Years of Age	Potential Future NRHP Eligibility as a Contributing or Non-Contributing Element of the Don Pedro Project Historic District	Potential Future NRHP Eligibility as a Contributing or Non-Contributing Element of the Don Pedro Recreation Agency Historic District
Dike A (HDR-2a)	Ineligible	Ineligible	Contributing Element	N/A
Dike B (HDR-2b)	Ineligible	Ineligible	Contributing Element	N/A
Dike C (HDR-2c)	Ineligible	Ineligible	Contributing Element	N/A
Gasburg Creek Dike (HDR-2d)	Ineligible	Ineligible	Contributing Element	N/A
Powerhouse (FR-2)	Ineligible	Eligible	Contributing Element	N/A
Switchyard (FR-3a)	Ineligible	Ineligible	Contributing Element	N/A
Power Tunnel (FR-4)	Ineligible	Eligible	Contributing Element	N/A
Outlet Works/Diversion Tunnel (FR-5)	Ineligible	Eligible	Contributing Element	N/A
Unit 1 Substation (HDR-3)	Ineligible	Ineligible	Non-Contributing Element	N/A
Unit 2 Substation (HDR-4)	Ineligible	Ineligible	Non-Contributing Element	N/A
Cable Hoist/Incline Track (HDR-5)	Ineligible	Eligible	Contributing Element	N/A
Don Pedro Reservoir (FR-6)	Ineligible	Ineligible	Contributing Element	N/A
TID and MID Transmission Lines				
TID (east) Transmission Line (FR-3b)	Ineligible	Ineligible	N/A	N/A
MID (west) Transmission Line (FR-3c)	Ineligible	Ineligible	N/A	N/A
Don Pedro Dam Construction-Related Resources				
Guy F. Atkinson Company construction camp powder house (Blue Oaks Campground) (HDR-6)	Ineligible	Ineligible	N/A	N/A
Don Pedro Project Operations Support Resources				
Dam Storage Yard Warehouse (HDR-8)	Ineligible	Ineligible	Non-Contributing Element	N/A
Riley Ridge Microwave Building and two towers (HDR-9)	Ineligible	Ineligible	Non-Contributing Element	N/A
Riley Ridge Employee Housing House 1 (HDR-10a)	Ineligible	Ineligible	Non-Contributing Element	N/A
Riley Ridge Employee Housing House 2 (HDR-10b)	Ineligible	Ineligible	Non-Contributing Element	N/A
Riley Ridge Employee Housing House 3 (HDR-10c)	Ineligible	Ineligible	Non-Contributing Element	N/A
Riley Ridge Employee Housing House 4 (HDR-10d)	Ineligible	Ineligible	Non-Contributing Element	N/A
Riley Ridge Employee Housing House 5 (HDR-10e)	Ineligible	Ineligible	Non-Contributing Element	N/A

Building/Structure (Field Designation)	NRHP Eligibility	Potential Future NRHP Eligibility of Resources Not Yet 50 Years of Age	Potential Future NRHP Eligibility as a Contributing or Non-Contributing Element of the Don Pedro Project Historic District	Potential Future NRHP Eligibility as a Contributing or Non-Contributing Element of the Don Pedro Recreation Agency Historic District
Riley Ridge Water Tank (HDR-11)	Ineligible	Ineligible	Non-Contributing Element	N/A
Don Pedro Project Recreation-Related Resources				
Headquarters and Visitor Center (HDR-12)	Ineligible	Eligible	N/A	Contributing Element
Moccasin Point Recreation Area (HDR 13)	Ineligible	Eligible	N/A	Contributing Element
Blue Oaks Recreation Area (HDR-14)	Ineligible	Eligible	N/A	Contributing Element
Fleming Meadows Recreation Area (HDR 15)	Ineligible	Eligible	N/A	Contributing Element
Historic Districts				
Don Pedro Project Historic District	Ineligible	Eligible	N/A	N/A
Don Pedro Recreation Agency Historic District	Ineligible	Eligible	N/A	N/A
Other Non-Don Pedro Project Resources				
Red Mountain Bar Siphon (P-55-3913/CA-TUO-2928H)	Unevaluated	N/A	N/A	N/A
La Grange Ditch (FW-DP-08)	Eligible	N/A	N/A	N/A
Kanaka Creek Cabin (FW-DP-57)[2]	Unevaluated	N/A	N/A	N/A
Hetch Hetchy Moccasin-Newark Transmission Line (HDR-16)	Ineligible	Ineligible	N/A	N/A
Moccasin Creek Stone Building (HDR-DP-101/P-55-1346/CA-TUO-321H)[3]	Unevaluated	N/A	N/A	N/A
Totals	**Ineligible = 33 Eligible = 1 Unevaluated = 3 Total = 37**	**Eligible = 13 Ineligible = 20 N/A = 4 Total = 37**	**Contributing = 13 Non-Contributing = 10 Total Elements = 23 N/A = 14**	**Contributing = 4 Non-Contributing = 0 Total Elements = 4 N/A = 33**

1 N/A = Not Applicable.

2 The Kanaka Creek Cabin (FW-DP-57) is also a contributing element to the Kanaka Creek Mining Landscape (FW-DP-53), which is discussed in the archaeological discussion above and has been evaluated as eligible for inclusion on the NRHP.

3 The Moccasin Creek Stone Building (HDR-DP-101) is a feature of an archaeological site (site HDR-DP-101) also addressed in the archaeological discussion above. The entire site remains unevaluated regarding its eligibility for inclusion on the NRHP.

3.11.1.5.2 Native American Traditional Cultural Properties Study

The primary goal of this study was to assist FERC in meeting its compliance requirements under Section 106 of the NHPA, as amended, by determining if licensing of the Don Pedro Project would have an adverse effect on eligible TCPs. The objective of this particular study was to identify TCPs that may potentially be affected by O&M, evaluate their eligibility to the NRHP, and identify Don Pedro Project-related activities that may affect eligible TCPs, and/or locations of ethnographic use.

To be considered a historic property, a TCP must have integrity and meet at least one of the NRHP criteria. When a place of traditional practices is evaluated as eligible for listing on the NRHP, it is termed a TCP. A TCP is defined as any property that is "…eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community" [NR Bulletin 38 (Parker and King 1998:1)].

TCPs are further defined in National Register Bulletin 38 (Parker and King 1998:1) as:

(1) Locations associated with the traditional beliefs of a Native American group about its origins, its cultural history, or the nature of the world.

(2) A rural community, whose organization, buildings and structures, or patterns of land use reflect the cultural traditions valued by its long-term residents.

(3) An urban neighborhood that is the traditional home of a particular cultural group, and that reflects its beliefs and practices.

(4) Locations where Native American religious practitioners have historically gone and are known or thought to go to today, to perform ceremonial cultural rules of practice.

The Districts contracted Dr. Michael Moratto in early 2012 to complete the Native American TCP Study. Dr. Moratto is a Senior Cultural Resources Specialist with Applied EarthWorks, Inc. and has over 40 years of experience in cultural studies throughout California.

The study included completing archival research focusing on locations used by or important to local Native Americans. The study also included outreach to both recognized and non-recognized Tribes and tribal members that may have interests in the Don Pedro Project location and may be able to offer intellectual knowledge of places important to local Native American groups. As part of this effort, Dr. Moratto conducted close to 20 face-to-face and telephone interviews with Tribal representatives (both individually and in groups) from three groups (the Tuolumne Band of Me-wuk Indians, the Southern Sierra Miwuk Nation, and the Chicken Ranch Rancheria) and one unaffiliated Yokuts/Miwuk individual that lives in Chinese Camp, California near the Don Pedro Project. Two field visits with Tribal representatives and Tribal elders to archaeological sites and other locations of importance to Tribal participants were also conducted. These investigations showed that certain traditional cultural activities—harvesting plants for use as foods, medicines, and basketry materials, the redistribution of harvested plants, fishing, and panning for gold—are still practiced today by residents of foothill Me-wuk communities.

As a result of the Native American TCP Study, eight cultural properties were identified as possible TCPs:

(1) the lower Kanaka Creek native plant gathering area;

(2) lower Moccasin Creek cultural area, encompassing a native plant harvesting area and archaeological sites 4-Tuo-307, 4-Tuo-313, 4-Tuo-314, 4-Tuo-318, FW-DP-81, and HDR-DP-192;

(3) auriferous streams;

(4) archaeological site HDR-DP-92;

(5) archaeological site HDR-DP-106;

(6) archaeological site HDR-DP-113;

(7) archaeological site HDR-DP-119; and

(8) a spring with associated native plants in the Blue Oaks Recreation Area.

Each of these properties was evaluated in terms of the significance and integrity criteria for the NRHP (36 CFR 60.4) as well as the additional qualifications for TCP status (Parker and King 1998). As a result of this evaluation process, one property—the Lower Kanaka Creek Traditional Native Plant Gathering District—was evaluated as NRHP-eligible under NRHP Criterion A (i.e., 36 CFR 60.4(a)) as a TCP and thus is a historic property that must be managed in accordance with Section 106 of the NHPA and its implementing regulations, 36 CFR 800 (see Attachment D for location map of the TCP). The archaeological resources investigated as potential TCPs were also assessed for the NRHP separately during the Historic Properties Study, for their archaeological attributes, the results of which are summarized in Section 3.11.2.1.1, above.

The diverse natural vegetation along lower Kanaka Creek has been viewed by generations of Indians as a source of traditional foods, medicines, and materials for making baskets and ceremonial regalia. Plants are still harvested in this locality today, and their availability contributes importantly to the maintenance of the foothill Me-wuk community's cultural traditions and identity. The plant-gathering area along lower Kanaka Creek is deemed to be a NRHP-eligible district significant under Criterion A because of its association with a "pattern of events or a historic trend that made a significant contribution to the development of a community, a State, or the nation" (NPS 1995:12), and specifically because of its association with cultural practices of a living community.

3.11.2 Resource Effects

Continued operation and maintenance of the Don Pedro Project may affect cultural resources that are listed on or eligible for listing on the NRHP (i.e., historic properties). The effect may be direct (e.g., result of ground disturbing activities), indirect (e.g., public access to recreation areas), or cumulative (e.g., caused by a Don Pedro Project activity in combination with other non-Don Pedro Project activities). Certain O&M activities may affect historic properties within the Project Boundary or outside the Project Boundary.

Adverse effects are activities that may alter those characteristics of an historic property that contribute to its NRHP eligibility in a manner diminishing the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Examples of adverse effects would include road maintenance that affects a previously undisturbed archaeological deposit, or a facilities upgrade that removes the windows or doors of an historic powerhouse and does not replace them in kind, with new windows and doors of a similar style and material. There are a number of such activities that could potentially affect historic properties within the APE, including use and maintenance of Don Pedro Project facilities and roads, maintenance to historic buildings or other structures, vegetation management activities, recreational site use, issuance of grazing leases, emergency actions, looting/vandalism, and erosion caused by wave action and fluctuating water levels of the reservoir. In addition, certain kinds of Don Pedro Project-related activities may not have a direct impact on historic properties, but may create the conditions by which damage occurs. For example, a Don Pedro Project road may not directly impact historic properties, but may enable public access to areas that do contain historic properties.

By contrast, there are Don Pedro Project O&M activities that may not have an adverse effect on historic properties and there may also be historic properties within the APE that are not subject to O&M activities. For example, the continued use of a paved access road that is closed to the public and travels through an historic property that is an archaeological site, will likely not be considered an adverse effect. As well, a historic property comprised of a recreation facility will likely not be adversely affected by continued use and maintenance of the facility, if the facility is used as it has been in the past and any maintenance activities maintain the existing integrity of the facility. Furthermore, there may be historic properties located within the APE that are substantially above the high waterline of the Don Pedro Reservoir and nowhere near any other Don Pedro Project facility or within the vicinity of O&M activities. Subsequently, O&M activities may not adversely affect these historic properties.

3.11.2.1 Types and Causes of Effects

The following sections describe in more detail some of the activities in the APE that may affect historic properties. Section 3.11.2.2, which follows, provides an assessment of Don Pedro Project-related effects on historic properties and resources not yet evaluated for the NRHP, as identified during relicensing studies within the APE.

3.11.2.1.1 <u>Routine Operation and Maintenance of Buildings and Structures</u>

The Don Pedro Project’s hydroelectric operating system includes dams, powerhouses, penstocks, etc., and associated features. As well, a few additional buildings, associated with other historic activities not directly related to the hydroelectric system, were also identified within the APE. As these facilities age, they may require maintenance to maintain operational efficiency or usefulness as a storage or residential facility. Maintenance can affect the character-defining features of a building or structure that contribute to its significance. Future activities might include structural, mechanical or electrical upgrades of these facilities, maintenance or repair of buildings and other structures, replacement of windows, doors, roofing, or other building components; expansion or improvement of parking and storage area; and similar activities. Moreover, above ground resources (i.e. buildings and structures) often require consideration of the integrity of their viewscape as an important factor. Viewscapes can contribute to a resource's significance and eligibility to the NRHP, and to the integrity of setting, association, and feeling of a resource. Planned and unplanned O&M tasks associated with structures and buildings, including repairs, upgrades, or viewscape changes, could result in negative or adverse effects on those built or engineered resources that are considered eligible for listing on the NRHP and must be considered.

3.11.2.1.2 Reservoir Inundation and Fluctuation[41]

Historic properties within a reservoir basin may be consistently inundated by water or subject to wet and dry cycles and wave action associated with annual fluctuations in reservoir water level. Research indicates that the effects of these actions may include erosion, deflation, hydrologic sorting or displacement of artifacts, and are primarily dependent on where within the reservoir basin a site is located (Lenihan et al. 1981). Inundated sites are subject to less impact than sites within the annual fluctuation zone.

Several studies have been conducted on the effects of reservoir inundation to archaeological sites in California and elsewhere (Foster et al. 1977; Foster and Bingham 1978; Henn and Sundahl 1986; Lenihan et al. 1981; Stoddard and Fredrickson 1978; Ware 1989). These studies show that the nature and extent of the effects are dependent on several factors, most notably the location of a cultural resource within the reservoir basin. Sites within the zone of seasonal fluctuation or drawdown suffer the greatest impacts, primarily in the form of erosion/scouring, deflation, hydrologic sorting, and artifact displacement caused by waves and currents. Sites located lower in the reservoir are more likely to be covered with silt, sometimes forming a protective cap, but burrowing clams and crayfish have been known to rework these sediments too. Finally, it should be emphasized that resources lying deep within the reservoir pool are also subject to erosion when major drawdown and refilling events occur (e.g., during major droughts or periodic maintenance activities).

3.11.2.1.3 Vegetation Management

In addition, DPRA complies with the CPRC section 4291 that requires maintenance of vegetation within 30 to 100 feet of a structure (defensible space). Additionally, DPRA maintains vegetation around developed campsites and other DPRA improvements to protect life and property from fire and other injury that could be caused by low hanging branches. The vegetation maintenance includes removal of all grassy vegetation in a 30 foot perimeter around structures and campsite furnishings, along road edges, and then the mowing of grassy vegetation for an additional 70 feet beyond the 30 foot cleared areas. Pruning of trees and shrubs is done

[41] The Proposed Action covered in the application for a new FERC license is the Districts' proposal to continue hydroelectric generation at the Don Pedro Project. While reservoir fluctuations have the potential to affect historic properties, the fluctuations of the Don Pedro Reservoir are due to operations for the purposes of water supply and flood control. Hydroelectric project operations are dependent upon water released for these purposes; therefore, reservoir fluctuations are not the result of hydroelectric operations. The effect of the Proposed Action has no measureable impact on reservoir fluctuations. During relicensing of the hydroelectric project, the Districts undertook comprehensive investigations of the cultural resources associated with the Don Pedro Project within the APE identified in the study plan. These cultural resource investigations considered the effects of all Don Pedro Project operations. The Districts intend to address the effects of all Don Pedro Project operations within the Historic Properties Management Plan.

around structures and furnishings to remove ladder fuels that are subject to spreading fire up into the trees and into structures, and to eliminate low branches that could injure passing humans.

3.11.2.1.4 Grazing Leases

Issuing grazing leases for lands within the Project Boundary may result in moderate to heavy cattle grazing/trampling which can cause both direct and indirect effects to historic properties. Direct effects result from cattle trampling which can impact the surface of an historic property. Indirect effects can result from both grazing and trampling. Grazing reduces vegetation coverage and can increase erosion. Cattle trampling around historic resources can also increase erosion, which can affect the integrity of historic resources.

3.11.2.1.5 Road Maintenance, Construction and Use

Numerous road maintenance and construction activities have the potential to affect historic properties. Dirt access roads within the Project Boundary are maintained by grading, which can affect historic properties that may lie buried beneath them. In addition, ditches excavated for roadway drainage may cause further impacts to archaeological sites. Vehicular traffic on dirt roadways can also damage historic properties by traveling through or over, depending on the condition of the road, the season of use, and the types of vehicles that travel the roads. Roads also make historic properties more accessible to the public, in some cases increasing their vulnerability to looting and vandalism.

3.11.2.1.6 Recreation

Common recreational activities include boating, fishing, hiking, picnicking, and camping. These activities can expose historic properties to public use and can lead to disturbance of intact cultural deposits, increased erosion or deterioration of sites, unauthorized artifact collection, or more severe vandalism and looting. Ongoing maintenance at recreational facilities, formal and informal improvements, and infrastructure development can also affect significant cultural values. The more accessible historic properties are to public traffic, the more likely they are to be affected by recreational activities.

3.11.2.1.7 Emergency Repairs

Emergency repairs to facilities, including dams, penstocks, powerhouses, etc., may be necessary in response to serious threats life, property, or the safe operation of Licensee's hydroelectric facilities. Such actions, however, have the potential to affect historic properties. For example, an historic dam may require repair not in keeping with its original materials, or the creation of a fire break could affect a lithic scatter.

3.11.2.1.8 Artifact Collection/Vandalism

Vandalism and looting pose potential threats to historic properties within the APE. Looting includes the casual collection of surface artifacts as well as deliberate unauthorized digging and theft of cultural resources. Vandalism is the destruction or defacement of cultural resources.

Looting is one form of vandalism, as it contributes to the destruction of a cultural resource, but vandalism can also include acts that don't necessarily result in the removal of materials, but certainly contribute to the defacement or physical destruction of a resource. A prehistoric rock art site can be vandalized by modern graffiti added to rock art panels or the removal of a panel. An historic structure can be vandalized by shooting holes through the windows or walls.

The more accessible historic properties are to public traffic, such as resources in close proximity to public roads and recreation areas, the more likely they are to be affected by vandalism. As well, reservoir drawdowns can expose artifacts and sites within the fluctuation zone to looting. Additionally, archaeological sites that have been impacted by looting in the past are prone to additional looting.

3.11.2.2 Assessment of Ongoing Don Pedro Project-Related Effects

This section presents an assessment of ongoing Don Pedro Project-related effects on historic properties and resources not yet evaluated for the NRHP, as identified during relicensing studies within the APE. The Districts have identified a total of 234 archaeological sites, 127 isolated finds, 37 built resources, and one TCP within the APE. Of the 234 archaeological sites identified within the APE, 130 have been evaluated as ineligible for the NRHP, 75 are unevaluated with regards to their eligibility for inclusion in the NRHP, and 29 have been evaluated as eligible for the NRHP. All 127 of the isolated finds are ineligible for listing on the NRHP. Of the 37 built resources, 33 have been evaluated as ineligible, three are unevaluated, and one is eligible for listing on the NRHP. The TCP identified within the APE has been evaluated as eligible for the NRHP.

The resources that have been evaluated as ineligible for the NRHP are not historic properties and are therefore not further assessed with regards to ongoing Don Pedro Project-related effects. The unevaluated and eligible resources are addressed below.

3.11.2.2.1 Ongoing Don Pedro Project-Related Effects on Archaeological Sites[42]

Of the 234 archaeological sites identified within the APE, 130 have been evaluated as ineligible for the NRHP, 75 are unevaluated with regards to their eligibility for inclusion in the NRHP, and 29 have been evaluated as eligible for the NRHP. Of the 29 eligible resources, 8 are historic, 12 are prehistoric, and 9 are of multi-component affiliation. Of the 75 unevaluated resources, 23 are historic, 37 are prehistoric, and 15 are of multi-component affiliation. As summarized in Table 3.11-9, below, there are a total of 26 eligible archaeological sites and 64 unevaluated archaeological sites experiencing ongoing Don Pedro Project-related effects.

[42] Note that archaeological isolated finds are not addressed as all of these finds have been determined to be ineligible for inclusion on the NRHP and, therefore, are not historic properties that require an assessment of Don Pedro Project-related effects.

Table 3.11-9. Summary of ongoing Don Pedro Project-related effects assessments for eligible and unevaluated archaeological sites.

Experiencing Ongoing Don Pedro Project-Related Effects	Age			
	Historic	Prehistoric	Multi-Component	Total
Eligible Archaeological Sites				
Yes	7	12	7	**26**
No	1	0	2	**3**
Total	**8**	**12**	**9**	**29**
Unevaluated Archaeological Sites				
Yes	17	34	13	**64**
No	6	3	2	**11**
Total	**23**	**37**	**15**	**75**

Of the 90 eligible and unevaluated archaeological sites experiencing ongoing Don Pedro Project-related effects, eight are experiencing effects from cattle grazing only; 47 are experiencing effects from fluctuating water levels only; 24 are experiencing effects from fluctuating water levels and recreation; one site is affected by fluctuating water levels and cattle grazing; one site is affected by fluctuating water levels, cattle grazing, and looting; one site is affected by fluctuating water levels, cattle grazing, looting, and recreation; one site is affected by fluctuating water levels, cattle grazing, and recreation; two sites are being affected by fluctuating water levels and looting; two sites are being affected by fluctuating water levels, looting, and recreation; and three sites are affected by recreation only. Table 3.11-10, below, lists all 104 unevaluated and eligible archaeological sites identified within the APE, and identifies which have been determined to be impacted by ongoing Don Pedro Project-related effects and which have not.

Table 3.11-10. Ongoing Don Pedro Project-related effects assessment for eligible and unevaluated archaeological sites.

Temp Number	Primary/ Trinomial/Other	Age	Type[1]	Individual Eligibility [2]	Land Ownership	Ongoing Don Pedro Project-Related Effects	Type of Ongoing Don Pedro Project Effects
FW-DP-003	--	Prehistoric	Lithic Scatter	U	TID/MID/ BLM	Yes	Fluctuating water levels, recreation
FW-DP-004	--	Prehistoric	Lithic Scatter	U	TID/MID/ BLM	Yes	Fluctuating water levels, recreation
FW-DP-005	--	Prehistoric	Lithic Scatter	U	TID/MID/ BLM	Yes	Fluctuating water levels, recreation
FW-DP-006	--	Prehistoric	Lithic Scatter	U	TID/MID/ BLM	Yes	Fluctuating water levels, recreation
FW-DP-017	P-55-6021	Multi-component	P: Long-term Habitation H: Habitation	E	TID/MID/ BLM	No	N/A
FW-DP-018	--	Multi-component	P: Long-term Habitation H: Mining	E	TID/MID/ BLM	Yes	Fluctuating water levels, recreation
FW-DP-021	--	Historic	Mining	U	TID/MID/ BLM	No	N/A
FW-DP-030/031	--	Historic	Mining	U	TID/MID/ BLM	No	N/A
FW-DP-043	--	Prehistoric	Long-term Habitation	E	TID/MID	Yes	Fluctuating water levels
FW-DP-046	P-55-3227 CA-TUO-2253H	Historic	WCH	E	TID/MID/ BLM	Yes	Fluctuating water levels
FW-DP-050	--	Historic	Mining	E	TID/MID/ BLM/Private	Yes	Fluctuating water levels
FW-DP-053	--	Historic	Mining	E	TID/MID/ BLM/Private	Yes	Fluctuating water levels
FW-DP-065	--	Historic	Mining	U	TID/MID/ BLM	Yes	Fluctuating water levels
FW-DP-069	--	Historic	Mining	U	TID/MID/ BLM	Yes	Fluctuating water levels
FW-DP-070/071	--	Historic	Mining	E	TID/MID/ BLM/Private	Yes	Fluctuating water levels, recreation
FW-DP-073	P-55-3877 CA-TUO-2893H	Historic	Transportation	U	TID/MID/ BLM	Yes	Fluctuating water levels, recreation

Temp Number	Primary/ Trinomial/Other	Age	Type[1]	Individual Eligibility[2]	Land Ownership	Ongoing Don Pedro Project-Related Effects	Type of Ongoing Don Pedro Project Effects
FW-DP-076	--	Historic	Mining	U	TID/MID/ BLM/Private	Yes	Recreation
FW-DP-078	P-55-1351 CA-TUO-326	Multi-component	P: Long-term Habitation H: Habitation	E	TID/MID/ BLM	Yes	Fluctuating water levels
FW-DP-081	--	Prehistoric	Rock Shelter	E	TID/MID/ Private	Yes	Fluctuating water levels, recreation
FW-DP-085	--	Multi-component	P: Short-term Habitation H: Mining	U	TID/MID/ BLM	Yes	Fluctuating water levels, recreation
FW-DP-086	--	Prehistoric	Short-term Habitation	U	TID/MID/ BLM	Yes	Fluctuating water levels, recreation
FW-DP-092	--	Historic	Habitation	U	TID/MID/ BLM	No	N/A
FW-DP-094	--	Historic	Mining	U	TID/MID/ BLM/Private	Yes	Fluctuating water levels, recreation
FW-DP-095	--	Historic	Mining	E	TID/MID/ Private	Yes	Fluctuating water levels, recreation
FW-DP-096	--	Historic	Mining	U	TID/MID/ Private	Yes	Fluctuating water levels, recreation
FW-DP-097	--	Historic	Mining	U	TID/MID/ BLM	Yes	Fluctuating water levels, recreation
FW-DP-098	--	Historic	Mining	U	TID/MID/ BLM	Yes	Fluctuating water levels, recreation
FW-DP-099	--	Multi-component	P: Milling Station H: Mining	U	TID/MID/ BLM	Yes	Fluctuating water levels
FW-DP-100	--	Historic	Transportation	U	TID/MID/ BLM	Yes	Fluctuating water levels
FW-DP-109	P-55-3876 CA-TUO-2892H	Historic	Transportation	U	BLM	Yes	Fluctuating water levels
HDR-DP-006	P-55-1902 CA-TUO-892	Multi-component	P: Quarry H: Habitation	U	TID/MID	Yes	Fluctuating water levels; Cattle grazing; Looting; Recreation
HDR-DP-018	--	Prehistoric	Quarry	U	TID/MID	Yes	Fluctuating water levels; Cattle grazing; Looting

Temp Number	Primary/ Trinomial/Other	Age	Type[1]	Individual Eligibility [2]	Land Ownership	Ongoing Don Pedro Project-Related Effects	Type of Ongoing Don Pedro Project Effects
HDR-DP-019	--	Multi-component	P: Short-term Habitation H: Mining	U	TID/MID	Yes	Fluctuating water levels; Cattle grazing
HDR-DP-024	--	Prehistoric	Long-term Habitation	E	TID/MID	Yes	Fluctuating water levels; Cattle grazing; Recreation
HDR-DP-026	--	Prehistoric	Long-term Habitation	E	TID/MID	Yes	Fluctuating water levels; Recreation
HDR-DP-027	--	Prehistoric	Other	U	TID/MID	No	N/A
HDR-DP-028	--	Prehistoric	Short-term Habitation	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-029	P-55-1920, P-55-1921, CA-TUO-910/H, CA-TUO-911/H	Multi-component	P: Long-term Habitation H: Habitation	E	TID/MID	Yes	Fluctuating water levels; Recreation
HDR-DP-033	--	Prehistoric	Lithic Scatter	U	TID/MID	Yes	Fluctuating water levels; Recreation
HDR-DP-035	--	Historic	Habitation	U	TID/MID	No	N/A
HDR-DP-039	--	Multi-component	P: Short-term Habitation H: Habitation	U	TID/MID	No	N/A
HDR-DP-041	--	Prehistoric	Quarry	U	TID/MID	Yes	Cattle grazing
HDR-DP-042	--	Multi-component	P: Lithic Scatter H: Habitation	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-043	--	Prehistoric	Lithic Scatter	U	TID/MID	Yes	Cattle grazing
HDR-DP-045	--	Multi-component	P: Lithic Scatter H: Utilities	U	TID/MID	Yes	Cattle grazing
HDR-DP-046	--	Prehistoric	Milling Feature	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-047	--	Prehistoric	Milling Feature	U	TID/MID	Yes	Cattle grazing
HDR-DP-049	--	Prehistoric	Lithic Scatter	U	TID/MID	No	N/A
HDR-DP-053	--	Multi-component	P: Short-term Habitation H: Utilities	U	TID/MID	Yes	Recreation
HDR-DP-058	--	Prehistoric	Lithic Scatter	U	TID/MID	Yes	Recreation
HDR-DP-060	--	Prehistoric	Lithic Scatter	U	TID/MID	Yes	Cattle grazing

Temp Number	Primary/ Trinomial/Other	Age	Type[1]	Individual Eligibility[2]	Land Ownership	Ongoing Don Pedro Project-Related Effects	Type of Ongoing Don Pedro Project Effects
HDR-DP-061	--	Prehistoric	Long-term Habitation	U	TID/MID	Yes	Cattle grazing
HDR-DP-063	--	Prehistoric	Quarry	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-065	--	Prehistoric	Lithic Scatter	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-066	--	Prehistoric	Short-term Habitation	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-073	--	Prehistoric	Lithic Scatter	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-074	--	Prehistoric	Long-term Habitation	E	TID/MID	Yes	Fluctuating water levels
HDR-DP-076	--	Prehistoric	Quarry	E	TID/MID	Yes	Fluctuating water levels
HDR-DP-077	--	Prehistoric	Quarry	E	TID/MID	Yes	Fluctuating water levels
HDR-DP-086	--	Historic	Mining	E	TID/MID	Yes	Fluctuating water levels; Recreation; Looting;
HDR-DP-087	P-55-1913, CA-TUO-903H	Historic	Habitation	E	TID/MID	Yes	Fluctuating water levels; Looting
HDR-DP-092	--	Multi-component	P: Long-term Habitation H: Utilities	E	TID/MID	Yes	Cattle grazing
HDR-DP-095	--	Prehistoric	Long-term Habitation	U	TID/MID	Yes	Cattle grazing
HDR-DP-098	--	Multi-component	P: Long-term Habitation H: Transportation	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-099	--	Multi-component	P: Long-term Habitation H: Ranching / Farming	U	TID/MID	Yes	Fluctuating water levels; Recreation
HDR-DP-101	--	Historic	Mining	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-106	--	Prehistoric	Long-term Habitation	E	TID/MID	Yes	Fluctuating water levels
HDR-DP-109	--	Prehistoric	Short-term Habitation	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-113	--	Prehistoric	Long-term Habitation	E	TID/MID	Yes	Fluctuating water levels

Temp Number	Primary/ Trinomial/Other	Age	Type[1]	Individual Eligibility [2]	Land Ownership	Ongoing Don Pedro Project-Related Effects	Type of Ongoing Don Pedro Project Effects
HDR-DP-116	--	Prehistoric	Long-term Habitation	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-118	--	Prehistoric	Short-term Habitation	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-119	P-55-1360 CA-TUO-336/H	Multi-component	P: Long-term Habitation H: Habitation	E	TID/MID/ BLM	Yes	Fluctuating water levels; Recreation
HDR-DP-122	--	Historic	Mining	U	TID/MID	Yes	Fluctuating water levels; Recreation
HDR-DP-126	--	Historic	Mining	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-127	--	Prehistoric	Long-term Habitation	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-128	--	Prehistoric	Short-term Habitation	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-130	--	Multi-component	P: Long-term Habitation H: Mining	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-131	--	Prehistoric	Other	E	TID/MID	Yes	Fluctuating water levels
HDR-DP-133	--	Historic	Mining	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-134	--	Multi-component	P: Short-term Habitation H: Mining	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-135	--	Prehistoric	Short-term Habitation	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-139	--	Multi-component	P: Lithic Scatter H: Trash Scatter	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-140	P-55-1331 CA-TUO-306	Prehistoric	Long-term Habitation	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-141	--	Prehistoric	Lithic Scatter	U	TID/MID	No	N/A
HDR-DP-142	P-55-1384 CA-TUO-361	Multi-component	P: Milling Feature H: Ranching / Farming	U	TID/MID	No	N/A
HDR-DP-145	--	Prehistoric	Lithic Scatter	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-147	--	Prehistoric	Lithic Scatter	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-148	--	Historic	Trash Scatter	U	TID/MID	No	N/A

Temp Number	Primary/ Trinomial/Other	Age	Type[1]	Individual Eligibility [2]	Land Ownership	Ongoing Don Pedro Project-Related Effects	Type of Ongoing Don Pedro Project Effects
HDR-DP-151	--	Prehistoric	Long-term Habitation	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-155	--	Prehistoric	Short-term Habitation	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-162	P-55-1927 CA-TUO-917	Multi-component	P: Short-term Habitation H: WCH	U	TID/MID	Yes	Fluctuating water levels; Recreation
HDR-DP-164	P-55-1925 CA-TUO-915	Prehistoric	Lithic Scatter	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-170	--	Historic	Other	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-171	--	Historic	Mining	U	TID/MID	Yes	Fluctuating water levels; Recreation
HDR-DP-179	--	Historic	Mining	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-186	--	Prehistoric	Short-term Habitation	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-189	--	Multi-component	P: Long-term Habitation H: Mining	E	TID/MID	Yes	Fluctuating water levels
HDR-DP-192	P-55-1363 CA-TUO-340	Prehistoric	Rock Shelter	E	TID/MID	Yes	Fluctuating water levels; Looting
HDR-DP-193	--	Historic	WCH	E	TID/MID	No	N/A
HDR-DP-195	--	Prehistoric	Milling Feature	U	TID/MID	Yes	Fluctuating water levels
HDR-DP-196	--	Prehistoric	District	E	TID/MID/ BLM	Yes	Fluctuating water levels; Recreation
HDR-DP-197	--	Historic	Transportation	U	TID/MID	No	N/A
HDR-DP-198	P-55-1928 CA-TUO-918/H	Multi-component	P: Short-term Habitation H: Habitation	E	TID/MID	No	N/A
HDR-DP-250	--	Multi-component	P: Millling Feature H: Mining	E	TID/MID/ BLM	Yes	Fluctuating water levels; Recreation; Looting

1 H: Historic; P: Prehistoric.
2 E: Eligible; U: Unevaluated.

3.11.2.2.2 Ongoing Don Pedro Project-Related Effects on Built Environment Resources

There are 37 built environment resources identified within the APE. Of these, 33 have been determined ineligible, three are unevaluated, and one is eligible for inclusion in the NRHP. The three unevaluated resources are Red Mountain Bar Siphon (P-55-3913/CA-TUO-2928), Kanaka Creek Cabin (FW-DP-57), and Moccasin Creek Stone Building (HDR-DP-101). The Red Mountain Bar Siphon is an inverted siphon constructed by the City and County of San Francisco in 1923 to carry the Hetch Hetchy Aqueduct under the Tuolumne River (later Don Pedro Reservoir). Though running under water, beneath the reservoir, the siphon is functioning as intended and is not being impacted by O&M. The Kanaka Creek Cabin (FW-DP-57) is also a contributing element to the Kanaka Creek Mining Landscape (FW-DP-53), which is documented with the archaeological resources above. The Moccasin Creek Stone Building (HDR-DP-101) is within a larger archaeological site and thus is also part of an archaeological site (site HDR-DP-101) discussed above. Both the cabin and stone building are in rather secluded areas and are above the high waterline of the reservoir and are not being impacted by any identified Don Pedro Project-related activity. The La Grange Ditch (FW-DP-08) is the NRHP eligible built environment resource. It is located on a steep canyon wall and is also not impacted by Don Pedro Project-related effects.

3.11.2.2.3 Ongoing Don Pedro Project-Related Effects on TCPs

Only one TCP was identified in the APE: Lower Kanaka Creek Native Plant Gathering Area. This is an area along lower Kanaka Creek, extending 100 meters (330 feet) on both sides of the stream and one kilometer (0.6 mile) upstream from the edge of Don Pedro Reservoir. It has been viewed by generations of Indians as a source of traditional foods, medicines, and materials for making baskets and ceremonial regalia. Plants are still harvested in this locality today, and their availability contributes importantly to the maintenance of the Tuolumne Me-wuk community's cultural traditions and identity (see Chapters 6 and 8 of the TCP Study Report, Moratto et al. 2014). This TCP is located predominately above the high waterline of the reservoir and is accessible by Tribal members from Jacksonville Road. While the Don Pedro Reservoir appears to inundate a small portion of the TCP, this does not appear to be adversely affecting the resource. No other potential Don Pedro Project-related effects to this resource were identified and it has been determined that there are no ongoing adverse effects to the TCP (TID/MID 2014b).

3.11.3 Proposed Resource Measures

The Districts have developed a draft HPMP to manage potential effects on historic properties throughout the term of any new license. The draft HPMP is Appendix E-4 of this Exhibit E (being filed as PRIVILEGED) and will be provided to the Tribes, BLM, and SHPO for review and comment. FERC typically completes Section 106 by entering into a Programmatic Agreement (PA) or Memorandum of Agreement (MOA) with the licensee, the ACHP, if they choose to participate, and the SHPO that requires the licensee to develop and implement an HPMP. Additionally, FERC requires the licensee to consult with various federal, state, tribal, and non-government parties in the development of any HPMP.

The purpose of an HPMP is to outline actions and processes to manage historic properties within the APE under the new license. It is intended to serve as a guide for the licensee's operating personnel when performing necessary O&M activities and identify resource treatments designed to address potential ongoing and future effects to historic properties. An HPMP should also describe a process of consultation with appropriate state and federal agencies, as well as with Native Americans who may have interests in historic properties within the APE. Following the Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects issued by FERC and ACHP in 2002 (FERC and ACHP 2002), an HPMP should include: management measures; training for all O&M staff; mechanisms for providing the public interpretive information on cultural resources; and periodic review and revision of the HPMP.

3.11.4 Unavoidable Adverse Impacts

Adverse impacts to historic properties are discussed above in Section 3.11.2. The HPMP describes those adverse impacts that cannot be avoided. The HPMP also provides a schedule and plan for managing adverse effects to historic properties caused by Don Pedro Project O&M. The draft HPMP is included herein as Appendix E-4 to this Exhibit E and is being filed with FERC as PRIVILEGED.

3.12 Socioeconomic Resources

The Don Pedro Project is essential to the economic welfare of the central San Joaquin Valley. The Don Pedro Project provides irrigation water to more than 200,000 ac of highly productive farmland, drinking water to residential and business customers, flood flow management, hydropower generation, recreation, and flows for the protection of aquatic resources. The Don Pedro Project also provides important benefits to the Bay Area by virtue of the 570,000 acre-foot "water bank" CCSF acquired by its financial contribution to the construction of the Don Pedro Project. As a part of the relicensing process, the Districts conducted a thorough analysis of the socioeconomic effects of the Don Pedro Project (TID/MID 2014). The primary goals of the Socioeconomics Study were to quantify the baseline economic values and socioeconomic effects of current Don Pedro Project operations. Because the primary purpose of Don Pedro Project is to supply water for regional agriculture, municipal, and industrial water users, any changes in operations may have broad socioeconomic effects well beyond changes to hydropower generation. Information from this analysis is summarized below, and more detailed information is available in the Socioeconomic Study Report (TID/MID 2014).

3.12.1 Existing Environment

The Don Pedro Project has many positive direct and indirect economic effects on the entire regional economy within Stanislaus, Merced, and Tuolumne counties. By providing reliable irrigation water supplies, it directly supports the vibrant agricultural sector which has evolved in the Districts' service areas. And by extension, it indirectly supports the large agribusiness complex that has developed around crop and dairy farm production, including input suppliers, dairy plants, food processing businesses, and many others. The Don Pedro Project also provides reliable M&I water supplies that are essential to meet population and business growth in the area.

The Districts' study of socioeconomics demonstrates the economic strength of the area, including the many people and industries which are directly and indirectly affected by the Don Pedro Project. The Don Pedro Project is shown to be a major economic factor in the region by supporting agriculture and many other industries which provide thousands of jobs and millions of dollars of output and income in the central San Joaquin Valley.

Table 3.12-1 presents a summary of the regional economic effects of the Don Pedro Project. Accounting for both directly supported activities and other forward-linked sectors, it is estimated that the Don Pedro Project supports approximately 18,900 total jobs and $734.8 million in total annual labor income.

Table 3.12-1. Regional economic benefits – summary ($millions per year).[1,2]

Activity	Output ($millions)		Labor Income ($millions)		Employment (Full and Part-Time Jobs)	
	Direct	Total	Direct	Total	Direct	Total
Directly-Supported Activities						
Crop Production	$527.9	$854.2	$171.7	$278.1	4,340	7,270
Recreation Spending	$6.2	$9.7	$1.9	$2.9	80	100
Hydropower	$24.7	$31.2	$7.5	$9.5	30	90
Directly-Supported Sub-total	*$558.9*	*$859.1*	*$181.1*	*$290.5*	*4,400*	*7,500*
Forward Linkages						
Crop Processing	$569.1	$854.9	$87.0	$165.8	1,050	3,020
Crop Processing Subtotal[3]	*$512.6*	*$854.9*	*$87.0*	*$173.4*	*1,050*	*2,870*
Dairy Production	$537.4	$816.7	$23.6	75	2,270	3,630
Dairy Processing	$787.6	$1,143.1	$71.8	156	1,060	3,040
Dairy Subtotal[3]	*$922.1*	*$1,959.8*	*$95.4*	*$231.6*	*3,330*	*6,670*
Cattle Production	$128.1	$233.0	$7.2	23	620	1,220
Cattle Processing	$119.8	$166.0	$11.8	24	270	630
Cattle Subtotal[3]	*$172.9*	*$399.0*	*$19.0*	*$46.9*	*890*	*1,850*
Forward-Linkage Sub-Total	*$1,607.6*	*$3,213.7*	*$201.4*	*$444.3*	*5,300*	*11,400*
Total Economic Benefits						
Total	**$2,166.4**	**$4,108.8**	**$382.5**	**$734.8**	**9,700**	**18,900**

Source: Cardno ENTRIX (based on IMPLAN modeling)

1 Monetary values reported in constant 2012 dollars adjusted using the California Consumer Price Index (CPI)

2 Results represent annual effects in three-county study area (Stanislaus, Merced, and Tuolumne counties)

3 Forward linkage direct output values are adjusted to avoid double counting of crop, dairy, and cattle output that become inputs into a processing sectors (where their value is included in the processing sector output value). For example, $56.5 million of crop output is estimated to be processed in the food and beverage processing sectors, and is included in the $569.1 direct processing output value. The direct additional output due to crop processing is thus $512.6 million ($569.1 million less the $56.5.0 million of crop input.)

3.12.1.1 Agriculture

Agriculture has been, and remains, a very important industry, particularly in Merced and Stanislaus counties. Agriculture has been a foundation industry of the San Joaquin Valley for more than 150 years. Development of surface water supplies encouraged additional land cultivation and helped offset the groundwater overdraft problems that resulted from widespread pumping in many parts of the Valley.

Water supply reliability has been a critical issue for agriculture in the San Joaquin Valley. In this respect, the Don Pedro Project has been crucial to the development, directly, of crop and dairy production in the MID and TID service areas. Water supply reliability has been one of the most important factors supporting the large investments made by farmers in such permanent crops as almonds, peaches, and grapes; and in the dairies which rely on the associated production of corn silage, alfalfa, and other forage crops used in those operations.

Today, crop and livestock operations in the Districts' service areas represent a cornerstone in the regional economy of Stanislaus and Merced counties. In revenue alone, farmers in the Districts' service areas contribute an estimated $1.2 billion annually directly into the local economy, including $527.9 million from crop production and $665.5 million from livestock operation. In addition to supporting about 7,230 on-farm (direct) full and part-time jobs generating an estimated $202.5 million in labor income.

The estimated $1.2 billion in annual gross agricultural production (e.g. crops, dairy and cattle) supported by crops grown with Don Pedro Project water supports an additional $2.9 billion in annual output, taking into account both the industries which support and which are supported by production agriculture. These industries create another 11,670 jobs generating $532.3 million in labor income. Among major employers in Stanislaus and Merced counties, half are directly related to agriculture.

Neither Stanislaus County nor Merced County would have the agricultural strength they have absent the reliable irrigation water supply provided by the Don Pedro Project. Neither county is capable of being served by the SWP or CVP, and groundwater availability and quality are not sufficient to independently support the large, highly productive agricultural land base in the area. Thus, Tuolumne River water provided by the Don Pedro Project has been critical to the success of agriculture.

In 2011, Merced and Stanislaus counties were the fifth and sixth largest counties in California as measured by gross value of agricultural production (Table 3.12-2).[43] Together, they contributed $6.5 billion in gross value, 12.3 percent of total gross value for the state, with a significant portion of this production coming from land irrigated with water supplies provided by MID and TID.

The Districts have key roles in the agricultural economies of Stanislaus and Merced counties and the entire San Joaquin Valley. Through the Don Pedro Project, the Districts have provided

[43] Gross value represents the product of price and quantity for farm products as they leave the farms where they are produced. It does not represent net income, which incorporates farm expenses.

highly reliable water supplies to their customers. With these reliable supplies, growers and producers have invested heavily in high-value perennial crops, such as almonds and peaches, as well as dairy production. The consistent, high value of agricultural output has, in turn, resulted in a large complex of agricultural support industries being developed in the area. With those supplies, the two counties are regularly among the top 10 most productive agricultural counties in California.

3.12.1.2 Municipal and Industrial Use

In addition to agriculture, the Don Pedro Project supplies water to M&I users in both Districts. M&I water demands trace directly to the economic development and job creation characterizing the area. In addition to those presently served, several municipalities within Stanislaus County are seeking Don Pedro Project water as a substitute for groundwater supplies. In addition, the CCSF, through its water bank credits in the Don Pedro Reservoir, is able to reliably deliver Hetch Hetchy water supplies to 26 water agencies in the Bay Area, serving 2.6 million customers.

The value of M&I water supplies is less easily estimated than that for agriculture. Farm profit is the difference between gross production value and costs, aggregated over all crops. The value of M&I supplies is not directly measurable and such measurement instead requires estimates of the costs of alternative supplies. Those alternatives may include groundwater, desalination, recycling, or transfers from other areas. Based on those alternatives, Don Pedro M&I water values range from $143 per AF (for groundwater pumping[44]) to $700 per AF, reflecting the estimated willingness to pay by the SFPUC for municipal water supplies.

3.12.1.3 Recreation

In addition to consumptive agricultural and M&I water uses, the Don Pedro Reservoir provides unique recreational opportunities in designated recreation areas managed by DPRA. Annual visitation to the reservoir is in the hundreds of thousands, whose expenditures benefit the entire regional economy. At current estimates of 378,000 visitor days per year, the economic value of recreation to participants is between $19.8 million and $25.4 million per year. Table 3.12-2 lists visitor use of the Don Pedro Reservoir for 2010–2012.

Table 3.12-2 presents the regional economic benefits generated by recreation spending by visitors to Don Pedro Reservoir. The approximate $10 million in recreation spending is estimated to generate about $6.2 million in direct output at local businesses and $9.7 million in total output across all industries on an annual basis. In addition, total labor income and jobs supported by recreation spending totals about $2.9 million per year and 100 total full and part-time jobs.

Table 3.12-2. Regional economic benefits – recreation visitation at DPRA ($millions).[1,2]

Metric	Direct	Indirect	Induced	Total
Output ($millions)	$6.2	$1.8	$1.7	$9.7

[44] Includes both fixed (capital) and variable (operating) costs associated with groundwater pumping.

Metric	Direct	Indirect	Induced	Total
Labor Income ($millions)	$1.9	$0.5	$0.5	$2.9
Employment (full and part-time jobs)	80	10	10	100

[1] Monetary values reported in constant 2012 dollars adjusted using the California Consumer Price Index (CPI).
[2] Results represent regional effects in three-county study area (Stanislaus, Merced, and Tuolumne counties).
Source: TID/MID 2014 (based on IMPLAN modeling).

3.12.1.4 Hydropower Generation

Another of the important benefits which the Don Pedro Project provides is hydroelectric generation. Since 1997, the facility has provided an average of 622,440 MWh of clean, low cost energy per year (1997-2012). It is used by MID and TID to serve 21 communities in their combined service areas. About 80 percent of the electrical accounts are residential or commercial and industrial, with agriculture, municipal, and street lighting, and other types making up the remainder.

MID provides electrical service to seven communities in Stanislaus and San Joaquin counties, comprising about 114,000 accounts in a service territory of 560 mi^2. The composition of those accounts is shown in Table 3.12-3.

Table 3.12-3. MID customer accounts, by type of account.

Type of Account	No. of Accounts	Percent of Accounts
Residential	94,119	82.6%
Commercial	12,265	10.8%
Industrial	157	0.1%
Agricultural	1,819	1.6%
Other	5,571	4.9%
Total	113,931	100.0%

Source: MID 2013.

TID serves 100,345 accounts across 14 communities in a service area of 662 mi^2 in Stanislaus, Merced, Tuolumne, and Mariposa counties. The communities served include Ballico, Ceres, Crows Landing, Delhi, Denair, Diablo Grande, Hickman, Hilmar, Hughson, Keyes, La Grange, Patterson, South Modesto, and Turlock. The composition of those accounts is shown in Table 3.12-4.

Table 3.12-4. TID customer accounts, by type of account.

Type of Account	No. of Accounts	Percent of Accounts
Residential	72,033	72%
Municipal/street lighting	16,367	16%
Commercial	6,983	7%
Agricultural	2,508	2%
Other	1,656	2%
Industrial	798	1%
Total	**100,345**	**100%**

Source: TID 2013.

The output and price data used to estimate hydropower output values are shown in Table 3.12-5. As shown, output varied considerably over the five years from 2008 to 2012, with peak production in 2012 at more than 1.0 billion kilowatt-hour (kWh); and the minimum in 2009, at about 340 million kWh. Over the same period, electricity prices varied from a peak of $0.085 per kWh in 2008 to a minimum of $0.032 per kWh in 2012, with an average price of $0.047 per kWh (in 2012 dollars). As shown, the five-year average value of hydropower generation supported by the Don Pedro Project is approximately $26.9 million annually.

Table 3.12-5. Value of hydropower generation, Don Pedro Hydroelectric Plant, 2008–2012.[1]

Year	Output (kWh)	Price/Value ($/kWh)[2]	Total Value
2008	399,858,940	$0.085	$33,947,361
2009	339,501,259	$0.042	$14,174,961
2010	364,964,701	$0.042	$15,352,087
2011	715,749,872	$0.037	$26,220,584
2012	1,013,360,425	$0.032	$32,447,801
Average (5 Year)	**556,687,039**	**$0.047**	**$26,902,782**

[1] Monetary values reported in constant 2012 dollars adjusted using the California Consumer Price Index (CPI).
[2] Prices are annual average day ahead on-peak prices.
Sources: TID/MID 2013, FERC 2013.

3.12.1.5 Land Values

Land values, particularly agricultural land values, are affected by the availability and reliability of affordable water and electricity from the Don Pedro Project. Irrigators who have access to reliable water supplies, other factors equal, will be more profitable than those who do not have such access. The availability of reliable water supplies at reasonable cost is capitalized into land values because those values frequently reflect the stream of net income available from the land; and because net income is higher, other factors being equal, with lower water prices.

Land values in the Districts' service areas have been relatively stable despite the economic recession, the effects of which have been offset by high crop prices, low interest rates, and available water supplies. Currently, cropland in the Districts' service areas is valued from 30 to 50 percent higher than similar cropland in other districts served by both surface water and groundwater. The land valuation is important in supporting the decisions by irrigators to invest in permanent and other high value crops that account for such a large part of overall agricultural value in the area.

Overall, there appears to be a clear premium on land values in the Districts' service areas compared to other nearby regions with access to surface or groundwater supplies. The land value differential is more dramatic when compared to rangeland without water supplies. Irrigated land values in the Districts' service areas are five to 15 times greater than rangeland values, demonstrating the value added by reliable water supplies for agricultural production. However, there are likely a number of factors other than water supplies that also drive land values in the region, such as soil quality and proximity to urban centers and infrastructure. Therefore, it is not reasonable to attribute the land value premium solely to water supplies. However, it is clear that high quality, reliable surface water supplies provided by the Don Pedro Project have a positive influence on land values. Table 3.12-6 shows regional land values from 2007 to 2011.

Table 3.12-6. Regional land values, 2007–2011.[1]

Region/Land Use	Land Value ($/acre)		
	Low	High	Average
Merced County			
Cropland: TID	**$15,870**	**$22,410**	**$19,140**
Cropland: Well Water (ENID & CWD)	$5,290	$10,580	$7,930
Cropland: Merced ID	$10,170	$19,290	$14,730
Cropland: Westside, Exchange Contractors	$5,700	$10,300	$8,000
Cropland: Westside, Federal and Other	$3,700	$5,820	$4,760
Permanent Cropland: Almonds	$12,690	$22,430	$17,560
Permanent Cropland: Walnuts	$12,450	$21,320	$16,880
Rangeland: West County	$530	$1,270	$900
Rangeland: East County and Mariposa County	$740	$1,670	$1,210
Stanislaus County			
Cropland: MID and TID	**$16,500**	**$26,040**	**$21,270**
Cropland: Non-Federal Water (Westside, incl. Gustine)	$10,000	$15,000	$12,500
Cropland: Well Water and Federal (Westside)	$8,170	$12,910	$10,540
Cropland: Well and OID (Eastside)	$10,370	$17,350	$13,860
Permanent Cropland: Almonds (MID and TID)	**$17,760**	**$28,160**	**$22,960**
Permanent Cropland: Almonds (Minor Irrigation Districts and Wells)	$15,020	$20,500	$17,760
Permanent Cropland: Walnuts	$14,560	$24,530	$19,540
Permanent Cropland: Cling Peaches	$15,230	$23,080	$19,160
Permanent Cropland: Wine Grapes (District 12)	$13,990	$20,980	$17,480
Rangeland: Westside	$1,060	$1,900	$1,480
Rangeland: Eastside and Tuolumne County	$1,940	$4,570	$3,250

1 Monetary values reported in constant 2012 dollars adjusted using the California Consumer Price Index (CPI).
ENID = El Nido Irrigation District
CWD = Chowchilla Water District
OID = Oakdale Irrigation District
Source: California Chapter of the American Society of Farm Managers and Rural Appraisers, 2012.

3.12.2 Resource Effects

Page 38 of FERC's SD2 identifies the following issues associated with socioeconomic resources:

- *The socioeconomic effects of any proposed measures to change Don Pedro Project operations on affected governments, residents, agriculture, businesses, and other related interests.*
- *Water supply effects on San Francisco Public Utility Commission retail and wholesale customers that would result if the CCSF were required to provide additional water to the Districts to support a change in operation for environmental mitigation.*

Several resources studies are not yet complete; analysis of proposed measures will be completed when all relevant data, reports, and models are available. The socioeconomic resources of the Bay Area are not analyzed as a part of this Exhibit.[45]

[45] CCSF prepared an independent study on the potential socioeconomic effects of potential changes in Don Pedro Project operations entitled *Socioeconomic Impacts of Water Shortages within the Hetch Hetchy Regional Water System Service Area.*

3.12.3 Proposed Resource Measures

No measures that specifically address socioeconomic resources are proposed.

3.12.4 Unavoidable Adverse Impacts

The Don Pedro Project has no known unavoidable adverse effects on socioeconomic resources.

4.0 CUMULATIVE EFFECTS OF THE PROPOSED ACTION

According to the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA) (50 CFR §1508.7), cumulative effects on a resource are the result of the combined influence of past, present, and reasonably foreseeable future actions within a specified geographical range (FERC 2008), regardless of what agency (federal or non-federal) or person undertakes such actions. Cumulative effects may be beneficial or adverse.

Resources of the Tuolumne River may be cumulatively affected by individually minor but collectively significant actions taking place over a period of time. Activities contributing to cumulative effects to resources in the Tuolumne and San Joaquin rivers may include hydropower operations, water storage and diversions for irrigation and M&I water supply, historical and ongoing gravel and gold mining, dredging operations, riparian diversions, urbanization, other land and water development activities, the introduction of non-native species to the watershed, channel modification by levees and for shipping, recreation, flood control operations, wastewater treatment plant discharges, climate change, and a host of other potential activities.

Based on scoping meetings, comments FERC received during scoping, and information in the PAD, FERC identified the resources having the potential to be cumulatively affected by the Proposed Action: (1) geomorphology, (2) water resources, (3) aquatic resources including anadromous fish and habitat, and (4) socioeconomic resources. For water resources, aquatic resources, anadromous fish and their essential habitat, and socioeconomics, FERC defined the geographic scope as extending from Hetch Hetchy Reservoir to San Francisco Bay. For geomorphology, the geographic scope extends only to the confluence of the Tuolumne and San Joaquin rivers. The temporal scope includes past and present actions and reasonably foreseeable actions that could occur over the next 30 to 50 years. Actions potentially contributing to cumulative effects to the identified resources are described in Section 4.1, and the cumulative effects of these actions are addressed, by resource, in sections 4.2 through 4.5 below.

The Don Pedro Project provides water storage for irrigation and municipal and industrial (M&I) use, flood control, hydroelectric generation, recreation, and natural resource protection (hereinafter, the “Don Pedro Project”). The environmental analysis contained in this Exhibit E considers all the components, facilities, operations, and maintenance that make up the Don Pedro Project. The Don Pedro Project was constructed for the following primary purposes: (1) to provide water supply for the co-licensees, Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts), for irrigation of over 200,000 acres (ac) of Central Valley farmland and for M&I use, (2) to provide flood control benefits along the Tuolumne and San Joaquin rivers, and (3) to provide a water banking arrangement for the benefit of the City and County of San Francisco (CCSF) and its 2.6 million Bay Area water customers. The original license was issued in 1966. In 1995, the Districts entered into an agreement with a number of parties which resulted in greater flows to the lower Tuolumne River for the protection of aquatic resources.

Hydroelectric generation is a secondary purpose of the Don Pedro Project. Hereinafter, the hydroelectric generation facilities and operations will be referred to as the “Don Pedro Hydroelectric Project”, or the “Project”. With this license application to FERC, the Districts are seeking a new license to continue generating hydroelectric power. Based on the information contained in this application, and other sources of information on the record, FERC will consider whether, and under what conditions, to issue a new license for the continued generation of hydropower at the Districts' Don Pedro Project. The Districts are providing a complete description of the facilities and operation of the Don Pedro Project so the effects of the operation and maintenance of the Don Pedro hydroelectric facilities can be distinguished from the effects of the operation and maintenance activities of the overall Don Pedro Project's flood control and water supply/consumptive use purposes.

Being able to differentiate the effects of the hydropower operations from the effects of the flood control and consumptive use purposes and needs of the Don Pedro Project will aid in defining the scope and substance of reasonable protection, mitigation, and enhancement (PM&E) alternatives to be considered in relicensing. As FERC states in Scoping Document 2 in a discussion related to alternative project operation scenarios: "…alternatives that address the consumptive use of water in the Tuolumne River through construction of new structures or methods designed to alter or reduce consumptive use of water are…alternative mitigation strategies that could not replace the Don Pedro *hydroelectric* project [emphasis added]. As such, these recommended alternatives do not satisfy the NEPA purpose and need for the Proposed Action and are not reasonable alternatives for the NEPA analysis."

4.1 Actions In and Outside of the Tuolumne River Basin

4.1.1 Summary of Chronology of In-Basin and Out-of-Basin Actions

In accordance with the requirements of cumulative effects assessments provided under NEPA, the initial step of performing the analysis is to identify significant past, present, and foreseeable future actions that potentially contribute to cumulative effects to the target resources. The Tuolumne and San Joaquin river basins have been affected by substantial resource management and land and water use activities over the past 150-years. Table 4-1.1 summarizes a chronology of the in-basin and out-of-basin actions that are likely to contribute to cumulative effects to the four resource areas identified in FERC's SD2. The information available to describe and address each of these actions varies greatly, ranging from very little (e.g., commercial and sport salmonid harvest in the early to mid 1900s) to volumes of studies (e.g., recent studies of salmonid juvenile and smolt survival studies in the Delta). A map of the San Joaquin River basin and Delta is provided in Figure 4.1-1.

Table 4.1-1. Chronology of actions in the San Joaquin River Basin and Delta contributing to cumulative effects.

Action	Date
Dams, Diversions, Flow Regulation	
Tuolumne River Basin	
Wheaton Dam	1871
La Grange Mining Ditch (Indian Bar Diversion)	1871
Phoenix Dam	1880
La Grange Diversion Dam	1893
Modesto Reservoir	1911
Turlock Lake	1914
Eleanor Dam	1918

Action	Date
Old Don Pedro Dam	1923
O'Shaughnessy Dam (Hetch Hetchy)	1923
Priest Dam	1923
Early Intake	1924
Dennett Dam	1933
Hetch Hetchy Aqueduct completed; exports to San Francisco begin	1934
O'Shaughnessy Dam raised	1938
Cherry Lake	1956
Pine Mountain Dam	1969
New Don Pedro Dam	1971
Riparian water diversions along the Lower Tuolumne River	1870s – present
San Joaquin River Basin and Delta (excluding Tuolumne River)	
Central Valley Project	
Friant Dam	1942
Madera Canal	1945
Friant-Kern Canal	1951
Jones Pumping Plant	1951
Delta-Mendota Canal	1951
Delta Cross-Channel	1951
Hidden and Buchanan Projects	1962
Los Banos Detention Dam	1965
Little Panoche Detention Dam	1966
B.F. Sisk Dam	1967
O'Neill Pumping Plant	1967
William R. Gianelli Pumping-Generating Plant	1967
San Luis Drain	Halted in 1975
New Melones Dam	1983
San Felipe Division	1964 – 1987
State Water Project	
Harvey O. Banks Pumping Plant	1968
Edmonston Pumping Plant	1971
Pyramid Dam	1973
Castaic Dam	1973
Warne Powerplant	1982
Alamo Powerplant	1986
Coastal Branch Aqueduct	1997
Upper San Joaquin River	
Mendota Dam	1871
Sack Dam	Seasonal 1870s – 1946
Merced River Basin	
Robla Canal Company begin diverting Merced River	1870
Merced Canal and Irrigation Company forms	1883
Merced Falls Diversion Dam	1901
Crocker-Huffman Dam	1910
Exchequer Dam	1926
New Exchequer Dam	1967
Stanislaus River Basin	
Big Dam	1856
Herring Creek, Upper Strawberry, and Lower Strawberry reservoirs	1856
Lyons Reservoir	1898
Sand Bar Diversion Dam	1908
OID/SJID purchase Tulloch water rights/distribution system	1910

Action	Date
Relief Dam	1910
Goodwin Dam	1913
Philadelphia Diversion Dam	1916
Lower Strawberry Reservoir	1917
Old Melones Dam	1926
Spicer Meadow Dam	1929
Lyons Reservoir enlarged	1930
Tri-Dam Project (Donnells, Beardsley, and Tulloch dams)	1958
New Melones Dam (also in CVP section)	1983
New Spicer Dam	1989
In-Channel and Floodplain Mining	
Tuolumne River Basin	
Placer mining	1848 – 1890
Hydraulic mining (La Grange)	1871 - c.1900
Dredge mining of the Lower Tuolumne River (gold)	1908-1942, 1945-1951
Gravel and aggregate mining of the Lower Tuolumne River	1940s to present
San Joaquin River Basin and Delta (excluding Tuolumne River)	
Sand and gravel mining from Bay floor shoals begins	1915
Channel Alteration	
Begin large-scale construction of levees in San Joaquin River basin and Delta	1850s
Stockton Deep Water Ship Channel	1930s
San Joaquin River and Tributaries Project (> 100 miles of levees and bypasses)	1950s - 1960s
Non-Native Fish Species	
18 fish species introduced in Tuolumne River basin by state/federal agencies	1874 – 1954
4 additional fish species introduced in Tuolumne River basin	After 1954
Hatchery Practices	
CDFW begins stocking fish in the inland waters of California	Late 1800s
CDFW begins large-scale supplementation of anadromous fish stocks	1945
California's hatcheries at times use out-of-basin broodstocks/move fry to other basins	Before 1980s
Salmon from Central Valley hatcheries released in San Francisco Bay	Ongoing
Commercial and Sport Harvest	
Commercial salmon fishing begins in California	Early 1850s
Gill net salmon fisheries well established in lower San Joaquin River	1860
Well developed canning industry (20 canneries)	1880
12 million pounds of salmon landed and processed	1882
Ocean troll fishery dominates harvest	1917
Last inland cannery shutdown due to decline of inland fishery	1919
Last commercial river salmon fishery closed in Sacramento-San Joaquin basin	1957
Agriculture, Livestock, and Timber Harvest	
Timber operations begin in upper watersheds	Mid 1800s to present
Large-scale agriculture and livestock grazing begins in region	Mid 1800s to present
Urban Development	
Within Tuolumne River watershed and downstream	Mid 1800s to present
San Francisco Bay Area (Hetch Hetchy diversions)	1934 to present
MID M&I diversions	1995 to present
Climate Change	
Changes in global climate and weather patterns	

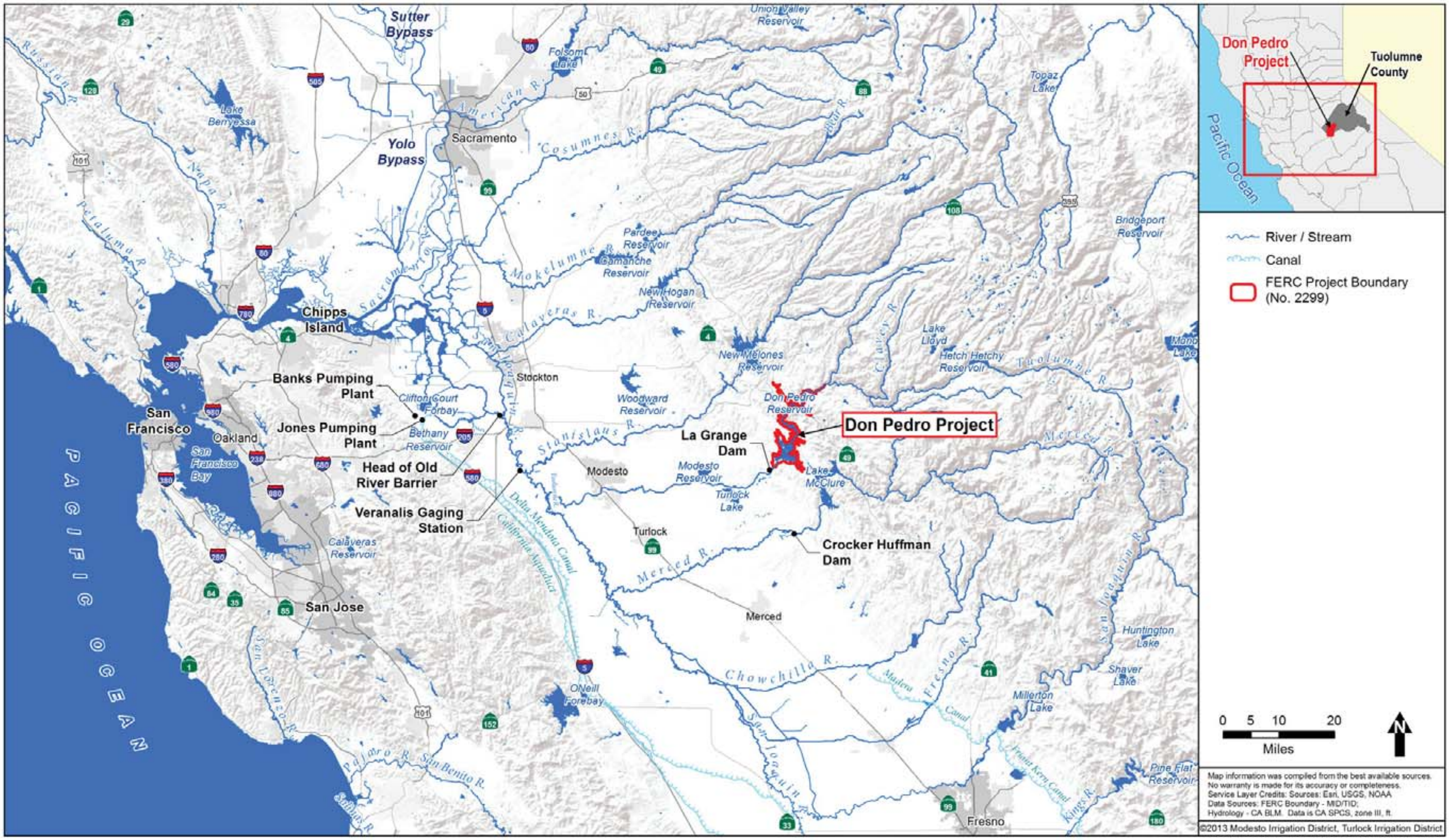

Figure 4.1-1. Map of the San Joaquin River basin and Delta.

4.1.2 Don Pedro Hydroelectric Project

4.1.2.1 Proposed Action

The Proposed Action under review by FERC is the issuance of a new license to the Districts to authorize the continued generation of hydroelectric power at Don Pedro Dam. As such, and as described in FERC's Scoping Document 2 (SD2) issued on July 25, 2011, any measures proposed to mitigate the Project's effects must be reasonably related to the purpose and need for the Proposed Action, which in this case is whether, and under what terms, to authorize the continuation of hydroelectric power generation at the Don Pedro Project.

Flow releases through the powerhouse from Don Pedro Reservoir are scheduled based on requirements for (1) flood flow management, including pre-releases in advance of anticipated high flows during wet years, (2) the Districts' irrigation and M&I demands, including flows to maintain water storage in Turlock Lake and Modesto Reservoir, and (3) protection of aquatic resources in the lower Tuolumne River in accordance with the terms of the FERC license. Once the weekly and daily flow schedules are established based on these demands, outflows from the Don Pedro powerhouse are scheduled to deliver these flows. During periods of on-peak electrical demand, daily outflows may be shaped to generate more electricity during on-peak periods and less during off-peak periods, subject to meeting the requirements of the pre-established flow schedule and the physical constraints of the Districts' irrigation systems. In accordance with the Districts' "water-first" policy, flow releases are scheduled around the three requirements listed above, then delivered via the generation units up to their capacity and availability. Hydroelectric generation at the Don Pedro Project is a secondary consideration with respect to flow scheduling.

Issuance of a new FERC license will allow the Districts to continue generating electricity at the Project for the term of the new license, producing low-cost electric power from a non-polluting, renewable resource. Clean, renewable hydropower generation is a valuable benefit of the Project. The average annual generation from the Project from 1997 to 2012 was 622 million kilowatt hours (kWh) of electricity. The current maximum hydraulic capacity of the four turbines is approximately 5,500 cfs, and the current FERC-authorized capacity is 168 MW.

The electricity generated at the Project is important to the State of California. The California Energy Commission (CEC) issued an Updated California Energy Demand Forecast 2011–2022 in May 2011. The report presented an update to the 2009 California Energy Demand electricity forecast adopted for the 2009 Integrated Energy Policy Report in December 2009. The updated forecast was meant to provide the CEC's best estimate of the effect of economic conditions on energy demand since the 2009 forecast was published. The updated forecast presents low, mid, and high forecasts for the state; average annual growth rates for consumption for 2010–2022 are 1.13 percent, 1.28 percent, and 1.53 percent, respectively (CEC 2011).

4.1.2.2 Independent Primary Purposes of the Don Pedro Project

Water storage and releases for the Don Pedro Project's primary purposes, i.e., irrigation, M&I uses, the City and County of San Francisco's (CCSF) water bank, and flood control in cooperation with the ACOE, are not dependent on the issuance of a FERC license for the Project, and would occur with or without the licensing of the Proposed Action. As such, these uses are not interrelated or interdependent with the issuance of a FERC license for hydroelectric power generation. Because the Districts are seeking a license to permit the Proposed Action, and power would be generated as it has been historically (i.e., the Proposed Action would be equivalent to the environmental baseline as defined by FERC, and there would be no effects on the lower Tuolumne River, as explained below), the non-hydropower water uses are independent actions. These independent actions contribute to cumulative effects in the Tuolumne and San Joaquin river basins but do not constitute direct or indirect effects associated with the Proposed Action.

4.1.2.3 Don Pedro Dam and Reservoir

Don Pedro Dam is a 1,900-foot-long and 580-foot-high, zoned earth and rockfill structure. The top of the dam is at 855 ft (NGVD 29). Don Pedro Reservoir extends upstream for approximately 24 miles at its normal maximum water surface elevation of 830 ft. The tailwater elevation at the outlet works tunnel is approximately 300 ft. Under normal operations of the hydroelectric units, the powerhouse tailwater elevation varies from about 300 ft to about 305 ft. Water levels in Don Pedro Reservoir have exceeded the normal maximum water level of 830 ft only once since Don Pedro Project construction, in early January 1997.

4.1.2.4 Timing and Magnitude of Flow Releases

As noted above, water is generally provided from Don Pedro Reservoir for only three reasons: (1) to provide water needed to meet the Districts' irrigation and M&I demands, (2) for flood management purposes, and (3) to provide flows required by the Project license for the benefit of aquatic resources in the lower Tuolumne River. In general, reservoir operations follow a relatively consistent annual cycle of water management for flood control, capturing runoff from snowmelt and seasonal rainfall, and delivery of water to serve the purposes identified above. Don Pedro Project operations must consider potential water availability over the course of multiple years, so that even in drier years the reservoir can retain a water supply to provide for consumptive use and resource protection.

Flows released at Don Pedro Dam to meet the Districts' irrigation and M&I water demands are all diverted from the Tuolumne River at La Grange Diversion Dam to the TID and MID canal systems. The Districts possess senior water rights in the Tuolumne River. Diversions for irrigation purposes can occur year-round, but generally occur from late February to early November. From 1971 to 2012, the average annual water diversion at La Grange Diversion Dam to the Districts' canals was approximately 900,000 AF for irrigation and M&I purposes.

ACOE guidelines call for making 340,000 AF of storage available in Don Pedro Reservoir for management of high-flow conditions. ACOE contributed financially to the construction of Don Pedro Dam to acquire this flood reservation. Flows released at Don Pedro Dam to comply with the ACOE flood management guidelines consist of both pre-releases in anticipation of high runoff and releases during periods of high runoff. Both of these release scenarios occur to balance reservoir levels, forecasted runoff, and downstream flows. "High" river flows can be defined as any flows released that are greater than those needed for irrigation and M&I purposes and protection of aquatic resources. Flow releases for high-flow management may occur from November to July, and from February to July these releases must also consider water supply needs for consumptive use purposes. High flows in the Tuolumne River upstream of the Don Pedro Project are affected by operation of CCSF's Hetch Hetchy system.

The resulting water elevations and water velocities in the lower Tuolumne River during high-flow releases are affected by past and present in-channel and floodplain mining, levee construction and maintenance, agricultural development on the floodplain, and urban development and encroachment, particularly in the Modesto area.

In addition to flood storage reservation within the reservoir, downstream flow restrictions also affect Don Pedro Project operations from a flood management perspective. The primary downstream flow guideline cited in the 1972 ACOE Flood Control Manual is that flow in the Tuolumne River at Modesto (as measured at the 9th Street Bridge) should generally not exceed 9,000 cfs. Flows in excess of 9,000 cfs have the potential to cause significant damage to property in this area of the Tuolumne River, while also potentially contributing to flood flows in the San Joaquin River. If a large volume of water that could result in releases higher than 9,000 cfs is forecasted, pre-flood releases may be made at Don Pedro Dam to reduce the risk of having to release greater flows at a later time.

Between La Grange Diversion Dam and 9th Street in Modesto, the single largest contributor of local flow to the Tuolumne River is Dry Creek. The Dry Creek watershed has its headwaters in the foothills just northwest of the Don Pedro Project. It is a flashy watershed, and once its soil is saturated rainfall events can result in rapid runoff. High flows, about 6,000 cfs or higher, can occur when significant rainfall occurs between Modesto and the upper end of the Dry Creek watershed. Because Dry Creek flows enter the Tuolumne River upstream of the USGS's 9th Street gage, they must be taken into account when making releases from Don Pedro Reservoir to the lower river to avoid exceeding the 9,000 cfs limit.

CCSF participated financially in the construction of the current Don Pedro Dam. In return for this financial participation, CCSF obtained up to 570,000 AF of water banking privileges in Don Pedro Reservoir, which has allowed CCSF to improve water supply management for its Bay Area water users. CCSF pre-releases water from its upstream facilities into the water bank in Don Pedro Reservoir so at other times it can hold back an equivalent amount of water that would otherwise have to be released to satisfy the Districts' senior water rights. Once the water enters Don Pedro Reservoir, it belongs to the Districts, which then have unrestricted entitlement to its use.

The FPC's 1964 decision set normal-year flow releases of 123,210 AF from the Don Pedro Project for fish protection during the first 20 years of the Don Pedro Project's existence. The decision also required the Districts to conduct studies that could be used to develop future fisheries requirements. FERC's 1996 order (FERC 1996) amending the Don Pedro Project license required the incorporation of the lower Tuolumne River minimum flow provisions contained in the 1995 Settlement Agreement between the Districts, CCSF, resource agencies, and environmental groups. The revised minimum flows in the lower Tuolumne River vary from 50 to 300 cfs depending on water year hydrology and time of year. The water year classifications are re-calculated each year to maintain approximately the same frequency distribution of water year types.

The settlement agreement and license order also specify certain pulse flows for the benefit of upstream migrating adult salmon and downstream migrating juveniles, the amount of which also varies with water year type. The downstream flow schedule provided for by the settlement agreement and subsequent FERC order is shown in Table 4.1.-2. Under certain circumstances, the Districts and CCSF share responsibility for meeting FERC license requirements in the lower Tuolumne River downstream of the Don Pedro Project.

4.1.2.5 Hydroelectric Power Production

As noted in Section 4.1.2.1, electric power is generated at the Don Pedro Project using flows released to satisfy the Don Pedro Project's independent, primary purposes (i.e., irrigation and M&I releases and flood management) and to provide flows to the lower Tuolumne River for the benefit of aquatic resources. Water deliveries and high-flow releases are pre-scheduled based on forecasted demands and actual projected inflows and then released through the powerhouse up to its hydraulic capacity. Scheduling of these releases is shaped, consistent with water supply requirements and physical constraints of the Districts' irrigations systems, to release flows with a preference for on-peak rather than off-peak hours during periods of high electrical demand.

4.1.2.6 Other Don Pedro Project-Related Actions

4.1.1.1.1 Recreation and Shoreline Protection at Don Pedro Reservoir

Don Pedro Reservoir is a popular recreation location providing about 400,000 user-days of recreation each year to mostly local and regional users. Recreation at the Don Pedro Project is well-managed and limited to the reservoir proper. The Districts' land use policy, implemented through the DPRA, prohibits shoreline disturbances such as dredging, docks, moorings, piers, or developed improvements of any kind. DPRA rules prohibit all off-road vehicle use on Don Pedro Project lands and restrict motorized boat access to designated boat launches. These and other rules ensure that over 90 percent of the reservoir shoreline remains in its natural condition. Recreational activities and facilities associated with the Don Pedro Project are independent of the Proposed Action, i.e., they would occur even in the absence of hydroelectric generation.

4.1.1.1.2 Herbicide and Pesticide Applications near Don Pedro Reservoir

The DPRA applies herbicides to certain areas in the Don Pedro Project area. Pre- and post-emergent herbicides are used to treat invasive plants at campsite pads and road edges. Other areas treated with herbicides include locations surrounding wastewater treatment facilities, wastewater ponds, shoreline trails and firebreaks, immediate areas around DPRA structures, immediate areas around shoreline restrooms, and semi-developed dispersed camping pads. Although rarely used, DPRA sometimes apply a rodenticide in early spring or late fall to control ground squirrels around developed recreation facilities. Application of these herbicides and rodenticide is independent of the Proposed Action, i.e., it would occur even in the absence of hydroelectric generation.

Table 4.1-2. Schedule of flow releases from the Don Pedro Project to the lower Tuolumne River by water year type contained in FERC's 1996 order.

Schedule	Units	# of Days	Critical and Below	Median Critical[1]	Interm. CD	Median Dry	Interm. D-BN	Median Below Normal	Interm. BN-AN[1]	Median Above Normal	Interm. AN-W	Median Wet/Max
Occurrence	%		6.4%	8.0%	6.1%	10.8%	9.1%	10.3%	15.5%	5.1%	15.4%	13.3%
October 1-15	cfs	15	100	100	150	150	180	200	300	300	300	300
	AF		2,975	2,975	4,463	4,463	5,355	5,950	8,926	8,926	8,926	8,926
Attraction Pulse	AF		none	none	None	none	1,676	1,736	5,950	5,950	5,950	5,950
October 16-May 31	cfs	228	150	150	150	150	180	175	300	300	300	300
	AF		67,835	67,835	67,835	67,835	81,402	79,140	135,669	135,669	135,669	135,669
Outmigration Pulse Flow	AF		11,091	20,091	32,619	37,060	35,920	60,027	89,882	89,882	89,882	898
June 1-Sept 30	cfs	122	50	50	50	75	75	75	250	250	250	250
	AF		12,099	12,099	12,099	18,149	18,149	18,149	60,496	60,496	60,496	60,496
Volume (total)	AF	365	94,000	103,000	117,016	127,507	142,502	165,003	300,923	300,923	300,923	300,923

[1] Between a Median Critical Water Year and an Intermediate Below Normal-Above Normal Water Year, the precise volume of flow to be released by the Districts each fish flow year is to be determined using accepted methods of interpolation between index values.

Source: FERC 1996.

4.1.3 Non-Don Pedro Project In-Basin Actions

The first dam built on the Tuolumne River, Wheaton Dam, was constructed in 1871 near the current location of La Grange Diversion Dam at approximately RM 52.2. There are currently a number of dams in the mainstem Tuolumne River and its tributaries, some of which are used for storage and others that are primarily diversion dams. Table 4.1-3 lists the owners of the dams in the Tuolumne River basin and the capacities of their associated impoundments, if known. Table 4.1-4 provides information on known hydropower facilities in the Tuolumne River basin, including both small and conventional hydroelectric generation facilities. Completion dates for select impoundments are also provided in Table 4.1-3.

Table 4.1-3. Owners and capacities of dams or diversion facilities and their associated reservoirs in the Tuolumne River basin.

Owner	FERC Project No.	Stream	Dam or Diversion Dam	Reservoir or Impoundment Name (date completed)	Capacity (AF)
CCSF	None	Tuolumne River	O'Shaughnessy Dam / diversion to Mountain Tunnel	Hetch Hetchy Reservoir (1923)	360,360 (USGS 1999)
CCSF	None	Eleanor Creek	Eleanor Dam	Lake Eleanor (1918)	26,146 (USGS 1999)
CCSF	None	Cherry Creek	Cherry Dam	Cherry Lake (1956)	274,2520 (USGS 1999)
CCSF	None	Tuolumne River	Early Intake (facility only used by CCSF for infrequent diversion from Cherry watershed)	n/a (1924)	<100
CCSF	None	Off-stream	Priest Dam	Priest Forebay (1923)	1,500
CCSF	None	Off-stream (Moccasin Creek and all local runoff diverted under or around impoundment)	Moccasin Dam	Moccasin Afterbay	Approx. 500
Private	None	Big Creek	Pine Mountain Dam	Pine Mountain Lake (1969)	7,700 (USGS 1999)
Private	None	Sullivan Creek (receives diversion from SF Stanislaus River)	Phoenix Dam	Phoenix Lake (1880)	612 (USGS 1999)
TID MID	2299	Tuolumne River	Don Pedro Dam	Don Pedro Reservoir	2,033,000
TID MID	None	Tuolumne River	La Grange Diversion Dam	La Grange Pool	100
MID	None	Off-stream	Modesto Reservoir Dam	Modesto Reservoir (1911)	28,000
TID	None	Off-stream	Turlock Lake Dam	Turlock Lake (1914)	48,000
TID	None	Off-stream	Dawson Dam	Dawson Lake	Unknown

Source: USGS 1999; CCSF 2006.

Table 4.1-4. Hydropower generation facilities in the Tuolumne River watershed.

Owner	FERC Project No.	Powerhouse	Location / Description
CCSF	None	Robert C. Kirkwood Powerplant	124 MW; Completed 1967; water diverted from Hetch Hetchy Reservoir to powerhouse via Canyon Tunnel (CCSF 2006)
CCSF	None	Dion R Holm Powerplant	169 MW; Completed 1960; water diverted from Lake Lloyd via Cherry Power Tunnel (CCSF 2006)
CCSF	None	Moccasin Powerhouse (off-stream)	110 MW; water diverted to powerhouse via CCSF Mountain Tunnel by way of Priest Forebay (CCSF 2006)
MID TID	2299	Don Pedro Powerhouse	Immediately downstream of Don Pedro Dam; 4 units, authorized capacity 168 MW.
TID	None	La Grange Powerhouse	4.5 MW Powerhouse; water source is TID Upper Main Canal.
TID	4450	Dawson Power Plant (off-stream)	5.5 MW; Small hydro located on TID Upper Main Canal between La Grange Diversion Dam and Turlock Lake
TID	3261	Turlock Lake (off-stream)	3.3 MW; Small hydro located at the outflow of TID's Turlock Lake
MID	290	Stone Drop (off stream)	230 kW; small hydro located on the MID main canal just below Modesto Reservoir
TID	1000	Hickman (off stream)	1,100 kW, first built 1979 on the TID Main Canal

4.1.3.1 Dam and Reservoir Operations Upstream of the Don Pedro Project

CCSF's Hetch Hetchy Water and Power Division maintains and operates several reservoirs in the middle-elevation band of the Tuolumne River watershed upstream of the Don Pedro Project, including CCSF's Cherry Lake (elevation 4,700 ft), Lake Eleanor (elevation 4,660 ft), and Hetch Hetchy Reservoir (elevation 3,800 ft) (CCSF 2006). These projects provide storage for water supply and also generate hydroelectric energy. CCSF stores and diverts water from the upper Tuolumne River for use outside the Tuolumne River basin. CCSF provides potable water to approximately 2.6 million Bay Area residents and serves much of the Bay Area's commercial, manufacturing, and industrial enterprises. The Hetch Hetchy system includes the San Joaquin Pipeline, which transports about 85 percent of CCSF's total water supply. The Hetch Hetchy system is an indispensable component of the welfare and economy of the Bay Area. The Hetch Hetchy system also produces about 1,700,000 MWh of renewable hydroelectric energy in an average year. The maximum rate of diversion from the upper Tuolumne River to the San Francisco Bay Area is about 465 cfs. The historical average annual diversion is about 250,000 AF, or about 13 percent of the average annual runoff.[1]

Another user of water in the upper Tuolumne River is CDFW, which operates the Moccasin Fish Hatchery below CCSF's Moccasin Reservoir, a 505-AF water supply reservoir. Flow to the hatchery is estimated to be about 15 million gallons per day (23 cfs) or about 11,000 AF per year. Water from the hatchery is discharged into Moccasin Creek, which flows into Don Pedro Reservoir. Water from Moccasin Reservoir also feeds CCSF's Foothill Tunnel, which delivers water to the San Joaquin Pipelines.

[1] For the period 1987 - 2012.

4.1.3.2 Dam and Reservoir Operations Downstream of the Don Pedro Project

Water released through the Don Pedro powerhouse or outlet works discharge into the Tuolumne River and about one mile downstream enters the La Grange pool. At La Grange Diversion Dam, an irrigation diversion dam owned by the Districts, water is diverted into MID's canal system on the north side of the Tuolumne River and into TID's canal system on the south side of the river. Flows greater than the Districts' irrigation and M&I needs continue on to the lower Tuolumne River by passing over the dam's spillway, through TID's La Grange powerhouse located off the TID main canal, or through sluice gates associated with the La Grange facilities.

La Grange Diversion Dam is located near the border of Stanislaus and Tuolumne counties at RM 52.2. Originally constructed by TID and MID between 1891 and 1893, the primary purpose of the dam is to raise the level of the Tuolumne River to permit diversion of water, by means of gravity, into the Districts' canal systems. La Grange Diversion Dam, which replaced Wheaton Dam (built by other parties in the early 1870s), was constructed at the downstream end of a narrow, steep-sided canyon. Operation of La Grange Diversion Dam results in very little fluctuation of water surface elevation in the La Grange pool. When not in spill mode (i.e., above elevation 296.5 ft, which occurs about 30 percent of the time), the pool operates between elevation 296 ft and 294 ft about 90 percent of the time. The volume of storage in this 2-ft operating band is less than 100 AF. La Grange Diversion Dam is the most downstream dam on the Tuolumne River. Flows in the lower Tuolumne River are recorded at the USGS' La Grange gage located about 0.3 miles below La Grange Diversion Dam.

4.1.3.3 Diversions Downstream of Don Pedro Project

There are 26 points of unscreened pumping diversions along the lower Tuolumne River between La Grange Diversion Dam and the San Joaquin River (with an estimated total combined withdrawal capacity of 76.6 cfs [CDWR 2013]), and four unscreened diversions along Dry Creek (Figure 4.1-2). There are numerous diversions and water exports along the San Joaquin River and in the Delta. The diversions along the lower Tuolumne River typically occur during irrigation season.

4.1.3.4 Accretion Flows

Runoff from Dry Creek, agricultural return flows, groundwater seepage, and operational spills from irrigation canals all enter the lower portion of the Tuolumne River. Average monthly accretion flows in the lower Tuolumne River range from 40 cfs to 200 cfs, with an estimated annual average accretion from water year 1970-2010 of 152 cfs (TID/MID 2013a, Attachment A).

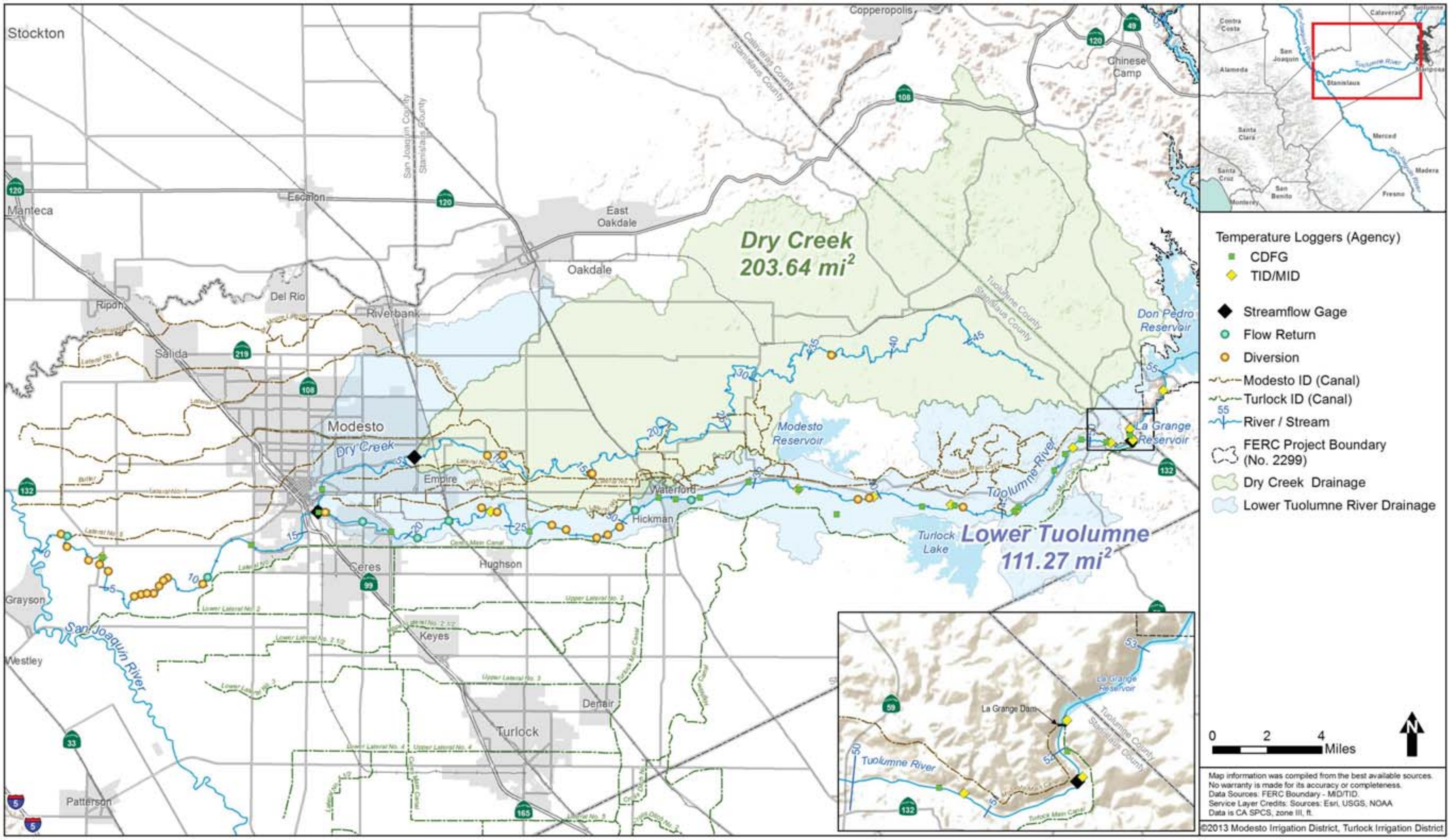

Figure 4.1-2. **Locations of diversions along the lower Tuolumne River and Dry Creek.**

4.1.3.5 Resource Extraction, Land Development, and Land Use Practices along the Tuolumne River

4.1.1.1.3 <u>In-Channel and Floodplain Mining</u>

Mining-related impacts in and along the mainstem Tuolumne River began with the California Gold Rush in 1848. The major mining camps of Sonora, Columbia, and Jacksonville were founded in 1848 and 1849. A historical timeline of mining activities in the San Joaquin River's tributaries, including the Tuolumne River, includes placer mining (1848–1880), hydraulic mining in the La Grange vicinity (1871 to about 1900), dredge mining (1908-1942, 1945-1951), and gravel and aggregate mining (1940s to present) (McBain & Trush 2000). Decades of dredge mining in the main channel of the Tuolumne River resulted in the excavation of channel and floodplain sediments, which has left a legacy of significant Tuolumne River channel modifications and dredger tailing deposits between RM 50.5 and 38.0. Gravel and aggregate mining, with their attendant floodplain modifications, continue to be conducted alongside the river corridor.

The chief mining commodities in the vicinity of the Don Pedro Project are gold and gravel. The Columbia and Springfield placer mining operations northwest of the Don Pedro Project produced approximately $55 million in gold prior to 1899 (TID/MID 2011). The pocket mines of Sonora and Bald Mountain, as well as others in their vicinity, have been highly productive and long-lived. Marble and limestone products have been second in value to gold. The Columbia marble beds northwest of the Don Pedro Project had a long history of production prior to 1941, and two plants are currently processing stone from these deposits (TID/MID 2011). From the 1860s to the 1940s, roughly 10,000 tons of chromite ore and several hundred tons of crude magnesite ore were mined in the Don Pedro Project vicinity (TID/MID 2011). Most of the chromite came from the McCormick Mine, located northwest of the Project Boundary. All magnesite production in Tuolumne County occurred in the 1920s and came from two sites in the northern portion of the Red Hills located northwest of the Don Pedro Project (TID/MID 2011).

Gold mined in Stanislaus County has come predominantly from placers. Quaternary gravels of the Tertiary lower Tuolumne River channel near Waterford were among the most productive (TID/MID 2011). In the early 1900s, large-scale dredging of Quaternary gravels began along the Tuolumne River between La Grange and Waterford, and most of the gold produced in Stanislaus County from 1932 through 1959 came from this area. In the late 1940s, gold mining declined sharply (Koschmann and Bergendahl 1968).

On the other hand, California leads the United States in aggregate production, and virtually all aggregate is removed from alluvial deposits (Kondolf 1995). As of 1994, sand and gravel mining exceeded the economic importance of gold mining in the state. Large-scale, in-channel aggregate mining began in the Tuolumne River corridor in the 1940s, when aggregate mines extracted sand and gravel directly from large pits excavated in the active river channel. Off-channel and floodplain aggregate mining along the Tuolumne River has also been extensive. Aggregate in Stanislaus County is currently classified as Aggregate Resources (potentially useable aggregate that may be mined in the future but for which no mining permit has been granted) and Aggregate Reserves (aggregate resources for which mining and processing permits have been granted) (Higgins and Dupras 1993).

An estimated 540 million tons (338 million yd^3) of aggregate resources are located in six different geographic areas of Stanislaus County (Higgins and Dupras 1993). The lower Tuolumne River corridor is the largest of the six areas and contains an estimated 217 million tons (135 million yd^3) in its channel and terraces (Higgins and Dupras 1993). The Gravel Mining Reach of the lower Tuolumne (RM 34.2 to 40.3) is currently the focus of development by commercial aggregate producers.

Much of the residual dredger tailings upstream of RM 45 were removed from the floodplain downstream of La Grange Diversion Dam as part of the construction of the new Don Pedro Dam in the 1960s. Reaches of the Tuolumne River between RM 47 and 50 that had been affected by gold dredger mining in the early 1900s were reconfigured following removal of the dredger tailings.

4.1.1.1.4 Agriculture, Livestock Grazing, and Timber Harvest

After the Gold Rush there was a substantial increase in crop production and ranching in the Central Valley (TID/MID 2013b). During this period, woody vegetation along the Tuolumne River was cleared to allow for crop production in the rich alluvial soils of the bottomlands. Levees were constructed to protect the new farmlands from flooding in spring, and irrigation canals were constructed to provide water during the growing season (Thompson 1961, Katibah 1984). Of the estimated 4 million acres of wetland that occurred historically in the Central Valley, only about 300,000 acres remained in 1990. The conversion of wetlands to agricultural uses accounts for much of this reduction in wetland area.

Land in the lower Tuolumne River watershed is primarily privately owned, including that used for agriculture and livestock grazing (Stanislaus County 2006). Primary agricultural land uses along the gravel-bedded reach include orchards, row crops (RM 24.0 - 40), and livestock grazing (RM 40 - 51) (McBain & Trush 2000).

Timber operations existed throughout the Sierra Nevada since the mid-1800s. However, the subsequent Gold Rush of 1849 fueled a human migration into California that resulted in dramatic increases in the demand for timber. The indirect effects of gold mining included steamship transportation along the major rivers of the Central Valley, which was fueled by cordwood harvested from adjacent lands, which likely resulted in the first wave of riparian forest clearing in some areas of the Tuolumne River basin (Rose 2000, as cited in McBain & Trush 2002).

In recent times, timber harvest in the Tuolumne River watershed has typically been limited to lands in the upper basin. The Yosemite Stanislaus Solutions (YSS) collaborative group was formed in December 2010 to assist the Stanislaus National Forest in developing restoration plans across the landscape regardless of ownership patterns, in the southern part of the Forest (USFS 2013). One critical area within the YSS collaborative is Hetch Hetchy Reservoir. Approximately one third of the land within the YSS boundary burned in 1987 and succeeding years. After 1987, the majority of this land was successfully reforested. The 2013 Rim Fire (which burned from August 17, 2013 through September 20, 2013) burned a total of 253,360 acres (USFS 2013); much of the burn occurred in the Tuolumne River watershed.

4.1.1.1.5 Industrial, Urban and Residential Development

Privately owned land in the lower Tuolumne River watershed is also used for rural residential purposes or for denser residential, municipal, and industrial purposes in communities such as Waterford and Modesto (Stanislaus County 2006). Many miles of river bank have been leveed and stabilized with riprap by agencies or landowners. Levees and bank revetment extend along portions of the river bank from near Modesto (RM 16) downstream to the San Joaquin River. Following the 1997 flood, some subdivisions that had been inundated in the Modesto area were found to have been constructed within the Federal Emergency Management Agency floodplain area designated prior to 1997 (TID/MID 2013b).

Four wastewater treatment plants (WWTPs), i.e., Tuolumne County Water District #1, Jamestown, Sonora, and Tuolumne contribute a little over 19 percent of the total phosphorus to the Don Pedro Reservoir. Urban runoff to the lower Tuolumne River from the Modesto area has been shown to contain pesticides (Dubrovsky et al. 1998). Fifteen pesticides were detected, and chlorpyrifos, diazinon, DCPA, metolachlor, and simazine were detected in almost every sample (Dubrovsky et al. 1998).

The CVRWQCB has issued various Cleanup and Abatement Orders for the Tuolumne River and its tributaries (TID/MID 2011). For example, in 2004, the CVRWQCB issued Order No. R5-2004-0718 for a discharger within the City of Hickman because a water retention pond at a nursery failed and caused 2,000 cubic yards of sediment and rock to enter the Tuolumne River. In 2008, the CVRWQCB issued Order No. R5-2008-0701 because two dischargers graded over 1,000 acres of land and caused significant discharges (11,200 NTU) of sediment into Peaslee Creek and the Tuolumne River. In 2009, the CVRWQCB issued Order No. R5-2009-0707 because a discharger graded over 76 acres of land and caused significant discharges of sediment into Peaslee Creek and one of its unnamed tributaries.

4.1.3.6 Fish Hatchery Practices

The following paragraphs relate to fish hatchery practices as they pertain specifically to the Tuolumne River and Don Pedro Reservoir. For a more in-depth discussion of hatchery practices in the State of California, see Section 4.1.4.8, Hatchery Practices of Exhibit E in this FLA.

Fall-run Chinook salmon are raised at five major Central Valley hatcheries, which release more than 32 million smolts each year. Due to concerns over population size and hatchery influence, the Central Valley fall/late fall-run Chinook salmon is a Species of Concern under the federal Endangered Species Act. Hatchery-origin fish contribute disproportionately to the salmon runs of the Central Valley (Barnett-Johnson et al. 2007, Johnson et al. 2011), and adipose-fin-clipped fish from hatcheries have been found in high percentages in Tuolumne River carcass surveys in some years (e.g., TID/MID 2005; TID/MID 2012, Report 2011-8). Recent studies have provided local evidence of high rates of straying into the Tuolumne River resulting from off-site hatchery releases by the Merced River Fish Facility and Mokelumne River Hatchery (Mesick 2001; ICF Jones & Stokes 2010).

CDFW manages the Don Pedro Reservoir fishery as a put-and-grow resource with substantial stocking and appropriate fishing regulations. As part of its Inland Salmon Program, CDFW generally plants rainbow trout (*O. mykiss*), kokanee (*O. nerka*), and land-locked Chinook salmon in Don Pedro Reservoir annually. Don Pedro Reservoir is also managed by CDFW as a year-round fishery for black bass. No known fish stocking has occurred in the reach of the Tuolumne River between Don Pedro Dam and La Grange Diversion Dam (TID/MID 2013d).

4.1.3.7 Freshwater Salmonid Harvest

CDFW implemented sport catch limits on salmon in the early 2000s within a portion of the Tuolumne River. Salmon fishing is currently banned in the lower Tuolumne River and San Joaquin River upstream of the Delta. No estimate of salmon lost to poaching is available (TID/MID 2013c). However, poaching of Chinook salmon, to the extent that it occurs, would likely only take place during the adult upstream migration period. No data are available that address the extent of *O. mykiss* poaching.

4.1.3.8 Non-Native Fish Species

Of the 23 non-native fish species documented in the lower Tuolumne River, 19 were introduced by state or federal agencies (CDFW, NMFS, USFWS, and the State Board of Human Health) between 1874 and 1954, and one was introduced with permission from CDFW in 1967 (Dill and Cordone 1997; Moyle 2002). The remaining three species were introduced by aquarists, catfish farms, or private individuals (Dill and Cordone 1997). Sixteen of the fish species released by state or federal agencies were introduced intentionally for sport or commercial fisheries, as a prey base for sport fish, or for mosquito control; two were introduced incidentally with shipments of sport fish (Dill and Cordone 1997). The most abundant and widespread non-native fish species in the lower Tuolumne River–bluegill, redear sunfish, and green sunfish–were first released in California between 1891 and 1954. Other introduced fish species in the lower Tuolumne River include threadfin shad, black and brown bullhead, white and channel catfish, common carp, fathead minnow, red shiner, golden shiner, goldfish, striped bass, largemouth bass, smallmouth bass, spotted bass, black and white crappie, warmouth, bigscale logperch, western mosquitofish, and inland silversides.

4.1.1.1.6 Black Bass and Striped Bass

Largemouth, smallmouth, and spotted bass (collectively black bass) were all introduced into California waters by CDFW and are now actively managed by CDFW in many locations. Largemouth and smallmouth bass were first released in California by CDFW between 1874 and 1891 (Dill and Cordone 1997; TID/MID 1992, and spotted bass were introduced in 1976. According to CDFW (2014), "Bass angling provides recreation and economic value to the state of California." Also according to CDFW (2014), "…California has been the center of attention for producing trophy-sized black bass. In a list of the top 25 largest largemouth bass caught in the U.S., 21 of the bass are from California waters." The California state record smallmouth bass is 9 pounds 13 ounces (CDFW 2014). Angler catches of Alabama spotted bass over six pounds have been verified by CDFW biologists for many California water bodies, including one spotted bass that weighed 10 pounds 4 ounces (CDFW 2014). All three species of black bass can be highly piscivorous and prey heavily on salmonids and other fish species (see below).

In 1990, largemouth bass abundance estimated for the lower Tuolumne River (RM 0.0 to RM 52.0) based on shoreline lengths was 11,074 individuals (TID/MID 1992). During 2012, the abundance of largemouth bass from RM 0.0 to RM 39.4 was estimated to be 3,323 based on shoreline length, and 3,891 based on habitat area (TID/MID 2013g). However differences in study methods between the 1990 and 2012 sampling years preclude comparison of these estimates. For largemouth bass, site-specific density estimates ranged from 0 to 218 fish per mile (collected in 1998, 1999, and 2003) (McBain & Trush and Stillwater Sciences 2006) and 4 to 196 per mile in 2012.

Smallmouth bass density estimates for the lower Tuolumne River (converted to fish per mile) from McBain & Trush and Stillwater Sciences (2006) (collected in 1998, 1999, and 2003) ranged from 2 to 97 fish per mile. In 2012, site-specific density estimates of smallmouth bass ranged from 0 to 251 fish per mile (TID/MID 2013g).

The Districts' 2012 Predation Study represented the first year that abundance estimates were produced by the Districts for smallmouth bass, largemouth bass, and striped bass, because only the abundance of largemouth bass was estimated during the 1990 study. Additional years of study are likely necessary to understand the population dynamics of these species in relation to river conditions.

There is limited information regarding the abundance of striped bass in the Tuolumne River. However, there is anecdotal evidence of large numbers of striped bass being found in the Tuolumne River as far back as 1903 (State Board of Fish Commissioners 1904). Striped bass were captured by electrofishing in the lower Tuolumne River in 1989 (TID/MID 1992) and during predator surveys in 1998, 1999, and 2003 (McBain & Trush and Stillwater Sciences 2006). The Districts' 2012 Predation Study estimated striped bass abundance in the lower river to be in the range of 500-750 individuals during summer 2012.

Average consumption rates of juvenile Chinook salmon (i.e., number of Chinook salmon per predator) by largemouth and smallmouth bass in the lower Tuolumne River (not scaled by gastric evacuation rates) ranged from 0–0.20 during the 2012 predation study (TID/MID 2013g) and from 0–1.7 in an earlier study conducted by the Districts (TID/MID 1992). In 2012, predation rates averaged for all habitat types and sampling events were 0.07 Chinook salmon per largemouth bass per day and 0.09 per smallmouth bass per day. Striped bass predation rates in the lower river were generally higher than those of smallmouth bass and largemouth bass (TID/MID 2013g). In 2012, predation rate averaged for all habitat types and sampling events was 0.68 Chinook salmon per striped bass per day.

Largemouth bass and smallmouth bass were estimated to have consumed about 37 percent and 49 percent, respectively, of the total potential juvenile Chinook salmon consumed by the three primary non-native predator species (i.e., largemouth bass, smallmouth bass, and striped bass).

Despite making up only a small fraction (< 4%) of the total of piscivore-sized fish (> 150 mm FL), striped bass were estimated to have consumed nearly 15 percent of the total potential juvenile Chinook salmon consumed by the three predator species. There was no evidence of consumption of Chinook salmon by Sacramento pikeminnow during either the 2012 study or the Districts' previous study (TID/MID 1992).

A conservative estimate of the total consumption of juvenile Chinook salmon by striped, largemouth, and smallmouth bass is about 42,000 during March 1-May 31, 2012 based on observed predation rates and estimated predator abundance. This suggests that nearly all juvenile Chinook salmon may be consumed by introduced predators between the Waterford and Grayson rotary screw traps. Only 2,268 Chinook salmon were estimated to have survived migration through the 25 miles between the screw-trapping sites (Robichaud and English 2013) during January through mid-June, making it plausible that most losses of juvenile Chinook salmon in the lower Tuolumne River between Waterford and Grayson during 2012 can be attributed to predation by non-native piscivorous fish species.

4.1.3.9 Tuolumne River Fisheries Management and Recovery Activities

4.1.1.1.7 Native Salmonid Management and Recovery Programs

The Ecosystem Restoration Program[2] is designed to improve the ecological health of the Bay-Delta watershed through restoring and protecting habitats, ecosystem functions, and native species. The Watershed Program Element specifically works in tandem with the Ecosystem Restoration Program Element to ensure that the ecological health of the Delta is restored and that water management is improved by working with communities at the watershed level.

The draft Central Valley Salmon and Steelhead Recovery Plan (NMFS 2009) addresses the Sacramento River winter-run Chinook salmon Evolutionarily Significant Unit (ESU), the Central Valley spring-run Chinook salmon ESU, and the Distinct Population Segment (DPS) of Central Valley steelhead. The draft plan describes recovery strategies, lists recovery goals, objectives, and criteria, and proposes recovery scenarios and numerous recovery actions throughout the Central Valley (see Section 4.1.4.11 of Exhibit E for greater detail regarding the plan).

The California Advisory Committee on Salmon and Steelhead Trout was established by California legislation in 1983 to develop a strategy for the conservation and restoration of salmon and steelhead in California. The committee's recommendations were advanced and discussed in the related publications described in the following four paragraphs.

The Central Valley Salmon and Steelhead Restoration and Enhancement Plan (CDFG 1990) was intended to outline CDFW's restoration and enhancement goals for salmon and steelhead resources of the Sacramento River and San Joaquin River systems and to provide direction for various CDFW programs and activities.

[2] (http://www.dfg.ca.gov/ERP)

The Restoring Central Valley Streams (CDFG 1993) plan identifies the following goals to benefit anadromous fish: restore and protect California's aquatic ecosystems that support fish and wildlife, protect threatened and endangered species, and incorporate the state legislature's mandate and policy to double the size of populations of anadromous fish in California. The plan encompasses only Central Valley waters accessible to anadromous fish, excluding the Sacramento-San Joaquin Delta.

The Steelhead Restoration and Management Plan for California (CDFG 1996) focuses on restoration of native and naturally produced (wild) fish stocks because they have the greatest value for maintaining genetic and biological diversity. Goals for steelhead restoration and management are: (1) increase natural production, as mandated by The Salmon, Steelhead Trout, and Anadromous Fisheries Program Act of 1988, so that steelhead populations are self-sustaining and maintained in good condition and (2) enhance angling opportunities and non-consumptive uses.

The Final Restoration Plan for Anadromous Fish Restoration Program (USFWS 2001) identifies restoration actions that may increase natural production of anadromous fish in the Central Valley of California. This plan is divided to address different watersheds within the Central Valley, and restoration actions are identified for each watershed. It also includes the involved parties, tools, priority rating, and evaluation of each restoration action. The plan addresses only Central Valley waters accessible to anadromous fish.

4.1.1.1.8 <u>Habitat Protection, Restoration, and Enhancement Projects</u>

The USFS Tuolumne Wild and Scenic River Management Plan was approved in 1986 and revised in 1988 (NPS 2006). The purpose of the plan is to provide "direction for managing the federal lands within the boundaries of the designated corridor." The plan addresses portions of the Tuolumne Wild and Scenic River (29 miles) outside of Yosemite National Park.

As directed under the 1995 Settlement Agreement, the TRTAC developed the following 10 top priority habitat restoration projects aimed at improving geomorphic and biological elements of the lower Tuolumne River corridor (completion status in parentheses):

- Channel and Riparian Restoration Projects (RM 34.3–RM 40.3):
- Gravel Mining Reach Phase I (Completed in 2003),
- Gravel Mining Reach Phase II (Not completed),
- Gravel Mining Reach Phase III (Not completed), and
- Gravel Mining Reach Phase IV (Not completed).
- Predator Isolation Projects:
- Special Run-Pool (SRP) 9 (RM 25.7–25.9) (Completed in 2001), and
- Special Run-Pool (SRP) 10 (RM 25.5) (Not completed).
- Sediment Management Projects (RM 47.5–RM 51.8):

- Riffle Cleaning (Fine sediment) (Not completed),
- Gasburg Creek basin (Fine sediment) (Completed prior to 2008),
- Gravel Augmentation (Coarse sediment) (Not completed), and
- River Mile 43 (Coarse sediment) (Completed in 2005).

Other restoration efforts have been implemented in the lower Tuolumne River corridor by various groups, including FOT, TRT, NRCS, ESRCD, USFWS, CDFW, Stanislaus County, and the cities of Waterford, Ceres, and Modesto. Habitat restoration projects are discussed in detail in Section 5.3.2.2 of the Districts' PAD (TID/MID 2011).

To improve salmonid spawning and rearing conditions in the lower Tuolumne River, several coarse sediment augmentation and habitat restoration projects have been completed (TID/MID 2005, from TID/MID 2013c). CDFW placed approximately 27,000 cubic yards of gravel in the river near Old La Grange Bridge (RM 50.5) from 1999 to 2003 (TID/MID 2007, Report 2006-10). Riffle and floodplain reconstruction projects have also been completed at Bobcat Flat (RM 43.5), near the site of 7/11 Materials (RM 40.3–37.7), and at Special Run Pools (SRPs) 9 and 10 (≈ RM 25.7), with designs and preliminary permitting completed for additional gravel augmentation projects at upstream locations (TID/MID 2007, Report 2006-8).

Riparian restoration projects along the Tuolumne River include Grayson River Ranch, Big Bend, SRP 9, 7/11 Mining Reach Segment #1, and River Mile 43 at Bobcat Flat. Floodplain restoration was conducted at Grayson River Ranch (located approximately 4 miles upstream of the San Joaquin River confluence) by The Friends of the Tuolumne in 2000. Anecdotal evidence indicates some recovery of riparian vegetation has occurred on the floodplain and along newly constructed sloughs. The Tuolumne River Trust and other partners acquired approximately 250 acres on both sides of the Tuolumne River at Big Bend (RM 5.8 to 7.4). Restoration was completed in 2005, and monitoring results suggest that planting to reestablish native, woody riparian species was effective. In 2001, restoration of river and floodplain habitat was completed at SRP 9 (RM 25.7 to 25.9). A brief survey conducted in 2002 indicated that tree survival typically exceeded 60 percent for most species one year after planting. In 2003, restoration of river and floodplain habitat was completed at the 7/11 site (RM 40.3 to 34.4). Post-project monitoring has been limited to quantifying survival of planted vegetation and replacing plants as stipulated in the construction contract. The Bobcat Flat restoration site includes 303 acres of riparian and instream habitat owned by Friends of the Tuolumne. Restoration was conducted in 2005–2006, and anecdotal evidence, including some site photos, indicates some success in restoration of riparian vegetation at the site.

The AMF was initiated in 2001 to review designs for restoration projects in Central Valley rivers and assist resource agencies and tributary restoration teams. The AMF panel of technical experts reviewed and made recommendations on tributary restoration projects, incorporating adaptive management into projects, and maximizing restoration success (Adaptive Management Forum Scientific and Technical Panel and Information Center for the Environment 2004).

As noted above, The Ecosystem Restoration Program[3] is designed to improve the ecological health of the Bay-Delta watershed through restoring and protecting habitats and ecosystem functions.

4.1.4 Non-Don Pedro Project Out-of-Basin Actions

The San Joaquin River originates in the high Sierra Nevada range, flows northward, and enters the legally-defined Delta near the USGS Vernalis gaging station (RM 73) (see Figure 4.1-1). The drainage area of the San Joaquin River above the Vernalis gage is 13,539 mi^2. The average annual flow at Vernalis was 3.26 million AF from WY 1924 through WY 2012 (3.19 million AF for WY 1971–WY 2012). The three main tributaries to the San Joaquin River above Vernalis are the Merced (drainage area 1,726 mi^2), Tuolumne (drainage area 1,960 mi^2), and Stanislaus (drainage area 1,075 mi^2) rivers.

The Sacramento and San Joaquin rivers meet at the western boundary of the Sacramento-San Joaquin Delta. Freshwater from the rivers mingles with saltwater from the Pacific Ocean, creating the West Coast's largest estuary. Under historical conditions, the south Delta and lower San Joaquin River were composed of tidal wetlands merging southward into floodplain wetlands interspersed with complex side-channel habitats, lakes, and ponds, with seasonal wetlands bordering upland habitats (Whipple et al. 2012). As summarized by Lund et al. (2007), the present day Delta encompasses about 60,000 acres of open water (exclusive of Suisun Bay), 520,000 acres of agricultural lands, 64,000 acres of towns and cities, and 75,000 acres of undeveloped areas.

For the purposes of documenting out-of-basin actions within the FERC-defined geographical scope for cumulative effects assessment, the following sections focus on water management and other past, present, and reasonably foreseeable actions in the lower San Joaquin River basin, including the mainstem San Joaquin River below Friant Dam, two of the three major San Joaquin River tributaries, i.e., the Merced and Stanislaus rivers (actions on the Tuolumne River have been discussed previously in sections 4.1.2 and 4.1.3), and the Delta.

4.1.4.1 CCSF Regional Water System

The CCSF, through the SFPUC, owns and operates a regional water system that extends from the Sierra Nevada to San Francisco and serves retail and wholesale customers in San Francisco, San Mateo, Santa Clara, Alameda, and Tuolumne Counties. The regional water system consists of water conveyance, treatment, and distribution facilities. The regional system includes over 280 miles of pipelines, over 60 miles of tunnels, 11 reservoirs, five pump stations, and two water treatment plants. The source of the water supply is a combination of local supplies from streamflow and runoff in the Alameda Creek watershed and in the San Mateo Creek and Pilarcitos Creek watersheds (referred to together as the Peninsula watersheds), along with imported supplies from the Tuolumne River watershed. Local watersheds provide about 15 percent of total supplies, with the Tuolumne River providing the remaining 85 percent.

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[3] (http://www.dfg.ca.gov/ERP)

The SFPUC serves about one-third of its water supplies directly to retail customers, primarily in San Francisco, and about two-thirds of its water supplies to wholesale customers by contractual agreement. The wholesale customers are largely represented by the Bay Area Water Supply and Conservation Agency (BAWSCA), which consists of 26 member agencies in Alameda, San Mateo, and Santa Clara Counties. Some of these wholesale customers have other sources of water in addition to what they receive from the SFPUC, while others rely completely on the SFPUC for supply.

4.1.4.2 Central Valley Project and State Water Project

The development and management of California's surface water is a process that has spanned decades and has involved the participation of private companies and local, state, and federal agencies (CDWR et al. 2013). Irrigated agriculture in the San Joaquin Valley proliferated after the Gold Rush and again in 1857, when the California State Legislature passed an act to promote the drainage and reclamation of floodplains (Galloway and Riley 1999). By 1900, much of the flow of the Kern River and all flow from the Kings River were diverted and routed through canals and ditches to irrigate fields in the southern part of the San Joaquin Valley (Nady and Laragueta 1983, as cited in Galloway and Riley 1999). Because early diversions did not have associated storage facilities, agricultural water supply was limited by low summer flows.

By 1910, almost all available surface water in the San Joaquin Valley was diverted, which led to the development of groundwater for irrigation (Galloway and Riley 1999). The first groundwater development took place in areas where shallow groundwater was abundant, particularly in the central part of the valley where flowing wells were common. When the output from the flowing wells declined, pumps were installed to maintain flows. Around 1930, the development of an improved deep-well turbine pump, along with a reliable electrical supply in rural areas, allowed for further groundwater development.

The cities of Los Angeles and San Francisco began to have water shortages early in the 1900s. They recognized the need to augment local water supplies and were the first to develop distant water sources for this purpose. As California's population grew, existing projects could not meet the demand for water. As a result, the federal CVP and the California SWP were initiated in 1937 and 1957, respectively (CDWR et al. 2013). These two major statewide projects were developed to serve agricultural, environmental, and municipal water users throughout California.

The SWP and CVP water infrastructure is operated in a coordinated manner, with joint points of diversion that allow one project to use the other's diversion facility under certain conditions (CDWR et al. 2013). To some degree, both the SWP and CVP systems rely on runoff and upstream reservoir releases from the Sacramento and San Joaquin River basins to deliver contracted water via the Sacramento and San Joaquin Delta export pumps located in the south Delta to deliver water to project customers. The CDWR exports water through the Harvey O. Banks Pumping Plant (Banks pumping plant, completed in 1968), which supplies the California Aqueduct. The USBR exports water into the Delta-Mendota Canal (completed in 1951) through the C. W. "Bill" Jones Pumping Plant (Jones pumping plant, completed in 1951). The history and structure of the CVP and SWP facilities are described in the following subsections.

4.1.1.1.9 Central Valley Project

The CVP is the largest water supply project in the United States. It includes 18 reservoirs with a combined storage capacity of more than 11 million AF, 11 hydroelectric power plants, and more than 500 miles of major canals and aqueducts (CDWR et al. 2013). The USBR operates and maintains the CVP as an integrated project and coordinates operations with the SWP. Authorized project purposes include flood management; navigation; water supply for irrigation and domestic uses; fish and wildlife protection, restoration and enhancement; and power generation. However, not all facilities are operated to meet each of these purposes. The USBR has entered into approximately 250 long-term contracts with water districts, irrigation districts, and others for delivery of CVP water. Currently, there are eight divisions of the project and 10 corresponding units. Of the contracted water supply, approximately 70 percent goes to agricultural users, almost 20 percent is dedicated to fish and wildlife habitat, and nearly 10 percent is allocated to M&I water users (USBR 2011). In addition to water storage and regulation, the system has a hydroelectric capacity of over 2,000 MW, provides recreation, and enables flood control with its dams and reservoirs.

There are five CVP divisions/units south of the Delta in the San Joaquin River basin: Friant Division, New Melones Unit, San Luis Unit, San Felipe Division, and Hidden Unit on the Chowchilla and Fresno rivers (described below).

Friant Division[4]

The Friant Division transports surplus water from northern California through the southern part of the Central Valley. The major facilities of this division are Friant Dam, Friant-Kern Canal, and Madera Canal, all constructed and operated by the USBR.

Friant Dam, located on the San Joaquin River 25 miles northeast of Fresno, was completed in 1942. The dam is a concrete gravity structure, 319 feet high, with a crest length of 3,488 ft. The dam controls San Joaquin River flows, provides downstream releases to meet water requirements above Mendota Pool, provides flood control and conservation storage, provides diversion into the Madera and Friant-Kern Canals; prevents saltwater from degrading thousands of acres of lands in the Delta, and delivers water to 1 million acres of agricultural lands in Fresno, Kern, Madera, and Tulare Counties. The reservoir, Millerton Lake, which first stored water in 1944, has a total capacity of approximately 520,500 AF, a surface area of 4,900 acres, and an approximate length of 15 miles.

Friant Dam`s spillway was designed to pass flood water into Millerton Lake. However, due to frequent drought cycles in central California over the past 50 years, water has seldom spilled at Friant Dam. The outlet works consist of four steel pipes through Friant Dam that are controlled by four hollow-jet valves at the outlet ends. The capacity of the jet valves is 16,400 cfs; but flow through the valves rarely exceeds 100 cfs. Small releases are made to the river through two pipes branching from Penstocks 3 and 4.

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[4] Source: http://www.usbr.gov/projects/Project.jsp?proj_Name=Central+Valley+Project

Construction of the Friant-Kern Canal began in 1945 and was completed in 1951. The canal has an initial capacity of 5,000 cfs that gradually decreases to 2,000 cfs at its endpoint in the Kern River. The canal outlet works consist of a stilling basin and four steel pipes through the dam. The canal carries water 151.8 miles from Millerton Lake to the Kern River, 4 miles west of Bakersfield. Along a 113-mile reach between Friant Dam and the White River, the canal has more than 500 different structures, including overchutes, drainage inlets, irrigation crossings, and turnouts. The water is used for supplemental and new irrigation supplies in Fresno, Tulare, and Kern Counties.

The 35.9-mile-long Madera Canal carries water north from Millerton Lake to lands in Madera County to provide supplemental and new irrigation supply. The canal, which was completed in 1945, has an initial capacity of 1,250 cfs, which decreases to 625 cfs at the Chowchilla River. The outlet works consists of two pipes that discharge into a stilling basin at the upstream end of the Madera Canal. Water ran for the first time through the canal's entire length on June 10, 1945. The John A. Franchi Diversion Dam, formerly the Madera Diversion Dam, on the Fresno River, is operated by the Madera Irrigation District. Built by the USBR, the facility was completed in 1964.

In 1947, riparian landowners sued the United States government under the California Fish and Game Code, stating that Friant Dam deprived them of commercial and recreational uses related to salmon fishing. The State Attorney General concluded the United States was not required by California law to discharge water to preserve fisheries downstream of the dam. In 1988, when first contracts for the Friant Division came up for renewal, 15 environmental groups sued the federal government, maintaining that contract renewals should be subject to environmental review under NEPA and the ESA. The lawsuit culminated in the signing of the San Joaquin River Restoration Settlement Act and development of the associated San Joaquin River Restoration Program (see Section 4.1.4.11).

Hidden and Buchanan Units

The Hidden and Buchanan Units, located on the Chowchilla and Fresno Rivers, provide flood control and water supply to the Chowchilla and Madera irrigation districts. The Hidden Unit provides 24,000 AF annually from Hensley Lake to the Madera Irrigation District, and the Buchanan Unit provides 24,000 AF annually from Eastman Lake to the Chowchilla Water District.

New Melones Unit[5]

The New Melones Dam and Power Plant are located on the Stanislaus River, about 60 miles upstream of its confluence with the San Joaquin River. The dam is a 625-foot-high earth and rockfill structure that impounds New Melones Lake, which has a capacity of 2.4 million AF at a pool elevation of 1,088.0 ft. Construction of the New Melones Dam project began in 1966, about 0.75 miles downstream of the original Melones Dam, which was built by the Oakdale and South San Joaquin Irrigation Districts in 1926. Construction of the diversion tunnel was

[5] Source: http://www.water.ca.gov/swp/swptoday.cfm

completed in 1973. Construction of the main dam began in 1974, and initial filling of the reservoir took place in 1983.

The outlet works consist of a 3,774-foot-long, 23-foot-diameter tunnel and two conduits for emergency releases. Releases for flood control and irrigation are made through a branch of the multipurpose tunnel. The outlet works have a capacity of 8,300 cfs. The spillway has an uncontrolled concrete crest, with a capacity 112,600 cfs. The New Melones Power Plant, located immediately downstream of the dam, has a dependable capacity of about 279 MW, producing about 455 million KWh of energy annually. The New Melones Unit was officially transferred to the USBR in 1979 for integrated operation as part of the CVP.

An original purpose of the New Melones Dam was flood control. New Melones Lake includes a flood control reservation of 450,000 AF. Under flood control conditions, release operations are designed not to exceed a flow of 8,000 cfs (channel capacity) in the Lower Stanislaus River from Goodwin Dam downstream to the San Joaquin River. Unit operations provide releases for downstream fisheries requirements, water quality, water rights, and a water supply yield estimated at about 180,000 AF to meet present and projected agricultural and M&I needs in the service area.

Water availability for the New Melones Project has proven to be significantly different from what had originally been expected. The USBR found that previous modeled estimates of drought and demand were significantly inaccurate. As a result, contracts negotiated with the Stockton East Water District and the Central San Joaquin Water Conservation District have not always been met during drought years, and the USBR has had to purchase water from the Tri-Dam Project to meet the release requirements for the fall Chinook salmon run.

When the lake levels are lower, the old Melones Dam, which is now submerged, prevents cold water at the bottom of the lake from reaching the outlet works of the new dam, resulting in temperatures that are too high for salmonids downstream of the dam. The situation becomes most critical when the volume of the lake drops below 350,000 AF.

San Luis Unit[6]

Authorized in 1960, the San Luis Unit was constructed by the USBR and the State of California. It is now jointly operated by the USBR and State of California, with some facilities operated by Westlands Water District (see below).

The joint-use facilities of the San Luis Unit include O'Neill Dam and Forebay, B.F. Sisk San Luis Dam and Reservoir, William R. Gianelli Pumping-Generating Plant, Dos Amigos Pumping Plant, Los Banos and Little Panoche reservoirs, and San Luis Canal from O'Neill Forebay to Kettleman City, together with the associated switchyard facilities. The federal/private facilities include the O`Neill Pumping Plant and Intake Canal, Coalinga Canal, Pleasant Valley Pumping Plant, and the San Luis Drain.

[6] Source: http://www.water.ca.gov/swp/swptoday.cfm

Los Banos (completed in 1965) and Little Panoche (completed in 1966) detention dams are located southwest of the town of Los Banos on Los Banos and Little Panoche Creeks, respectively. B.F. Sisk Dam and Reservoir, a 382-foot-tall zoned earthfill structure located on San Luis Creek near Los Banos, were completed in 1967. The reservoir has a capacity of 2,041,000 AF. O'Neill Dam, an 87-foot-high zoned earthfill structure located on San Luis Creek about 2.5 miles downstream of San Luis Dam, was completed in 1967. The O'Neill Pumping Plant was also completed in 1967. The William R. Gianelli Pumping-Generating Plant, located at San Luis Dam, was completed in 1967. The San Luis Canal, the largest earth-moving project in USBR history, extends 102.5 miles from the O'Neill Forebay to a location west of Kettleman City. Water was first released into the canal in 1967. The Dos Amigos Pumping Plant is located 17 miles south of the O'Neill Forebay.

The Pleasant Valley Pumping Plant, operated by Westlands Water District, lifts water at an intake channel leading from the San Luis Canal at mile 74. Coalinga Canal, also operated in part by Westlands Water District, extends from the turnout structure on the San Luis Canal to the Coalinga area in Fresno County. Construction of the San Luis Drain, designed to convey and dispose of subsurface irrigation return flows from the San Luis service area, began in April 1968. Construction was halted in 1975 because of high costs and concerns about the quality of the agricultural drainage that would enter the Delta.

San Luis Reservoir serves as the primary storage reservoir, and O'Neill Forebay serves as an equalizing basin for the pumping-generating plant. Pumps at the base of O'Neill Dam take water from the Delta-Mendota Canal through an intake channel and release it into the O'Neill Forebay. The California Aqueduct flows directly into O'Neill Forebay. The pumping-generating units take water from the O'Neill Forebay and discharge it into the main reservoir. When not pumping, the units generate electric power by reversing flow through the turbines. Water used for irrigation is discharged into the San Luis Canal and flows via gravity to Dos Amigos Pumping Plant, where it is elevated to allow for gravity flow to its terminus at Kettleman City.
A state canal system extends to southern coastal areas. During the irrigation season, water from the California Aqueduct flows through O'Neill Forebay into San Luis Canal rather than being pumped into San Luis Reservoir. Two reservoirs, Los Banos and Little Panoche, are used to control cross drainage along the San Luis Canal and also provide flood control benefits. B.F. Sisk Reservoir is used to store surplus water of the Sacramento-San Joaquin Delta. A hydraulic junction for federal and state waters, B. F. Sisk Reservoir acts as a forebay for the Gianelli Pumping-Generating Plant. The primary purpose of the federal portion of the San Luis Unit facilities is to furnish approximately 1.25 million AF of water to supplement irrigation supply to approximately 600,000 acres in western Fresno, Kings, and Merced counties.

San Felipe Division[7]

Initial authorization for construction of elements of the San Felipe Division occurred in 1960, and the division was fully authorized in 1967. Construction began in 1964 and was completed in 1987. The division consists of the Pacheco Tunnel, 48.5 miles of closed conduits, the Pacheco and Coyote pumping plants, San Justo Dam and Reservoir, and two associated switchyards. The

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[7] Source: http://www.water.ca.gov/swp/swptoday.cfm

Santa Clara Valley Water District (SCVWD) manages the Santa Clara Tunnel and Conduit, Pacheco Tunnel and Conduit, and Pacheco and Coyote Pumping Plants. The Western Area Power Administration (WAPA) manages Pacheco Switchyard, and San Benito County Water District (SBCWD) manages San Justo Dam and Reservoir and Hollister Conduit.

Water from the Delta is transported through the Delta-Mendota Canal to O'Neill Forebay (see San Luis Unit, above), pumped into San Luis Reservoir, and then diverted through the Pacheco Tunnel Reach 1 to the Pacheco Pumping Plant. At the pumping plant, water is lifted to the Pacheco Tunnel Reach 2. The water flows through the tunnel and the 7.92-mile-long Pacheco Conduit, which extends to the bifurcation of the Santa Clara and Hollister conduits. The 22-mile-long Santa Clara Tunnel and Conduit convey water from the Pacheco conduit to the Coyote Pumping Plant, which is located at the end of the Santa Clara Conduit, near Anderson Dam. The 19.5-mile-long Hollister Conduit extends from the Pacheco Conduit to San Justo Reservoir. San Justo Dam, located about 3 miles southwest of Hollister, is a 151-foot-high earthfill structure that impounds a reservoir with a capacity of 9,785 AF.

The primary recipients of water from the San Felipe Division are municipal and industrial users. The San Felipe Division provides supplemental irrigation to 63,500 acres and about 132,400 AF of water annually for municipal and industrial uses.

4.1.1.1.10 State Water Project

The SWP is a complex system composed of pumping plants, hydroelectric power plants, water storage facilities with a combined capacity of approximately 5.8 million AF, and approximately 700 miles of pipelines and canals (CDWR et al. 2013). It is the largest state-built water storage and conveyance project in the United States. The CDWR operates and maintains the SWP, which delivers water to 29 agricultural and municipal and industrial contractors in northern California, the San Joaquin Valley, the Bay Area, the Central Coast, and southern California.

SWP facilities south of the Delta in the San Joaquin River basin include the following: (1) the San Luis Area, which includes the Gianelli Pumping-Generating Plant and the Dos Amigos Pumping Plant, (2) the Coastal Branch Area, which consists of the Devil's Den, Bluestone, and Polonio Pass pumping plants and the Las Perillas and Badger Hill pumping plants, (3) the South San Joaquin Area, which includes the Buena Vista, Teerink and Chrisman, and Edmonston pumping plants, (4) the West Branch Area, which includes the Oso and Alamo pumping plants and the Warne and Castaic power plants, and (5) the East Branch Area, which includes Lake Perris, the Pearblossom Pumping Plants, and the Mojave and Devil Canyon power plants. The Gianelli Pumping-Generating Plant and Dos Amigos Pumping Plant are joint-use facilities, described above in the context of the CVP (see preceding section). The remaining facilities are described below.[8]

As noted above, water is pumped into the California Aqueduct at the Banks Pumping Plant and flows south by gravity to the San Luis Joint-Use Complex. After leaving the San Luis Joint-Use Complex, water travels through the California Aqueduct in the central San Joaquin Valley, until

[8] Source: http://www.water.ca.gov/swp/swptoday.cfm

it reaches the bifurcation near Kettleman City, which conveys a portion of the water into the Coastal Branch Aqueduct (completed in 1997) to serve San Luis Obispo and Santa Barbara counties. The water remaining in the mainstem of the California Aqueduct is pumped uphill by the Buena Vista, Teerink, and Chrisman pumping plants until it reaches Edmonston Pumping Plant (operational beginning in 1971), the SWP's largest pumping facility and the world's largest water lift. The Edmonston Plant pumps water nearly 2,000 feet up and over the Tehachapi Mountains through approximately 10 miles of tunnels. In so doing, it consumes 40 percent of the electricity used by the SWP.

As the water reaches the bottom of the mountain, it bifurcates into the West Branch and the East Branch aqueducts (the latter is the mainstem). Water in the West Branch is pumped by the Oso Pumping Plant into Quail Lake, from where it enters a pipeline leading into Warne Powerplant (operating since 1982). Water is then discharged into Pyramid Lake (Pyramid Dam was completed in 1973) and through Angeles Tunnel to the Castaic Powerplant (the latter two facilities are jointly operated by CDWR and the Los Angeles Department of Water and Power, which owns the facilities). At the end of the West Branch is Castaic Lake (Castaic Dam was completed in 1973) and Castaic Lagoon.

Water flowing down the East Branch generates power at Alamo Powerplant (completed in 1986) and is then pumped uphill by the Pearblossom Plant, from where it flows downhill through an open aqueduct, linked at its end to four underground pipelines that carry the water into the Mojave Siphon Powerplant, which discharges the water into Lake Silverwood. When water is needed, it is discharged into Devil Canyon Powerplant and its two afterbays. The 28-mile-long Santa Ana Pipeline then conveys the water underground to Lake Perris, the southernmost SWP facility.

The SWP's most recently constructed facility, the East Branch Extension, conveys water from Devil Canyon Powerplant's afterbay to Yucaipa Valley and the San Gorgonio Pass area in San Bernardino and Riverside counties. The project, which consists of 13 miles of buried pipeline, three pump stations, and a 90 AF regulatory reservoir, is expected to meet the region's water needs for 40 years. SWP water will be used to recharge groundwater basins and allow greater flexibility for local water systems. The extension, completed in 2003, is a cooperative project between CDWR, the San Bernardino Valley Municipal Water District, and the San Gorgonio Pass Water Agency.

SWP deliveries provide water to 25 million Californians and about 750,000 ac of irrigated farmland. Other project functions include flood management, water quality maintenance, power generation, recreation, and fish and wildlife enhancement. The SWP operates under long-term contracts with public water agencies throughout California from counties north of the Delta to southern California. These public water agencies in turn deliver water to wholesalers or retailers or deliver it directly to agricultural and M&I water users (USBR and CDWR 2005). Of the contracted water supply, approximately 75 percent goes to M&I users and 25 percent to agricultural users.

4.1.4.3 Water Management in the San Joaquin, Merced, and Stanislaus Rivers

There are currently more than 80 dams on the San Joaquin, Merced, Tuolumne, and Stanislaus rivers, with a total storage capacity of over 7.7 million AF. Combined, these facilities have the capacity to capture and control the entire average annual yield of the rivers they dam for the primary purposes of water supply, flood control, and hydroelectric power generation. The relatively large flows from the eastside tributaries, i.e., the Merced, Tuolumne, and Stanislaus rivers, strongly influence flow and water quality in the mainstem San Joaquin River. The westside tributaries are ephemeral, so water entering the San Joaquin River from the west side of the basin consists largely of agricultural return flows, which strongly influences the quality of water in the river.

4.1.1.1.11 San Joaquin River Mainstem

The flow regime downstream of Friant Dam (described as part of the Friant Division) has been managed since the implementation of the CVP (Cain et al. 2003). Friant Dam and its associated infrastructure irrigate approximately 1 million acres of agricultural land along the San Joaquin Valley's east side (Cain et al. 2003). In most years, these diversions take 95 percent of the river's average annual yield. A small fraction of the water is released according to a 1957 legal settlement to maintain flows (typically 250 cfs or less) during the irrigation season to support agricultural diversions by riparian water rights holders in the 36-mile reach between Friant Dam and the Gravelly Ford Canal. As a result, this reach of the river is wetted all year.

Below the Gravelly Ford Canal, the river channel is underlain by highly permeable bed material, and there are high rates of flow losses to infiltration. This reach has been allowed to go dry to avoid losing valuable surface water to groundwater infiltration (Cain et al. 2003). Riparian water rights holders downstream of Gravelly Ford have been served by the Delta-Mendota Canal, which delivers water from the Delta to the San Joaquin River at Mendota Pool. Mendota Pool is formed behind Mendota Dam and was originally constructed in the 1800s to divert irrigation water from the San Joaquin River to several irrigation districts now known as the San Joaquin River Exchange Contractors (Exchange Contractors). The Exchange Contractors agreed not to exercise their historic rights to the San Joaquin River's water in exchange for Delta water delivered via the Delta- Mendota Canal. Today, Mendota Pool has a storage capacity of 3,000 AF and distributes Delta water into a system of irrigation canals. Some water is released downstream of Mendota Pool into the historical channel of the San Joaquin River for subsequent diversion into Arroyo Canal at Sack Dam, 22 miles downstream of the Mendota Pool. Below Sack Dam, the river is often dry for several miles except during flood events.

The San Joaquin River between Gravelly Ford and the Merced River has an unusually complex system of flood bypasses, which route most flood flows around the historical river channel and flood basin of the San Joaquin River (Cain et al. 2003). Authorized by the Flood Control Act of 1944, the San Joaquin River and Tributaries Project was constructed in the 1950s and 1960s and includes over 100 miles of levees and bypasses. Starting 35 miles downstream of Friant Dam, a levee-confined floodway between Gravelly Ford and the Chowchilla bypass is designed to convey 12,000 cfs, but due to channel aggradation and levee instability may only be able to safely convey 8,000 cfs. Approximately 45 miles downstream of Friant, large flood releases are diverted into the Chowchilla and Eastside Flood bypass systems, which route most of the river's floodwaters around the historical flood basin downstream of Mendota Pool.

There are hundreds of entities with rights to divert water from the San Joaquin River between the mouth of the Merced River and the Delta. Many of these are small, unscreened private irrigation diversions. Some diversions, such as those of the Patterson Irrigation District (at which a new fish screening facility was constructed in 2011) and the West Stanislaus Irrigation District, are capable of diverting hundreds of cfs of water.

The median annual unimpaired flow in the San Joaquin River at Vernalis from WY 1930 through 2008 was reportedly 5.9 million AF (Cain et al. 2003). The median annual actual flow was reportedly 1.9 million AF, or 32 percent of the median annual unimpaired flow. This reduction in actual flow compared to unimpaired flow is attributable to exports of water to locations outside the basin and consumptive use of water within the basin. Unimpaired flow in the San Joaquin River at Vernalis is primarily attributable to flow from the Stanislaus, Tuolumne, and Merced rivers, and during wetter water years, the upper San Joaquin River. In flood years, water from the Kings River also contributes to the flow in the San Joaquin River.

The San Joaquin River Restoration Program (see Section 4.1.4.11 for a description of the Program), includes flow releases at Friant Dam to restore and maintain fish populations in good condition in the mainstem San Joaquin River. Interim flows were first released from Friant Dam on October 1, 2009. In 2013, interim flows between 350 and 400 cfs were released from Friant Dam to maintain the flow target at Gravelly Ford.[9] Up to 1,060 cfs was released from Friant Dam in 2013 as part of spring pulse flows. On January 2, 2014, flows released from Friant Dam were increased to 475 cfs to maintain the flow target at Gravelly Ford. However, beginning in February 2014, flows released from Friant Dam were decreased to 360 cfs to begin ceasing restoration flows because of drought conditions (i.e., a critical low-water year beginning March 1, 2014). Flows were reduced in 50-cfs increments until all restoration flows were discontinued. If drought conditions persist, restoration flows are unlikely to resume before March 2015.

4.1.1.1.12 Merced River

In about 1870, the Robla Canal Company, a private water company, began diverting water from the Merced River to eastern Merced County (Merced Irrigation District 2012). The Robla Canal Company was succeeded by the Farmers Canal Company, which was acquired by the Merced Canal and Irrigation Company in 1883 (Merced Irrigation District 2012).

Currently, four dams control the majority of flow in the Merced River: Merced Falls Diversion Dam, New Exchequer Dam, McSwain Dam, and Crocker-Huffman Dam (Cain et al. 2003). Merced Falls Diversion Dam (RM 55.0), constructed in 1901 by Pacific Gas and Electric Company (PG&E), generates hydroelectric power and diverts flow into the Merced Irrigation District (Merced ID) Northside Canal, which has a capacity of 90 cfs. In 1910, the Merced ID constructed Crocker-Huffman Dam (RM 52.0), which diverts flow into the Main Canal. The Main Canal has a capacity of 1,900 cfs and delivers water to lands south of the Merced River.

[9] Source: http://restoresjr.net/activities/if/index.html

Exchequer Dam, the first major storage facility on the Merced River, was constructed in 1926 by the Merced ID. It stored flows during the high spring run-off period and released them during the irrigation season into the North and Main Canals at Merced Falls and at the Crocker-Huffman Diversion Dam. Due to its limited capacity of 281,000 AF, Exchequer Dam did not capture all spring run-off and therefore did not allow for inter-annual water storage. Exchequer Dam, now known as Old Exchequer Dam, was inundated in 1967 by Lake McClure, when the Merced ID constructed New Exchequer Dam immediately downstream of the old dam (RM 62.5).

New Exchequer Dam and its downstream counterpart, McSwain Dam (RM 56.0), are the primary components of the Merced River Development Project, which is owned by the Merced ID and licensed by FERC. Lake McClure, the reservoir created by New Exchequer Dam, has a storage capacity of 1.03 million AF and enables the Merced ID to store water in wet years for use during subsequent dry years. Lake McSwain, located 6.5 miles downstream of New Exchequer Dam, has a capacity of 9,730 AF and is operated as a re-regulation reservoir and hydroelectric facility. Together, the New Exchequer and McSwain projects have a combined storage capacity of 1.04 million AF, which amounts to 102 percent of the average annual runoff from the Merced River watershed. The Merced River Development Project provides agricultural water supply, hydroelectric power, flood control, recreation, and some water to maintain minimum instream flows for fish in the Merced River.

The ACOE regulates flood control operations on the New Exchequer Dam and Reservoir. According to the ACOE Water Control Manual, which dictates operations of the dam for flood control, a maximum of 400,000 AF of space is dedicated to flood control during the winter runoff season, i.e., November 1 through March 15 (Stillwater Sciences 2001). The ACOE limits maximum reservoir releases to 6,000 cfs, measured at Stevinson gage near the confluence with the San Joaquin River. The maximum physical release from the New Exchequer outlet structure is 12,400 cfs. A flood reservation storage capacity of 350,000 AF is maintained for the rain flood pool between October 31 and March 15, and an additional 50,000 AF is reserved for the forecasted spring snowmelt after March 1.

The Merced River between Crocker-Huffman Dam (RM 52.0) and Shaffer Bridge (RM 32.5) has been extensively affected by alteration of the flow regime, water withdrawals, agricultural water returns, and land use activities (Stillwater Sciences 2001). The major water withdrawals are associated with the Cowell Agreement water users and riparian water users. These water users have maintained seven main channel diversions in this reach since the mid 1800s and have the right to divert annually up to approximately 94,000 AF of water. The users divert water to private canals via small wing dams constructed in the channel each year with rock and gravel excavated from the river. Most of these diversions are unscreened. There are numerous agricultural water returns in this section of river as well. Downstream of Shaffer Bridge, CDFW identified 238 diversions, generally small pumps that deliver water for agricultural purposes (Stillwater Sciences 2001).

4.1.1.1.13 Stanislaus River

There are more than 30 dams in the Stanislaus River watershed, with a combined storage capacity of approximately 2.7 million AF, more than 220 percent of the river basin's average annual runoff (Cain et al. 2003). Development of dams and diversions for both mining and irrigation began soon after the Gold Rush. Beginning in 1856, a series of water and power companies constructed several water supply and power facilities in the Stanislaus River Watershed. On the South Fork Stanislaus River, Big Dam and Herring Creek, Upper Strawberry, and Lower Strawberry reservoirs were constructed in 1856, Lyons Reservoir was constructed in 1898, and Philadelphia Diversion Dam (11-ft-high concrete face rock masonry overflow spillway dam) in 1916. The Oakdale Irrigation District and San Joaquin Irrigation District were formed in 1909 and bought the Tulloch water rights and physical distribution system in 1910. The Sand Bar Diversion Dam (24-ft-high timber crib overflow spillway dam) and the Stanislaus Forebay (60-ft-high shotcrete face earthfill compacted rock overlay dam) were constructed on the Middle Fork Stanislaus River in 1908, and Relief Dam (144.5-foot-high concrete face rock masonry dam) in 1910. In 1917, Lower Strawberry Reservoir was enlarged from 1,190 AF to 17,900 AF (Strawberry Dam is a 133-ft-high concrete face rock masonry dam).

The Oakdale and San Joaquin irrigation districts built the original 80-foot Goodwin Dam in 1913 to divert water into the Oakdale and South San Joaquin Irrigation Canals. Despite its height, Goodwin Diversion Dam provided no usable storage. Oakdale Canal, with a capacity of 560 cfs, diverts water to the south, and the South San Joaquin Canal diverts up to 1,320 cfs to the north. The height of Goodwin Dam was increased in the late 1950s to create a re-regulating reservoir for the New Tulloch Dam.

In 1926, Oakland Irrigation District and San Joaquin Irrigation District constructed Melones Dam and its associated 112,500 AF reservoir 15 miles upstream of Goodwin Dam to store spring runoff and release it downstream for diversion at Goodwin Dam (Cain et al. 2003). In 1929, Spicer Meadow Dam (with a reservoir capacity of 4,060 AF) was completed on the North Fork Stanislaus River, and in 1930, Lyons Reservoir was enlarged from 839 to 5,508 AF.

In 1948, the Oakdale and San Joaquin irrigation districts agreed to investigate the cost and feasibility of constructing additional dams to increase water supply and provide power production, and in 1955 the districts agreed to construct the Tri-Dam Project, including the Donnells Dam (483 ft high) and Reservoir (64,325 AF) and Beardsley Dam (280 ft high) and Reservoir (97,802 AF) on the Middle Fork Stanislaus River upstream of Melones Dam, and the Tulloch Dam (205 ft high) and Reservoir (66,968 AF) downstream of Melones Dam. Construction of the three facilities was completed in 1957 and the facilities became operational in 1958. As part of the construction of the Tri-Dam Project, the height of Goodwin Diversion Dam was increased to 87 ft to create an afterbay to regulate discharge from Tulloch Dam. From 1985–1990, the Calaveras County Water District constructed the North Fork Stanislaus Hydroelectric Project, which included the construction of New Spicer Dam (265 ft high) and Reservoir (189,000 AF) in 1989.

Melones Dam, now known as Old Melones Dam, was replaced and inundated in 1979 when the ACOE constructed New Melones Dam. New Melones Dam is the largest reservoir in the San

Joaquin River Basin, with a storage capacity of 2.4 million AF or 2.4 times the Stanislaus River's average annual runoff. New Melones Dam is operated and maintained by the USBR for flood control, to provide water for CVP contractors in the watershed, and to maintain water quality in the Stanislaus River and Delta.

4.1.4.4 Stockton Deep Water Ship Channel

The lower San Joaquin River flows north past the City of Stockton and into the Delta. The river connects the global economy to the Port of Stockton (Port) through a 78-mile-long Deep Water Ship Channel (DWSC) (Newcomb and Pierce 2010). The DWSC, which was first dredged in the 1930s, terminates at the Deep Water Turning Basin adjacent to the Port. The channel serves as a shipping corridor for cargo ships traveling from San Francisco Bay to the Stockton Port.

Periods of low dissolved oxygen (DO) concentrations have historically been observed in the DWSC; the majority of these low DO periods have occurred during summer and fall upstream of Turner Cut. In January 1998, the State Water Resources Control Board (SWRCB) adopted the CWA Section 303(d) list that identified this DO impairment, and the CVRWQCB initiated development of a TMDL to identify factors contributing to the DO impairment and assign responsibility for correcting the low DO problem (ICF International 2010).

Since the approval of the San Joaquin River DO TMDL Basin Plan Amendment in 2005, two actions have been implemented to alleviate low DO conditions in the DWSC: (1) the City of Stockton added engineered wetlands and two nitrifying bio-towers to the Stockton Regional Wastewater Control Facility to reduce ammonia discharges to the San Joaquin River and (2) the CDWR constructed the Demonstration Dissolved Oxygen Aeration Facility (Aeration Facility) at Rough and Ready Island to evaluate its applicability for improving DO conditions in the DWSC (ICF International 2010).

A full-scale aerator was constructed (using public grant funds) in the Stockton DWSC by CDWR and was operated by CDFW until 2011. In 2011, CDWR deeded the aerator to the Port of Stockton, which now owns and operates the facility. The annual cost of operating the aerator is the subject of a multi-party agreement. Twenty five percent of the cost is provided by the San Joaquin Tributaries Authority and San Joaquin River Group Authority, a joint powers authority that includes the Districts. The other cost-share partners in the operating agreement, and their cost-share percentages, are the CDWR jointly with the State Water Contractors (17%), the San Luis Delta Mendota Water Authority (12.5%), the San Joaquin Valley Drainage Authority (12.5%), and the Port of Stockton (33%). Upon completion of the operation agreement, the Port of Stockton will continue to own and operate the aerator.

4.1.4.5 Delta Water Management and Diversions

The Delta's boundaries are defined in Water Code § 12220, and encompass a roughly triangular area extending from Chipps Island near Pittsburg on the west, to the City of Sacramento on the Sacramento River on the north, and to the Vernalis gaging station on the San Joaquin River on the south. With the construction of the CVP and SWP, the Delta became a critical link in California's complex water distribution system (CDWR et al. 2013). Delta channels transport water mostly from upstream Sacramento Valley reservoirs to the South Delta, where the Banks and Jones pumping plants divert water into the California Aqueduct and the Delta Mendota Canal, respectively. The Delta is currently a conduit for water that is used for a wide range of instream, riparian, and other beneficial uses, including critical habitat for several native aquatic and terrestrial species, drinking water for more than 25 million people, and irrigation water for 4 million acres of farmland throughout the Delta and San Joaquin Valley.

The water balance in the Delta—i.e., total inflow versus total outflow—is controlled by supply from the Sacramento and San Joaquin rivers, eastside tributary rivers and streams, contributions from Coast Range watersheds, upstream diversions, demand from in-Delta water users, outflows from the Delta to the San Francisco Bay and Pacific Ocean, and exports to agricultural and M&I users outside the Delta (CDWR et al. 2013). Precipitation in the Delta region and small tributary inflows provide some water to the Delta, but these are minor compared to the flow contributions of the large rivers. The largest volume of water exiting the Delta is outflow, which is the water that travels through the Delta, contributes to in-channel and wetland coverage, and exits through the San Francisco Bay to the Pacific Ocean. Exports of water through the SWP and the CVP, followed by in-Delta use and local diversions, constitute the next largest volumes of water exiting the Delta.

There are over 3,000 diversions that remove water from upstream and in-Delta waterways for agriculture and M&I use (CDWR et al. 2013). Of these, 722 are located in the mainstem San Joaquin and Sacramento rivers, and 2,209 diversions are in the Delta (Herren and Kawasaki 2001). Of the 2,209 diversions in the Delta, most are unscreened and used for in-Delta agricultural irrigation (Herren and Kawasaki 2001). There are also numerous water management activities and diversions in eastside rivers that affect inflows to the Delta (e.g., to support M&I uses, hydroelectric generation, agriculture, and flood control in the Calaveras and Mokelumne river watersheds).

4.1.1.1.14 Population Growth and Water Demand

In the past decade, California's population has increased by 25 percent, double the national average (CDWR et al. 2013). The California Department of Finance estimates that the current population of 37 million will exceed 52 million by 2030 and reach nearly 60 million by 2050. In its 2009 update of the California Water Plan, CDWR used three possible future scenarios to forecast water demands up to the year 2050. It is estimated that water demands will be as high as 10 million AF per year. In addition to the increased demand for Delta water resulting from population growth, established flow release requirements and restrictions on project operations for the protection of certain fish and wildlife species with critical life stages that depend on freshwater flows are expected to increase in the future. These current and projected future requirements all increase the competition for water supplies in the State of California.

With forecasts of reduced precipitation, shifts in timing of peak flow and runoff periods, reductions in snowpack, and impacts from a rising sea level resulting from global climate change, the struggle to meet the divergent demands for water will increase in the future. Nevertheless, the Delta will remain the center of California's water system, because the economies of major regions of the state depend on the water flowing through the Delta.

4.1.4.6 San Joaquin River and Delta Levee Construction and Maintenance

Beginning in the 1850s, the construction of levees around the San Joaquin River and Delta facilitated the conversion of lands to agricultural and other human uses. Combined with the straightening, widening, and dredging of channels, levee construction increased shipping access to the Central Valley and increased the ability to control water conveyance and prevent flooding (CDWR et al. 2013). Currently, the Delta is a highly engineered environment, composed of 57 leveed island tracts and 700 miles of sloughs and winding channels. Over 1,100 miles of levees protect 738,000 acres of Delta islands, tracts, and population centers from flooding and safeguard a large portion of California's water supply (CDWR et al. 2013). The extensive levee system supports widespread farming throughout the Delta. This has allowed farmers to drain and farm a large portion of the Delta, which in its natural state was a tidal marsh.

Most of the levees protecting the Delta (approximately 65%) are not part of the federal/state Sacramento Flood Control Project system and were constructed and now maintained by island landowners or local reclamation districts (CDWR et al. 2013). These levees are generally built to an agricultural standard and may be less stable than those constructed and maintained to protect urban areas. Improvement and maintenance of these "non-project" levees can be challenging; the peat deposits that made the Delta a fertile farming location make poor materials for constructing levees and/or their foundations. Oxidization of these peat soils has led to island and levee subsidence, which has increased the burden on the levee system. Another way that the Delta levees are distinguished from levees along rivers such as the Sacramento and San Joaquin rivers is that they are constantly exposed to water, so they often act more as dams than levees, although they are not constructed or regulated to the same engineering standards as dams.

Currently, California has several programs in place to help manage risk and improve the environment in the Delta (CDWR et al. 2013). Local reclamation districts are responsible for maintaining their levees but may be reimbursed for a portion of the cost of maintenance under the State's Delta Levees Subvention Program, which was established in 1973. The Delta Flood Protection Fund Act of 1988 and the Delta Levee's Special Project program also provide financial assistance to local levee maintenance programs.

4.1.4.7 Land Use

4.1.1.1.15 <u>Mining</u>

Known mineral resources in the western Delta are primarily sand and gravel deposits that are valuable as construction aggregate or as construction fill material (CSLC 2012). Since 1915, millions of cubic yards of sand and gravel have been mined from Bay floor shoals. Sand mining in recent decades has been conducted under mining leases granted by the California State Lands Commission (CSLC).

Based on the 2006 CGS study of aggregate availability, estimates of demand for construction aggregate in California over the next 50 years will total approximately 13.5 billion tons (Kohler 2006), not including increased demand following major bond initiatives (e.g., for public infrastructure projects, reconstruction following a major earthquake, etc.). Under the latest mining leases, for the years 1998 through 2007, an average of approximately 135,700 cubic yards per year were mined from the Delta and Carquinez Strait lease areas. Recently proposed 10-year mineral extraction leases that would enable continuation of dredge mining in the western Delta have been reviewed and approved by the CSLC.

4.1.1.1.16 Agriculture and Livestock Grazing

Agriculture is the primary land use along the lower San Joaquin River from its confluence with the Tuolumne River to Vernalis, with uses including fruit and nut orchards, field crops, vegetables, seed and other row crops, vineyards, and pastures (Mintier Harnish et al. 2009). The Delta's combination of highly productive soils, a climate conducive to agriculture, and readily available high quality irrigation water support a broad range of agriculture, including high value crops (CDWR et al. 2013). According to the Farmland Mapping and Monitoring Program classifications, Delta land used for agricultural purposes totals more than 575,000 acres, including approximately 395,000 acres of Prime Farmland, 33,000 acres of Farmland of Statewide Importance, 41,000 acres of Unique Farmland, 44,000 acres of Farmland of Local Importance (including locally-designated Farmland of Local Potential), and 63,000 acres of Grazing land (CDWR et al. 2013).

Over 30 types of crops are grown in the Delta region, including alfalfa, almonds, apples, apricots, asparagus, cherries, corn, squashes and melons, dry beans, grain and hay, wine and table grapes, miscellaneous truck crops, olives, peaches and nectarines, pears, rice, safflower, subtropical trees, Sudan grass, sugar beets, sunflowers, tomatoes, turf, and walnuts (CDWR et al. 2013). Areas with less productive soils such as hard pan or areas with high water tables or poor drainage are often used as pasture.

Delta agricultural production relies heavily on irrigation because there is low rainfall during the majority of the growing season (CDWR et al. 2013). Irrigation and drainage practices vary depending on the kind of crop being irrigated. Methods include drip, sprinkler, furrow, flood, border strip, basin, sub-irrigation, or a combination of these. Most crops produced in the Delta require weekly or biweekly irrigation throughout the growing season until a few weeks before harvest. In-season irrigation quantities depend on crop type, stage of crop growth, soil moisture profile, management of plant pests and diseases, and weather conditions. Generally, irrigation water is diverted directly from Delta waterways and transported to agricultural lands via canals. In some cases water is pumped directly into field furrows. Irrigation and drainage canals are operated and maintained in the Delta by reclamation districts, irrigation districts, and water agencies. Some of the agricultural surface water diversions are screened to protect fish, but many are not (CDWR et al. 2013).

Fertilizers, pesticides, and herbicides are commonly used to maximize yields and protect crops (CDWR et al. 2013). Fertilizers are used to replenish soil nutrients and may be composed of natural and/or synthetic materials with varying concentrations of plant nutrients. Although pesticides are designed to break down after a period of time, spray drift and groundwater contamination are common problems associated with applied pesticides (CDWR et al. 2013). Application methods for fertilizers, pesticides, and herbicides vary by crop and chemical type and include: chemigation (i.e., application through the irrigation system), orchard spray rigs, spray booms, brush brooms, broadcast spreaders, chemically coated seeds, and aerial applicators (crop dusters). The California Department of Pesticide Regulation (CDPR) has documented over 300 herbicides and pesticides that are discharged throughout agricultural regions of California's Central Valley and Delta (Werner et al. 2008).

Delta agricultural runoff percolates into the water table or is discharged into Delta waterways (CDWR et al. 2013). Within the Delta, reclamation district canals and ditches frequently function as both water supply and drainage conveyance facilities, and they are typically kept at low water levels during the drainage season and pumped out by the reclamation districts to remove drainage and stormwater. During the crop irrigation season in subsurface irrigated areas, water is diverted from the Delta into these same ditches. Agricultural drainage water is captured in the canals and ditches and reused in subsequent irrigation. Most reclamation district drainage discharged into Delta waterways is for stormwater and flood management (CDWR et al. 2013).

4.1.1.1.17 Industrial and Residential Development

There are no incorporated cities along the lower San Joaquin River from its confluence with the Merced River to Vernalis. Rural residential use is typically the only type of development, and much of the population resides in surrounding cities (Mintier Harnish et al. 2009).

California is presently losing agricultural land at a rate of 49,700 ac annually, due in part to urban development fueled by population growth, housing prices, and commuting patterns (Kuminoff and Sumner 2001) as well as drainage problems, loss of reliable or affordable water supply, and conversion to wildlife habitat. These circumstances suggest that the existing land use patterns in the Delta and surrounding areas (including the lower San Joaquin River watershed) may experience continuing changes in the future, with a shift to more industrial, commercial, and residential land uses. Currently, there are 64,000 ac in the Delta that support urban and commercial land uses, although this is expected to increase due to population growth and the concomitant conversion of agricultural land to urban and residential uses.

There is little infrastructure along the lower San Joaquin River aside from that which supports agriculture and rural residential development. The Delta, on the other hand, contains much infrastructure of statewide importance, including transportation facilities and power generation and transmission facilities (Mintier Harnish et al. 2009). Three interstate highways (I-5, I-80, and I-580) pass along the periphery of the Delta; Interstate-5 is one of the most important north-south transportation routes on the west coast, running from the Mexican border to the Canadian border. It also runs along the entire eastern edge of the Delta. On an average day, the segments of I-5 that pass through Stockton carry approximately 130,000 vehicles.

Ship traffic in the Delta supports interstate and international commerce. More than 300 ships and barges used the Stockton DWSC in 2005.

Electricity, gasoline, and other energy supplies for the region are provided by pipelines and transmission facilities that cross the Delta, and in 2004, there were approximately 240 operating natural gas wells in the Delta (Mintier Harnish et al. 2009). In addition, a large PG&E gas storage facility is located under McDonald Island within the San Joaquin County portion of the

Delta (Mintier Harnish et al. 2009). More than 500 miles of electrical transmission lines run through the Delta, portions of which carry power to other parts of the western United States. The petroleum pipelines that cross the Delta provide approximately 50 percent of the transportation fuel used in Northern California and Nevada (Mintier Harnish et al. 2009).

4.1.1.1.18 Recreation

Recreational use is a critical asset to the San Joaquin River watershed and Delta region. Visitors include local residents, residents from nearby communities, and many visitors from the Bay Area and other parts of the state (CDWR et al. 2013). Along the San Joaquin River and Delta waterways and on Delta islands, activities include picnicking, swimming, fishing, boating, waterskiing, nature study, sightseeing, horseback riding, tent and RV camping, biking, hunting, and hiking. Although these recreational activities contribute to local economies, they also increase pressure on an already fragile environment.

To support the high levels and diversity of recreational use, an extensive infrastructure of public (county, state, and federal) and private providers has been established within the region (CDWR et al. 2013). Tent and RV camping sites are located throughout the area. Most of the camping areas are privately owned at marinas around the Delta. There are, however, publicly owned camping sites such as Dos Reis Park on the San Joaquin River and Caswell Memorial State Park on the Lower Stanislaus River (near its confluence with the San Joaquin River). Public picnic areas along Delta waterways can be found at Buckley Cove Park (on the DWSC), Dos Reis Park, Mossdale Crossing (on the San Joaquin River), and at Westgate Landing (on the Mokelumne River).

Habitat preserves and state and county parks (Dos Reis and Mossdale Crossing regional parks and Durham Ferry State Recreation Area) along the San Joaquin River provide recreational access (CDWR et al. 2013). The 7,000-ac San Joaquin River National Wildlife Refuge supports a mix of habitats that provide excellent conditions for wildlife and plant diversity. Visitor activities at the refuge include wildlife viewing, interpretation and environmental education, and photography. Formal fishing access and hunting opportunities are generally available in publicly owned parks or wildlife areas. Along some waterways, particularly along the DWSC, there are sandy beaches which are heavily used by boaters. Public boat launch facilities are available throughout the Delta, but a significant number of launches are associated with private marinas.

4.1.1.1.19 Changes in Land Use

With population growth in California above the national average, i.e., 2.1 percent versus 1.7 percent between 2010 and 2012,[10] changes in land use in the lower San Joaquin and Delta area are likely, but the nature and extent of those changes are uncertain. Urban development to accommodate population growth continues to occur in the counties of the Delta (CDWR et al. 2013). Limited housing supply and high home prices in the Bay Area have induced many Bay Area residents to relocate to Delta counties and commute long distances to work. As an example, since 1992, cities in San Joaquin County have annexed 27,769 acres, or 3 percent of the

[10] http://quickfacts.census.gov/qfd/states/06000.html

total area for urban development (CDWR et al. 2013). Additionally, population growth within and outside the Delta region will inevitably increase the amount of infrastructure that is required to support increases in residential, commercial, and industrial land development. Much of the land that will support this development will be acquired by conversion of agricultural lands.

California's focus on climate change and greenhouse gas reduction could also dramatically change the form of land use in the future (CDWR et al. 2013). Adopted on September 30, 2008, Senate Bill (SB) 375 is the State's first attempt to control greenhouse gas emissions by reducing urban sprawl. SB 375 links land use and transportation planning and encourages more compact, higher-density development through various incentives, including transportation funding and streamlined California Environmental Quality Act (CEQA) review. The bill has the potential to significantly change land use planning and growth patterns in and around the Delta region.

Increasing environmental management and recovery activities in the San Joaquin and Sacramento river basins and in the Delta region (e.g., related to water management, water quality, conservation/recovery of rare, threatened, and endangered or commercially-viable species, etc.) may also impact patterns of land use change (CDWR et al. 2013) (see Section 4.1.4.11, San Joaquin and Delta Aquatic Resources Management and Recovery Activities).

4.1.4.8 Fish Hatchery Practices

CDFW is the principal agency responsible for managing and conserving fisheries and aquatic resources in California. As part of its responsibility, CDFW operates a statewide system of fish hatcheries that rear and subsequently release millions of trout, salmon, and steelhead of various age and size classes into state waters. These fish are reared and released for recreational fishing and commercial harvest, conservation and restoration of native fish species, mitigation for habitat losses caused by development, and mitigation for fish lost at pumping facilities in the Delta.

Anadromous fish hatcheries have been present in California since the first one was established by the United States Commission of Fish and Fisheries on the McCloud River in 1872 (JHRC 2001). In the early 1900s, CDFW assumed responsibility for stocking hatchery trout into state lakes and rivers. Since 1945, CDFW has reared inland and anadromous fish species at 21 hatcheries throughout California. CDFW currently stocks trout in high mountain lakes, low elevation reservoirs, and various streams and creeks. Salmon have been stocked primarily in rivers and direct tributaries to the Pacific Ocean, with the exception of kokanee, Coho, and Chinook salmon planted in reservoirs for sport fishing. Currently, California operates both trout (14) and salmon and steelhead (10) hatcheries throughout the state (ICF Jones & Stokes 2010). In addition to anadromous fish releases in the San Joaquin River basin, discussed below, fish are released from CDFW facilities in the Sacramento River basin, including fall-run Chinook salmon produced at the Nimbus Hatchery.

In the 1970s CDFW began stocking Chinook salmon in some California lakes and reservoirs (JHRC 2001). Initially, out-of-state sources of eggs were used, but subsequently, because none of these sources could provide disease-free eggs, eggs that were in excess of CDFW hatcheries' needs were used (JHRC 2001). Salmon, often from out-of-basin stocks, may have escaped downstream from the lakes and reservoirs in which they were planted and later returned as adults to that stream, possibly interbreeding with wild adult salmon from that stream (JHRC 2001). Until the early 1980s, California's hatcheries occasionally used broodstock from other basins or moved fry to other basins (JHRC 2001). This practice could have affected the genetics of fish naturally occurring in the receiving basins or resulted in the transfer of diseases from the hatchery to the wild populations (JHRC 2001).

Significant numbers of salmon from Central Valley hatcheries have been transported by truck to San Francisco Bay and released (JHRC 2001). For example, in 1999 the following releases of fall Chinook smolts were made downstream of the Delta: 5.88 million from the Feather River Hatchery; 3.8 million from the Nimbus Hatchery, and 1.72 million from the Mokelumne River Hatchery (JHRC 2001). Also in 1999, the Feather River Hatchery released 2.12 million of its spring Chinook smolts in San Pablo Bay (JHRC 2001). Releasing hatchery salmon downstream of the Delta improves their survival and contribution to fisheries and reduces the potential for competition of hatchery smolts with naturally produced fish (JHRC 2001). However, off-site releases may also increase the straying rate of returning adult salmon. Dettman and Kelley (1987) (as cited in JHRC 2001) estimated that 46 percent of Feather River Hatchery fish released in the Delta returned to rivers other than the Feather River. Releases that substantially increase the rate of straying fish, and likely increase interbreeding between natural and hatchery populations of different watersheds, are inconsistent with the CDFW and NMFS goal of maintaining the genetic integrity of wild salmon stocks (JHRC 2001).

The Merced River Fish Hatchery, located just downstream of the Crocker-Huffman Diversion Dam and operated by CDFW, began production in 1970 (Merced Irrigation District 2012). The hatchery rears fall-run Chinook salmon and follows an integrated broodstock strategy. Broodstock consists of unsegregated, natural and hatchery-produced Chinook salmon that volitionally enter the hatchery's facilities. Average annual production (from 2004–2008) was 972,344 fish, with most fish stocked as smolts. Most Merced River Hatchery fish are released from the hatchery from April through June, at 70 to 90 fish per pound. A Hatchery Genetic Management Plan (HGMP) has not been prepared for the Merced River Fish Hatchery, and until a HGMP is completed, the hatchery will continue to operate according to the existing hatchery and stocking plan.

Chinook salmon produced at the Merced River Fish Hatchery are routinely used for investigations in the San Joaquin River watershed, such as the previously conducted VAMP smolt survival evaluations, and have been stocked in the Stanislaus and Tuolumne rivers. The Merced Irrigation District and others voluntarily fund the coded-wire tagging of smolts produced at the hatchery.

The Mokelumne River Fish Hatchery was built in 1963 by the East Bay Municipal District (and is operated by CDFW) to offset impacts to fisheries due to construction of Camanche Dam (ICF Jones & Stokes 2010). The hatchery is located on the south bank of the Mokelumne River immediately downstream of Camanche Dam and raises fall-run Chinook salmon and steelhead with water from Camanche Reservoir. In addition to mitigation responsibilities, the Mokelumne River Hatchery has an enhancement program supported by commercial salmon trollers. The Mokelumne River Hatchery receives its steelhead broodstock from the Feather River Hatchery or from adults returning to the hatchery, and has received broodstock fish from the American River, and Battle Creek (CDFW 2012). The Chinook salmon broodstock is of Central Valley origin. Average annual fish production at the Mokelumne River Hatchery from 2004 through 2008 was 5,351,901 fish. The normal Mokelumne River Hatchery release schedule is as follows: (1) fall-run Chinook salmon smolts are released from May through July into San Pablo Bay at 40–60 fish per pound and (2) steelhead yearlings are released from January through February into the lower Mokelumne River at four fish per pound.

4.1.4.9 Freshwater Salmonid Harvest

Commercial salmon fishing in California began in the early 1850s, coinciding with the influx of miners associated with the Gold Rush. By 1860, gill net salmon fisheries were well established in the lower San Joaquin River. Growth of this fishery was enhanced by the canning industry (CDFW 2013), and by 1880 there were 20 salmon canneries operating in the Sacramento and San Joaquin rivers, which increased fishing effort to maintain the supply of salmon. The salmon fishery reached its peak in 1882 when about 12 million pounds were landed and processed. Shortly thereafter, the fishery collapsed due to a sudden decline in salmon stocks caused by the pollution and degradation of rivers from mining, agriculture, and timber operations, combined with excessive fishing pressure. By 1919, the last inland salmon cannery had shutdown, and in 1957, the last remaining commercial river fishery closed in the Sacramento-San Joaquin basin (CDFW 2013).

In past years, sport fishing for trout, steelhead, and salmon was closed from the I-5 bridge at Mossdale upstream on the San Joaquin River (CDFG 2011). However, 2013–2014 regulations allow two hatchery trout or hatchery steelhead (four total possession limit) to be taken year round (CDFW 2013). Salmon fishing remains closed in the San Joaquin River, although some sport harvest takes place in the Delta.

4.1.4.10 Non-Native Species

Non-native species enter a region's aquatic systems in a variety of ways, most prominently through historical stocking by state resource management agencies, illegal introductions by anglers, ballast water discharged from ships, and boating activities. Introduction of non-native species has resulted in large changes in the fish community structure of the Central Valley (Moyle 2002). Non-native fish introductions in California date back to European settlement, and current fish communities in the lower reaches of the San Joaquin River tributaries and Delta are dominated by non-native taxa. Over 200 non-native species have been introduced in the Delta and become naturalized (Cohen and Carlton 1995), including many fish (e.g., smallmouth bass, largemouth bass, and striped bass) that prey on juvenile salmonids.

CDFW continues to manage some non-native fish species for recreational angling, such as black bass (open year round in the Delta with a five fish daily bag limit), striped bass (open year round in the Delta and lower San Joaquin River with a two fish limit), sunfish and crappie (open year round in the Delta with no size limit and a combined bag limit of 25), and catfish and bullhead (open year round in the Delta with no size or catch limit) (CDFG 2011).

The Delta, particularly the San Joaquin River between the Antioch Bridge and the mouth of Middle River and other channels in this area, are important spawning grounds for striped bass (CDFW 2014). Another important spawning area is the Sacramento River between Sacramento and Princeton (CDFW 2014). Sublegal striped bass, under 18 inches long, are found all year in large numbers upstream of San Francisco Bay, but their migratory patterns are poorly understood. After spawning, most adult striped bass move out of the rivers and into brackish and salt water for the summer and fall. However, some adult fish remain in freshwater during summer, and many anglers have caught striped bass at unexpected times and places (CDFW 2014).

4.1.4.11 San Joaquin River and Delta Aquatic Resources Management and Recovery Activities

There are numerous programs and efforts in the San Joaquin River Basin and Delta that have been completed, are currently underway, or are planned for the foreseeable future. These programs are likely to result in the establishment of new environmental mandates such as streamflow requirements, aquatic habitat restoration measures, and fish protection and recovery objectives. Cumulatively, these requirements could have effects on aquatic resources and threatened and endangered species in the lower San Joaquin River and the Delta.

4.1.1.1.20 Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead

In 2009, NMFS issued a Public Draft Recovery Plan (NMFS 2009 for several ESA listed anadromous salmonids in the Sacramento River and Central Valley: the endangered Sacramento River winter-run Chinook salmon ESU, threatened Central Valley spring-run Chinook salmon ESU, and threatened Central Valley steelhead DPS. Implementation of the recovery plan is intended to improve the viability of these species so they can be removed from federal protection under the ESA. The recovery plan describes the steps, strategies, and actions projected to return the three species to viable status in the Central Valley, thereby ensuring their long-term (i.e., greater than 100 years) persistence and evolutionary potential.

The recovery plan establishes watershed- and site-specific recovery actions. Watershed-specific actions address threats occurring in each of the rivers or creeks that support spawning populations of the ESUs and/or DPS. Site-specific actions address threats to these species occurring within a migration corridor (e.g., the Delta). Recovery actions were identified using two recovery planning public workshops and a number of ecosystem and/or anadromous fish enhancement plans. Recovery actions that have been identified in the Delta include development of alternative water diversion operations and conveyance systems, large-scale habitat restoration, integration of existing restoration programs, non-native predatory fish control, Yolo Bypass floodplain and fish passage enhancements, modifications to long-term operations of the CVP and SWP, and new stream flow requirements. Recovery actions that have been identified in the mainstem San Joaquin River include restoring floodplain habitat, implementing ecological flow schedules, reducing contaminants and improving water quality, and improving juvenile outmigration for steelhead and future spring-run Chinook salmon at CVP and SWP facilities.

4.1.1.1.21 San Joaquin River Restoration Settlement Act

The San Joaquin River Restoration Program (SJRRP) is a direct result of a settlement reached in September 2006 to provide sufficient fish habitat in the San Joaquin River below Friant Dam. Parties to the Settlement include the U.S. Departments of the Interior and Commerce, the Natural Resources Defense Council (NRDC), and the Friant Water Users Authority (FWUA). The settlement received Federal court approval in October 2006. Federal legislation was passed in March 2009 authorizing Federal agencies to implement the settlement.

The settlement is based on two goals: (1) to restore and maintain fish populations in "good condition" in the mainstem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish, and (2) to reduce or avoid adverse water supply impacts to all of the Friant Division long-term contractors that could result from the interim flows and restoration flows provided for in the settlement.

The SJRRP outlines a comprehensive long-term effort to provide flows in the San Joaquin River from Friant Dam to the confluence of the Merced River to restore a self-sustaining spring-run Chinook salmon fishery while reducing or avoiding adverse water supply impacts. The program calls for full restoration flows beginning in 2014.

Implementation of the 2009 San Joaquin River Restoration Settlement Act and SJRRP has had significant effects on stream flows in the basin.[11] Annual restoration flows in the San Joaquin River vary between 0 AF in dry years to more than 550,000 AF in wet years. Combined with other flows in the watershed upstream of the Merced River confluence, these restoration flows are anticipated to provide 275,000 to 750,000 AF of water in the San Joaquin River as measured at the confluence with the Merced River, depending on hydrologic conditions. The flow schedule is designed to support spring-run Chinook salmon reintroduction and may not be compatible with efforts to improve conditions for other salmonid species in the Merced River and other tributaries in the San Joaquin River basin.

The first interim water releases from Friant Dam in support of the SJRRP began on October 1, 2009. In 2013, interim flows between 350 and 400 cfs were released from Friant Dam to maintain the flow target at Gravelly Ford.[12] Up to 1,060 cfs was released from Friant Dam in 2013 as part of spring pulse flows. On January 2, 2014, flows released from Friant Dam were increased to 475 cfs to maintain the flow target at Gravelly Ford. However, beginning in February 2014, flows released from Friant Dam were decreased to 360 cfs to begin ceasing restoration flows because of drought conditions (i.e., a critical low-water year beginning March 1, 2014). Flows were reduced in 50-cfs increments until all restoration flows were discontinued. If drought conditions persist, restoration flows are unlikely to resume before March 2015.

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[11] Source: www.restoresjr.net
[12] Source: http://restoresjr.net/activities/if/index.html

4.1.1.1.22 Delta Water Quality Control Planning

Recognizing that many water issues in California involved both water quantity and quality, the California Assembly Committee on Water Pollution proposed a coordinated water regulatory program.[13] Concomitant statutory changes enacted in 1967 merged the State Water Quality Control Board and State Water Rights Board to form the SWRCB. In 1969, the California State Legislature enacted the Porter-Cologne Water Quality Control Act, which is the basis of current water protection efforts in California. In 1972, the State assumed responsibility for enforcing the federal CWA, which involved blending state and federal processes to regulate activities such as setting water quality standards and issuing discharge permits.

On August 16, 1978, the SWRCB adopted the 1978 Delta Plan and Decision 1485 (D-1485). The 1978 Delta Plan included water quality objectives intended to protect M&I, agricultural, and fish and wildlife beneficial uses in the Delta, and fish and wildlife beneficial uses in Suisun Marsh. The 1978 Delta Plan and D-1485 standards were based on the principle that Delta water quality should be at least as good as it would have been had the state and federal water projects not been constructed. The fish and wildlife standards in the 1978 Delta Plan and D-1485 were based on an agreement developed by CDWR, CDFW (then CDFG), the USBR, and USFWS. It was acknowledged that these standards did not afford a "without-project" level of protection for salmon, but the level of protection was believed to be reasonable until determinations regarding Delta mitigation measures were finalized.

D-1485 added conditions to the CVP's and the SWP's operating permits requiring that the projects meet applicable water quality objectives. In all SWP and CVP permits affecting the Delta, the SWRCB reserved jurisdiction to formulate or revise terms and conditions for salinity control and fish and wildlife protection, and to coordinate the terms and conditions between the two projects.

In 1985, some D-1485 standards were amended to modify or omit some monitoring stations in Suisun Marsh and to revise the schedule for implementation of salinity objectives. In May 1991, the SWRCB adopted the 1991 Bay-Delta Plan, which superseded water quality objectives in the 1978 Delta Plan and the San Francisco Bay and the Sacramento-San Joaquin Delta regional water quality control plans in instances where the existing plans conflicted with the 1991 Bay-Delta Plan. The 1991 Bay-Delta Plan contained a range of water quality objectives aimed at protecting beneficial uses. These objectives addressed (1) salinity levels for municipal and industrial intakes, Delta agriculture, water export agriculture, and estuarine fish and wildlife resources, (2) an expanded period of protection for striped bass spawning, and (3) temperature and DO levels for Delta fisheries. The 1991 Bay-Delta Plan did not include Delta outflow objectives and operational constraints. The flow and operational objectives in the 1978 Delta Plan remained in effect, implemented via D-1485. Beneficial uses and water quality objectives in the 1991 Bay-Delta Plan were submitted to EPA, which approved the objectives for M&I uses, agricultural uses, and DO for Fish and Wildlife in the San Joaquin River. However, all other fish and wildlife objectives were not approved by EPA, so relevant standards in D-1485 remained in effect.

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[13] Source: http://www.swrcb.ca.gov/about_us/water_boards_structure/history_water_policy.shtml

In May 1995, the SWRCB adopted the 1995 Bay-Delta Plan, which was superseded by the 2006 Bay-Delta Plan, in instances where the 1995 plan conflicted with the 2006 plan. The 2006 Bay-Delta Plan included updates to address emerging issues that, because of changing circumstances or increases in scientific understanding, were either unregulated or not fully regulated by preceding plans. These issues included pelagic organism decline (pelagic fishes in the Delta Estuary and Suisun Bay), climate change, Delta and Central Valley salinity, and San Joaquin River flows. The 2006 Bay-Delta Plan included specific objectives related to the following variables: Delta outflow, flows in the Sacramento River at Rio Vista, flows in the San Joaquin River at Vernalis, export limits, Delta cross channel gates operation, and salinity.

Beginning on February 13, 2009, the SWRCB began updating and implementing the 2006 San Francisco Bay/Sacramento-San Joaquin Delta Estuary Plan (Bay-Delta Plan), particularly with regard to water quality and flow objectives and changes to water rights and water quality regulation consistent with the program of implementation. A technical report on the first phase of the project, Southern Delta Salinity and San Joaquin River flow objectives, was peer reviewed, and a final report was scheduled for release in early 2012. On January 24, 2012, the SWRCB issued a notice requesting additional information for the review of the Bay-Delta Plan.

The Bay-Delta Plan identifies beneficial uses of the Bay-Delta, water quality objectives for the reasonable protection of those beneficial uses, and a program of implementation for achieving the water quality objectives. The SWRCB recognizes that changing conditions may alter the flows needed to protect beneficial uses in the Bay-Delta. Changes in conditions that could affect flow needs include, but are not limited to, reduced reverse flows in Delta channels, increased tidal habitat, improved water quality, reduced competition from invasive species, changes in the points of diversion of the SWP and CVP, and climate change. The SWRCB will consider whether certain water quality objectives should be phased in over time and under what conditions that phasing should occur, in addition to what type of contingencies should be provided in the program if expected habitat improvements do not occur or if actions do not produce the expected results.

4.1.1.1.23 San Joaquin River TMDL Plans

Adoption of TMDLs required under the CWA § 303(d) has the potential to affect stream flows in the San Joaquin River. The SWRCB has initiated a comprehensive effort to address salinity and nitrate problems in the Central Valley and to adopt long-term solutions that will lead to enhanced water quality and economic sustainability. The Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) effort is a collaborative basin planning effort aimed at developing and implementing a comprehensive salinity and nitrate management program.

Additional San Joaquin River flows are being targeted to help dilute saline agricultural return waters and naturally occurring saline waters, pesticides, and other potentially toxic compounds and to reduce temperatures throughout the watershed. A partial list of TMDLs that may directly or indirectly affect flows and water quality in the San Joaquin River is shown below (SWRCB 2010):

- Completed:

- San Joaquin River diazinon and chlorpyrifos,
- San Joaquin River salt/boron at Vernalis, and
- San Joaquin River DO at Stockton.

▪ To be completed:

- San Joaquin River salt/boron upstream of Vernalis,
- San Joaquin River unknown toxicity, and
- San Joaquin River temperature.

4.1.1.1.24 Bay-Delta Conservation Plan

The Bay-Delta Conservation Plan (BDCP) is expected to provide for water supply reliability and recovery of listed species through a Habitat Conservation Plan (HCP) under federal law and a Natural Community Conservation Plan (NCCP) under state law. The BDCP will include a wide range of actions related to habitat restoration, protection, and enhancement; water conveyance facilities; water operations and management; monitoring, assessment, and adaptive management; costs and funding; and governance structure and decision-making.

The BDCP is being developed to address ecological needs of at-risk Delta species, primarily fish, while improving and securing a reliable water supply. The BDCP will be structured to improve the health of the system as a whole by implementing a comprehensive restoration program for the Delta. The plan includes a suite of conservation measures designed to improve the state of natural communities and in so doing improve the overall health of the Delta ecosystem. The BDCP attempts to balance species conservation with a variety of other important uses in the Delta. A joint EIS/EIR, to be prepared by state and federal agencies, will include an analysis of the environmental impacts of improved water conveyance infrastructure and habitat conservation measures. Implementation of the BDCP will likely require changes to the Bay-Delta Plan (see Section 4.1.4.11.3).

Implementation of the BDCP will occur over a 50-year timeframe and be conducted by a number of agencies and organizations with specific roles and responsibilities as prescribed by the BDCP. A major part of implementation will be monitoring conservation measures to evaluate their effectiveness and revising actions through adaptive management.

4.1.1.1.25 Delta Stewardship Council

In November 2009, the Sacramento-San Joaquin Delta Reform Act was passed by the California Legislature and signed by the governor. It established a State policy of coequal goals (i.e., providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem) for the Delta and created the Delta Stewardship Council as a new, independent agency to determine how goals would be met through development and implementation of the Delta Plan. The BDCP (see preceding section) is to be included in the Delta Plan providing it is approved by state regulatory agencies and meets certain additional criteria. Because the Delta is linked to many statewide issues, the Plan will address decisions pertaining to statewide water use, flood management, and the Delta watershed.

4.1.1.1.26 Biological and Conference Opinion on the Long-Term Operation of the CVP and SWP

On June 4, 2009, NMFS released the Biological and Conference Opinion on the Long-Term Operation of the CVP and SWP. The opinion included a series of alternatives to avoid jeopardy of the continued existence of Central Valley steelhead, among other species, and adverse modification of its designated critical habitat. Among the alternatives identified are significantly higher instream flows in the Stanislaus River, San Joaquin River minimum flow requirements at Vernalis, and Delta export limitations to protect out-migrating anadromous salmonids.

Although the opinion addressed only the combined CVP and SWP operations, it concluded that "the long-term viability of this diversity group [steelhead] will depend not only on implementation of this reasonable and prudent alternative (RPA), but also on actions outside this consultation, most significantly increasing flows in the Tuolumne and Merced rivers." On September 20, 2011, the U. S. District Court invalidated the Biological and Conference Opinion and remanded it to NMFS for further consideration in accordance with the court's decision and the requirements of law. The decision has been appealed.

4.1.1.1.27 The Central Valley Project Improvement Act

As noted previously, the Ecosystem Restoration Program[14] has funded projects involving habitat restoration, floodplain restoration and/or protection, instream habitat restoration, riparian habitat restoration and protection, fish screening and passage projects, research on and eradication of non-native species and contaminants, research on and monitoring of fisheries, and watershed stewardship and outreach. An Environmental Water Account is used to offset losses of juvenile fish at the Delta pumps, and to provide higher instream flows in the Yuba, Stanislaus, American, and Merced rivers to benefit salmonids.

The Central Valley Project Improvement Act (CVPIA) added the purposes of fish and wildlife protection, restoration, and mitigation to the original CVP purposes of irrigation, domestic water use, fish and wildlife enhancement, and power augmentation. As part of the CVPIA, the following actions have been implemented: modifications of CVP operations, management and acquisition of water for fish and wildlife needs, flow management for fish migration and passage, increased flows, replenishment of spawning gravels, restoration of riparian habitats, screening of water diversions, and habitat restoration.

4.1.1.1.28 The Delta Pumping Plant Fish Protection Agreement and Tracy Fish Collection Mitigation Agreement

The Delta Pumping Plant Fish Protection Agreement and Tracy Fish Collection Mitigation Agreement mitigate for SWP pumping plant impacts by screening water diversions, enhancing

[14] http://www.dfg.ca.gov/ERP

law enforcement efforts to reduce illegal fish harvest, installing seasonal barriers to guide fish away from undesirable spawning habitat or migration corridors, and restoring salmon habitat. Mitigation has also included the removal of four dams to improve Chinook and steelhead passage on Butte Creek. Approximately one-third of the approved funding for salmonid projects specifically targets spring-run Chinook salmon and steelhead in upper Sacramento River tributaries.

4.1.1.1.29 CCSF Water System Improvement Program

On October 30, 2008, the SFPUC adopted a system-wide program, the Water System Improvement Program (WSIP, also known as the "Phased WSIP Variant") (SFPUC Resolution No. 08-200). The WSIP is a comprehensive program designed to improve the regional system with respect to water quality, seismic response, and water delivery based on a planning horizon through the year 2030. The WSIP also aims to improve the regional system with respect to water supply to meet water delivery needs in the service area through the year 2018.

The overall goals of the WSIP are to: maintain high-quality water, reduce vulnerability to earthquakes, increase delivery reliability and improve the ability to maintain the system, meet customer water supply needs, enhance sustainability in all system activities, and achieve a cost effective, fully operational system. To further these program goals, the WSIP also includes objectives that address system performance in the areas of water quality, seismic reliability, delivery reliability, and water supply.

Under the WSIP, the SFPUC established the year 2018 as an interim mid-term planning horizon for its water supply strategy. Thus, the SFPUC made a decision about a water supply strategy to serve its customers through 2018, and is deferring a decision regarding long-term water supply after 2018 and through 2030 until it undertakes further water supply planning and demand analysis.

The WSIP includes the following key program elements:

- Full implementation of all 17 proposed WSIP facility improvement projects described in the Program Environmental Impact Report (PEIR).
- Water supply delivery of 265 million gallons per day (mgd) (average annual target delivery) to regional water system customers through 2018, with water supplies originating from the Tuolumne, Alameda, and Peninsula watersheds. This includes 184 mgd for wholesale customers (including 9 mgd for the cities of San Jose and Santa Clara) and 81 mgd for retail customers.
- Development of 20 mgd of conservation, recycled water, and groundwater within the SFPUC service area (10 mgd in the retail service area and 10 mgd in the wholesale service area).
- Dry-year transfer from the Modesto and/or Turlock Irrigation Districts of about 2 mgd coupled with the a conjunctive-use project to meet the drought year goal of limiting rationing to no more than 20 percent on a system-wide basis.

- Reevaluation of 2030 demand projections, potential regional water system purchase requests, and water supply options by 2018, as well as a separate SFPUC decision in 2018 regarding regional system water deliveries after 2018.

Under the WSIP, the SFPUC will deliver to customers up to 265 mgd from the SFPUC watersheds on an average annual basis. While average annual deliveries from the SFPUC watersheds would be limited to 265 mgd, such that there would be no increase in diversions from the Tuolumne River to serve additional demand, there would be a small increase in average annual Tuolumne River diversions of about 2 mgd over existing conditions to meet delivery and drought reliability goals through 2018.

Day-to-day operation of the regional water system under the WSIP would be similar to existing operations, but would provide for additional facility maintenance activities and improved emergency preparedness. This would allow the SFPUC to meet its WSIP objectives and provide for increased system reliability and additional flexibility for scheduling repairs and maintenance. The proposed operations strategy would also include a multistage drought response program. Under the WSIP, regional water system operations would continue to comply with all applicable institutional and planning requirements, including complying with all water quality, environmental and public safety regulations; maximizing the use of water from local watersheds; assigning a higher priority to water delivery over hydropower generation; and meeting all downstream flow requirements.

4.2 Geomorphology

Geomorphology in the Tuolumne River is cumulatively affected by a variety of anthropogenic actions within the Tuolumne River watershed (see Section 4.1 of Exhibit E for a discussion of in-basin actions), including in-channel and floodplain mining, hydrologic alteration resulting from water management activities associated with multiple dams, and sediment retention in reservoirs. Because the Proposed Action would have no influence on flows downstream of La Grange Diversion Dam, and Don Pedro Reservoir would exist and continue to exist in the absence of hydroelectric generation, the Proposed Action would not contribute to cumulative effects on geomorphology in the lower Tuolumne River. The Don Pedro Project's primary purposes (water storage and supply for irrigation and M&I uses and flood control) contribute to these cumulative effects, but these effects diminish relative to other impacts, mainly those associated with aggregate mining, with increasing distance downstream of La Grange Diversion Dam. As a result, with greater distance downstream of the Don Pedro Project, it becomes increasingly difficult to isolate the effects of the Don Pedro Project's primary purposes on geomorphologic conditions in the river channel.

FERC's SD2 (page 35) identifies the following potential Don Pedro Project effects related to geomorphology in the Tuolumne River:

- *Effects of project operation and maintenance on soil erosion and shoreline erosion at the project reservoir and stream reaches.*
- *Potential effects of any project-related changes in streamflow and sediment delivery to project stream reaches on stream geomorphic processes or reservoir bathymetry.*

- *Potential effects of project operations on large woody debris distribution and recruitment.*

FERC's SD2 defines the geographic scope for geomorphology as extending upstream on the Tuolumne River to Hetch Hetchy Reservoir and downstream to the confluence of the Tuolumne and San Joaquin rivers. The temporal scope of the cumulative effects analysis includes past, present, and reasonably foreseeable future actions. FERC stated in it SD2 that based on the potential term of a new license, the temporal scope for analysis is to extend 30 to 50 years into the future, with concentration on resource effects resulting from reasonably foreseeable future actions. FERC notes that the historical discussion of cumulative effects is limited to the amount of available information for a given resource.

4.2.1 Effects of Mining, Hydrologic Alteration, and Sediment Retention on Tuolumne River Geomorphology

Prior to widespread European settlement, the channel form of the lower Tuolumne River consisted of a combination of single-thread and split channels that migrated and avulsed (McBain & Trush 2000). Variation in hydrologic and geological controls, primarily valley width and the location and elevation of underlying bedrock, resulted in variable and complex localized channel morphologies (McBain & Trush 2000). The riparian corridor was miles wide in places where the river lacked confinement (McBain & Trush 2000).

More than a century of anthropogenic impacts have altered the alluvial dynamics of the Tuolumne River. The cumulative effects of gold and aggregate mining, agricultural and urban encroachment, and a reduction in coarse sediment supply and high flows, have resulted in a relatively static channel within a floodway confined by dikes and agricultural uses.

4.2.1.1 In-Channel and Floodplain Mining

Prior to the construction of the major dams in the Tuolumne River basin, geomorphic conditions in the Tuolumne River were adversely affected by gravel and gold mining (TID/MID 2005) (see Section 4.1 for a summary of the chronology of historic and current actions within the defined geographic scope for cumulative effects).

Hydraulic mining, dredging, lode mining, and ore processing have left visible scars along the Tuolumne River and its tributaries upstream of Don Pedro Dam. Adverse impacts from acid mine drainage and ore processing have left trace metals, arsenic, iron, and mercury (Mount and Purdy 2010) at various locations in the watershed upstream of, and in the reach now impounded by, the Don Pedro Project.

In the lower Tuolumne River, stored bed material was excavated for gold and aggregate to depths below the river thalweg, resulting in sediment imbalances in the lower Tuolumne River channel, eliminating active floodplains and terraces, and creating large in-channel and off-channel pits (McBain & Trush 2000). By the end of the gold mining era, 12.5 miles of river channel and floodplain from RM 50.5 to RM 38 were dredged and converted to tailings piles, and much of the gravel-bedded zone (RM 52–24) of the river was converted to long, deep pools.

More recently, in-channel excavation of sand and gravel created large, in-channel pits now referred to as Special Run Pools (SRPs). These SRPs are as much as 400 ft wide and 35 ft deep, occupying 32 percent of the channel length in the gravel-bedded zone.

Mining, in combination with other actions (addressed below), has resulted in a channel downstream of La Grange Diversion Dam that is characterized by downcutting, widening, armoring, and depletion of sediment storage features (e.g., lateral bars and riffles) (CDWR 1994; McBain & Trush 2004). Sequences of historical photos show that channel corridor width has been progressively reduced by mining and other land uses (McBain & Trush 2000), and channel migration has been substantially curtailed. Floodplain and terrace pits in the lower river are typically separated from the channel by narrow berms that can breach during high flows, resulting in capture of the river channel. The January 1997 flood caused extensive damage to dikes that separated deep gravel mining pits from the river, breaching or overtopping nearly every dike along an approximately 6-mile-long reach from RM 34.2 to RM 40.3 (TID/MID 2011).

4.2.1.2 Alteration of Hydrologic Conditions and Sediment Dynamics

Over the past 120 years, each increment of flow regulation (Wheaton, La Grange, O'Shaughnessy, old Don Pedro, and new Don Pedro dams along the mainstem and dams constructed along tributaries below O'Shaughnessy Dam, including Cherry and Eleanor Creeks) has modified the Tuolumne River's flow regime. Historically, Wheaton Dam and the present day La Grange Diversion Dam lacked the storage capacity needed to affect high flow conveyance to the lower Tuolumne River during winter and spring (McBain & Trush 2000). CCSF's Hetch Hetchy Project, the Districts' New Don Pedro Dam, and CCSF's Cherry Lake combined to reduce the magnitude and frequency of flood flows and snowmelt runoff to the lower Tuolumne River downstream of La Grange Diversion Dam.

Analyses of streamflow records from the USGS gaging station at La Grange (Station 11-289650) reveal the following alterations of hydrologic conditions: (1) annual water yield to the lower Tuolumne River below La Grange Diversion Dam has been reduced from an average unimpaired yield of 1,906,000 AF to 772,000 AF, a 60 percent reduction in volume; (2) the magnitude and variability of summer and winter baseflows, fall and winter storms, and spring snowmelt runoff have been reduced; and (3) the magnitude, duration, and frequency of winter floods have been reduced (McBain & Trush 2000). Following completion of the New Don Pedro Dam in 1971, compliance with ACOE flood control and other flow requirements reduced the estimated average annual flood (based on annual maximum series) from 18,400 cfs to 6,400 cfs. The 1.5-year recurrence event (approximately bankfull discharge) was reduced from 8,400 cfs to 2,600 cfs (McBain & Trush 2000). The reductions in flood frequency attest to the success of the Don Pedro Project's flood control purpose. At the same time, these changes in hydrology have had impacts on sediment supply and transport and, as a result, channel morphology

Flow regulation associated with upstream dams may also affect riparian vegetation by modifying the hydrologic and fluvial processes that influence survival and mortality of riparian plants (TID/MID 2013b) As noted above, each increment of flow regulation (La Grange Diversion Dam, O'Shaughnessy Dam, Old Don Pedro Dam, New Don Pedro Dam) successively reduced the magnitude, duration, and frequency of flood flows, and removed key mortality agents, including scour, channel migration, flood-induced toppling, and inundation (McBain & Trush 2000). Reduced flood scour resulting from the flood control purposes of the Don Pedro Project allowed riparian vegetation to initiate along the low water channel, where historically vegetation would have been absent, increasing sediment stability along the channel margin and influencing sediment dynamics in the channel as a whole.

Together, the dams on the Tuolumne River trap all coarse sediment and woody debris that would otherwise pass downstream to the lower Tuolumne River. Brown and Thorp (1947) estimated that 4,734 AF (7,637,520 yd^3) of sediment accumulated in Don Pedro Reservoir behind Old Don Pedro Dam during the 23-year period from 1923 to 1946 (McBain & Trush 2004). This estimated annual volume equates to an average total sediment and coarse-grained sediment deposition of approximately 431,601 tons/year and 43,160 tons/year, respectively. These estimates assume 100 percent trap efficiency, an average sediment density of 1.30 tons/yd^3, and an average coarse-to-total sediment ratio of 0.10 (Reid and Dunne 1996, Snyder et al. 2004). Sediment yield to Don Pedro Reservoir based on improved accuracies of measuring reservoir bathymetry conducted in 2011 is discussed in Section 4.2.2. Small tributaries downstream of La Grange Diversion Dam do not supply significant quantities of coarse sediment (McBain & Trush 2004).

Fine (predominantly <2 mm) bed material (FBM) is supplied to the lower Tuolumne River primarily by three tributaries downstream of La Grange Diversion Dam (Gasburg, Dominici, and Peaslee Creeks) and by bank and floodplain erosion. Gasburg Creek (RM 50.3) and Peaslee Creek (RM 45.5) have relatively large input potential, and Lower Dominici Creek (RM 47.8) has moderate input potential (McBain & Trush 2000). These assessments were based in part on the size of deltas observed at each of the tributary mouths, believed to have been deposited on the receding limb of the January 1997 flood.

The January 1997 flood eroded approximately 500,000 yd^3 of sediment from the spillway channel at Don Pedro Dam, depositing sediment behind La Grange Diversion Dam and a large volume of fine sediment in downstream reaches of the Tuolumne River (McBain & Trush 2000, 2004). In June 2001, discrete fine sediment deposits in the channel were mapped from the USGS gauging station near La Grange Diversion Dam (RM 52.1) downstream to Roberts Ferry Bridge (RM 39.6) (Stillwater Sciences 2002). The results of the survey were used to estimate fine sediment storage in pools and other discrete deposits and estimate the relative contribution of fine sediment from tributaries. Survey results indicate that fine sediment constituted a large fraction of the channel bed surface. Discrete fine sediment deposits were more common in pools from Basso Bridge (RM 47.5) to Peaslee Creek (RM 45.5) than in upstream reaches, and the largest volumes of fine sediment were observed from Peaslee Creek to Roberts Ferry Bridge (RM 39.5). Gasburg Creek and Peaslee Creek appeared to be the largest contributors of fine sediment in the surveyed reach.

Sediment source analyses conducted for the Gasburg Creek watershed in 2003 and 2004 indicated that the tributary supplied approximately 1,203 yd^3 of fine sediment annually to the Tuolumne River (Stillwater Sciences 2004, PWA 2004). The Gasburg Creek Fine Sediment Reduction Project was implemented in 2007 to reduce fine sediment delivery from a deeply incised gully (the dominant erosion feature identified in the watershed) and to modify the Gasburg Creek floodway extending from the MID canal culvert downstream to approximately Old LaGrange Road (Laird 2005, McBain & Trush 2007). Beginning on January 6, 2008, the lower Tuolumne River experienced several episodes of high turbidity resulting from fine sediment input from the Peasley Creek watershed. Following the event, the Districts conducted turbidity monitoring, bulk sediment sampling, photo-monitoring, and benthic invertebrate sampling in the Tuolumne River in the vicinities of the Peasley Creek confluence and Bobcat Flat (located approximately 2 miles downstream of the Peasley Creek confluence) to document any effects related to the increased fine sediment supply (McBain & Trush 2008). In addition to the episodes of elevated fine sediment delivery from Peaslee Creek, several small dams that impounded fine sediment in Lower Dominici Creek failed in February 2006, releasing fine sediment to downstream reaches (CRWQCB 2006 as cited in Stillwater Sciences 2006).

Most woody debris captured in Don Pedro Reservoir is small, and it appears that the majority of it would pass through the lower river during higher flows if it were not trapped in the reservoir (TID/MID 2013e). The lower Tuolumne River between RM 52 and 26 has channel widths averaging 119 feet, and woody debris would have a limited effect on channel morphology in this reach (TID/MID 2013e). It is unknown, however, to what extent smaller pieces of wood might add to existing wood accumulations or initiate small jams in the lower river, thereby possibly influencing channel sediment dynamics.

4.2.2 2012 Spawning Gravel Study in the Lower Tuolumne River

To assess the contribution of the overall Don Pedro Project's continued presence and operation to cumulative effects to the supply, transport, and storage of coarse and fine sediment downstream of La Grange Diversion Dam, the Districts conducted a study in 2012 of spawning gravel in the lower Tuolumne River (TID/MID 2013f). Results of this study update information from prior studies to address the following objectives:

- Estimate average annual sediment yield to Don Pedro Reservoir based on reservoir sedimentation,
- Estimate changes in the volume of coarse (> 2 mm) bed material stored in the lower Tuolumne River channel over the 2005–2012 period,
- Map current FBM (predominantly < 2 mm) in the lower Tuolumne River channel and compare results to those of surveys conducted in 2001 (Stillwater Sciences 2002), and
- Develop a reach-specific coarse sediment budget to determine any cumulative effects of the Don Pedro Project on Don Pedro Project-affected reaches of the lower Tuolumne River.

In addition, the Districts conducted the Don Pedro Reservoir Bathymetric Study (HDR 2012) to develop an accurate geometry of Don Pedro Reservoir and update the reservoir's elevation-storage curve.

The results of the Districts' 2012 Spawning Gravel in the Lower Tuolumne River study (TID/MID 2013f) and bathymetric study are provided in the following subsections.

4.2.2.1 Average Annual Sediment Yield to Don Pedro Reservoir

Comparison of storage capacity curves for Don Pedro Reservoir in 1971 and 2011 indicates that there has been 15,694 AF (25,319,653 yd^3) of storage loss due to sedimentation since closure of the Don Pedro Dam, which represents less than 1 percent of the original storage capacity of Don Pedro Reservoir in 1971 (HDR 2012; TID/MID 2013f). Average annual total and coarse (>2 mm) sediment yields to the reservoir, calculated over the 1923–2011 period, are approximately 373,966 tons/year and 37,397 tons/year, respectively. These estimates are within 13 percent of estimates based on reservoir storage capacity changes during the period 1923–1946 reported by Brown and Thorp (1947) and are comparable to sediment yields estimated for other reservoirs on the western slope of the Sierra Nevada.

4.2.2.2 Changes in Volume of Bed Material Stored in the Lower Tuolumne River, 2005–2012

Previous studies have estimated the minimum threshold for significant bed mobility in the lower Tuolumne River to be 5,400–6,880 cfs (McBain & Trush 2000, 2004), with an average annual bedload transport rate of 1,930 tons/year based on an empirically derived bedload rating curve (McBain & Trush 2004). Sediment transport modeling has estimated a similar average annual bedload transport rate of 1,412 tons/year (McBain & Trush 2004). The following indicators suggest a deficit in coarse sediment supply relative to bedload transport downstream of La Grange Diversion Dam (CDWR 1994, McBain & Trush 2004):

- Channel cross section surveys indicate that the channel is wider than expected in many reaches, lacks bankfull channel confinement, and has cross sectional dimensions that are not adjusted to the contemporary flow regime.
- SRPs deprive downstream reaches of sediment by trapping all particles larger than coarse sand (4 mm), provide little or no high quality salmonid habitat, and provide suitable habitat for non-native piscivores that prey on juvenile salmonids (McBain & Trush 2000).

The coarse sediment budget developed through sediment transport modeling and analysis of changes in bed topography (TID/MID 2013f) indicates that without gravel augmentation, the channel in the first 12.4 miles downstream of La Grange Diversion Dam would be slowly degrading in response to a reduction in coarse sediment supply by upstream dams. Between 2005 and 2012, approximately 5,913–8,720 tons of coarse (>2 mm) bed material was lost from storage between RM 45.8 and 52.1, an area that encompasses the Dominant Salmon Spawning Reach (i.e., RM 46.6–RM 52.1) (TID/MID 2013f). Gravel augmentation has helped increase coarse sediment storage in the reach, and 94 percent of the coarse sediment added through augmentation has been retained within that reach.

Differencing of channel topography surveyed in 2005 and 2012 shows that little change in storage occurred during this period at the reach scale, but that high-flow events in WY 2006 and WY 2011 locally scoured the bed and redistributed coarse and fine sediment deposits (TID/MID 2013f). Pools commonly scoured 3 to 5 feet, mobilizing finer sediment to depositional areas in channel margins and coarser sediment to pool tails and riffles, where 1 to 3 feet of aggradation is commonly observed. The total estimated volume lost from storage in the reach that extends from RM 45.8 and 52.1 is comparable in magnitude to the quantity of coarse sediment added during any one of the augmentation projects (approximately 7,000–14,000 tons) that have occurred since 2002.

The results of sediment transport modeling and topographic differencing suggest that augmentation material is being mobilized short distances during infrequent high-flow events (e.g., during WY 2006 and WY 2011), but that routing is slow due to low bedload transport capacity. Prolonged retention of augmented coarse sediment may allow the gravel framework to fill with fine sediment.

4.2.2.3 Fine Bed Material Deposits in the Lower Tuolumne River

The total volume of discrete FBM (predominantly <2 mm) deposits in the reach from La Grange Diversion Dam (RM 52.1) to Roberts Ferry Bridge (RM 39.6) decreased by 48 percent from 2001 (Stillwater Sciences 2002) to 2012. Discrete FBM deposits mapped in 2012 were distributed nearly equally among pool margins, channel margins, and alcoves and backwaters but were more frequent and larger immediately downstream of Gasburg and Peaslee creeks, suggesting that supply from these tributaries continues to be an important source of fine sediment to the lower Tuolumne River channel (TID/MID 2013f).

4.2.2.4 Riffle Area in the Lower Tuolumne River

A total of 3,527,200 ft^2 of riffle mesohabitat was mapped from RM 52.1 to RM 23 in 2012, of which 2,967,500 ft^2 (84%) was occupied by spawning gravel (TID/MID 2013f). The particle size distribution of spawning gravel deposits was relatively uniform, with an average estimated D50 of 51 mm. Comparing the results of riffle surveys conducted in 1988 and 2012 suggests that riffle area increased by 606,200 ft^2 (21%). However, comparing the 2001 and 2012 surveys suggests a more significant increase of 709,500 ft^2 (54%). Increases in riffle area from 2001 to 2012 are largely attributed to differences in the methods used to map riffles over time (e.g., variability in the discharge and wetted channel area in aerial photographs used in desktop mapping and during field surveys, mapping criteria based on flow depth and gravel substrate, and accuracy and precision of riffle delineation [see Section 5.4.1 of TID/MID 2013f]). Although differences in riffle area are likely attributed to methodological differences, pool scour and associated deposition of coarse sediment in pool tails and riffles during high flow events in WY 2006 and WY 2011 increased the size and modified the distribution of riffle mesohabitats.

4.3 Water Resources

FERC's SD2 (page 35) identifies the following potential Don Pedro Project effects related to water resources in the Tuolumne River:

- *Effects of project operation on the quantity and timing of streamflow in the project-affected downstream reach, including water storage, peaking operations, and ramping rates*
- *Potential effects of project operation and maintenance on water quality, water temperature, and water quantity in the project reservoir and the project-affected downstream reach*

For water resources, FERC defines the geographic scope of cumulative effects as extending upstream on the Tuolumne River to Hetch Hetchy Reservoir and downstream to San Francisco Bay. FERC noted that based on the potential term of a new license, the temporal scope should include reasonably foreseeable actions extending 30 to 50 years into the future. Assessment of past actions that have contributed to cumulative effects on water resources is necessarily limited by the availability of information.

Water quantity and water quality within the geographic scope of the cumulative effects analysis are affected by a myriad of actions within and outside the Tuolumne River basin (see Section 4.1 of Exhibit E for a discussion of these actions), including in-channel and floodplain mining; water storage and diversion at numerous dams; and a variety of land uses, including agriculture and industrial development. Because the Proposed Action would have no influence on flows downstream of the Don Pedro Project or water surface elevations in Don Pedro Reservoir, and the reservoir would exist and continue to exist in the absence of hydroelectric generation, the Proposed Action would not contribute to cumulative effects on water resources within the geographic scope defined by FERC. The Don Pedro Project's primary purposes (water storage and supply for irrigation and M&I uses and water management for flood control) do contribute to cumulative effects, but these effects diminish relative to other impacts, such as those associated with other water management projects and land uses in the San Joaquin basin, with increasing distance downstream of the Don Pedro Project. As a result, with greater distance downstream of the Don Pedro Project, it becomes increasingly difficult to isolate the effects of the Don Pedro Project's primary purposes of water supply and flood control on water resources.

Within the geographic scope identified by FERC, major actions (in addition to the existing Don Pedro Project) that contribute or have contributed to cumulative effects on water quantity and/or water quality are listed below (descriptions of the history and nature of these actions are provided in Section 4.1 of Exhibit E):

- CCSF's Hetch Hetchy water system (1923–present) on the upper Tuolumne River, which is used for water supply and hydroelectric generation, including construction of the San Joaquin Pipeline with a capacity to deliver up to 484 cfs, or 313 mgd, to CCSF's Bay Area customers,

- The Districts' original Don Pedro Project (1923–1971), which had about 300,000 AF of water storage for irrigation,
- Construction and operation of the Districts' La Grange Diversion Dam (1893–present) located about 2 miles downstream of Don Pedro Dam. The purpose of the diversion dam is to raise the level of the Tuolumne River to enable diversion of water into TID's and MID's canal systems, which provide water for irrigation and M&I uses,
- Flood control operations by the ACOE or under ACOE guidelines on the San Joaquin River and its tributaries,
- In-channel river dredging and modification of the Tuolumne River's floodplain for gold mining and aggregate extraction (1850–present),
- Operational spills from irrigation systems and runoff from farms into the Tuolumne River, Dry Creek, and the San Joaquin River (1890s–present),
- Diversion and pumping of water by riparian water users along the lower Tuolumne River (1880s–present),
- Groundwater accretion/depletion along the Tuolumne River (1880–present),
- Riparian diversions along the San Joaquin River and in the Delta (1880–present),
- Construction and operation of major storage reservoirs in the San Joaquin, Merced, Stanislaus, and Mokelumne river basins (1920s–present),
- Construction and operation of major water diversions, pumping, and canal delivery systems in the San Joaquin River and Delta (1940s–present), including the California Aqueduct, Friant Kern system, and Delta Mendota Canal,
- Development and operation of the Stockton Deep Water Ship Channel on the San Joaquin River (1930–present),
- Urbanization and its resulting pollution along the San Joaquin River and its tributaries and within the Delta,
- Use of pesticides, herbicides, and fertilizers to support agriculture,
- Development and expansion of wastewater systems to support urban development, and
- Climate change.

In addition to the actions listed above, there are numerous minor actions (e.g., levees for flood control, water withdrawals and wastewater discharges for industrial use) that also contribute to cumulative effects on water resources. The complexity and co-occurrence of past, present, and potential future actions in the San Joaquin River, it tributaries, and the Delta make it very difficult, and in many instances impossible, to isolate specific contributions, particularly quantitatively, to cumulative effects on water resources associated with individual actions.

4.3.1 Water Quantity

Major factors contributing to cumulative effects on the hydrology of the Tuolumne River include the operation of CCSF's Hetch Hetchy system, the operation of the Don Pedro Project for water storage and flood control, the diversion of water at La Grange Diversion Dam to the Districts' irrigation systems for irrigation and M&I uses, irrigation return flows in Dry Creek and along the lower Tuolumne River, and riparian water withdrawals along the lower Tuolumne River.

CCSF's diversion of 250,000 AF of water from the watershed affects both the quantity of water available in the watershed and the timing of flows in the Tuolumne River. CCSF's dams and reservoirs regulate approximately 50 percent of the Tuolumne River's flows above Don Pedro Reservoir. CCSF's regulation can affect Tuolumne River flows during low, normal, and moderately high-flow conditions. CCSF's historical average diversion is about 12 percent of the total average unimpaired flow of the Tuolumne River at La Grange Diversion Dam. During drought years, if CCSF uses credits available to it in the water bank, the only inflow to Don Pedro Reservoir can be that originating in the unregulated portion of the Tuolumne River along with minimum flow releases made by CCSF.

Based on data from the Tuolumne River Operations Model, the operation of the Districts' Don Pedro Reservoir primarily affects the timing of flows in the lower Tuolumne River below Don Pedro Dam (Figure 4.3-1). Reservoir inflows can be less than 100 cfs, but outflows are very seldom less than 200 cfs. A primary function of Don Pedro Reservoir is to store water during higher flows for later release during the irrigation season, with the highest releases for consumptive use purposes occurring in July and August, when the median reservoir inflow is about 500 to 600 cfs and the median outflow is about 2,700 cfs. As Figure 4.3-1 indicates, inflows can exceed 4,000 cfs about 20 percent of the time, whereas outflows exceed 4,000 cfs about 14 percent of the time. Operation of the Don Pedro Project results primarily in seasonal differences between inflows and outflows due to monthly and annual storage carryover in the reservoir, but except for evaporation losses, long-term inflow must equal long-term outflow. These seasonal differences are illustrated by the examples shown in Figures 4.3-2 and 4.3-3, which depict the February and August flow magnitudes and frequencies of reservoir inflows and outflows.

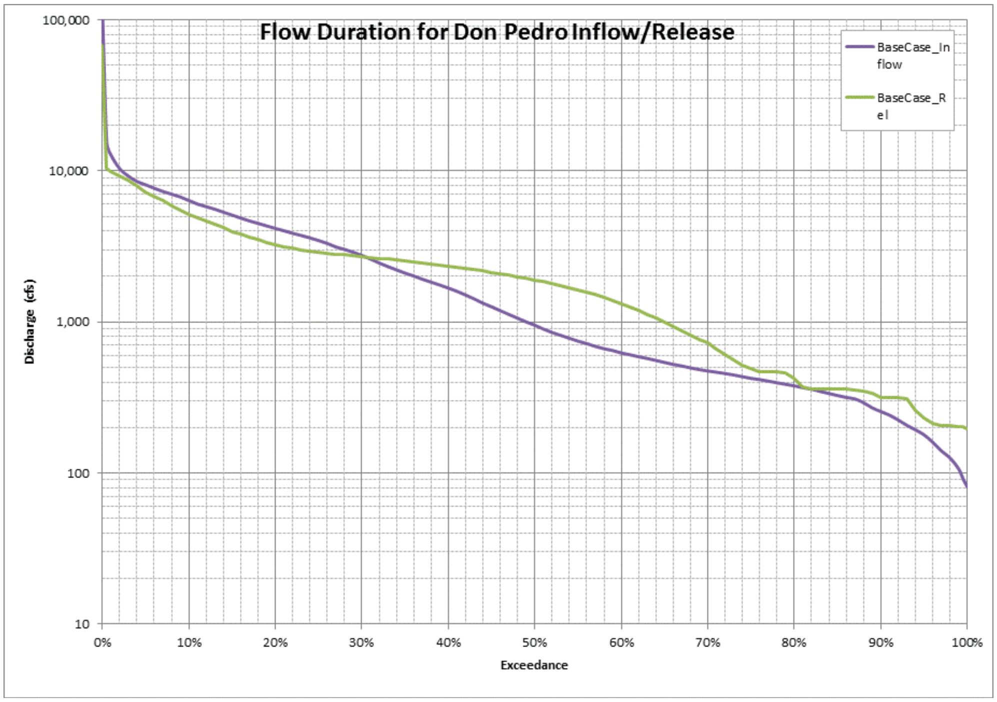

Figure 4.3-1. Don Pedro Reservoir annual inflow and outflow, 1971–2012.

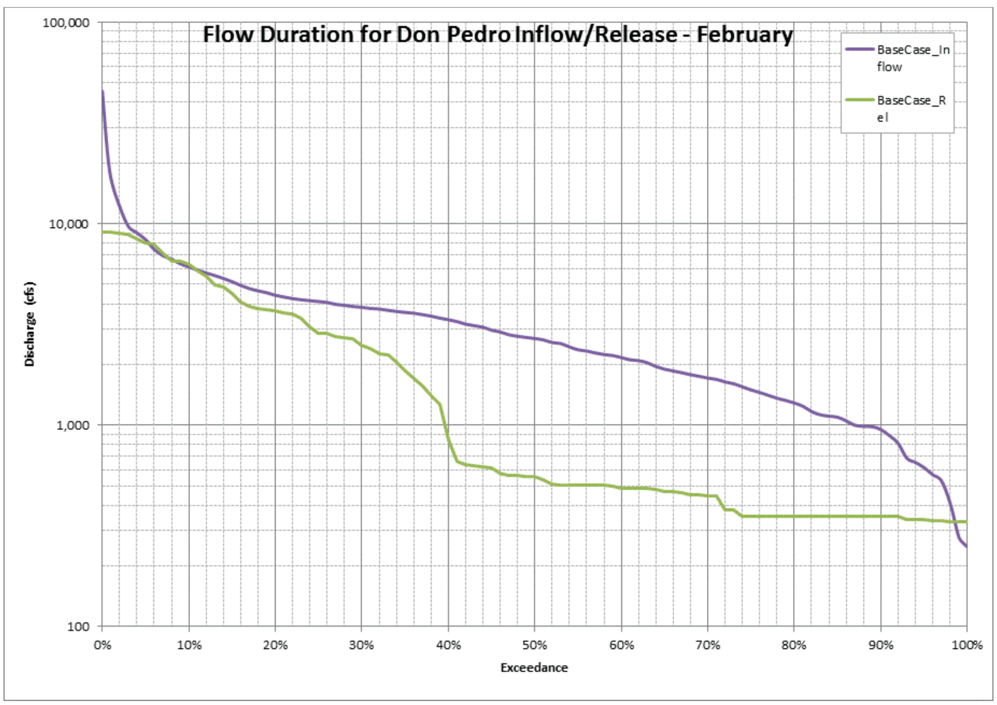

Figure 4.3-2. Don Pedro Reservoir February inflow and outflow, 1971–2012.

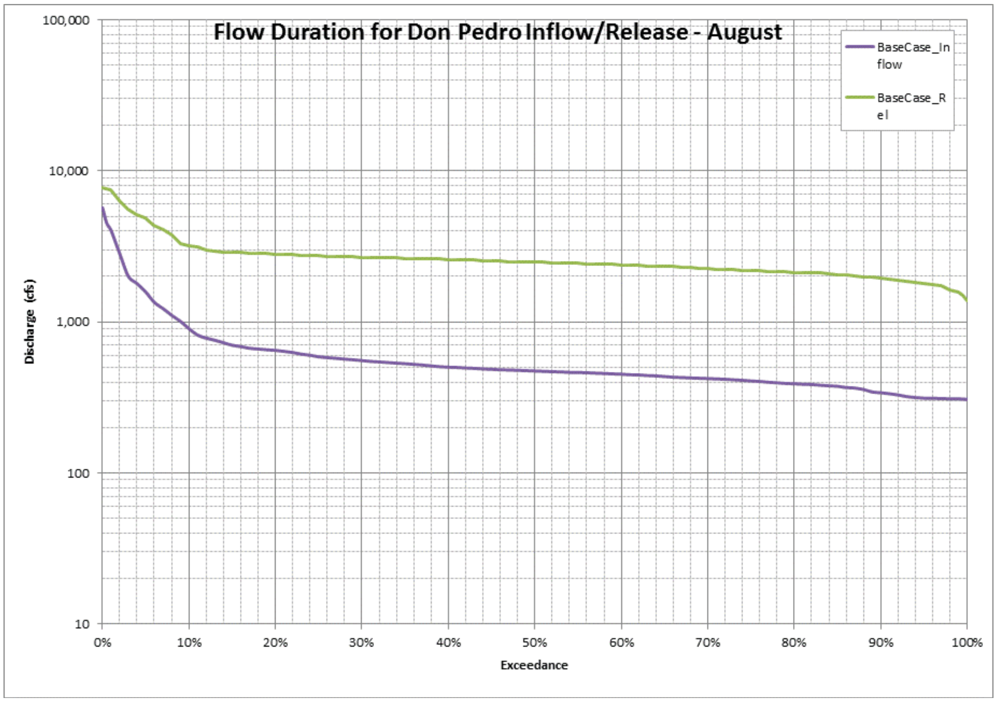

Figure 4.3-3. Don Pedro Reservoir August inflow and outflow, 1971–2012.

It is the operation of the Districts' 120-year-old La Grange Diversion Dam that has the most pronounced effects on water quantity in the lower Tuolumne River from RM 52.2 to the confluence with the San Joaquin River. This can be shown by the differences in flows released at the Don Pedro Project and those recorded at the USGS gage at La Grange. Figure 4.3-1 shows the median annual outflow from Don Pedro to be approximately 1,900 cfs. The median flow recorded at the USGS La Grange gage using 1997–2012 gage data is 325 cfs (Figure 4.3-4). The release from Don Pedro exceeds 300 cfs approximately 93 percent of the time, while the flows at the La Grange gage exceed 300 cfs 55 percent of the time (Figure 4.3-4). Inflows to Don Pedro Reservoir exceed 4,000 cfs about 20 percent of the time. Flows greater than 4,000 cfs are released from Don Pedro about 14 percent of the time, whereas flows greater than 4,000 cfs occur at the La Grange gage about 10 percent of the time.

The 1913 Raker Act required CCSF to recognize the prior water rights of the Districts. The Act requires that CCSF release 2,350 cfs or the unimpaired flow, whichever is less, year round, and up to 4,000 cfs for 60 days beginning April 15, whenever such water may be beneficially used. The Fourth Agreement requires CCSF to recognize an additional water right of 66 cfs, which is additive to the Districts' Raker Act entitlements. The Districts divert the flows they are entitled to under their water rights at La Grange Diversion Dam into the MID and TID canal systems. Therefore, absent the Don Pedro Project, the Districts are entitled to divert at La Grange Diversion Dam 100 percent of the unimpaired flow of the river, up to the capacity of their water rights. Diversions by the Districts' full water right entitlement at La Grange Diversion Dam would, absent Don Pedro Dam, leave the lower Tuolumne River without water during a substantial portion of the year (Figure 4.3-5).

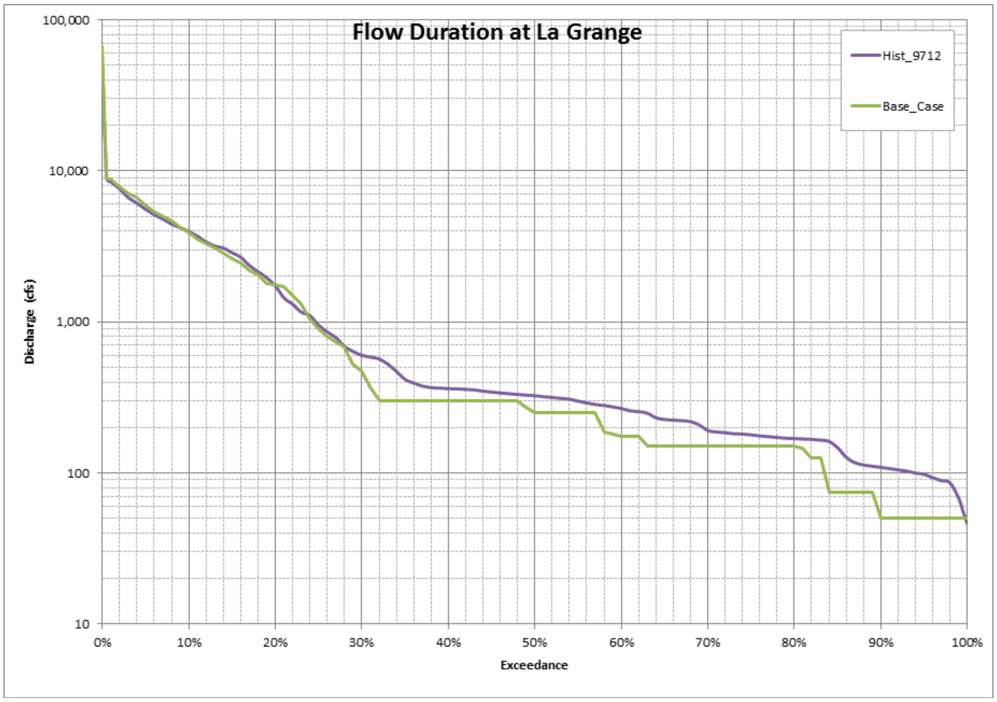

Figure 4.3-4. Historical (1997–2012) and modeled Base Case (1971–2012) flows at the USGS La Grange gage.

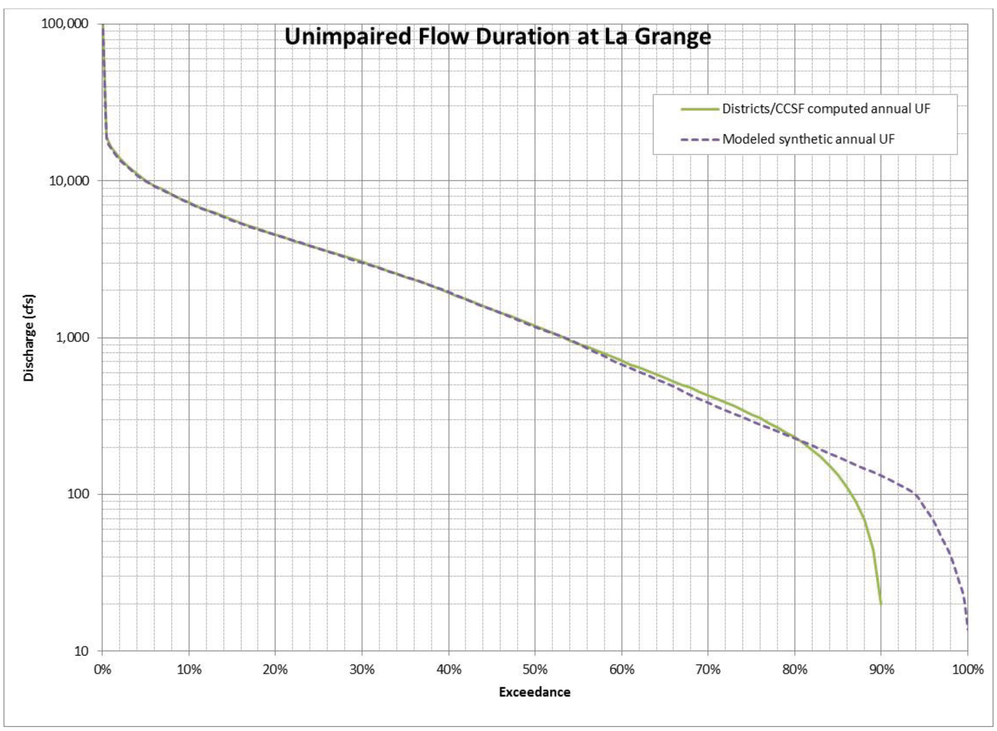

Figure 4.3-5. Estimates of unimpaired flow at USGS La Grange gage, 1971—2012.

The Don Pedro Project is required under its FERC license to provide flows to the lower Tuolumne River, measured by the USGS gage at La Grange, which vary with water year type from an annual minimum of 94,000 AF up to 300,923 AF. By percentage, the annual minimum release of 94,000 AF to the lower Tuolumne River occurs over the long term in just 6.4 percent of the years, and the annual maximum occurs approximately 50 percent of the years. The FERC-required minimum continuous flow is 50 cfs, although flows this low have occurred less than one percent of the time since 1997. In fact, a flow greater than 100 cfs has occurred 99 percent of the time since 1997. Therefore, the Don Pedro Project currently contributes positively to cumulative effects on water quantity in the lower Tuolumne River whenever the unimpaired flow would have been less than the Districts' water rights.

Water storage in Don Pedro Reservoir for flood control and irrigation and M&I uses reduces the occurrence of higher flows in the lower Tuolumne River. Don Pedro Reservoir inflow, for the period 1971 to 2012, exceeded 5,000 cfs approximately 15 percent of the time (Figure 4.3-1), and flows at the USGS La Grange gage since 1997 (post-FERC amendment to flows) exceeded 5,000 cfs 10 percent of the time (Figure 4.3-4).

Flows in the lower Tuolumne River are increased by occasional operational spills from the Districts' irrigation system, farm runoff, and groundwater accretion, and flows are decreased by riparian pumping. Quantitative values for these factors are generally unavailable, but direct accretion measurements made by the Districts as part of relicensing studies show that the lower Tuolumne River is generally a gaining river. However, riparian diversions, acting together, can contribute to significant loss of flow. There are 26 known riparian diversions with an estimated total combined withdrawal capacity of 76.6 cfs (CDWR 2013).

Factors contributing to cumulative effects on water quantity in the San Joaquin River and the Delta are numerous and are not all well quantified. Major factors include water development and diversion of flows on the San Joaquin River at Friant Dam to the Friant-Kern and Madera canals and associated facilities serving over 1 million acres of irrigated farmland. Friant Dam was constructed in 1942 and materially changed the flow regime of the San Joaquin River. In many years mean annual flows below Friant Dam are less than 200 cfs (SJRRP 2011). Construction of other major water storage and diversion projects on the Merced, Stanislaus, and Mokelumne rivers, as well as the Tuolumne River, all contribute to cumulative effects on water quantity in the San Joaquin River and Delta systems.

The total drainage area of the San Joaquin River is 31,800 mi^2, and at its entrance to the Delta (i.e., at Vernalis) the drainage area is 13,539 mi^2. The Tuolumne River has a drainage area of approximately 1,960 mi^2, or 14 percent of the San Joaquin River watershed at Vernalis and 6 percent of the total San Joaquin watershed area. In addition to water development projects associated with the SWP and CVP, numerous riparian diversions also occur along the San Joaquin River and its tributaries and throughout the Delta. Except for the State and Federal pumping plants, the total quantity of water historically diverted and pumped by these diversions is not well known.

4.3.2 Water Quality

Many of the factors listed above in Section 4.3 also contribute to cumulative effects on water quality in the Tuolumne and San Joaquin rivers and in the Delta. A study performed as part of relicensing (TID/MID 2013h) indicates that water quality in Don Pedro Reservoir and in the Tuolumne River immediately downstream of Don Pedro Dam meets California's water quality standards. Section 3.4 of Exhibit E describes sampling results for a range of water quality variables including, DO, pH, biostimulatory substances, turbidity, select pesticides, toxicity, mercury/methylmercury, bacteria, oil and grease, sediment, and taste and odor. Based on these results, it is apparent that the Don Pedro Project's presence and primary purposes of water supply and flood control do not contribute to adverse cumulative effects related to any of these variables. Because the Proposed Action does not influence overall storage and flow release schedule, it cannot, by definition, contribute to cumulative effects on any water quality variables, including temperature.

The lower Tuolumne River accumulates pollution loadings from pesticides and wastewater discharge as it travels downstream. The section of the Tuolumne River from Don Pedro Reservoir to the San Joaquin River is included on the State of California's CWA § 303(d) list in relation to the non-point discharge of some agricultural pesticides (SWRCB 2010). Agricultural chemicals on the 303(d) list are chlorpyrifos, diazinon, and the Group A Pesticides: aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexanes (including lindane), endosulfan, and toxaphene. This reach of the Tuolumne River is also 303(d) listed for mercury, a legacy contaminant of the gold mining era (SWRCB 2010).

Six pesticides were detected in runoff from agricultural and urban areas during a study conducted in the lower Tuolumne River, and chlorpyrifos, DCPA, metolachlor, and simazine were detected in almost every sample (Dubrovsky et al. 1998). Peak diazinon concentrations measured in the lower Tuolumne River have frequently exceeded levels that can be acutely toxic to some aquatic organisms (Dubrovsky et al. 1998).

The presence of the Don Pedro Project and its operation to satisfy the primary purposes of water supply and flood control do not contribute to cumulative adverse effects associated with agricultural pesticides or mercury downstream of the Don Pedro Project. Herbicides applied for control of invasive plants at some reservoir shoreline facilities are applied in such small amounts that their contribution to levels of chemical constituents in the Tuolumne River basin is negligible. For the same reason, rodenticides applied rarely to control ground squirrels near certain recreational facilities adjacent to Don Pedro Reservoir, are used in such small amounts that their effects are also considered insignificant.

4.3.2.1 Water Temperature

The section of the Tuolumne River from Don Pedro Reservoir to the San Joaquin River is also included in the State of California's CWA § 303(d) list in relation to water temperature. In addition to the natural climate characteristics of the Central Valley, factors contributing to the thermal conditions in the lower Tuolumne River include (among others) water storage in Don Pedro Reservoir; water diversions at the Hetch Hetchy Project and at La Grange Diversion Dam;

substantial in-channel and floodplain habitat modifications, including removal of riparian vegetation; return flow from irrigation operations and alteration of groundwater accretion; riparian diversions; Dry Creek inflows; and wastewater discharges. As explained previously, the Proposed Action would not contribute to cumulative effects on water temperature in the Tuolumne River basin, because it would have no significant effect on water management, i.e., storage and diversion. However, the Don Pedro Project's primary purposes have a localized effect on temperature, as explained below, which is attenuated with increasing distance downstream.

4.1.1.1.30 Water Temperature Effects of Don Pedro Reservoir Operations

At over 400-feet deep, the Don Pedro Reservoir is a large reservoir which goes through a well-established annual cycle of temperature stratification and destratification. Temperature stratification begins to be established by early April, is well established by June, and remains until turnover in late October/early November or later. The effect of thermal stratification within Don Pedro Reservoir is to enable it to support both a robust cold-water and warm-water fishery.

The best indicator of the overall effects of the Don Pedro Reservoir on water temperatures is to compare the differences between the reservoir inflow and outflow temperatures. Figure 4.3-6 displays actual mean daily reservoir inflow and outflow temperatures recorded over the period of October 2010 through December 2012. The figure demonstrates the effects of the Don Pedro Reservoir on Tuolumne River temperatures. While reservoir inflow temperatures vary considerably due to local meteorological and geophysical conditions, outflow temperatures vary only slightly. Outflow temperatures are generally slightly higher than inflow temperatures from November to early April when inflow temperature ranged from 3 to 10°C and outflow temperatures were relatively steady at 10 to 11°C. Outflow temperatures were cooler than inflow temperatures from early April through early October when outflow temperatures are relatively steady at 11 to 12°C and inflow temperatures ranged from 12 to 22°C. In 2011, from mid-June to mid-September, daily average inflow temperatures ranged from 19 to 23°C. Reservoir inflow and outflow temperatures are relatively equal during the April through mid-May time frame and the mid-October to mid-November time at about 10 to 11°C.

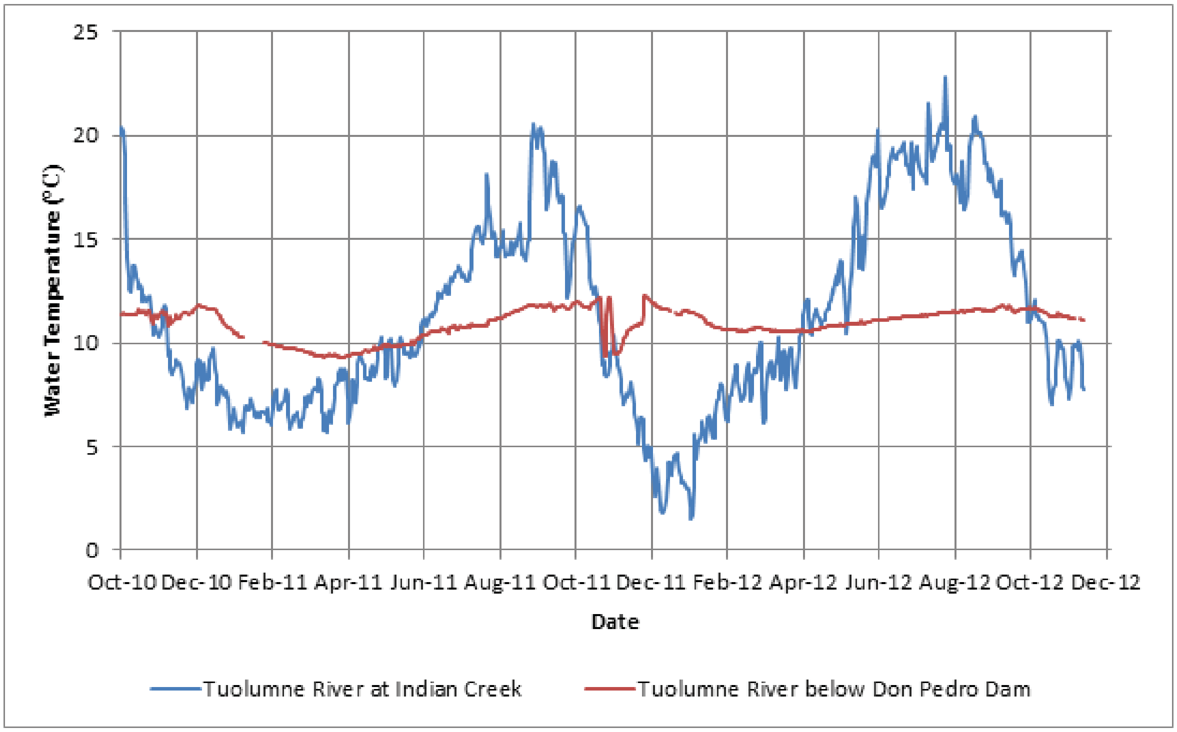

Figure 4.3-6. Don Pedro Reservoir inflow and outflow temperature.

These temperature patterns show very little change through the La Grange pool and just below La Grange Diversion dam. La Grange pool is shallow and short and is more riverine than lacustrine from a temperature perspective. La Grange pool does not stratify due to its shallowness and the flow-through is large relative to its volume, especially during summer months when releases for irrigation are at their highest. The contribution of the Don Pedro Project to cumulative effects to river temperature in the lower Tuolumne River would be consistent with its overall effects on water temperature; that is, Don Pedro Project operations tend to provide an initial cooling effect to temperatures in the river from June to early October, have no significant cumulative effect during the early April to mid-May and mid-October to mid-November time frames, and tend to provide a slight initial warming during the November to early April period.

The above findings of the cooling effects of Don Pedro Reservoir from the June through early October period applies only so long as the thermal stratification of the reservoir is intact. Modeling studies conducted during the development of the Don Pedro Reservoir 3-D temperature model indicate that once reservoir levels reach about elevation 625 to 650 ft, the reservoir temperatures become uniform and the thermal stratification breaks down. If these reservoir levels are reached during warmer periods (May-September), outflow temperatures can be expected to rise sharply.

4.1.1.1.31 With- and Without-Dams Project Temperature Comparisons

As explained previously, the Districts have developed a computer simulation of the temperature regime of the Tuolumne River without dams. The focus of the Tuolumne River Flow and Water Temperature Model: Without Dams Assessment (Jayasundara et al. 2014) was to develop a flow and water temperature model to simulate water temperatures in the Tuolumne River without the existing Hetch Hetchy (which includes Cherry and Eleanor reservoirs), Don Pedro, and La Grange projects. The model was developed to complement detailed models developed for Don Pedro and La Grange Reservoirs (TID/MID 2013i) and the lower Tuolumne River (TID/MID 2013j). Supporting data included the development of long-term flow and meteorological conditions to assess flow and water temperatures over a multi-decade period, i.e., 1970–2012. The following text and plots provide a characterization of with- and without-dam conditions to demonstrate the impoundments' contribution to cumulative effects on water temperatures in the Tuolumne River basin, in particular the reach between Don Pedro Dam and the San Joaquin River.

Figures 4.3-7–4.3-16 provide a comparison of simulated without-dams 7DADM temperatures to simulated (below the Don Pedro Project) and empirically derived (above the Don Pedro Project) with-dams temperatures at the following locations: (1) below the South Fork Tuolumne River (≈ RM 98), (2) the Tuolumne River below Indian Creek (≈ RM 88), (3) immediately below Don Pedro Dam (≈ RM 54), (4) RM 51.5, 46, 40, 34, and 24 in the lower Tuolumne River above Dry Creek (5) and RM 10 and RM 1 on the lower Tuolumne River below Dry Creek.

Comparison of 7DADM water temperatures under with- and without-dams conditions upstream of the Don Pedro Project indicates that during summer, water would be substantially warmer in the absence of the upstream impoundments than it is under existing conditions, particularly at RM 98 (Figures 4.3-7 and 4.3-8). With-dams temperatures are slightly warmer than without-dams temperatures during the November through February period by from 1 to 3°C at times (Figures 4.3-7 and 4.3-8). As noted in the figure captions, plots for RM 98 and RM 88 compare simulated without-dams temperatures to empirically derived with-dams temperatures.

The without-dams simulation reveals that average water temperatures in the Tuolumne River mainstem, in the absence of impoundments, would approach thermal equilibrium well upstream of the current location of the Don Pedro Project, i.e., the without-dams temperature regime at RMs 88 and 98 are very close to each other. Moreover, the highest without-dams 7DADM temperatures at RMs 88 and 98 (≈ 24 °C) are similar to the highest without-dams temperatures in the lower river (≈ 25 °C).

Immediately below Don Pedro Dam, with-dams 7DADM temperatures are relatively cool year-round, with little variability (Figure 4.3-9), because water is released from the reservoir's hypolimnion. Because of the thermal mass of the reservoir, water at depth is to a large degree buffered from the influence of seasonal and diel variability in air temperature and other climatic factors. With-dams 7DADM temperatures are much cooler than without-dams temperatures in summer but are slightly warmer by 1 to 5°C from about November through February.

With-dams 7DADM temperatures during summer rise rapidly with increasing distance downstream of the Don Pedro Dam, and by RM 46 temperatures during July reach 20 °C (Figure 4.3-11), while without-dams 7DADM temperatures reach 24°C. By approximately RM 34, thermal equilibrium has largely been restored under with-dams conditions, and with-dams and without-dams thermal regimes are closely matched. This condition persists from this point to the above Dry Creek. With-dams summer 7DADM temperatures are 2 to 5°C warmer below Dry Creek from mid-May to mid-September (Figures 4.3-15 – 4.3-16). Also, at all locations in the lower river, except immediately below Don Pedro Dam, there is a decrease in daily average water temperatures from mid-April to mid-May under the with-dams base case condition, which is the result of pulse flow releases scheduled to benefit fish downstream of La Grange Diversion Dam.

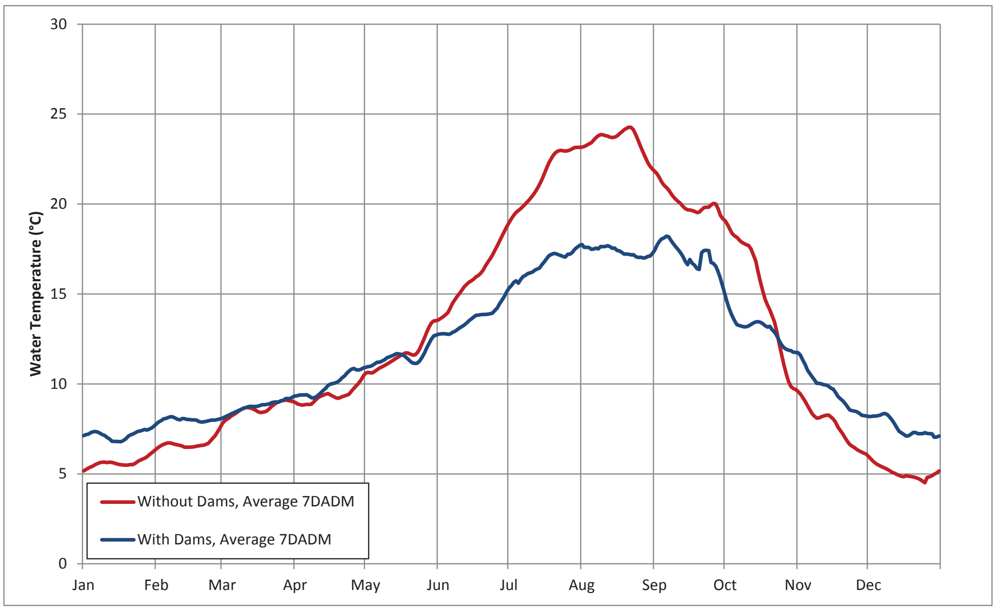

Figure 4.3-7. Comparison of 7DADM water temperatures under with- and without-dams conditions in the Tuolumne River below the South Fork Tuolumne River (≈RM 98). Without-dams temperatures are simulated based on the period 1970 - 2012 (Jayasundara et al. 2014), and with-dams temperatures are based on data collected by temperature loggers from 2005 - 2012.

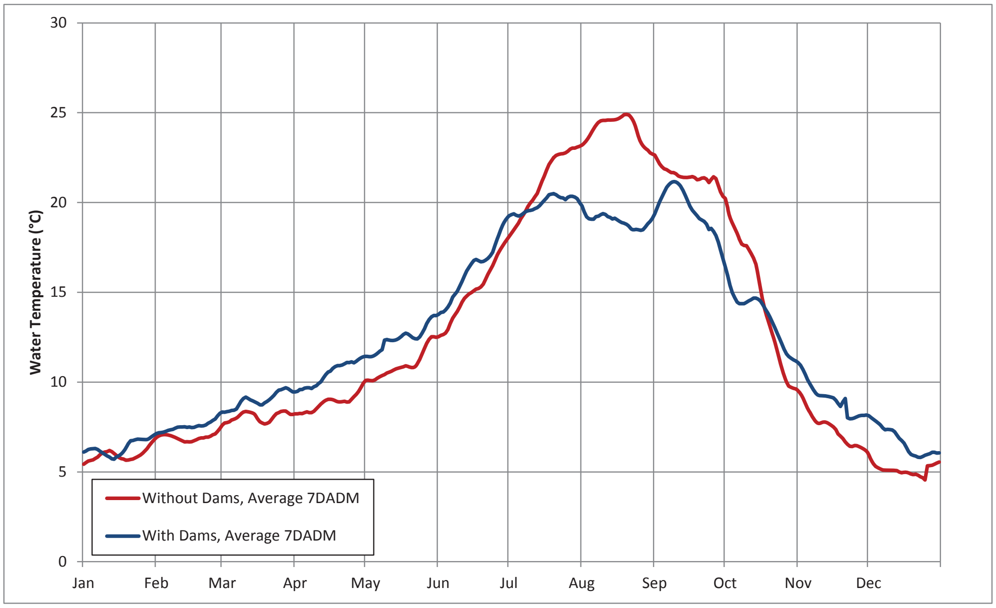

Figure 4.3-8. Comparison of 7DADM water temperatures under with- and without-dams conditions in the Tuolumne River below Indian Creek (≈RM 88). Without-dams temperatures are simulated based on the period 1970 - 2012 (Jayasundara et al. 2014), and with-dams temperatures are based on data collected by temperature loggers from 2009 – 2012.

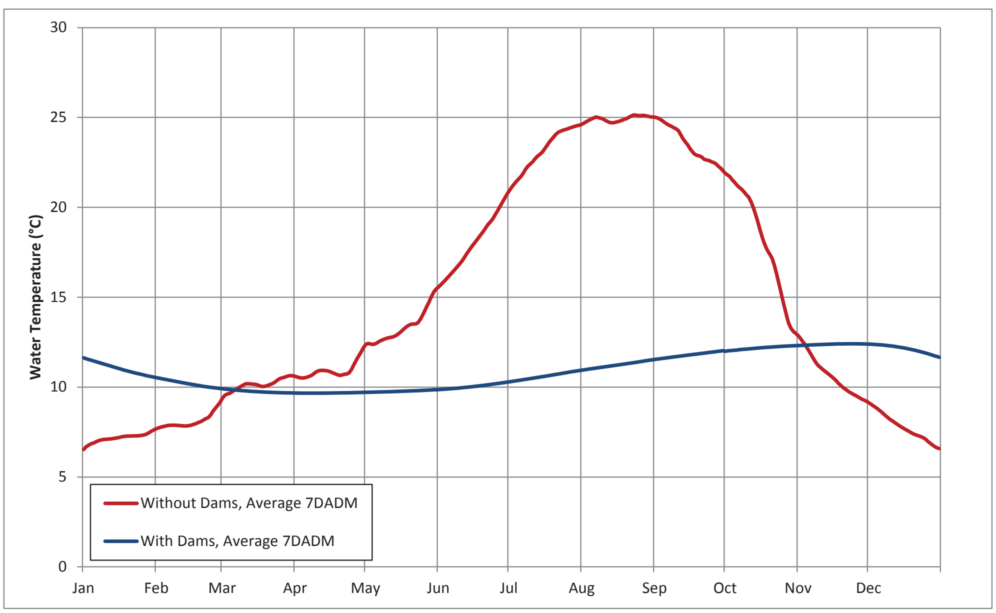

Figure 4.3-9. Comparison of 7DADM water temperatures under with- and without-dams conditions in the Tuolumne River below Don Pedro Dam (≈RM 54). Without-dams temperatures (Jayasundara et al. 2014) and with-dams temperatures (TID/MID 2013j) are simulated based on the period 1970 - 2012.

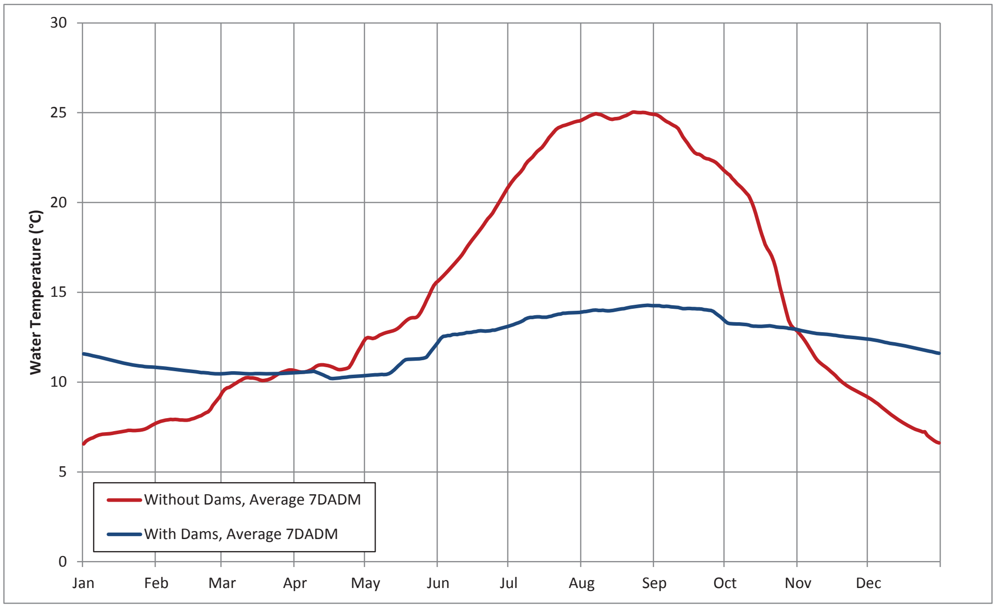

Figure 4.3-10. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 51.5. Without-dams temperatures (Jayasundara et al. 2014) and with-dams temperatures (TID/MID 2013j) are simulated based on the period 1970 – 2012.

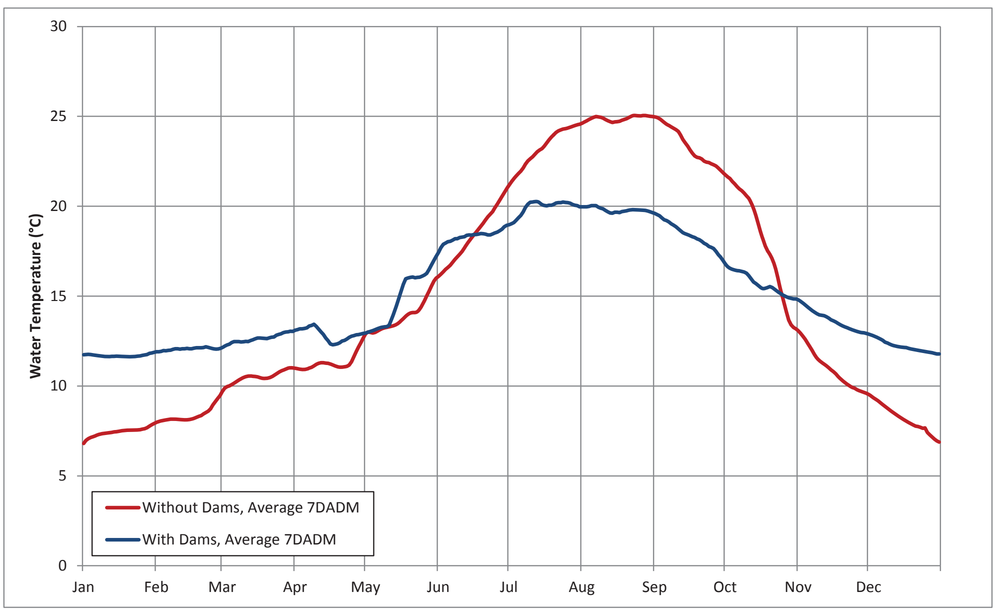

Figure 4.3-11. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 46. Without-dams temperatures (Jayasundara et al. 2014) and with-dams temperatures (TID/MID 2013j) are simulated based on the period 1970 - 2012.

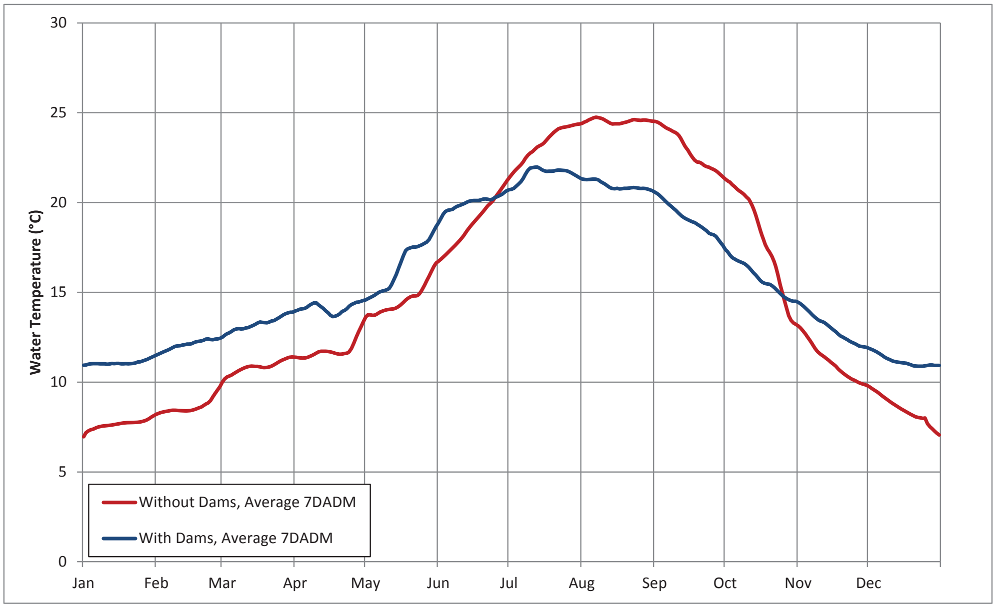

Figure 4.3-12. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 40. Without-dams temperatures (Jayasundara et al. 2014) and with-dams temperatures (TID/MID 2013j) are simulated based on the period 1970 - 2012.

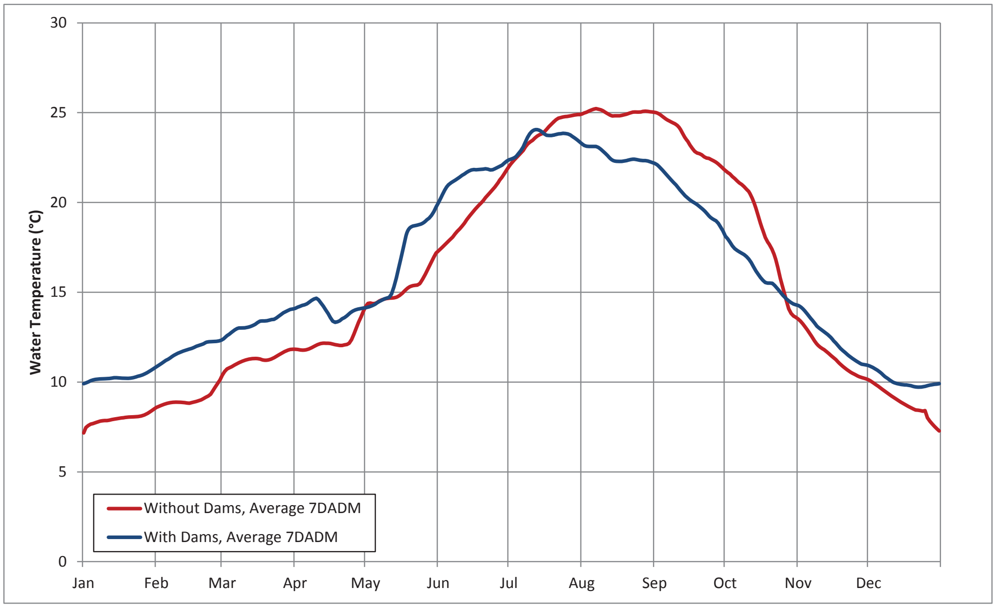

Figure 4.3-13. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 34. Without-dams temperatures (Jayasundara et al. 2014) and with-dams temperatures (TID/MID 2013j) are simulated based on the period 1970 - 2012.

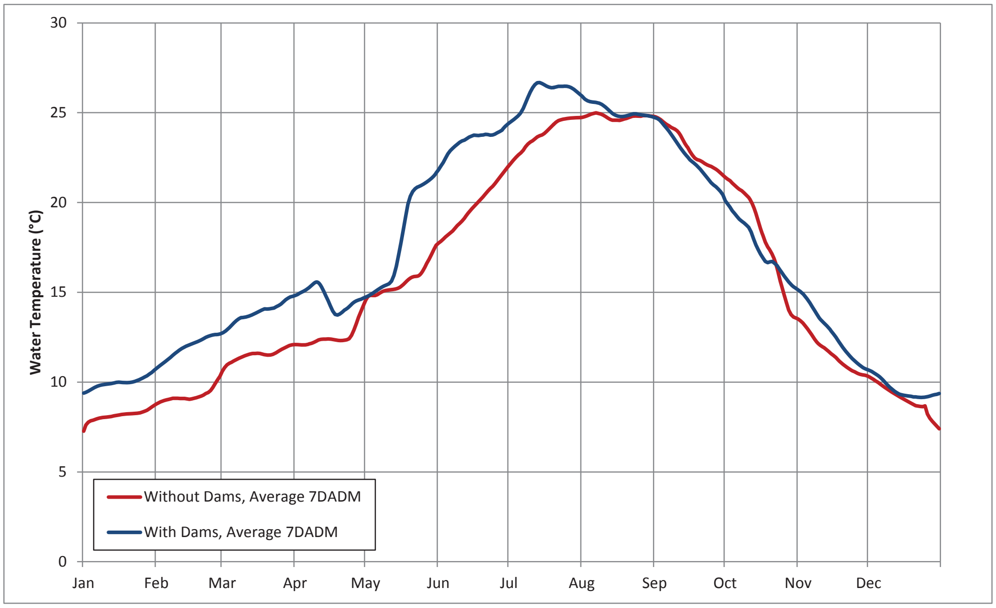

Figure 4.3-14. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 24. Without-dams temperatures (Jayasundara et al. 2014) and with-dams temperatures (TID/MID 2013j) are simulated based on the period 1970 - 2012.

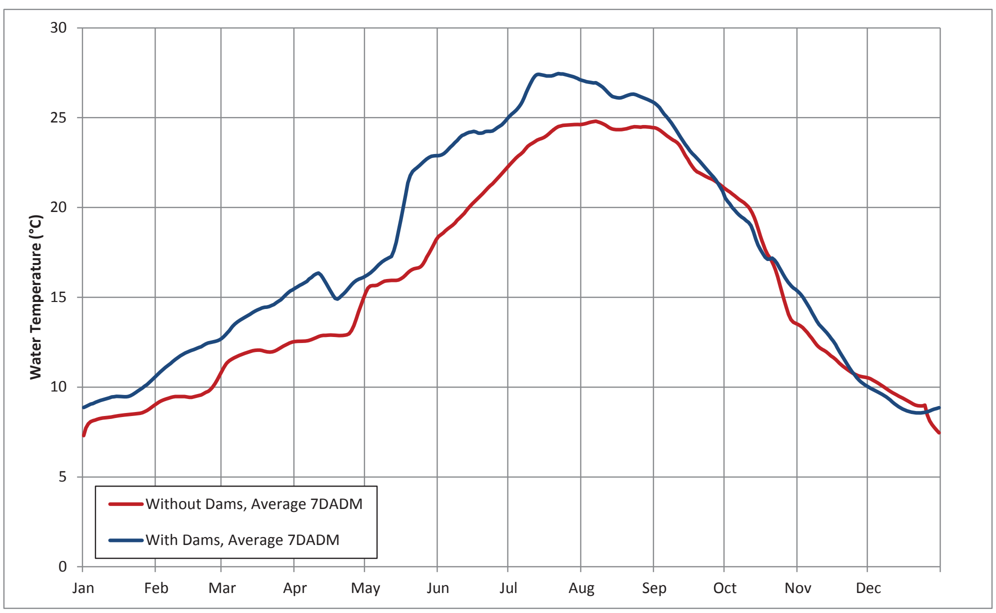

Figure 4.3-15. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 10. Without-dams temperatures (Jayasundara et al. 2014) and with-dams temperatures (TID/MID 2013j) are simulated based on the period 1970 - 2012.

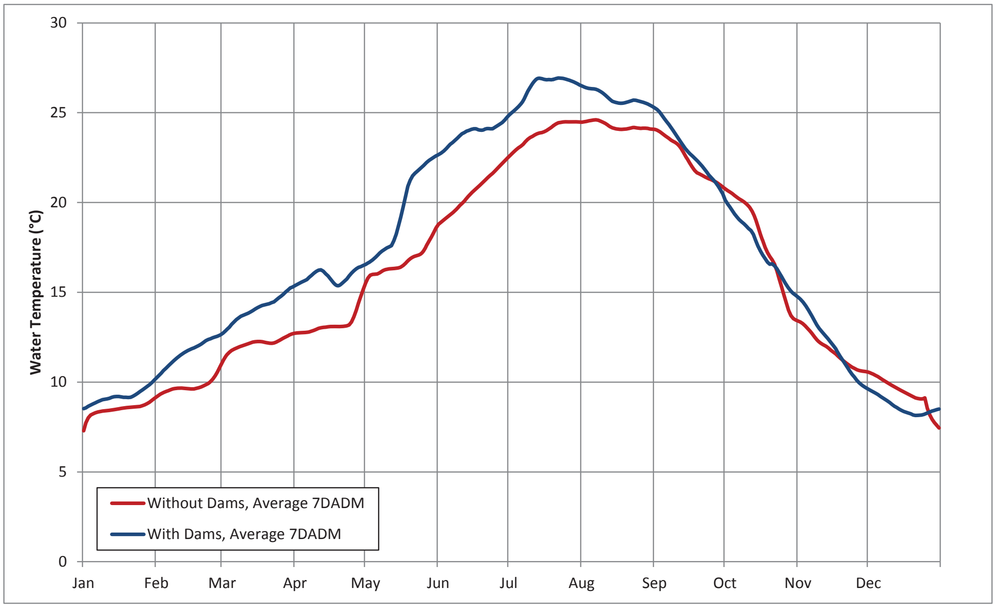

Figure 4.3-16. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 1. Without-dams temperatures (Jayasundara et al. 2014) and with-dams temperatures (TID/MID 2013j) are simulated based on the period 1970 - 2012.

4.1.1.1.32 Effects of Ambient Air Temperatures on Tuolumne River Water Temperatures

As ambient air temperatures and the number of hours of direct sunlight increase in the Tuolumne River valley during spring and summer, water temperatures become heavily influenced by local meteorological conditions. This is demonstrated in Figures 4.3-17, 4.3-18, and 4.3-19. Based on the Districts' HEC-RAS river hydraulic and temperature model (TID/MID 2013j), these figures depict the relationship between ambient air temperatures and river flow at three locations along the lower Tuolumne River, RM 39.5, RM 30, and RM 16.5.

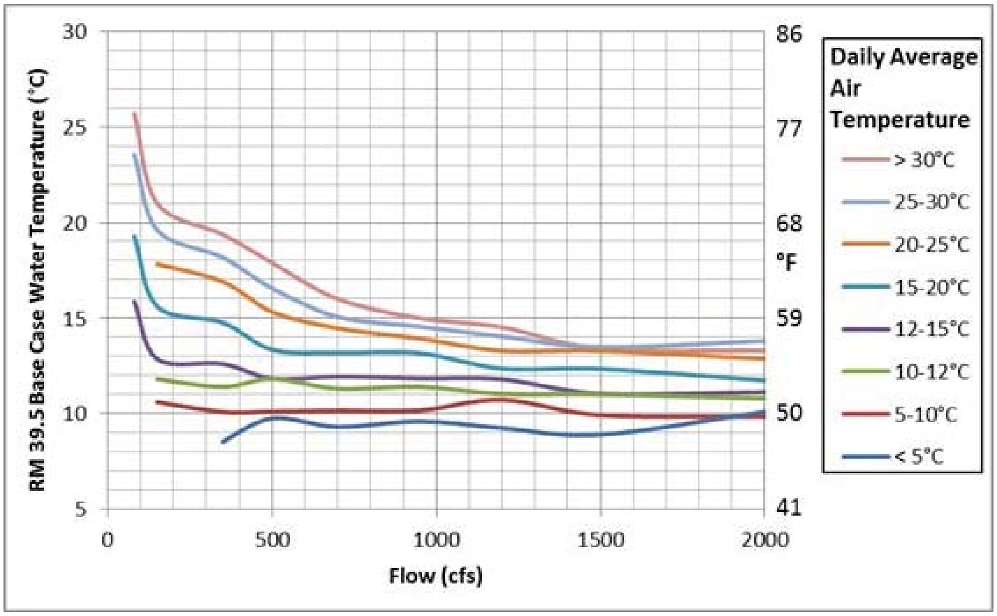

Figure 4.3-17. Relationship between average daily ambient air temperature, water temperature and flow in the lower Tuolumne River, RM 39.5.

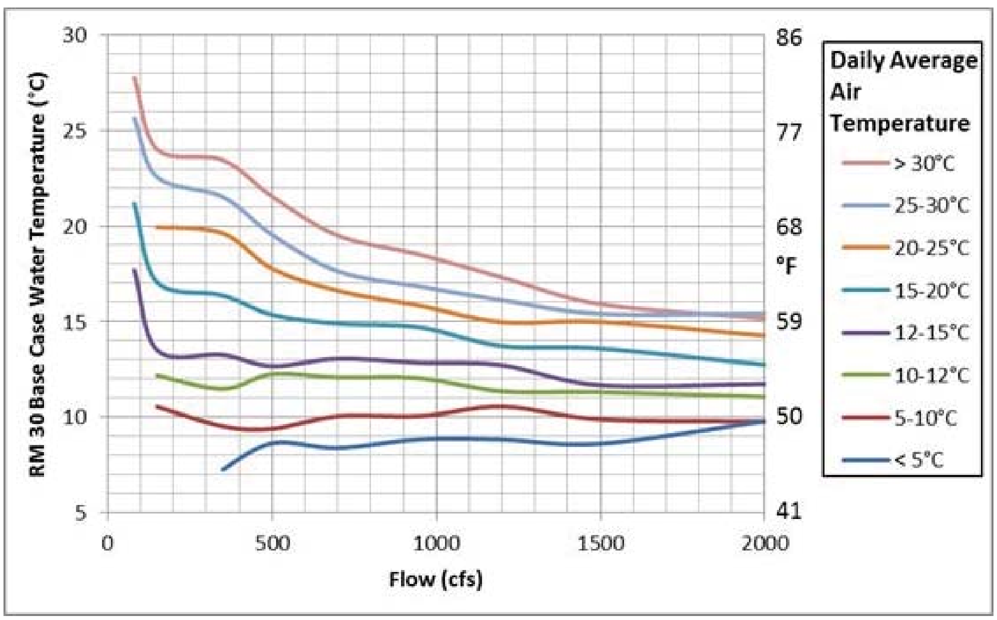

Figure 4.3-18. Relationship between average daily ambient air temperature, water temperature and flow in the lower Tuolumne River, RM 30.0.

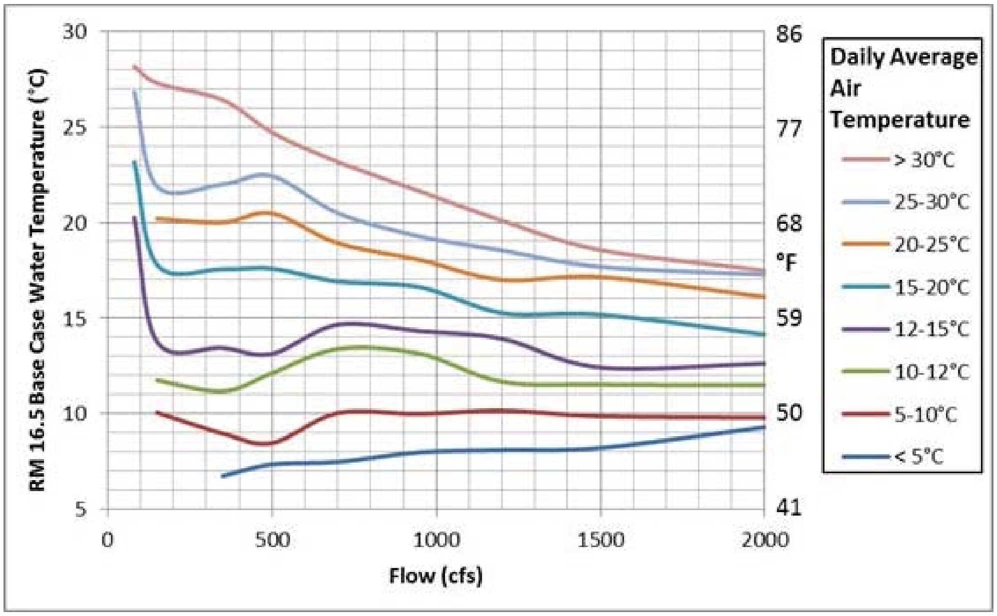

Figure 4.3-19. Relationship between average daily ambient air temperature, water temperature and flow in the lower Tuolumne River, RM 16.5.

When average daily ambient air temperatures are between 15 and 20°C (April/May), a flow of 100 cfs results in an average daily water temperature at RM 39.5 of 18°C[15] (Figure 4.3-17). A flow increase to 200 cfs would be required to reduce the water temperature by 3°C to 15°C, an increase in flow to 500 cfs would be required to reduce the water temperature to 13°C, and an increase in flow to 2,000 cfs would be required to reduce water temperature just one degree more to 12°C.

As expected, the influence of ambient air temperature is more extreme as air temperatures increase. For example, at the same RM 39.5, in the summer months when average daily air temperatures can routinely reach 25°C (July/August/September), a flow of 100 cfs results in a water temperature of 20°C (Figure 4.3-17). A flow of 300 cfs is required in order to reduce the river temperature by 3°C to 17°C, an increase in flow to 1,000 cfs would be required to reduce the water temperature to 14°C, and an increase in flow to 2,000 cfs would be required to reduce water temperature just one degree more to 13°C.

With increasing distance downstream, the influence of ambient climate on water temperature significantly increases. At just nine miles further downstream, at RM 30, when ambient air temperature is between 25 and 30°C and flow is 100 cfs, the resulting river temperature is 24 °C (Figure 4.3-18). To reduce the river's average daily temperature to 20°C would require a flow increase to 800 cfs and a flow of 1,400 cfs would be required to reduce river water temperature just 2°C more to 18°C. Attaining one additional degree temperature drop to 17°C would require a flow of well over 3,000 cfs, a flow that occurs less than two percent of the time in August under unimpaired flow conditions. Therefore, it is likely that historical average daily water

[15] All starting temperatures are 10°C

temperatures were seldom, if ever, less than 18°C in the lower Tuolumne River from July through September. This result further reinforces the findings of the without-dam assessment discussed above.

4.1.1.1.33 Effects of Accretion Flows on Water Temperature in the Lower Tuolumne River

Accretion flows due to groundwater are normally expected to be about 12–14°C, which would be anticipated to slightly warm streamflows during cold months and cool them during warm months. Data from temperature loggers located in the lower river indicate that some cooling occurs between RM 16.2 and RM 3.5 during most months (Table 4.3-1), and based on the Districts' flow measurements this reach of river appears to receive contributions from groundwater accretion. Withdrawals by riparian water users tend to increase water temperatures during the peak of the irrigation season. The Districts' intensive water temperature data collection conducted during the summer of 2013 (TID/MID 2014) showed no apparent influence on water temperatures from groundwater accretions in the river above RM 24.

4.1.1.1.34 Cumulative Effects on Water Quality in the San Joaquin River and Delta

Factors contributing to cumulative effects to water quality expand significantly downstream of the confluence of the Tuolumne and San Joaquin rivers, with an immense number of actions affecting conditions in the mainstem San Joaquin River and the Delta. Prominent among these are river diversions at Friant Dam on the San Joaquin River, at Crocker-Huffman Dam on the Merced River, at New Melones and other dams on the Stanislaus River, and riparian withdrawals along all these waters. Intense agricultural development along the San Joaquin River and its tributaries has resulted in additional river water withdrawals and introduction of an array of pesticides and herbicides.

The CDPR has documented over 300 herbicides and pesticides that are discharged throughout agricultural regions of the Central Valley and Delta (Werner et al. 2008). Agriculture, which is the primary land use adjacent to the Merced River downstream of the Crocker-Huffman Diversion Dam, has the potential to affect water quality and aquatic resources primarily through water returns to the river. Discharge of nutrients such as nitrogen and phosphorus from non-point runoff of agricultural fertilizer and point sources, such as water treatment facilities, stimulates algae growth, with attendant increases in the magnitude of diurnal DO variation.

Reduction in flows in the San Joaquin River, particularly between Gravelly Ford Canal and the Merced River, has increased the concentration of pesticides and fertilizers in the river, which has contributed to pollution that has impacted aquatic species (Cain et al. 2003). Hundreds of agricultural and urban drains discharge into the San Joaquin River downstream of the Merced River confluence, many of which are also designated as impaired water bodies, such as the Harding Drain, the Grayson Drain, the Newman Wasteway, and the Westley Waterway (SWRCB 2010). The San Joaquin River has been identified by the SWRCB as an impaired water body for arsenic, boron, dacthal, *Escherichia coli* (*E. coli*), dichloro-diphenyl-dichloroethylene (DDE), mercury, temperature, selenium, electrical conductivity, and several pesticides, both upstream and downstream of the Merced River confluence.

Table 4.3-1. Monthly seven-day average daily maximum (7DADM) temperatures in the lower Tuolumne River (dates vary).

Month	Average Temperature			7-Day Average Daily Maximum Temperature																	
	Don Pedro Project Outflow			@ USGS 11289650 - Tuolumne River Below La Grange Diversion Dam			Tuolumne River at Riffle 13B			Tuolumne River at Roberts Ferry Bridge			Tuolumne River at Hughson			Tuolumne River at 9th St Bridge			Tuolumne River at Shiloh Bridge		
	RM 54.3			Near La Grange, CA												Near Modesto, CA			Near San Joaquin Confluence		
	1/1987 - 9/1988 and			RM 51.8			RM 45.5			RM 39.5			RM 23.6			RM 16.2			RM 3.5		
	5/2010 - 2/2013			Nov 2001 – Oct 2012			Nov 2001 – Nov 2012			Aug 1998 – Jul 2010			Dec 1997 – Jan 2010			Jul 68-Apr 79 and Sep 88-Jun 13			Apr 1987 – Dec 2012		
	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest
January	10.46	11.7	8.9	10.9	11.6	10.4	11.0	11.8	10.6	10.9	11.9	10.1	11.1	12.4	9.9	10.7	12.7	9.2	10.7	12.6	8.4
February	9.68	11.4	8.5	10.8	11.2	10.1	11.6	12.2	10.6	11.9	13.0	10.9	12.3	13.9	10.9	12.5	15.9	8.4	12.5	14.6	10.1
March	9.33	11.1	7.8	10.8	11.6	9.7	12.4	13.5	10.5	13.4	15.5	11.0	14.3	17.4	11.1	15.4	19.7	10.5	15.3	18.5	10.5
April	9.38	10.9	8.3	10.8	11.7	9.9	12.8	14.6	10.9	13.5	15.2	11.4	15.1	17.2	11.7	17.8	22.0	11.4	16.7	21.5	11.3
May	9.8	11.1	8.6	11.3	12.0	10.4	14.0	15.6	11.7	15.5	18.1	12.7	18.0	20.9	12.9	20.8	24.6	12.9	19.6	27.4	12.9
June	10.15	11.7	9	12.0	12.9	11.1	16.9	20.6	12.6	20.3	26.0	13.8	23.8	27.9	14.1	25.0	31.3	13.9	23.4	28.7	15.1
July	10.56	11.7	9.4	12.4	13.3	11.7	18.3	21.9	14.1	21.4	26.3	15.3	25.7	28.9	16.0	27.2	31.4	17.4	25.8	29.6	18.0
August	10.87	12.2	9.4	12.7	13.4	12.1	18.0	20.7	13.8	20.8	24.7	16.0	25.0	28.3	19.0	26.1	29.9	16.1	25.0	28.1	17.3
September	11.1	12.2	10	12.7	13.3	12.2	16.9	19.1	15.0	18.8	22.1	14.6	22.3	25.3	16.4	23.1	27.1	18.5	22.2	25.7	16.8
October	11.31	12.2	10	12.3	12.8	12.0	14.0	14.6	13.4	14.8	16.1	13.9	17.0	18.9	15.2	18.1	22.1	14.9	17.7	20.3	14.9
November	11.26	13.3	9.25	11.5	12.0	10.9	12.2	12.6	11.5	12.4	13.3	11.7	13.4	14.6	12.0	13.8	18.6	11.6	13.2	14.7	9.6
December	11.24	12.22	10.1	11.2	11.6	10.7	11.2	11.7	10.3	11.0	11.5	10.0	10.9	12.0	10.1	10.6	12.5	8.5	10.4	11.8	7.5

The flow of subsurface drainage water from intensively irrigated agricultural land on the west side of the San Joaquin Valley into the San Joaquin River has created a well-documented water salinity and specific ion (selenium and boron) problem in the river. The flow of water from the Tuolumne River (and the Merced and Stanislaus rivers) dilutes and improves the overall water quality, including the salinity level, of the San Joaquin River as it moves downstream toward the Delta.

Urbanization along the San Joaquin River and in the Delta has resulted in a number of water quality concerns, including adverse effects from urban runoff and M&I wastewater and stormwater discharges. The development of the Stockton Deep Water Ship Channel resulted in a zone of near-zero DO that has only just recently been addressed by adding aeration directly to the channel portion of the river and reducing nitrogen loads from the Stockton Wastewater Treatment Plant (see Section 4.1.4.4 for a discussion of the Stockton DWSC and associated mitigation measures). In general, the factors affecting water quality in the San Joaquin River and Delta ecosystems are likely proportional to the human population, amount of water development, and number of irrigated acres. The population of the San Joaquin Valley and Bay Area combined exceeds 10 million people; the population served by the Don Pedro Project is about 250,000, or about 2 percent of that total. The irrigated acreage in the San Joaquin Valley exceeds 5 million acres;[16] the Don Pedro Project serves approximately 210,000 acres, or about 4 percent of the total. There are 20 major dams on tributaries to the lower San Joaquin River and Delta that store over 20 million AF of water for irrigation, M&I uses, and flood control;[17] the total usable storage in Don Pedro Reservoir for those purposes is 1.7 million AF, or about 8 percent of the total.

With respect to pollution loadings and DO concerns in the San Joaquin River, the Don Pedro Project does not contribute to cumulative adverse effects on these water quality constituents. As discussed in Section 4.3.2.1.1, the Don Pedro Project has little to no influence on water temperatures by the time flows reach the confluence with the San Joaquin River, and even less by the time water reaches the Delta.

4.3.3 Climate Change

Although it is impossible to quantify the contribution of global climate change to cumulative effects on water resources in the San Joaquin River basin, general patterns of impact can be described. In general, increases in temperature and alteration of precipitation regime are likely to result in higher instream water temperatures, especially in the lower reaches of Central Valley rivers, and a reduction in summer flow.

The global mean surface temperature has increased by 1.1°F since the 1800s (IPCC Synthesis report, 2001, as cited in CEPA 2006), and climate change scenarios indicate that temperatures in the United States are likely to rise by approximately 5–9°F (3–5°C) on average over the next 100 years (CEPA 2006). However, high range estimates for global increases in average temperature are as high as 8.0–10.4°F (4.4–5.8°C) (CEPA 2006).

[16](http://www.idrinkwine.net/the-sjv/)
[17](http://cdec.water.ca.gov/cdecapp/resapp/getResGraphsMain.action)

According to CEPA (2006), there is no clear trend in precipitation projections for California over the next 100 years, but the consensus based on recent Intergovernmental Panel on Climate Change (IPCC) model projections is for small changes in total precipitation, with slightly greater winter and lower spring precipitation. Despite the modest projected change in precipitation, warmer temperatures may reduce snow accumulation in the Sierra Nevada. A greater proportion of precipitation may be in the form of rain, and snowmelt may occur earlier.

Reductions in snowpack and earlier runoff would have impacts on water supply and natural ecosystems. Climate simulations predict that losses in snowpack may become progressively larger during the 21st century, and by the 2035–2064 period, snowpack in the Sierra Nevada could decline from 10 to 40 percent (CEPA 2006). By 2100, snowpack could decrease by as much as 90 percent if temperatures rise at the high end of the range of predicted increases.

Declining snowpack will exacerbate the already substantial competition for water resources in California (CEPA 2006). The snowpack in the Sierra Nevada provides water storage equivalent to about half the capacity of California's major reservoirs. This loss in storage in the form of snow could lead to greater and longer duration future water shortages. Under most scenarios, stream flows are projected to decline slightly by about 2050, with more dramatic changes possibly occurring near the end of the century (CEPA 2006).

4.4 Fish and Aquatic Resources

FERC's SD2 (pages 35-36) identifies the following potential Don Pedro Project effects on fish and aquatic resources in the Tuolumne River:

- *Effects of project operation and maintenance on fish populations in project reservoirs and the project-affected stream reach including fall Chinook salmon*
- *Effects of retention of sediment in the project reservoir on downstream fish spawning habitat and benthic macroinvertebrate populations*
- *Potential effects of project-related changes in the recruitment and movement of large woody debris on aquatic resources and their habitat*
- *Potential effects of project operations on stranding or displacement of fish*

For aquatic resources, FERC defines the geographic scope of cumulative effects as extending upstream on the Tuolumne River to Hetch Hetchy Reservoir and downstream to San Francisco Bay. At the time of the release of its SD2, FERC tentatively identified a cumulative geographic scope for anadromous fish and essential fish habitat (EFH) that includes the Tuolumne River basin downstream to the confluence with the San Joaquin River, and the San Joaquin River through the Delta to San Francisco Bay. FERC noted that based on the potential term of a new license, the temporal scope is 30 to 50 years into the future and any consideration of such future effects should focus on reasonably foreseeable future actions.

The fish and aquatic resources of the lower Tuolumne River are affected by a large number of past, present, and potential future anthropogenic actions and background environmental conditions, both within and outside the Tuolumne River watershed. The primary purposes (i.e., storage and release of flows for irrigation and M&I uses and flood control) of the Don Pedro Project contribute to cumulative effects on fish and aquatic resources in the lower river, including positive effects associated with FERC-required flow releases designed to benefit fall-run Chinook salmon and other fish species. However, because the Proposed Action would have no influence on flows downstream of La Grange Diversion Dam, and Don Pedro Reservoir would exist and continue to exist in the absence of hydroelectric generation, the Proposed Action would not contribute to cumulative effects, positive or negative, on fish and aquatic resources in the Tuolumne River. Other factors that influence fish and aquatic resources in the lower river include water management activities by other entities within and outside the basin, past and present in-river and floodplain mining activities, a variety of historical and current land-use practices, introduced non-native species, and ongoing fisheries management.

The cumulative effects of the Don Pedro Project are attenuated with increasing distance downstream in the Tuolumne River and into the San Joaquin River basin and the Delta. As fall-run Chinook salmon and any Central Valley steelhead that may occur in the lower river migrate farther downstream from the Don Pedro Project, the number and complexity of contributing factors affecting the environment grow considerably, and it becomes increasingly difficult to isolate the specific effects of any individual action from all of the contributing factors affecting individual life stages of these fish.

The cumulative effects assessment for fish and aquatic resources includes an assessment of the degree to which the Don Pedro Project may contribute to the cumulatively affected resources identified by FERC. The number and complexity of co-occurring past, current, and future actions in the Tuolumne River basin make it exceedingly difficult, if not impossible, to meaningfully isolate the specific effects on aquatic resources of each of the numerous past and present individual actions, including the actions of the Don Pedro Project. To the extent that the degree of influence of any individual action on a resource is indeterminate, then the effect of modifying that action is also likely to be indeterminate.

4.4.1 Fish and Aquatic Resources Cumulative Effects Assessment

The following cumulative effects assessment section is organized according to the types of effects resulting from the actions described in Section 4.1. Topics include (1) hydrologic and physical habitat alteration, (2) temperature and water quality, (3) connectivity and entrainment, (4) hatchery propagation and stocking, (5) introduced species and predation, (6) benthic invertebrates and fish food availability, and (7) freshwater harvest. The geographic scope of the assessment, as noted above, includes the Tuolumne River from O'Shaughnessy Dam to its confluence with the San Joaquin River and the San Joaquin River downstream through the Delta.

The Don Pedro Project contributes to cumulative effects to fish and aquatics resources, including fall-run Chinook salmon and Central Valley steelhead, in the lower Tuolumne River and downstream in the San Joaquin River and Delta. Other actions conducted within the Tuolumne River basin that contribute to cumulative effects include (see Section 4.1) CCSF's operations of the Hetch Hetchy system, water diversions at La Grange Diversion Dam, riparian withdrawals by water users, discharge of irrigation return flows, historic and current mining activities, agricultural and urban land uses, the presence of non-native species, and stocking of hatchery salmonids. In addition, ongoing operation of reservoir and diversion facilities in the San Joaquin River and its tributaries, along with an array of other actions (see Section 4.1), also contribute to cumulative effects on aquatic organisms within the analysis area for cumulative effects.

4.4.1.1 Hydrologic and Physical Habitat Alteration

4.1.1.1.35 Lower Tuolumne River

Prior to widespread European settlement, the channel form of the lower Tuolumne River consisted of a combination of single-thread and split channels that migrated and avulsed (McBain & Trush 2000). Variation in hydrologic and geological controls, primarily valley width and the location and elevation of underlying bedrock, resulted in variable and complex localized channel morphologies (McBain & Trush 2000). The riparian corridor was miles wide in places where the river lacked confinement (McBain & Trush 2000). More than a century of cumulative impacts have transformed the lower Tuolumne River from a dynamic, alluvial system capable of forming its own bed and bank morphology to a river highly constrained between either man-made dikes or agricultural fields, or constrained by riparian vegetation that has encroached into the low water channel (McBain & Trush 2000).

Hydrologic Alteration

Over the past 120 years, each increment of flow regulation (Wheaton, La Grange, Dennett, O'Shaughnessy, old Don Pedro, and new Don Pedro dams along the mainstem and dams constructed along tributaries above O'Shaughnessy Dam, including Cherry and Eleanor Creeks) has modified the lower Tuolumne River's flow regime. Historically, Wheaton Dam and the present day La Grange Diversion Dam lacked the storage capacity needed to affect high flow conveyance to the lower Tuolumne River during winter and spring (McBain & Trush 2000). CCSF's Hetch Hetchy Project, the Districts' new Don Pedro Dam, and CCSF's Cherry Lake combined to reduce the magnitude and frequency of flood flows and snowmelt runoff to the lower Tuolumne River downstream of La Grange Diversion Dam. Indeed, the ACOE contributed financially to the construction of the new Don Pedro Dam for the purpose of flood control. The resulting reduction in flood-flow frequency attests to the successful implementation of that Don Pedro Project purpose.

Analyses of streamflow records from the USGS gaging station at La Grange (Station 11-289650) reveal the following alterations of hydrologic conditions: (1) the magnitude and variability of summer and winter baseflows, fall and winter storms, and spring snowmelt runoff have been reduced and (2) the magnitude, duration, and frequency of winter floods have been reduced (McBain & Trush 2000). Following completion of the New Don Pedro Dam in 1971, compliance with ACOE flood control and other flow requirements reduced the estimated average annual flood (based on annual maximum series) from 18,400 cfs to 6,400 cfs.

Physical Habitat and Riparian Alteration

Gravel and gold mining, as well as other land uses, adversely affected aquatic habitat prior to the construction of dams on the Tuolumne River (TID/MID 2005) (see Section 4.1.1 for a summary of the chronology of current and historical actions within the defined geographic scope for cumulative effects). The presence of dams, aggregate extraction, agricultural and urban encroachment, and other land uses, including hydraulic mining practices near La Grange, have resulted in imbalances of sediment supply and transport in the lower Tuolumne River channel (McBain & Trush 2000). Don Pedro Dam and La Grange Diversion Dam, combined with other dams upstream of the Project Boundary, trap all coarse sediment and LWD that would otherwise pass downstream. In the lower river, in-channel excavation of bed material to depths well below the river thalweg for gold and aggregate has significantly reduced available spawning habitat, eliminated active floodplains and terraces, and created large in- and off-channel pits that provide favorable habitat for non-native predator species.

The cumulative effect of sediment trapping by upstream reservoirs, mining, and other land uses has altered the channel downstream of La Grange Diversion Dam (CDWR 1994; McBain & Trush 2004). Sequences of historical photos show that channel corridor width has been progressively reduced by land use (McBain & Trush 2000). Sediment model simulations indicate that without gravel augmentation, the channel bed from RM 52 to 39.7 would undergo a slow loss of gravel and coarsening (armoring) in response to the reduction in coarse sediment supply (TID/MID 2013f). Gravel augmentation, however, has helped to increase coarse sediment storage in this area (TID/MID 2013f). The rate of current gravel transport compared to the stores of gravel in this reach is low and little change in overall gravel availability is expected to occur over the next license term.

Large in-channel pits (SRPs) were created where sand and gravel aggregate were extracted. Historical deposits of dredger tailings (RM 50.5–38.0) confined the active river channel, preventing sediment recruitment that would otherwise have resulted from the normal process of channel migration (McBain & Trush 2000). Under current conditions, channel migration has been substantially curtailed.

More recent aggregate mining operations have excavated sand and gravel from floodplains and terraces immediately adjacent to the river channel at several locations downstream of Roberts Ferry Bridge (RM 39.5). Floodplain and terrace pits in this reach are typically separated from the channel by narrow berms that can breach during high flows, resulting in capture of the river channel. The January 1997 flood caused extensive damage to dikes separating deep gravel mining pits from the river, breaching or overtopping nearly every dike along a 6-mile-long reach (TID/MID 2011).

Most woody debris captured in Don Pedro Reservoir is small, and it appears that the majority of it would pass through the lower river during normal high flows if it were not trapped in the reservoir (TID/MID 2013e). The lower Tuolumne River between RM 52 and 26 has channel widths averaging 119 feet, and woody debris would have a limited effect on channel morphology in this reach (TID/MID 2013e).

Historical clearing of riparian forests in the Tuolumne River basin modified vegetation and associated habitat, halting many attendant ecosystem processes (Katibah 1984, Naiman et al. 2005). Urban and agricultural encroachment and mining have resulted in the direct removal of large tracts of riparian vegetation in the lower Tuolumne River corridor. Livestock selectively graze younger vegetation, which limits the establishment of riparian plants (McBain & Trush 2000). Clearing woody plant cover has also created openings in the riparian corridor where non-native plant species have become established and proliferated (McBain & Trush 2000). Land conversion and levee construction that constrained channel migration, including alteration of meander bends and cutoff/oxbow formations, have reduced riparian complexity (McBain & Trush 2000, Grant et al. 2003).

Mining has also substantially altered riparian conditions along the lower Tuolumne River. Aggregate mining leaves large pits in the floodplain, converting floodplain vegetation to open water. Levees built to isolate mining pits from the river constrain lateral movement of the river (TID/MID 2013b). These activities preclude regeneration of riparian vegetation by eliminating habitat and limit lateral movement of the river, reducing the amount and diversity of riparian habitat surfaces (TID/MID 2013b). Dredger tailings of unconsolidated sediments on the floodplain have replaced rich soils with poor ones, resulting in changes in riparian species composition and a reduced extent and diversity of riparian vegetation (TID/MID 2013b). The reduced development of riparian vegetation on dredger spoil piles has diminished riparian habitat connectivity (TID/MID 2013b).

Flow regulation and sediment trapping associated with upstream dams indirectly affected riparian vegetation by modifying the hydrologic and fluvial processes that influence survival and mortality of riparian vegetation. As noted above, each increment of flow regulation (La Grange Diversion Dam, O'Shaughnessy Dam, Old Don Pedro Dam, New Don Pedro Dam) successively reduced the magnitude, duration, and frequency of flood flows, and removed key mortality agents, including scour, channel migration, flood-induced toppling, and inundation (McBain & Trush 2000). In some areas, reduced flood scour has allowed riparian vegetation to encroach along the low water channel, where historically vegetation would have been absent. In other areas, as noted above, the legacy of impacts has altered the structure of the floodplain and reduced the potential for establishment.

The lateral extent of riparian vegetation along the Tuolumne River remains greatly diminished from what it was prior to large-scale settlement along the river. Currently, less than 15 percent of the historical riparian forests remain along the Tuolumne River (McBain & Trush 2000). However, over the past 15 years the areal extent and location of lands dominated by non-native plants has actually decreased (TID/MID 2013b). Overall, the 52-acre average of native riparian vegetation per river mile is slowly changing, with a 419-acre increase in the net extent of native vegetation between 1996 and 2012 (an average increase of about 8 acres/mile), assisted by active restoration projects (TID/MID 2013b).

Effects on Salmonids

Anadromous fish abundance in the Tuolumne River has been reduced by habitat degradation and extensive instream and floodplain mining beginning in the mid-1800s (McBain & Trush 2000). Dams and water diversions associated with mining had affected fish migration as early as 1852 (Snyder 1993 unpublished memorandum, *as cited* in Yoshiyama et al.1996). Access to historic spawning and rearing habitat was significantly restricted beginning in the 1870s, when a number of dams and irrigation diversion projects were constructed. Wheaton Dam, built in 1871 near the site of the present-day La Grange Diversion Dam, was a barrier to salmon migration. In 1884, the California Fish and Game Commission reported that the Tuolumne River was "dammed in such a way to prevent the fish from ascending" (California Fish and Game Commission 1884, *as cited* in Yoshiyama et al. 1996).

During their upstream migration, Tuolumne River flows may affect homing of Tuolumne River origin Chinook salmon, and may also affect straying of salmonids from other rivers into the Tuolumne River (TID/MID 2013c).

Studies conducted in the Tuolumne River indicate that a lack of spawning gravel and curtailed sediment recruitment, due to in-river and floodplain mining, trapping by upstream dams, and other land uses, may result in density-dependent competition and exclusion from suitable spawning sites and may limit the number of female Chinook salmon that successfully spawn in the lower Tuolumne River (TID/MID 1992, Appendix 6; TID/MID 2000, Report 1999-1; TID/MID 2001, Report 2000-1). Model simulations indicate that Chinook salmon are limited by spawning habitat availability only at high spawning densities (TID/MID 2013k). Upstream reaches affected by gold dredger mining in the early part of the century (RM 50–47) were "reconfigured" following removal of dredger tailings for construction of the new Don Pedro Dam and this reach currently supports the majority of Chinook salmon spawning activity (TID/MID 2013c). Due to higher channel gradient, overbank habitats in this reach do not provide the same relative benefits as other river floodplain habitats studied in lowland portions of the Central Valley (Stillwater Sciences 2012a). Further, the remnant dredger pits and multiple connected backwaters along the lower Tuolumne River have been identified as an area of potential juvenile Chinook stranding (TID/MID 2001) and may actually create favorable habitat for predator species (Stillwater Sciences 2012a).

Although there is the potential for Chinook redd scouring to occur during flood events, minimum spawning flows required by FERC have reduced the risk of redd dewatering (TID/MID 2013c). The risk of mortality due to redd scour, redd dewatering, and entombment is expected to be low in the Tuolumne River due to current operations and reduced fine sediment supply (TID/MID 2013c). Egg displacement and mortality resulting from redd superimposition of spawning steelhead is not expected to occur in the Tuolumne River at current spawner levels (TID/MID 2013c).

Because current Don Pedro Project operations do not include power peaking, potential risk of juvenile Chinook salmon and *O. mykiss* stranding and entrapment are low. Some stranding may occur during flow reductions following flood control releases; however, the low frequency of these flood events in combination with ramping rate restrictions required by the current FERC license likely result in a low risk of fish mortality due to stranding and entrapment (TID/MID 2013c). A comprehensive evaluation of stranding surveys was conducted on the lower Tuolumne River (TID/MID 2000, Report 2000-6) and is summarized in the 2005 Ten-Year Summary Report (TID/MID 2005). This evaluation indicated that the highest potential for stranding occurred at flows between 1,100 and 3,100 cfs, i.e., the range of flows under which the floodplain is inundated in several areas of the Chinook spawning reach.

Floodplain access for rearing juvenile Chinook salmon is limited in the lower Tuolumne River due to flows and habitat modification. Based on analysis of historical inundation mapping, the majority of floodplain habitat available at flows ranging from 1,000–5,000 cfs is limited to several disturbed areas between RM 51.5 and RM 42 that were formerly overlain by tailings (Stillwater Sciences 2012a).

Although increased structure has been shown to reduce territory size that must be defended (Imre et al. 2002) and improve steelhead feeding opportunities (Fausch 1993), it is unlikely that the alluvial portions of the Tuolumne River downstream of La Grange Diversion Dam historically supported the large wood or boulder features that are more typically found in high gradient streams of the Central Valley and along the coasts of California and Oregon (TID/MID 2013c), so it is unclear to what degree LWD retention by upstream dams has contributed to adverse habitat effects in the lower river. Although LWD provides habitat for salmonids in some systems, there are no data available for the Tuolumne River or neighboring Merced River that specifically address the role of LWD on salmonid abundance (TID/MID 2013e). Of the 121 locations within the W&AR-12 study reach where LWD was recorded, about 80 percent of it was located in or adjacent to runs or pools, which are not typically the preferred habitat of juvenile or adult *O. mykiss* in the lower Tuolumne River. Because most LWD in the lower Tuolumne River is partially or wholly out of the channel, and due to its small size, it does not provide significant cover for fish, which in turn limits its value as protection from avian and aquatic predators. Due to its generally small size, location, and lack of complexity, most LWD from RM 52 to 24 provides little habitat value for *O. mykiss*.

SRPs, created by in-channel mining, can be up to 400 ft wide and 35 ft deep and occupy approximately 32 percent of the length of the channel in the gravel-bedded zone (RM 52–24). These habitat features harbor non-native fish, such as introduced largemouth and smallmouth bass that prey on juvenile salmonids (see Introduced Fish Species, below). Introduced predators have been, and continue to be, most abundant in large, slow-moving areas prevalent in the middle section of the lower river, downstream of the major Chinook salmon spawning areas (Orr 1997). It is likely that the present pattern and degree of predation mortality for Chinook (and also for any steelhead that may occur) in the Tuolumne River is to a large extent a result of past sand and gravel mining coupled with the deliberate introduction by CDFW of non-native piscivorous fish species (Orr 1997).

4.1.1.1.36 San Joaquin River and Delta

Flows in the San Joaquin River and its tributaries, combined with flow diversions at the SWP and CVP water export facilities, may affect homing of Tuolumne River-origin Chinook salmon during their upstream migration (TID/MID 2013c). Homing fidelity of Chinook salmon to their natal streams is related to the sequence of olfactory cues imprinted during rearing and outmigration, so attraction flows and entrainment of flows into the SWP and CVP may affect the numbers of Chinook salmon returning to the Tuolumne River. However, other than the broad relationships between Vernalis flows, water exports at the SWP and CVP facilities, and subsequent recoveries of hatchery-reared, code-wire-tagged fish recovered in Sacramento and San Joaquin River basin hatcheries (Mesick 2001), the relationship between San Joaquin River tributary homing and attraction flows remains poorly understood. Although almost no upstream migrant steelhead have been documented in either historical or present day monitoring in the Tuolumne River, flows in lower San Joaquin River tributaries and flows entrained by the SWP and CVP water export facilities could also affect homing of any Central Valley steelhead originating in the Tuolumne River (TID/MID 2013c). Flow alterations may also affect straying of salmonids from other rivers into the Tuolumne River (TID/MID 2013c).

The extent of historical flooding in Central Valley rivers was vast (Kelley 1989), and the timing of Chinook salmon outmigration would have allowed juveniles to exploit habitats provided by prolonged periods of floodplain inundation. Reductions in wetland and floodplain habitats in the lower San Joaquin River and South Delta, and changes in tributary flow magnitudes and timing, have reduced access to Delta floodplain habitats used by rearing and emigrating Chinook salmon from the Tuolumne River (Whipple et al. 2012; TID/MID 2013c).

Few locations in the eastern and central Delta provide suitable habitat for rearing salmonids (TID/MID 2013c). Because extended periods of floodplain inundation do not occur in most areas of the lower San Joaquin River and Delta, except as the result of large flood control releases from tributaries, it is likely that changes in Delta habitats have affected the number and growth of rearing Chinook salmon and steelhead smolts, resulting in a reduction in the number and size of smolts entering the ocean and potential reduction in ocean survival (TID/MID 2013c). However, winter inundation of some flood bypasses and floodplains along the lower portions of some San Joaquin River tributaries still provides some juvenile Chinook salmon rearing habitat (Feyrer et al. 2006; Sommer et al. 2001; Sommer et al. 2005; Moyle et al 2007). Although the Delta has generally been considered an outmigration corridor for steelhead, active feeding of juvenile steelhead has been documented in the Yolo bypass during flood conditions in some years (USBR 2008), suggesting that loss of historical floodplain habitat access in the Delta may have effects on steelhead rearing and subsequent smolt emigration.

The Delta is interlaced with hundreds of miles of waterways, and relies on more than 1,000 miles of levees for protection against flooding (Moore and Shlemon 2008). These levees have eliminated the majority of tidally exchanged marsh habitats in the Delta (Whipple et al. 2012), areas historically used as nursery areas for a variety of Delta fish species (Kimmerer et al. 2008), and few locations in the eastern and central Delta now provide suitable habitat for rearing Chinook salmon. The combined effects of continued land subsidence, rising sea level, increased seismic risk, and increased winter flooding increase the vulnerability of the extensive Delta levee system, which can result in degradation of water quality and exposure of habitat adjacent to islands to increased seepage and wave action (CDWR et al. 2013). Much of the rich Delta farmland has lost soil from oxidation, compaction, and wind erosion, resulting in lowered elevations of some islands, in some cases up to 25 ft below sea level.

Measures have been undertaken to address conditions for migratory salmonids in the lower San Joaquin River and Delta. The results of south Delta survival studies indicate that installation of the Head of Old River Barrier (HORB) increases salmon smolt survival through the Delta by 16 to 61 percent (TID/MID 2013c) (see also Temperature and Water Quality, below).

Non-salmonid special status fish species affected by flow and habitat modification in the lower San Joaquin River and/or Delta include the Sacramento splittail (*Pogonichthys macrolepidotus*), hardhead (*Mylopharodon conocephalus*), Sacramento-San Joaquin roach (*Lavinius symmetricus symmetricus*), and delta smelt (*Hypomesus transpacificus*). Historically, Sacramento splittail inhabited sloughs, lakes, and rivers of the Central Valley, with populations extending upstream to Redding in the Sacramento River, to Butte Creek/Sutter Bypass, to Oroville in the Feather River, to Folsom in the American River, and to Friant in the San Joaquin River (Moyle et al. 2004). Their current distribution is limited by dams and other barriers, and the species is largely confined to the Delta, Suisun Bay, Suisun Marsh, Napa River, Petaluma River, and other parts of the Sacramento-San Joaquin estuary (Moyle 2002). Historically, hardhead were widely distributed and locally abundant in the Central Valley. Their specialized habitat requirements coupled with widespread alteration of downstream habitats have resulted in population declines and isolation of populations (Moyle 2002). The Sacramento-San Joaquin roach, although abundant in a large number of streams, is now absent from a number of streams and stream reaches where it once occurred (Moyle 2002). The Delta smelt has been adversely affected by entrainment into the SWP and CVP (CDWR et al. 2013) and habitat and flow alteration in the Delta.

4.4.1.2 Water Quality

4.1.1.1.37 <u>Water Temperature</u>

The effects of impoundments on water temperatures in the Tuolumne River are discussed in detail in Section 4.3.2.1 of Exhibit E. Water temperature conditions in the lower Tuolumne River are unlikely to result in mortality of upstream migrant adult salmonids, either directly or as the result of increased susceptibility to pathogens (TID/MID 2013c). No evidence of Chinook salmon pre-spawning mortality has been identified in the lower Tuolumne River (TID/MID 2013c), and no instances of water temperature related mortality of any fish species have been observed in the lower Tuolumne River (TID/MID 2013c). Because the majority of adult Central Valley steelhead migration occurs from November through March, when water temperatures are low, temperature-related effects on steelhead arrival timing and pre-spawn mortality are unlikely (TID/MID 2013c) in the Tuolumne River (although the vast majority of *O. mykiss* in the lower Tuolumne River display a resident life history). Fall-run Chinook adults must first traverse the much warmer waters of the Delta and San Joaquin River before encountering the Tuolumne River, which has significantly cooler temperatures during the late September through November peak migration periods than these downstream reaches.

Based on assessments of seasonal water temperatures and typical spawning periods, fall-run Chinook salmon in San Joaquin River basin tributaries are unlikely to encounter unsuitable water temperatures leading to reduced egg viability (TID/MID 2013c), and Myrick and Cech (2001) suggested that only the earliest spawners arriving in San Joaquin River basin tributaries during September might encounter unsuitable temperatures. Intragravel water temperatures measured during February and March 1991 at several locations in the lower Tuolumne River ranged from 11 to 15°C (TID/MID 1997, Report 96-11), indicating that water temperature conditions are suitable for Chinook salmon egg incubation.

Rotary screw trap data indicate that two juvenile outmigration life-history strategies exist for Tuolumne River fall-run Chinook salmon: winter outmigration of fry in January-February and spring outmigration of subyearling smolts (>70 mm) from April-June. In all years, water temperatures remain well below the incipient lethal limit (25°C) during winter fry outmigration. In most years, water temperatures for spring outmigrants remain below incipient lethal temperatures, although temporally isolated events of high water temperature can occur. In general, flow releases resulting from the 1996 FERC Order help maintain appropriate water temperatures during Chinook salmon rearing and emigration.

The Central Valley steelhead spawning period extends from December through April and peaks in February and March, so if the lower Tuolumne River had a steelhead run, water temperature would be unlikely to adversely affect spawning success (TID/MID 2013c). However, available information indicates that juvenile *O. mykiss* rearing habitat may potentially be limiting in the lower Tuolumne River during summer due to a combination of high water temperatures and potential territorial interactions with *O mykiss* of older age classes (TID/MID 2013c). Increased densities and downstream distribution of juvenile *O. mykiss* have been documented since implementation of increased summer baseflows under the 1996 FERC Order, and during years with extended flood control releases (TID/MID 2013c).

Because adult resident *O. mykiss* are generally found in upstream habitats year-round (Stillwater Sciences 2012b), temperature related mortality is unlikely to occur in the lower Tuolumne River. It is unknown, however, whether adverse temperature effects occur during potential smolt emigration that would occur late in the spring (TID/MID 2013c). Increased summer baseflows and stable summer temperatures in the Tuolumne River since 1996 appear to select for a largely resident *O. mykiss* life history (TID/MID 2013c).

Water temperature in the lower San Joaquin River and Delta are unlikely to result in direct mortality of upstream migrating adult Chinook salmon and steelhead or increased susceptibility to disease (TID/MID 2013c). However, there are periods when elevated water temperatures in the lower San Joaquin River and Delta likely have substantial effects on juvenile salmonids. Baker et al. (1995) showed that water temperature explains much of the variation in Delta smolt survival studies from 1983–1992 (TID/MID 2013c). By examining the relationship between water temperature in the Delta and predation-related mortality, it is clear that high water temperatures reduce juvenile Chinook salmon survival in the Delta (Williams 2006). Temperatures of 25°C associated with increased salmonid mortality (Myrick and Cech 2001) routinely occur in the south Delta. However, suitable water temperatures for smolt emigration in the range of 18 to 21°C exist at Vernalis as late as mid-May in most years, and it is likely that Delta conditions are suitable for smolt emigration as late as June in some years. Unsuitable temperature conditions in excess of 25°C are likely exceeded at Vernalis by late June in most years, limiting successful emigration or any salmonid rearing in the Delta during summer (TID/MID 2013c).

4.1.1.1.38 Dissolved Oxygen

Measurements of water column and intragravel DO in artificial Chinook salmon spawning redds (TID/MID 2007, Report 2006-7) indicate that water quality conditions in the lower Tuolumne are generally suitable during the egg incubation period.

In the lower San Joaquin River, beginning in the 1960s, CDFW documented potentially adverse effects of low DO levels on adult salmon. Hallock et al. (1970) documented that low DO areas in the Delta blocked adult Chinook salmon upstream migration into the San Joaquin River. More recent water quality data and literature reviews by Newcomb and Pierce (2010) indicate that low DO at Stockton may adversely affect adult anadromous salmonids in September and October during the upstream migration period and juvenile anadromous salmonids in June during the downstream migration period. Chinook salmon are considered more likely to be exposed to low DO levels than steelhead because peak migration for steelhead occurs outside of the months with low DO. For juvenile salmonids, literature reviews by Newcomb and Pierce (2010) suggest that low DO levels can lead to decreased swimming performance, reduced growth, impaired development, and increased susceptibility to predation, pathogens, and contaminants.

Periods of low DO concentrations observed in the Stockton DWSC in the summer and fall months upstream of Turner Cut show that this portion of the lower San Joaquin River does not meet Central Valley Basin Plan (Basin Plan) water quality objectives for DO (5 mg/l December - August and 6 mg/l September -November) (ICF International 2010). In 2008, the Department of Water Resources implemented the Stockton Deep Water Ship Channel Demonstration Dissolved Oxygen Aeration Facility Project (Aeration Facility) to increase DO levels and thereby potentially reduce adverse effects on migrating anadromous salmonids (Newcomb and Pierce 2010).

Testing showed that operating strategies for the Aeration Facility can be developed for a range of DWSC flows, depending on inflowing DO and biological oxygen demand (BOD) concentrations (ICF International 2010). At times, water column BOD exceeds the capacity of the Aeration Facility to help meet the DO objective in some portions of the DWSC. Evaluating fisheries data over time will allow researchers to assess trends in Chinook salmon and steelhead populations and the respective timings of their upstream migration runs. If populations increase and fish begin to arrive in the San Joaquin River earlier, it will be reasonable to infer that low DO is no longer a considerable stressor for migrants in the DWSC (Newcomb and Pierce 2010).

Water quality monitoring was conducted on the San Joaquin River from Mossdale Crossing to Turner Cut to assess the benefit of installing the Head of Old River Barrier (HORB) (Brunell et al. 2010). The HORB is installed by CDWR in conjunction with reservoir releases to increase flow and DO concentrations in the DWSC for migrating fall Chinook salmon; these practices can temporarily increase DO. Since 2000, DO levels in the DWSC have been observed to increase about 2 to 3 mg/l with the increased DWSC flows associated with the placement of the HORB (Brunell et al. 2010). However, low DO may recur after removal of the HORB following the spring pulse flow releases from the San Joaquin River's tributaries (Brunell et al. 2010). However, the response of DO in the DWSC is complex and difficult to predict solely by flow management; other factors, such as BOD (see above) and temperature, also influence DO.

4.1.1.1.39 <u>Nutrients and Contaminants</u>

Shoreline protection measures at Don Pedro Reservoir, including prohibition of shoreline disturbances and off-road vehicle use on Don Pedro Project lands, may benefit reservoir water quality, which could translate into limited downstream water quality benefits. There is no evidence that regulated herbicide and pesticide applications near Don Pedro Reservoir have adverse effects on water quality, and as a result aquatic biota, in the lower Tuolumne River.

The CDPR has documented over 300 herbicides and pesticides that are discharged throughout agricultural regions of the Central Valley and Delta (Werner et al. 2008). Six pesticides were detected in runoff from agricultural and urban areas during a study conducted in the lower Tuolumne River, and chlorpyrifos, DCPA, metolachlor, and simazine were detected in almost every sample (Dubrovsky et al. 1998). Peak diazinon concentrations measured in the lower Tuolumne River have frequently exceeded levels that can be acutely toxic to some aquatic organisms (Dubrovsky et al. 1998). Like the Tuolumne River, agriculture is the primary land use adjacent to the Merced River downstream of the Crocker-Huffman Diversion Dam, where agricultural chemicals have the potential to affect water quality and aquatic resources primarily through water returns to the river. The return water often contains pollutants, which affect fish, BMI, and other aquatic species.

Reduction in flows in the San Joaquin River, particularly between Gravelly Ford Canal and the Merced River, has increased the concentration of pesticides and fertilizers in the river, which has contributed to pollution that has impacted aquatic species (Cain et al. 2003). Hundreds of agricultural and urban drains discharge into the San Joaquin River downstream of the Merced River confluence, many of which are also designated as impaired water bodies, such as the Harding Drain, the Grayson Drain, the Newman Wasteway, and the Westley Waterway (SWRCB 2010). The San Joaquin River has been identified by the SWRCB as an impaired water body for arsenic, boron, dacthal, *Escherichia coli* (*E. coli*), dichloro-diphenyl-dichloroethylene (DDE), mercury, temperature, selenium, electrical conductivity, and several pesticides, both upstream and downstream of the Merced River confluence.

The flow of subsurface drainage water from intensively irrigated agricultural land on the west side of the San Joaquin Valley into the San Joaquin River has created a well-known water salinity and specific ion (selenium and boron) problem in the river. The flow of water from the Tuolumne River (and the Merced and Stanislaus rivers) dilutes and improves the overall water quality, including the salinity level, of the San Joaquin River as it moves downstream toward the Delta.

Discharge of nutrients such as nitrogen and phosphorus from non-point runoff of agricultural fertilizer and point sources, such as water treatment facilities, stimulates algae growth, with attendant increases in the magnitude of diurnal DO variation. This has caused changes in the food webs of the San Joaquin River and Delta (Durand 2008), and as a result food availability for Delta fish populations (TID/MID 2013c). Large numbers of pesticides are used on lands upstream of and within the Delta (Brown 1996, Kuivala and Foe 1995), and they have been shown to inhibit olfactory-mediated alarm responses in salmonids (Scholz et al. 2000). However, it is unknown whether pesticide levels in Delta waters affect rearing or out-migrating Chinook salmon or steelhead juveniles, and no studies of predation related mortality due to chemical contaminants are available for the Central Valley rivers (TID/MID 2013c).

A range of literature sources suggests that early life history exposure to trace metals, herbicides, and pesticides may impair olfactory capabilities required for homing sensitivity in salmonids

(Hansen et al. 1999, Scholz et al. 2000, Tierney et al. 2010), which could affect arrival of adult steelhead in their natal streams. However, olfactory impairment of Central Valley steelhead has not been documented in the Tuolumne or other Central Valley rivers (TID/MID 2013c).

4.4.1.3 Connectivity and Entrainment

4.1.1.1.40 Upstream Migration Barriers

Dams throughout the San Joaquin River and its tributaries are barriers to upstream migration of anadromous salmonids and other migratory fish species. Dams and water diversions associated with mining adversely affected fish migration in the Tuolumne River as early as 1852 (Snyder 1993 unpublished memorandum, *as cited* in Yoshiyama et al.1996). Access to historic spawning and rearing habitat was significantly restricted beginning in the 1870s, when a number of dams and irrigation diversion projects were constructed. Wheaton Dam, built in 1871 at the site of present-day La Grange Diversion Dam (RM 52.2), was a barrier to salmon and steelhead migration, and in 1884, the California Fish and Game Commission reported that the Tuolumne River was “dammed in such a way to prevent the fish from ascending” (California Fish and Game Commission 1884, *as cited* in Yoshiyama et al. 1996). Currently, La Grange Diversion Dam is a complete barrier to upstream migration of fall-run Chinook, any Central Valley steelhead that occur in the lower Tuolumne River, and other migratory fish species.

4.1.1.1.41 Entrainment

Anadromous fish downstream of the diversion dam are subject to entrainment in numerous intakes along the river. Irrigation withdrawals for frost protection at diversions along the lower reaches of the Tuolumne River are rare during the Chinook salmon in-river rearing period (TID/MID 2013c). Therefore, significant mortality due to entrainment of juvenile Chinook in the lower Tuolumne River is considered unlikely (TID/MID 2013c). It is unknown to what extent these diversions affect resident native and non-native fish.

Juvenile salmonid entrainment and increased exposure to predation occur at major diversion facilities on the lower San Joaquin River and in the Delta. Although entrainment in smaller irrigation diversions has not been well quantified, entrainment related mortality in the SWP and CVP export facilities is considered to be a major source of mortality for rearing and out-migrating Chinook salmon and steelhead juveniles, with effects on the number of Chinook recruits to the ocean fishery and effects on long-term population levels of steelhead.

Based on paired releases of tagged Chinook salmon in the Clifton Court forebay of the SWP, Gingras (1997) estimated pre-screen mortality to be between 63 and 99 percent. Clark et al. (2009) estimated pre-screening mortality of steelhead to be between 78 and 82 percent. Fish entrained in the Clifton Court forebay experience stress and may undergo physical damage during salvage operations (TID/MID 2013c), and salvage losses of Chinook salmon entrained into the SWP and CVP increase with increasing export flows (TID/MID 2013c).

4.4.1.4 Hatchery Propagation and Stocking

Recent studies have increasingly demonstrated potentially adverse effects of hatchery-reared fish on co-occurring wild stocks with which they may interact via interbreeding, competition, or predation. An issue of concern is genetic introgression of hatchery stocks with "natural" stocks, resulting in a decrease in the biological fitness of the natural stocks (e.g., ISAB 2003, Berejikian and Ford 2004, Kostow 2004, Araki et al. 2007, Lindley et al. 2007, CDFG and NMFS 2001).

Hatchery-origin fish represent a large proportion of the Central Valley fall-run Chinook salmon harvest (TID/MID 2013c). Although the proportion of adipose-fin-clipped Chinook salmon identified as originating from hatcheries has been historically low in Tuolumne River spawning surveys, this proportion has increased dramatically from the 1990s to the present (TID/MID 2005; Mesick 2009; TID/MID 2012, Report 2011-8). Recent estimates of the composition of Chinook salmon escapement indicate that up to 50 percent of the escapement to the Tuolumne River is made up of hatchery-produced salmon from other rivers (Merced Irrigation District 2012). In the Central Valley as a whole, it is estimated that hatchery production has provided over half of the Central Valley harvest and escapement of salmon in some years (CDFG and NMFS 2001). Barnett-Johnson et al. (2007) recently estimated that only 10 percent of Central Valley Chinook salmon captured in the ocean troll fishery were not raised in a hatchery setting. Assuming roughly equivalent survival of hatchery- and natural-origin fish from the fishery to the spawning grounds, these results imply that up to 90 percent of annual escapement could consist of hatchery reared fish (TID/MID 2013c).

Facilities that produce anadromous fish whose life histories could overlap temporally or spatially with Tuolumne River anadromous salmonids include the Feather River Hatchery (spring and fall-run Chinook and steelhead), Nimbus Hatchery (fall-run Chinook and steelhead), Mokelumne River Hatchery (fall-run Chinook and steelhead), Merced River Hatchery (fall-run Chinook), and the Coleman National Fish Hatchery, a federal facility that produces fall-run Chinook (ICF Jones & Stokes 2010). Fish from the Merced and Mokelumne hatcheries, because of the proximity of these facilities to the Tuolumne River, may be more likely than fish from other facilities to stray into the lower Tuolumne River, and thereby contribute to cumulative adverse effects on aquatic resources, primarily anadromous salmonids.

To provide more accurate estimates of the proportions of hatchery reared and naturally produced Chinook salmon in Central Valley rivers, a Constant Fractional Marking (CFM) Program was initiated by the Pacific States Marine Fisheries Commission in spring 2007, with an adipose fin clip and coded-wire tag applied to at least 25 percent of the fish released from 2007 through 2012 (Buttars 2011). Although the Merced River Fish Facility does not participate in the CFM Program, observations of adipose-fin-clipped salmon have steadily risen in the Merced, Tuolumne, and Stanislaus rivers since 2007, reflecting a higher proportion of adipose-fin-clipping at the participating hatcheries[18]. Natural and hatchery contributions to historical escapements are not available prior to the CFM years (Newman and Hankin 2004).

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[18] Hatcheries participating in the PFMC CFM Program include the Coleman National Fish Hatchery, Feather River Hatchery, Feather River Hatchery Annex, Nimbus Hatchery, and Mokelumne River Hatchery.

In the absence of appropriate hatchery management practices, hatcheries may select for early run timing by spawning a disproportionately higher percentage of earlier returning fish (Flagg et al. 2000), resulting in reduced spawning success (TID/MID 2013c). There is, however, no evidence that the introduction of hatchery fish has altered the run timing of Chinook salmon in the Tuolumne River. Although the proportion of hatchery-origin Chinook salmon in Tuolumne River spawning runs has increased in recent years, size-at-return does not appear to have decreased in response to hatchery introgression for the period 1981–2010, suggesting that any hatchery influences on Tuolumne River spawner fecundity and spawning success are minor (TID/MID 2013c).

Genetic analyses suggest that the majority of Central Valley steelhead stocks have been genetically introgressed by hatchery-produced ancestors, particularly from shared out-of-basin broodstocks (Eel River and American River) used at the Nimbus and other hatcheries (Garza and Pearse 2008). Lindley et al. (2007) suggest that hatchery introductions have altered the genetic structure of salmonid populations in the Central Valley. Although hatchery straying likely affects the number of steelhead spawning in the lower Tuolumne River, the absence of basin-specific data on spawning or straying from out-of-basin hatcheries makes it difficult to estimate the proportion of hatchery-origin steelhead that may spawn in the lower Tuolumne River (TID/MID 2013c). However, based on the low numbers of steelhead relative to resident *O. mykiss* documented in otolith analyses in the Tuolumne River (Zimmerman et al. 2009), it is likely that any effects of hatchery-origin fish would primarily be on resident *O. mykiss* (TID/MID 2013c).

Hatchery Genetic Management Plans (HGMPs) are being prepared pursuant to Section 7 of the ESA for salmon and steelhead hatcheries in California to guide the propagation of Chinook salmon and steelhead. The goal of the plans is to prevent adverse impacts on the genome of federally-listed fish and any potential effects of stocking on the size, abundance, run-timing, and distribution of wild fish.

4.4.1.5 Introduced Species and Predation

Predation on native salmonids by non-native predators introduced to the lower Tuolumne River is influenced by channel modifications that have created habitats favorable to non-native piscivores. Inter-annual variations in flows and water temperatures have been associated with variations in river-wide predator distribution (Ford and Brown 2001) and year-class strength in multi-year surveys conducted as part of the SRP 9 habitat restoration project at RM 25.7 (McBain & Trush and Stillwater Sciences 2006).

High levels of predation related mortality have been documented in direct surveys by the Districts, in multi-year Chinook smolt survival tests, and by comparisons of upstream and downstream smolt passage at rotary screw traps (TID/MID 2013c). Apparent variations in the relationship between spring flows and Chinook smolt passage (Mesick et al. 2008) and subsequent adult Chinook escapement (TID/MID 1992; Speed 1993; TID/MID 1997, Report 96-5; Mesick and Marston 2007; Mesick et al. 2008) suggest that predation, primarily by introduced fish species, is a major source of salmonid mortality, with effects on long-term population levels in the Tuolumne River (TID/MID 2013c). Studies conducted in the lower Tuolumne River identified 12 fish species that potentially prey on Chinook salmon fry and juveniles, but largemouth, smallmouth, and striped bass (all of which are introduced species) are the primary predators (TID/MID 1992, TID/MID 2013g).

Average consumption rates of juvenile Chinook salmon (i.e., number of Chinook salmon per predator) by largemouth and smallmouth bass in the lower Tuolumne River (not scaled by gastric evacuation rates) ranged from 0–0.20 during the 2012 predation study (TID/MID 2013g) and from 0–1.7 in an earlier study conducted by the Districts (TID/MID 1992). In 2012, predation rates averaged for all habitat types and sampling events were 0.07 Chinook salmon per largemouth bass per day and 0.09 per smallmouth bass per day. Striped bass predation rates in the lower river were generally higher than those of smallmouth bass and largemouth bass (TID/MID 2013g). In 2012, predation rate averaged for all habitat types and sampling events was 0.68 Chinook salmon per striped bass per day.

Largemouth bass and smallmouth bass were estimated to have consumed about 37 percent and 49 percent, respectively, of the total potential juvenile Chinook salmon consumed by the three primary non-native predator species (i.e., largemouth bass, smallmouth bass, and striped bass). Despite making up only a small fraction (< 4%) of the total of piscivore-sized fish (> 150 mm FL), striped bass were estimated to have consumed nearly 15 percent of the total potential juvenile Chinook salmon consumed by the three predator species. There was no evidence of consumption of Chinook salmon by Sacramento pikeminnow during either the 2012 study or the Districts' previous study (TID/MID 1992).

A conservative estimate of the total consumption of juvenile Chinook salmon by striped, largemouth, and smallmouth bass is about 42,000 during March 1-May 31, 2012 based on observed predation rates and estimated predator abundance. This suggests that nearly all juvenile Chinook salmon may be consumed by introduced predators between the Waterford and Grayson rotary screw traps. Only 2,268 Chinook salmon were estimated to have survived migration through the 25 miles between the screw-trapping sites (Robichaud and English 2013) during January through mid-June, making it plausible that most losses of juvenile Chinook salmon in the lower Tuolumne River between Waterford and Grayson during 2012 can be attributed to predation by non-native piscivorous fish species.

No data exist to document the degree of piscine or avian predation on juvenile *O. mykiss* in the lower Tuolumne River. However, piscine predation risk is probably low because *O. mykiss* distribution during summer is generally restricted to cool water locations upstream of Roberts Ferry Bridge (RM 39.5), and piscine predators are found mostly downstream of this reach (Brown and Ford 2002). In addition to this habitat segregation, the larger body size of adult *O mykiss* limits their risk to predation, so mortality is most likely limited to Age 0+ fish during water-year types with low flows and warmer temperatures that allow predators to move upstream (TID/MID 2013c).

Predation in the lower San Joaquin River, Delta, and at the SWP and CVP export facilities is considered a primary cause of mortality for Chinook salmon, with effects on long-term population levels (TID/MID 2013c). The SWP and CVP facilities create lentic habitats that support the persistence of non-native fish species. Delta water exports, in combination with non-native species introductions, have resulted in dramatic changes in the Delta fish species assemblage, with numerous predatory fish species benefitting from current Delta hydrology (Lund et al. 2007). It is likely that predation has its greatest impact on Chinook salmon populations in the lower San Joaquin River and Delta when juveniles and smolts out-migrate in large concentrations during the spring through the lower reaches of rivers and estuaries on their way to the ocean (Mather 1998). Based on review of available information, predation in the lower San Joaquin River and Delta, as well as predation related mortality in the Clifton Court forebay of the SWP and CVP water export facilities, are key factors affecting the numbers of Chinook salmon recruited to the ocean fishery (TID/MID 2013c). For Chinook salmon outmigrants from the Tuolumne River, increased flows at Vernalis have been shown to reduce predation related mortality, but the relationship is highly dependent on the presence of the HORB (TID/MID 2013c).

Avian and pinniped (seals and sea lions) predation on juvenile Chinook salmon have been documented in San Francisco Bay (Evans et al. 2011) and along the California coast (Scordino 2010), respectively, and it is likely that at least avian predation occurs to some extent in or near the Delta as well. Whether and to what extent such predation is mediated by anthropogenic influences in the region is unknown.

Predation on juvenile salmonids is not the only adverse effect associated with introduced species. Introduced zooplankton species and the overbite clam (*Corbula amurensis*) in the lower Tuolumne and San Joaquin rivers (Brown et al. 2007) may have affected the availability of suitable prey for rearing salmonids (see also, Benthic Invertebrates and Fish Food Availability, below).

Predation also affects non-salmonid native fish species in the San Joaquin River and its tributaries. Predation on hardhead by smallmouth bass has resulted in population declines and isolation of populations (Moyle 2002). Hardhead have at times been abundant in reservoirs. However, most of these reservoir populations have proved to be temporary, presumably the result of colonization of the reservoir by juvenile hardhead before introduced predators became established. Brown and Moyle (1993) found that hardhead tend to disappear from water bodies following colonization by bass.

4.4.1.6 Benthic Invertebrates and Fish Food Availability

Analysis of historical drift samples and stomach contents of rearing juvenile Chinook salmon indicates that there are adequate food resources for juvenile rearing in the Tuolumne River (TID/MID 2013c), and analysis of long-term Hess sampling data gathered from 1988–2009 at Riffle 4A (RM 48.8) indicates that increased summer flows since 1996 have resulted in beneficial shifts in the invertebrate food supply of fishes. Overall invertebrate abundances in Riffle 4A samples declined slightly from 1996 to the present. However, community composition shifted away from pollution-tolerant invertebrate taxa and toward those with higher food value for juvenile salmonids and other fish (TID/MID 2010, Report 2009-7).

A number of factors affect aquatic food sources available to rearing juvenile Chinook salmon in the Delta: changes in flow magnitudes and timing, water exports at the SWP and CVP facilities, construction of levees and the resulting conversion of marsh habitats to agricultural and urban land uses, and anthropogenic introductions of nutrients, contaminants, and non-native species (TID/MID 2013c).

Although warmer waters in the Delta provide a higher growth rate potential for juvenile salmonids than that associated with cooler upstream tributary habitats, degradation of Delta habitat conditions has adversely affected the primary and secondary productivity that support Delta food webs, resulting in low growth rates of Chinook salmon juveniles (TID/MID 2013c) Based on documentation of reduced Chinook salmon growth rates in the Delta, as well as declines in pelagic prey species, including insect drift and zooplankton, food resources may also be limiting for actively feeding steelhead smolts outside of flood conditions (TID/MID 2013c).

As noted above, introduced zooplankton species and the overbite clam in the lower Tuolumne and San Joaquin rivers (Brown et al. 2007) may compete with native fauna and thereby affect the availability of suitable prey for rearing salmonids in these areas.

4.4.1.7 Freshwater Harvest and Poaching

CDFW implemented sport fishing catch limits on salmon in the early 2000s within a portion of the Tuolumne River, and salmon fishing is currently banned in the lower Tuolumne River and San Joaquin River upstream of the Delta. There is no available estimate of the number of Chinook salmon lost to poaching in the Tuolumne or San Joaquin rivers (TID/MID 2013c). However, poaching of Chinook salmon, to the extent that it occurs, would take place during the adult upstream migration period.

McEwan and Jackson (1996) contend that legal harvest in the years prior to the listing of Central Valley steelhead was not the cause of recent population declines. Annual fishing report cards (Jackson 2007) do not provide data to quantitatively assess hooking mortality or other sport fishing impacts on steelhead, and no information appears to be available to assess the effect of poaching on upstream migrating adult steelhead in the Tuolumne River (TID/MID 2013c). Illegal harvest of resident *O. mykiss* could occur year-round, but there is no estimate of its extent in the Tuolumne River.

4.4.1.8 Effects of Ocean Conditions on Fall-Run Chinook Salmon

As noted above, FERC defines the geographic scope of cumulative effects for aquatic resources as extending upstream on the Tuolumne River to Hetch Hetchy Reservoir and downstream to San Francisco Bay. Although the Pacific Ocean is outside the geographical limits of the analysis, environmental conditions and commercial harvest of Chinook salmon in the ocean exert a strong influence on the abundance and health of the Chinook salmon population in the Tuolumne River, in some years potentially overwhelming the effects of many in- and out-of-basin actions in the rivers or Delta (128 FERC ¶ 61,035 [2009]).

In the open ocean, seasonal and longer-term changes in meteorological and oceanographic conditions determine water temperature and coastal circulation patterns, with effects on nutrient upwelling and primary and secondary productivity of the marine food web that supports ocean feeding and growth of Tuolumne River fall-run Chinook salmon. Major climate-ocean factors such the Pacific Decadal Oscillation (PDO) and shorter-term El Niño/Southern Oscillation (ENSO) influence ocean productivity, and consequently salmon numbers through a series of complex processes (Pearcy 1992, Williams 2006). For example, the recent dramatic collapse of Sacramento fall-run Chinook stocks during the 2007 and 2008 spawning years was attributed to highly anomalous coastal ocean conditions during 2005 and 2006, i.e., late and weakened seasonal upwelling associated with warmer sea surface temperatures led to the deterioration of coastal food webs on which juvenile salmon depend (CalCOFI 2006, 2007, NMFS 2009.

Ocean harvest has the potential to reduce the number of adult Chinook salmon migrating into the Tuolumne River (Williams 2006, PFMC 2013). For many years, an annual average of 60 percent of the Central Valley Chinook salmon population has been taken in the ocean fishery, directly affecting the species' escapement to fresh water (TID/MID 2013c). Harvest mortality of larger fish generally reduces the age- and size-at-return, and consequently the fecundity, of upstream migrating spawners (Williams 2006; TID/MID 2013c). The transition from inland gill net fishing to an ocean troll fishery at the end of the nineteenth century had significant impacts on Central Valley salmon populations; fish are exposed to trolling over a period of years, resulting in younger and smaller salmon returning to California streams. There is evidence that such a reduction in the age-distribution of Central Valley fall-run Chinook salmon has occurred (Williams 2006). Chinook harvest management by the PFMC is based exclusively on meeting escapement goals for the hatchery-supported Sacramento River fall run. Because "mixed stock fisheries supported by strong stocks may overharvest weaker ones," (Williams 2006) there is a potential to overharvest already diminished San Joaquin River Basin stocks. The PFMC dropped its San Joaquin Basin escapement goal in 1984 because of the effects of Delta export pumps on those runs (Boydstun 2001).

4.4.1.9 Climate Change

Although it is impossible to quantify the contribution of global climate change to cumulative effects on fish and aquatic resources in the San Joaquin River basin, general patterns of impact can be described. In general, increases in temperature and alteration of precipitation regime are likely to have adverse effects on cold-water aquatic organisms, including fall-run Chinook and Central Valley steelhead, in parts of the Tuolumne River and throughout the San Joaquin River and Delta.

The global mean surface temperature has reportedly increased by 1.1°F since the 1800s (IPCC Synthesis report, 2001, as cited in CEPA 2006). Climate change scenarios indicate that temperatures in the United States may rise by approximately 5–9°F (3–5°C) on average over the next 100 years (CEPA 2006). However, high range estimates for global increases in average temperature are as high as 8.0–10.4°F (4.4–5.8°C) (CEPA 2006).

According to CEPA (2006), there is no clear trend in precipitation projections for California over the next 100 years, but the consensus based on recent Intergovernmental Panel on Climate Change (IPCC) model projections is for small changes in total precipitation, with slightly greater winter and lower spring precipitation. Despite the modest projected change in precipitation, warmer temperatures may reduce snow accumulation in the Sierra Nevada. A greater proportion of precipitation may be in the form of rain, and snowmelt may occur earlier.

Reductions in snowpack and earlier runoff would have impacts on water supply and natural ecosystems. Climate simulations predict that losses in snowpack may become progressively larger during the 21st century, and by the 2035–2064 period, snowpack in the Sierra Nevada could decline by 10–40 percent (CEPA 2006). By 2100, snowpack could decrease by as much as 90 percent if temperatures rise at the high end of the range of predicted increases.

Declining snowpack would exacerbate the already substantial competition for water resources in California (CEPA 2006). The snowpack in the Sierra Nevada provides water storage equivalent to about half the capacity of California's major reservoirs. This loss in storage in the form of snow could lead to greater and longer duration future water shortages. Under most scenarios, stream flows are projected to decline slightly by about 2050, with more dramatic changes possibly occurring near the end of the century (CEPA 2006).

Managing California's reservoirs efficiently will be critical to avoiding or minimizing the effects of any such shortages. Flows into the major Sierra Nevada reservoirs could decline from 25–30 percent, even under moderate warming levels (CEPA 2006), i.e., nearly twice the decrease projected if temperatures increase within the lower range of possible warming. After about 2050, alteration of the volume and timing of snowmelt runoff may reduce the ability of the major water storage projects to deliver irrigation water to users south of the Delta (CEPA 2006). The reductions in the availability of water would be exacerbated by any increases in demand, and by 2100, increasing temperatures would increase the crop demand for water from 2–13 percent in the low to medium warming ranges, respectively (CEPA 2006).

If the Central Valley warms, Chinook salmon and steelhead, two species at the southern end of their distributions, will be at greater risk than under current conditions (NMFS 2009). If temperatures rise and flows decline in California, it will become more difficult to manage cold-water fisheries, as increasing air temperatures, particularly during summer, would raise water temperatures in rivers and streams, thereby increasing stress on cold-water species.

4.5 Socioeconomics

4.5.1 Districts' Service Areas

A primary purpose of the Don Pedro Project is to provide direct water supply and consumptive use benefits for the two districts irrigation and M&I customers and for the Bay Area communities and industries served by the City and County of San Francisco's Hetch Hetchy water system. The water supply and hydropower generation benefits of Don Pedro are essential components of the economic livelihood and welfare of Stanislaus County communities and the Central Valley region as a whole. The water banking privilege acquired by CCSF through its financial contribution to the construction of the Don Pedro Project is a critical part of CCSF's water supply system which serves 2.6 million people in the Bay Area.

FERC's SD2 (page 38) identifies the following potential Don Pedro Project effects on socioeconomic resources:

- *The socioeconomic effects of any proposed measures to change Don Pedro Project operations on affected governments, residents, agriculture, businesses, and other related interests.*
- *Water supply effects on San Francisco Public Utility Commission retail and wholesale customers that would result if the CCSF were required to provide additional water to the Districts to support a change in operation for environmental mitigation.*

In order to determine the potential socioeconomic impact to the Central Valley and Bay Area regions due to alternative protection, mitigation, and enhancement (PM&E) measures proposed by the Districts, CCSF, or any other party, the Districts and CCSF have both developed economic models of the baseline conditions of their regions assessing the role that water supply plays in the economic welfare of their service areas. In addition, the Districts collaboratively developed the Tuolumne River Operations Model (Operations Model), fully described in Exhibit B of this application, to depict the base case water supply operations of both the Districts and CCSF. In the base case, under certain circumstances the Districts and CCSF share responsibility for meeting FERC license requirements in the lower Tuolumne River downstream of the Don Pedro Project consistent with the Fourth Agreement. Another use of the Operations Model is to evaluate the effects of alternative operations scenarios on water supply deliveries to the Districts and CCSF.

In response to FERC's SD2 requirements, the Districts prepared a draft Socioeconomic Study which was issued as part of the Updated Study Report, and the final report is included in this application for new license. The objectives of the Districts' Socioeconomics Study are to qualitatively and quantitatively describe local economic conditions in the regions that are directly and indirectly affected by the existing Don Pedro Project operations; assess the key factors influenced by Don Pedro Project operations that generate economic activity in affected regions; estimate the economic value generated by the water storage in various uses, both consumptive (agriculture and urban) and non-consumptive (reservoir recreation); measure the role and significance of the Don Pedro Project in the local economy; assess the role and significance of the Don Pedro Project to the general welfare of the local communities served; and develop a framework to be able to assess the socioeconomic impacts on affected groups and industries resulting from changes in water supply operations, including economic, community welfare, and environmental justice considerations.

The study area consisted of the three-county area of Stanislaus, Merced, and Tuolumne counties, which captured both the direct and indirect economic effects of the Don Pedro Project. The direct effects are associated with use of related facilities, including the reservoir (recreation) and the hydroelectric plant (power generation), and water use throughout the Districts' water service areas (agriculture and urban uses). The indirect effects of the Don Pedro Project on the broader economy are also important to recognize and are a key component of the study.

The Districts' water service areas cover approximately 300,000 acres, of which approximately 220,000 are currently irrigable with surface water. According to the 2010 census, the population in the three-county exceeds 800,000 people, with population in the Districts' water service area accounting for 466,000 people. Minority groups and Hispanics represent about 35 percent and 44 percent of the regional population, respectively. Between 2007 and 2011, the total civilian labor force averaged approximately 374,800 people with approximately 320,600 employed, which equates to an unemployment rate of 14.5 percent. Farm-level employment in the study area averaged 18,100 jobs over the same time period, or 5.5 percent of the study area total. Indirectly, agriculture also provides numerous jobs in those industries that supply inputs to farming operations (e.g., farm machinery and fertilizers) and industries that are reliant on agricultural commodities (e.g., food processing plants), which are reported in categories outside the farm sector. In Stanislaus County, eight of the 10 largest employers are in agricultural production or food processing, and the remaining two are in health-related industries.

The farmland within the two-county area are highly productive. In 2011, Merced and Stanislaus counties were the fifth and sixth largest counties in California as measured by gross value of agricultural production. Together, they contributed $6.5 billion in gross value, 12.3 percent of total gross value for the state, with a significant portion of this production coming from land irrigated with water supplies provided by MID and TID.

The Districts play key roles in the agricultural economies of Stanislaus and Merced counties and the entire San Joaquin Valley. Through the Don Pedro Project, the Districts have provided highly reliable water supplies to their customers, e.g., consistent annual deliveries of high-quality surface water to maintain crops during periods of drought. With those reliable supplies, growers and producers have invested heavily in high-valued perennial crops, such as almonds and peaches, as well as dairy production, which has resulted in the large complex of agricultural-support industries being developed in the area. In Stanislaus County, the largest crop acreages, averaged over the period 2007 through 2011, are in nuts, at 32.4 percent of the total, corn (including corn silage) at 25.8 percent, hay at 14.5 percent, and vegetables at 8.2 percent, and the gross crop production value from 2007-2011 was over $1.2 billion, with the largest contributions from nuts (at 49.2 percent of the total), vegetables (12.4 percent of the total), field and other (10.9 percent of the total), and fruit (10.0 percent of the total). In Merced County, the largest crop acreages averaged over the period of 2007 through 2011 are in corn silage (27.7 percent), nuts (17.6 percent), hay (15.8 percent) and vegetables at 9.3 percent of total normalized average acres. Merced County gross crop production value from 2007 through 2011 was over $1.1 billion, with the largest contributions from nuts (at 30.4 percent), vegetables (28.2 percent), corn silage (10.7 percent) and field and other crops (10.1 percent).

In addition to crop production, the Districts' service area includes a large dairy sector. In 2011, the value of milk production in Stanislaus and Merced counties was $1.9 billion (Stanislaus County Agricultural Commissioner 2011 and Merced County Agricultural Commissioner 2011). For the five years from 2007-2011, the normalized average of dairy production values in the two-county area was $1.7 billion, and the value of dairy production supported by crops grown in the Districts' service areas is estimated at $537.4 million, or 31.0 percent of the two-county total.

Specifically related to the Districts' service areas, the average of gross crop production value for the period 2007-2011 totaled $527.93 million. The value of dairy production for the same period supported by crops grown in the two districts was $537.4 million. Thus, the gross value of agricultural production (both crops and dairies) for the period 2007-2011 was approximately $1.1 billion.

The Socioeconomic Study also evaluated the economic benefit of the current recreation use of Don Pedro Reservoir. Based on the average use of 378,000 visitor-days annually, recreation has a direct economic value of $6.2 million per year. Hydropower generation was also evaluated in the study and estimated to have an annual value of slightly less than $25 million per year.

The *total* economic impact, or economic contribution, of an industry represents the sum of direct, indirect, and induced effects as defined below. The measurement of total economic effects captures the multiplier (or "ripple") effect associated with direct effects.

- **Direct effects.** Represent the impacts for the expenditures and/or production values specified as direct final demand changes
- **Indirect effects.** Represent changes in output, income, and employment resulting from the iterations of industries purchasing from other industries caused by the direct economic effects.
- **Induced effects.** Represent changes in output, income, and employment caused by the expenditures associated with new household income generated by direct and indirect economic effects.

The model used to estimate total economic contribution for the Don Pedro Project was developed using IMPLAN software and data. IMPLAN (IMpact Analysis for PLANning) is a widely-used and accepted regional economic modeling system that can measure the effect of projects, programs, and/or policies on local economic conditions. It was originally developed by the U.S. Department of Agriculture, Forest Service in the late 1970s to assist in land and resource management planning, but its role has expanded to serve clients in Federal, state, and local governments, universities, and the private companies.

Based on IMPLAN modeling, the agricultural sector alone has a total regional economic benefit of $4.3 billion per year.

4.5.2 City and County of San Francisco Service Area

CCSF manages the San Francisco Regional Water System (RWS). The Hetch Hetchy water system supplies 85 percent of the water supply for CCSF and its 27 wholesale customers in the RWS. The water supply available in the future to the Bay Area from the Hetch Hetchy water system may be affected by the outcome of the Project relicensing. Under certain circumstances, the Districts and CCSF share responsibility for meeting FERC license requirements in the lower Tuolumne River downstream of the Don Pedro Project.

To understand this potential impact, CCSF prepared an independent study on the potential socioeconomic effects of potential changes in Don Pedro Project operations entitled *Socioeconomic Impacts of Water Shortages within the Hetch Hetchy Regional Water System Service Area.* The report documents the pattern of urban water supplies and demands that may likely occur in the San Francisco Regional Water System service area in the coming decades, and evaluates the socioeconomic impacts of water shortages relative to baseline demands under normal economic and weather conditions. The analysis in this report incorporates the effect of demand growth over the coming decades and the development of non-RWS water supplies developed by CCSF and the Wholesale Customers. Specifically, the impacts of RWS supply reductions are calculated for CCSF and SFPUC's 27 wholesale customers receiving RWS water supplies. Socioeconomic impacts are measured in terms of lost welfare of ratepayers, and changes in business sales and employment. CCSF will be filing this study with FERC as part of the relicensing process.

5.0 DEVELOPMENTAL ANALYSIS

The Developmental Analysis section of this Exhibit E contains the assessment of the cost of hydropower generation under the current license conditions ("base case") and the potential change in costs of generation under alternative future license conditions. This FLA also evaluates the socioeconomic impact of alternative future operations and maintenance requirements associated with the Districts' proposed plan of future operations, including proposed PM&E measures, and alternative operations and PM&E measures considered by the Districts or proposed by others, and not adopted.

The Don Pedro Project provides water storage for irrigation and municipal and industrial (M&I) use, flood control, hydroelectric generation, recreation, and natural resource protection (hereinafter, the "Don Pedro Project"). The environmental analysis contained in this Exhibit E considers all the components, facilities, operations, and maintenance that make up the Don Pedro Project. The Don Pedro Project was originally conceived as a water supply project. The Don Pedro Project is operated for the following primary purposes: (1) to provide water supply for the co-licensees, Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts), for irrigation of over 200,000 acres of Central Valley farmland and M&I use, (2) to provide flood control benefits along the Tuolumne and San Joaquin rivers, and (3) to provide a water banking arrangement for the benefit of the City and County of San Francisco (CCSF) and its 2.6 million Bay Area water customers. The original license was issued in 1966. In 1995, the Districts entered into an agreement with a number of parties which resulted in greater flows to the lower Tuolumne River for the protection of aquatic resources.

Hydroelectric generation is a secondary purpose of the Don Pedro Project. Hereinafter, the hydroelectric generation facilities and operations will be referred to as the "Don Pedro Hydroelectric Project", or the "Project". With this license application to FERC, the Districts are seeking a new license to continue generating hydroelectric power. Based on the information contained in this application, and other sources of information on the record, FERC will consider whether, and under what conditions, to issue a new license for the continued generation of hydropower at the Districts' Don Pedro Project. The Districts are providing a complete description of the facilities and operation of the Don Pedro Project so the effects of the operation and maintenance of the hydroelectric facilities can be distinguished from the effects of the operation and maintenance activities of the overall Don Pedro Project's flood control and water supply/consumptive use purposes.

Being able to differentiate the effects of the hydropower operations from the effects of the flood control and consumptive use purposes and needs of the Don Pedro Project will aid in defining the scope and substance of reasonable protection, mitigation, and enhancement (PM&E) alternatives to be considered in relicensing. As FERC states in Scoping Document 2 in a discussion related to alternative project operation scenarios: "…alternatives that address the consumptive use of water in the Tuolumne River through construction of new structures or methods designed to alter or reduce consumptive use of water are…alternative mitigation strategies that could not replace the Don Pedro *hydroelectric* project [emphasis added]. As such, these recommended alternatives do not satisfy the NEPA purpose and need for the proposed action and are not reasonable alternatives for the NEPA analysis."

5.1 Analytical Methods

In accordance with the detailed study plans proposed by the Districts, reviewed and commented upon by relicensing participants, and subsequently approved or approved with modification by FERC, the Districts have developed a suite of five (5) core, river-specific computer models of the Don Pedro Project and the Tuolumne River to evaluate alternative operational scenarios and flow and non-flow PM&E measures. These models represent Don Pedro Project operations and the resource conditions of the Tuolumne River to a refined level of detail and go well beyond a general treatment of the watershed. The development of each of these models has included the conduct of numerous Consultation Workshops with relicensing participants. The final, working models were provided to relicensing participants, along with training sessions on the use of the models. The core models are summarized below:

- Tuolumne River Operations Model,
- Don Pedro Reservoir Temperature Model,
- Lower Tuolumne River Temperature Model,
- Tuolumne River Fall-run Chinook Population Model, and
- Tuolumne River *O.mykiss* Population Model.

The development of each of these models included the conduct of Consultation Workshops with relicensing participants to share information, encourage dialogue, and obtain interim review and comment on model architecture, parameters, and methodologies during the model development process. In total, 17 Workshops were held with relicensing participants over the two year period of model development. This programmatic consultation has been documented in a series of Workshop Meeting Notes, all of which have been previously filed with FERC.

Four additional models have been developed that are also intended to aid informed decision-making. The Districts have developed a model to evaluate in-river gravel resources and predict effects to gravel availability over the next 50-years based on observed trends recorded over more recent years. This model may be used to assess the effects of alternative scenarios on gravel availability. The Districts have also developed an Instream Flow Incremental Methodology (IFIM) study for portions of the lower Tuolumne River to assess flow and habitat relationships for fall-run Chinook and *O.mykiss*, a Socioeconomic Model for the purpose of estimating the effects to the economic welfare of local and regional populations resulting from alternative future operating scenarios that would affect water supplies, and a temperature model for the entire Tuolumne River from above Hetch Hetchy Reservoir to the San Joaquin confluence under "without dams" conditions. The City and County of San Francisco (CCSF) has developed a model for purposes of evaluating socioeconomic effects to its Bay Area service area under alternative scenarios that could affect CCSF water supplies.

All of the Districts' models are described in detail in separate reports. Together, these models provide an in-depth, site-specific analysis of the Tuolumne River, the Don Pedro Project, and affected resources and populations. In addition, the Tuolumne River Operations Model includes the water supply operations of CCSF's Hetch Hetchy Water System (see Exhibit B of this application), enabling an assessment of potential impacts to CCSF and its Bay Area customers' water supply that may result from any increased flows to the lower Tuolumne River.

The models work in an integrated fashion to enable users to understand the complex interrelationships among Don Pedro Project operations, river flows, reservoir and river temperatures, salmonid habitat and in-river life stages, and the effects of alternative operations scenarios on each of these resources. Each model has gone through calibration and validation processes, and the "base case" conditions have been established. The "base case" under FERC's procedures and protocols represents the scenario of future operations under the current license conditions. Specifically for the Tuolumne River Operations Model, the "base case" depicts the operation of the Don Pedro Project in accordance with the current FERC license, ACOE flood management guidelines, and the Districts' irrigation and M&I water management practices. For purposes of representing CCSF operations, the base case in addition to recent operations, also includes changes in operations resulting from construction of capital improvement projects that are permitted under CEQA, approved by CCSF, and authorized (funded), but not yet fully implemented. The base case is considered the "no action" alternative under FERC's assessment of the effects of alternative operations scenarios. Each of the five core models utilizes the same hydrology covering the 1971 through 2012 period that was collaboratively developed with relicensing participants.

The models are designed to operate in tandem, with the output of one providing input to the next. The Operations Model is a Tuolumne River watershed model. The model depicts the physical operation of the Don Pedro Project in accordance with current FERC license requirements, relevant provisions of the Fourth Agreement between the Districts and CCSF, ACOE's Flood Control Manual, water deliveries to satisfy the water supply needs of the Districts' customers, and Hetch Hetchy water supply operations. The base case can be modified to evaluate alternative operating scenarios. Each alternative scenario provides a new Operations Model output that describes the changes to reservoir inflows, reservoir releases, reservoir water levels, and water supply to the Districts' and CCSF's customers as a result of the different operating regime. Operations Model scenarios serve as the input to the Don Pedro Reservoir Temperature Model, a detailed three-dimensional depiction of the reservoir used to predict changes in reservoir thermal regime and outflow temperatures resulting from alternative operations. The outputs from the reservoir temperature model and Operations Model serve as the input to the lower Tuolumne River temperature model, which in turn provides the flow and temperature inputs to the in-river fall-run Chinook and/or *O.mykiss* models. Changes in water supply to the Districts or to CCSF can then be used as inputs into the respective socioeconomic models to estimate the consequences to local and regional economic welfare.

All of the models have now been completed in accordance with the FERC-approved study plans and are available for use. The Districts have provided user manuals and/or training in the use of the Operations Model, temperature models, and the two salmonid models. The models are easily updated as Tuolumne River-specific empirical data continues to be collected. Data collected as part of the yet-to-be-completed assessment of floodplain hydraulics and habitat, the update to the 2012 predation study, and the *O.mykiss* swim tube study may yield valuable information and lead to model refinements. Schedules for completing these studies, preparing any model updates, evaluating alternative operations and PM&E scenarios, and preparing any needed amendment to this FLA are provided as part of this application (see Section 1.0 of this Exhibit E).

5.2 Applicant Proposed PM&E Measures

As part of the relicensing process, the Districts have undertaken 38 studies examining cultural, terrestrial, recreation, aquatic and water resources potentially affected by Don Pedro Project operations and maintenance practices. While five important water and aquatic resource studies have yet to be completed, all other studies have been completed[19]. When the full suite of water and aquatic resource studies have been completed and any model refinements made, the Districts will undertake a comprehensive evaluation of potential effects and potential PM&E measures related to these resources. For resource areas where studies have been completed, the Districts have evaluated resource impacts and opportunities for resource enhancement and have developed a number of PM&E measures proposed for implementation under the new license. These measures, and their estimated costs, are listed below and described in detail in the relevant sections of this license application.

The Districts have developed cost estimates for each proposed new PM&E measure contained in this application. The associated capital and annual O&M cost are provided in Table 5.2-1 below for each proposed resource-related PM&E measure.

Table 5.2-1. Estimated capital and annual O&M cost for new PM&E measures

PM&E Measure	Capital Cost/Annualized Capital Cost[1] (2014 dollars)	Average Annual O&M Cost (2014 dollars)
Historic Properties Management Plan	$300,000/ $17,350	$270,000/yr for first 15 years[2]; $30,000/yr thereafter.
Bald Eagle Management Plan	N/A	$12,500/yr for the first 5 years; $5,000/yr thereafter.
Vegetation Management Plan	N/A	$23,200/yr.
Bat Protection Measures	N/A	$4,000/yr.
Recreation Resource Management Plan	$1,100,000/$63,600	$289,000/yr for years 2 through 6; and 17 through 21.
Total	$1,400,000/$80,950	$405,700/yr for first 10 years $393,200/yr for years 11-15 $158,200/yr thereafter.

1 Annualized cost are estimated at an amortization rate of 4% over 30 years.
2 Starting in year two after the Districts' acceptance of the new license.

The Districts are also proposing to increase the hydropower capacity of the Project from the currently authorized 168 MW to the proposed new authorized capacity of 220 MW, with a maximum output of 244 MW compared to the current maximum of 203 MW at maximum head. The estimated cost of the upgrade is $46.1 million (2014 dollars). The expected increase in

19 Two cultural resources studies, CR-01 and CR-02, have been issued as draft reports to the Cultural Resources Work Group for review and comment. Both of these studies contain sensitive and privileged information and will be filed with FERC under separate cover as PRIVILEGED once Work Group reviews are completed.

annual energy production is approximately 20 million kWh. The annualized capital cost would be $2.7 million.

Further PM&E measures may be proposed once all supporting studies have been completed.

5.3 Measures Proposed By Others

5.3.1 Operational Measures

During the development of the initial study plans, the Lower Tuolumne Farmers (LTF), a group of irrigators on the Tuolumne River located primarily below the City of Modesto with farmland along the Tuolumne River, raised concerns that the Districts' manner of operating the Don Pedro Project may result in the occurrence of higher spring flows than necessary. LTF asserts that these higher flows can lead to property damage and crop loss. LTF requested that the Districts consider earlier and more frequent snow surveys, additional weather stations, or other means of reliably predicting future flows over the long-term. FERC's December 2011 Study Plan Determination recommended that the Districts evaluate whether obtaining early-season (December, January, February) snowpack information or alternative operational strategies could "improve operations"; that is, reduce the occurrence of higher late spring flows.

The Districts point out that none of the concerns raised by LTF are affected by Don Pedro hydroelectric operations, the specific action being considered by this license application. Additionally, the Districts have never been presented any data or evidence confirming any property or crop damage. The Districts met with LTF to understand more precisely at what flows the asserted "property and crop damage" begins to occur. LTF reported that such "damage" would begin at approximately 6,000 cubic feet per second (cfs) in the lower Tuolumne River below Modesto. It is important to note that such flows are not uncommon on the lower Tuolumne River, and that it is likely that LTF is cultivating lands within the active floodplain. Also, the predominant location of LTF lands is below Dry Creek and in areas where backwater effects from the San Joaquin River can influence water levels along the Tuolumne River.

Nevertheless, in September 2011, the Districts contacted the California Department of Water Resources (CDWR) and inquired as to the potential usefulness and feasibility of earlier-season snowpack measurements and flow forecasting. CDWR is the state agency responsible for developing snowpack and runoff forecasts for the state. CDWR responded on January 31, 2012. CDWR reported that *"… quantitatively, January surveys add no value to the way DWR produces seasonal runoff forecasts. DWR does not begin producing seasonal runoff forecasts (April thru July runoff) until February 1. The reason for this has to do with data available (very few snow courses are measured on January 1) and lack of a good correlation between January 1 surveys and April-July (AJ) runoff."* CDWR's letter went on to conclude *"[a]lso, consider that on January 1 two-thirds of the three major winter months (December, January, and February) are yet to come. As such, it is unlikely that April 1 snow conditions can be predicted from any trends evident in the January 1 surveys. This is why, statewide, only a handful of January 1 surveys are completed, and those that are mostly just satisfy a media curiosity for an "early season look" at water conditions. My opinion is that paying for January snow surveys boils down to a curious* *and costly look at conditions; something that can already be obtained by our remote snow sensor network. The idea of more frequent surveys is also one that is not a viable solution."*

The Districts also considered whether operational changes could be used to potentially reduce flow occurrences below 6,000 cfs. By examining historical and base case flow conditions, it was determined that from 1971 to 2012 flows in the lower Tuolumne River exceeded 6,000 cfs in 18 years of this 42 year period. In 12 of these 18 years, flows exceeding 6,000 cfs occurred in November, December, January, and/or February ('80, '82, '83, '84, '86, '96, '97, '98, '99, '00, '06, '11). High flows in the early part of the water year should serve as an indication not to plant crops in the floodplain prior to the June/July time frame because the reservoir is already near full. As CDWR points out in its letter, additional early season snowpack measurements (December, January) or flow forecasts would not be useful or helpful because the uncertainty associated with such forecasts result in a very large range of potential future flows. This leaves six of 42 years in which potentially different reservoir operations may have resulted in being able to keep flows in the lower Tuolumne River at less than 6,000 cfs. Further examination of the base case model output indicated that, except for one year in the 42 year period (1983), when Don Pedro water levels were below 784 ft on February 1, lower Tuolumne River flows did not exceed 6,000 cfs. By inspection of the base case model, the combination of the Districts adopting an initial target flow of less than 6,000 cfs (say, 5,500 cfs) when February 1 water levels are less than 784 ft, and the LTF farmers not planting in the floodplain when February 1 Don Pedro water levels are above 784 ft would substantially reduce the possibility of damage to crops (once in 42 years according to the base case model). However, there will always be some risk associated with planting in historical floodplains.

5.3.2 Flow Measures

Several relicensing participants recommended alternative scenarios for the schedule and amount of minimum and pulse flows to be released by the Don Pedro Project to the lower Tuolumne River. The Districts identify each of these recommendations in their response to relicensing participants' comments on the draft license application, which the Districts have filed as an attachment to this license application. Several studies yet to be completed deal with resource issues germane to these flow recommendations. Therefore, the Districts will review, consider, and respond to each of these recommendations, and any further such recommendations, upon the completion of all resource studies, and in accordance with the schedule provided in this license application. The Districts point out that none of the flow recommendations put forth by relicensing participants provided a connection between the Project's hydroelectric operations and their effect on the downstream resources to be protected and enhanced by the alternative downstream flows.

The State Water Resources Control Board (SWRCB) requested the Districts evaluate the ability of the Don Pedro Project to meet certain temperature guidelines contained in the EPA (2003) guidance document and outlined in the EPA's October 2011 Tuolumne River impairment decision (EPA 2011) and to determine what flows would be required to be released to the lower Tuolumne River to meet these guidelines. FERC requested the Districts perform a similar evaluation. The Districts performed this analysis using the Tuolumne River-specific operations, reservoir, and river temperature models developed as part of the relicensing process. The analysis is presented as part of the Districts' response to relicensing participants' comments on the draft license application (see Attachment A to this final license application). The operations scenario developed by the Districts to perform this evaluation assumed that the Districts' Don Pedro Project and CCSF's Hetch Hetchy Project were operated for the sole purposes of meeting the EPA temperature "requirements" and the ACOE's flood control guidelines. In summary, the analysis demonstrated that even when all consumptive uses of Tuolumne River water were completely eliminated, there would be temperature exceedances in 41 of the 42 years of the period analyzed (1971-2012), varying from a few days to, in many years, exceedances of the temperature guidelines virtually the entire period for which the temperature thresholds were in effect. The modeled scenario eliminated the delivery of water to the Districts' irrigation and M&I customers, and eliminated 85 percent of the water supply to CCSF's 2.6 million customers in the Bay Area. Even under these unrealistic and extreme circumstances, the EPA temperature benchmarks were not met in 41 of the 42 years. Further, using the Districts' "without dams" model, which employs unimpaired flow conditions, river temperatures would exceed EPA's temperature benchmarks in each of the 42 years analyzed.

5.3.3 Non-Flow Measures

Similar to flow recommendations, several relicensing participants recommended alternative non-flow measures for the lower Tuolumne River. The Districts identify each of these recommendations in their response to relicensing participants' comments to the draft license application, which the Districts have filed as Attachment A to this license application. Several studies that are yet to be completed deal with resource issues germane to these non-flow recommendations. Therefore, the Districts will review, consider, and respond to each of these recommendations, and any further such recommendations, upon the completion of all resource studies, and in accordance with the schedule provided in this license application. The Districts point out that none of the non-flow recommendations put forth by relicensing participants provided a connection between the Project's hydroelectric operations and their effect on the downstream resources to be protected and enhanced by these recommended alternative measures.

6.0 CONCLUSIONS

6.1 Comparison of Alternatives

A comprehensive comparison of alternatives will be provided in the Districts' amended license application following completion of all studies. This section discusses the modeling tools developed by the Districts for evaluation of alternatives and proposed alternatives submitted by relicensing participants for further analysis.

6.1.1 Lower Tuolumne River Management Alternatives

As described in Section 5 of this Exhibit E, the Districts have developed a suite of modeling tools to assist in the evaluation of alternatives. In accordance with the detailed study plans proposed by the Districts, reviewed and commented upon by relicensing participants, and subsequently approved or approved with modification by FERC, the Districts have developed a suite of five (5) core, river-specific computer models of the Don Pedro Project and the Tuolumne River to evaluate alternative operational scenarios and flow and non-flow PM&E measures. These models depict Don Pedro Project operations and the resource conditions of the Tuolumne River to a refined level of detail and go well beyond a general treatment of the watershed. The core models are summarized below:

- Tuolumne River Operations Model,
- Don Pedro Reservoir Temperature Model,
- Lower Tuolumne River Temperature Model,
- Tuolumne River Fall-run Chinook Population Model, and
- Tuolumne River *O.mykiss* Population Model.

The models work in an integrated fashion to enable users to understand the complex interrelationships among Don Pedro Project operations, river flows, reservoir and river temperatures, salmonid habitat and in-river life stages, and the effects of alternative operations scenarios on each of these resources. Each model has gone through calibration and validation processes, and the "base case" conditions have been established. The "base case" under FERC's procedures and protocols represents the scenario of future operations under the current license conditions. Specifically for the Tuolumne River Operations Model, the "base case" depicts the operation of the Don Pedro Project in accordance with the current FERC license, ACOE flood management guidelines, and the Districts' irrigation and M&I water management practices. For purposes of representing CCSF operations, the base case in addition to recent operations, also includes changes in operations resulting from construction of capital improvement projects that are permitted under CEQA, approved by CCSF, and authorized (funded), but not yet fully implemented. The base case is considered the "no action" alternative under FERC's assessment of the effects of alternative operations scenarios. Each of the five core models utilizes the same hydrology covering the 1971 through 2012 period that was collaboratively developed with relicensing participants.

The resources of the lower Tuolumne River have been extensively studied throughout the term of the current license with no fewer than 200 individual reports being prepared describing individual studies, monitoring, and compilations of environmental investigations. Through this effort, including FERC-ordered studies in connection with the July 2009 Order on Rehearing (128 FERC ¶ 61,035), an abundance of relevant empirical information has been developed on lower Tuolumne River resources. Additional models applicable to issues raised in relicensing were created through these various efforts, including instream flow and pulse flow studies using PHABSIM methods.

Consistent with the most recent study schedules approved by FERC through the ILP's study plan determinations, several important studies involving the resources of the lower Tuolumne River have yet to be completed. Until these studies are completed, the Districts are unable to complete a comprehensive assessment of the direct, indirect and cumulative effects to the resources of the lower Tuolumne River, or complete an assessment of the costs and benefits of potential PM&E measures to enhance the resources of the lower Tuolumne River. The specific studies yet to be completed and their currently scheduled FERC-filing dates are:

- Lower Tuolumne River Predation Study using a mark-recapture approach -- April 2016
- Fall-run Chinook Salmon Otolith Study – February 2015
- Lower Tuolumne River Floodplain Hydraulic Assessment – February 2015
- Non-Native Predator IFIM Assessment -- April 2016
- *O.Mykiss* Swim Tunnel and Temperature Criteria Study -- February 2015

Once these studies are completed, the Districts will use all relevant data, reports, and models then available for the purpose of identifying and evaluating potential resource PM&E measures to address the direct, indirect, and cumulative effects of Project operations and maintenance. This assessment may potentially involve the assessment of a number of flow and non-flow measures, and consider changes to the current operations and maintenance practices of the Districts. The costs of potential measures, their benefit to resources, and their potential impacts to the water supplies of the Districts and the City and County of San Francisco will be determined. Once these assessments are completed, the Districts will prepare any needed amendments to this license application to incorporate the results of the completed studies, the evaluations conducted, and any proposed PM&E measures. The Districts have projected a date of filing of any required amendments to this license application of November 2016. A detailed schedule for completion of studies and filing any amendments is provided in Section 1 of this Exhibit E.

6.2 Alternatives Analysis Requested by Relicensing Participants

6.2.1 Assessment of Don Pedro Project Operations to Meet EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards

The SWRCB and FERC requested the Districts evaluate the ability of the Don Pedro Project to meet four specific temperature benchmarks identified in the EPA's October 2011 Tuolumne River impairment ruling and to determine what flows would be required to be released to the lower Tuolumne River to meet these temperature benchmarks. The Districts performed this analysis using the Tuolumne River-specific operations, reservoir, and river temperature models developed as part of the relicensing process. This analysis is presented as an appendix to the Districts' response to relicensing participants' comments on the draft license application (see Attachment A to this final license application). In summary, the analysis demonstrated that even with both the Districts' Don Pedro Reservoir and all of CCSF's Hetch Hetchy system reservoirs devoted *solely* to trying to meet the referenced EPA temperatures, the benchmark temperatures would not be met in 41 of the 42-year period of analysis, with temperature exceedances of more than 50 days in 70 percent of the years[20]. This modeling scenario eliminated all deliveries of water to the Districts irrigation and M&I customers, and eliminated all of CCSF's San Joaquin Pipeline deliveries to the Bay Area for the full 42-year period of analysis. Even with the complete elimination of all consumptive uses of Tuolumne River water, including the elimination of irrigation of 200,000 acres of Central Valley farmland and 85 percent of the water supply to CCSF's 2.6 million customers in the Bay Area, the EPA temperature benchmarks could not be met.

6.2.2 Operational Changes Requested by Lower Tuolumne Farmers

As detailed in Section 5.0 of this Exhibit E, during the development of the initial study plans, the Lower Tuolumne Farmers (LTF), a group of irrigators on the Tuolumne River located primarily below the City of Modesto with farmland along the Tuolumne River, raised concerns that the Districts' manner of operating the Don Pedro Project may result in the occurrence of higher spring flows than necessary. LTF asserts that these higher flows can lead to property damage and crop loss. LTF requested that the Districts consider earlier and more frequent snow surveys, additional weather stations, or other means of reliably predicting future flows over the long-term. FERC's December 2011 Study Plan Determination recommended that the Districts evaluate whether obtaining early-season (December, January, February) snowpack information or alternative operational strategies could "improve operations"; that is, reduce the occurrence of higher late spring flows.

The Districts point out that none of the concerns raised by LTF are affected by Don Pedro hydroelectric operations, the specific action being considered by this license application. Nevertheless, in September 2011, the Districts contacted the California Department of Water Resources (CDWR) and inquired as to the potential usefulness and feasibility of earlier-season snowpack measurements and flow forecasting. CDWR is the California agency responsible for developing snowpack and runoff forecasts for the state. CDWR responded to the Districts inquiry on January 31, 2012. CDWR reported that the LTF proposals for earlier season snowpack measurement and flow forecasting were not viable, indicating that "*… quantitatively, January surveys add no value to the way DWR produces seasonal runoff..*" and further that

[20] In fact, the only year where all four EPA temperature benchmarks were met was 1971, the first year of the analysis, because the analysis assumed for modeling purposes that the Don Pedro and Hetch Hetchy reservoirs start out full. The analysis retained the need for Don Pedro Reservoir operations to continue to meet the requirements of the ACOE Flood Control Manual.

"…*statewide, only a handful of January 1 surveys are completed, and those that are mostly just satisfy a media curiosity for an "early season look" at water conditions. My opinion is that paying for January snow surveys boils down to a curious and costly look at conditions; something that can already be obtained by our remote snow* sensor *network. The idea of more frequent surveys is also one that is not a viable solution.*"

The Districts also considered whether operational changes could be used to potentially reduce flow occurrences below 6,000 cfs, a flow guideline provided by LTF. By examining historical and base case flow conditions, it was determined that from 1971 to 2012 flows in the lower Tuolumne River exceeded 6,000 cfs in 18 years of this 42 year period. In 12 of these 18 years, flows exceeding 6,000 cfs occurred in November, December, January, and/or February ('80, '82, '83, '84, '86, '96, '97, '98, '99, '00, '06, '11). High flows in the early part of the water year should serve as an indication not to plant crops in the floodplain prior to the June/July time frame because the reservoir is already near full. As CDWR points out in its letter, additional early season snowpack measurements (December, January) or flow forecasts would not be useful or helpful because the uncertainty associated with such forecasts result in a very large range of potential future flows. This leaves six of 42 years in which potentially a different reservoir operation may have resulted in being able to keep flows in the lower Tuolumne River at less than 6,000 cfs. Further examination of the base case model output indicated that, except for one year in the 42 year period (1983), when Don Pedro water levels were below 784 ft on February 1, lower Tuolumne River flows did not exceed 6,000 cfs. By inspection of the base case model, the combination of the Districts adopting an initial target flow of less than 6,000 cfs (say, 5,500 cfs) when February 1 water levels are less than 784 ft, and the LTF farmers not planting in the floodplain when February 1 Don Pedro water levels are above 784 ft would substantially reduce the possibility of damage to crops (once in 42 years according to the base case model). However, there will always be some risk associated with planting in historical floodplains.

6.2.3 Alternative Flow Measures

In their comments on the draft license application, several relicensing participants recommended alternative scenarios for the amount and timing of minimum and pulse flows to be released by the Don Pedro Project to the lower Tuolumne River. The Districts identify each of these recommendations in their response to relicensing participants' comments on the draft license application in Attachment A of this license application, and summarize these requests for flow measures in Table 6.2-1.

Several studies yet to be completed will provide information regarding resource issues germane to these flow recommendations. Therefore, the Districts will review, evaluate, and respond to each of these recommendations, and any further such recommendations, upon the completion of all resource studies, and in accordance with the schedule provided in this license application. The Districts point out that none of the flow recommendations put forth by relicensing participants provided a connection between the Project's hydroelectric operations and their effect on the downstream resources to be protected and enhanced by the alternative downstream flows. In the evaluation of these alternatives, the Districts will continue to consult with relicensing participants to develop a fuller understanding of these alternatives.

Table 6.2-1. Flow alternatives requested by relicensing participants in comments on the draft license application.

Organization	Page of Comment Letter	Summary of Comment
Conservation Groups	9	The FLA should consider flow increases to improve juvenile rearing habitat. Such flow improvements could include flows to improve juvenile rearing in-channel and to improve the regularity, frequency, and duration of floodplain inundation. The FLA should consider flow pulses in February and March to stimulate downstream migration of juvenile Chinook in the fry and par (sic) life stages to diversify the life history strategies of Tuolumne River Chinook. The FLA should consider flow pulses in April and May in order to stimulate outmigration of Chinook in the smolt stage. For all flow pulses, the FLA should consider both long pulses (or simply higher base flows) and short term pulses to stimulate short-term outmigration events.
Conservation Groups	20	Recommendations: The FLA should include measures to stabilize and increase the O. mykiss population in the lower Tuolumne River. Whether this may reduce the likelihood of anadromy is a second order question. Low flows prior to 1996 certainly did not increase the steelhead population. 0. mykiss juveniles that survive oversummering in the Tuolumne River are 100% more likely to adopt an anadromous life history than 0. mykiss juveniles that do not survive oversummering.
NMFS	12	NMFS is looking forward to the Districts including new environmental measures in the Final License Application which will increase the frequency and duration of overbank areas which are currently negatively affecting salmonids and other species.
USFWS	15	Based on our review of the two final reports, we would propose the following flow requirements (justification for the Service's flow recommendations is contained in Enclosures 6 and 7) to support anadromous salmonids in the Tuolumne River:
USFWS	15	Base flows to improve the quantity, suitability, and consistency (including thermal conditions) of the aquatic habitat for all stages of steelhead: Year-round minimum flow of 275 cfs, during all water year (WY) types. In addition, release the greater of the year-round minimum flow (275 cfs) or the flow required to maintain stream water temperatures of 18° C or less from the LaGrange Powerhouse (RM 52) downstream to Robert's Ferry Bridge (RM 40) or 60% of unimpaired flows whichever is greater.
USFWS	15	Fall flows to improve the migration habitat, including thermal conditions, for adult fall-run Chinook salmon and steelhead, and thereby promote successful immigration: During all WY types, from September 1 through October 31, release the greater of the 275 cfs minimum base flow, or the flow required to maintain stream water temperatures of 18° C or less from the LaGrange Powerhouse (RM 52) to the San Joaquin River confluence (RM 0). In addition, release a flow of 1,200 cfs for 10 days in mid-October, with the timing of release coordinated with releases from the Merced and Stanislaus Rivers, and the San Joaquin Restoration Program.
USFWS	15	Spawning flows to improve the habitat (including thermal conditions) for spawning, egg incubation, and alevin stages of fall-run Chinook salmon and steelhead: During all WY types, from October 15 through February 15, release the greater of the 275 cfs minimum base flow, the 1,200 cfs mid-October immigration flow, or the flow requires to maintain stream water temperatures of 13 •C or less from the LaGrange Powerhouse (RM 52) to Robert's Ferry Bridge (RM40).

Organization	Page of Comment Letter	Summary of Comment
USFWS	15	Winter flow releases to improve the migration habitat for adult steelhead, and to inundate floodplain habitats to promote the survival, growth, and development (rearing) of juvenile fall-run Chinook salmon and steelhead: Release 3,000 cfs between February 1 and March 15, with the frequency and duration of the releases defined by WY type as follows: Critical and Dry WYs: A single, 2-day release in late February. Below Normal and Above Normal WYs: A single, 14-day continuous release, or two continuous 7-day releases, one in February and one in March; Wet WY: Releases in any multiples of continuous 7-day releases adding to 21 days.
USFWS	15	Spring flow releases to improve the migration habitat for adult steelhead, inundate floodplain habitats, and improve thermal conditions to promote rearing and downstream migrations of juvenile fall-run Chinook salmon and steelhead smolts: Critical and Dry WYs: From March 20 through April 20, release the greater of the 275 cfs minimum base flow or the flow required to maintain stream water temperatures of 15° C or less from the LaGrange Powerhouse (RM 52) to the San Joaquin River confluence (RM 0). Below Normal WY: From March 20 through April 30, release the greater of the 275 cfs minimum base flow or the flow required to maintain stream water temperatures of 15° C or less from the LaGrange Powerhouse (RM 52) to the San Joaquin River confluence (RM 0). Above Normal and Wet WYs: From March 20 through May 15, release the greater of the 275 cfs minimum base flow or the flow required to maintain stream water temperatures of 15° C or less from the LaGrange Powerhouse (RM 52) to the San Joaquin River confluence (RM 0).

6.2.4 Non-Flow Measures

Several relicensing participants' recommended alternative non-flow measures for the lower Tuolumne River. The Districts identify each of these recommendations in their response to relicensing participants' comments to the draft license application in Attachment A to this license application and summarize these recommendations in Table 6.2-2. Several studies yet to be completed will provided information on resource issues germane to these non-flow recommendations. Therefore, the Districts will review, evaluate, and respond to each of these recommendations, and any further such recommendations, upon the completion of all resource studies, and in accordance with the schedule provided in this license application. The Districts point out that none of the non-flow recommendations put forth by relicensing participants provided a connection between the Project's hydroelectric operations and their effect on the downstream resources to be protected and enhanced by these recommended alternative measures.

Table 6.2-2. Non-flow measures requested by relicensing participants in comments on the draft license application.

Organization	Page of Comment Letter	Summary of Comment
CDFW	27	A project impact assessment that is missing from the DLA concerns blocked access to historic anadromous fish habitat. CDFW, pursuant to Fish and Game Code Section 5930, has determined that the La Grange and New Don Pedro Dam complex, in there present condition, is impeding upstream migration of salmon and steelhead. To offset this production loss, the Districts should consider how naturally produced salmon and steelhead populations can be augmented with hatchery production from a new

Organization	Page of Comment Letter	Summary of Comment
		hatchery located in the lower Tuolumne River The Districts would fund the construction, and CDFW operation, of a hatchery with production goals to be determined during the relicensing process.
CG	9	The FLA should consider post-licensing implementation of a Chinook Salmon Outmigration Study, similar to the studies proposed by the Districts, USFWS, and Conservation Groups for inclusion in the first and second years of the Study Plan but not adopted by OEP. The study is appropriate because there is inadequate understanding-of short-term or long-term flow management actions that may induce downstream migration.
CG	9	In addition, the FLA should consider measures that would complete the channel restoration projects that were previously recommended by the TAC, or alternative projects that are identified in collaboration with resource agencies and Conservation Groups
NMFS	13/14	As stated above, the current lack of significant LWD in the lower Tuolumne River is a result of project operations, indicates the existing baseline condition, and does not reflect the natural state of the river. The DLA contains no Project actions or PM&E measures to mitigate Project effects or enhance LWD conditions. The Districts should include such PM&E measures in the Final License Application, to mitigate for these negative effects and enhance conditions for anadromous salmonids and other species.

6.3 Districts' Proposed Measures

6.3.1 Resource Measures

Terrestrial, recreation, aesthetic, cultural, and reservoir-related aquatic resource studies are complete, and results of these studies are presented in Section 3 of this Exhibit E. The Districts are proposing certain resource management plans where study results indicate such plans are warranted. The attached draft management plans are intended to guide resource management activities over the term of the new license and provide for the protection and enhancement of resources within the Project Boundary. The management plans attached to this Exhibit E are:

- Historic Properties Management Plan, including proposed cultural resource education exhibits
- Bald Eagle Management Plan
- Vegetation Management Plan
- Recreation Resource Management Plan, including improvements to the current whitewater boating take-out at the Ward's Ferry Bridge

In comments on the draft license application, several relicensing participants' requested additional measures related to aquatic, terrestrial and recreation resource management. These requested measures and the Districts' response are included in the Districts response to DLA comments provided in Attachment A of this license application, and summarized in Table 6.3-1.

6.3.2 Flood Management Modification

The Districts have initiated discussions with the ACOE on the possibility of amending a part of the 1972 Flood Control Manual. Specifically, the Districts are asking the ACOE to consider modifying the date when full flood control space is to be available from the current date of October 7 to November 7. Initial research conducted by the Districts indicates no increased risk of flood damage resulting from this change. The drawdown to elevation 801.9 ft by October 6 appears to have been driven primarily by preparation for a potential early season warm rain on snow event. The Districts believe that improved weather tracking, snow measurement by satellite, and computer-based runoff risk assessment allow extending this date to later in the calendar year. The date of November 7 fits better with possible release of stored water to benefit upmigrating adult fall-run Chinook salmon. Therefore, releases of stored water to reach elevation 801.9 ft could be used as pulse flow water if drawdown to 801.9 ft can be delayed to November 7. The Districts plan to research this potential change further in close coordination with ACOE, and if acceptable to the ACOE, would formally request ACOE approval following the appropriate research and analyses.

Table 6.3-1. Resource measures proposed by relicensing participants.

Organization	Proposed Measure	Districts' Response
BLM	Aquatic Water Resource Plan: We expect to see at least the following addressed in this plan: reservoir fish, western pond turtle, riparian vegetation, water temperature, and water quality.	As described in the FLA, resource studies do not indicate either a need for or Project effects to the reservoir resources noted by BLM. Therefore, there is not a specific, identified resource concern that calls for an Aquatic Resource Plan for the reservoir. The Districts have proposed a Vegetation Management Plan for the Project, which deals with riparian vegetation
BLM	Recreation Facilities Plan: This plan will include at the very minimum Licensee contact, Annual Recreation Coordination Meeting, Review of Recreation Developments, Recreation Survey and Monitoring, General Measures for all Recreational Sites, Vegetation Management in Recreation Sites, Recreation Operation, Maintenance, Administration, and Recreation costs, and Recreation Plan Revision.	The Districts have provided a Draft Recreation Resource Management Plan with the FLA and will continue to consult with the BLM regarding the RRMP.
BLM	Fire Management Plan: Licensee's will develop a Fire Management Plan that will include pile of burning, campfires, notification and written approval by BLM Authorized Officer and other BLM Fire Staff for all Burn plans, season of use, reporting of all project fires to the BLM, and procedures that the licensee will have to abide by while working on BLM land.	A Fire Management Plan has not been provided, however, as a part of the current routine DPRA activities, the Districts have strict regulations dealing with fires within the Project Boundary. The Districts also comply with state air quality regulations for prescribed burns of accumulated wood collected in the reservoir.
BLM	Terrestrial Invasive Species Management Plan: This plan will cover how the licensee will monitor, report and eradicate terrestrial invasive species of plants on BLM lands.	The Draft Vegetation Management Plan submitted with the FLA discusses noxious weed management on BLM lands.
BLM	Aquatic Invasive Species Management Plan: The scope of this plan will include public education and outreach, monitoring, and actions if they are discovered.	The DPRA participates in state-wide efforts to limit the spread of aquatic invasive species and provides educational materials regarding recommended boat cleaning and other prevention efforts that lake users can do to reduce the spread of aquatic invasive species. The Districts do not believe an additional Aquatic Invasive Species management plan is necessary at this time. The Districts summarize ongoing activities to monitor for aquatic invasive species in Section 3.5 of the FLA. A report, Potential Distribution of Zebra Mussels *(Dreissena polymorpha)* and Quagga Mussels *(Dreissena bugensis)* in California, prepared for CDFW, assessed the threat of these mussels to California water bodies based on the mussels' ability to tolerate a range of temperatures, calcium concentrations, pH, dissolved oxygen, and salinity (Cohen 2008). Based on its ambient conditions, Don Pedro Reservoir is not considered to be vulnerable to colonization.
BLM	Transportation Plan" BLM has not received any information on project roads that cross BLM land including dirt, gravel, and paved roads need to be identified and a condition and maintenance schedule	The Districts will meet with the BLM to review this information request to better understand which roads are being referenced by BLM.

Organization	Proposed Measure	Districts' Response
	will need to be developed.	
BLM	Large Woody Debris Management Plan: The BLM notices that the Licensees' use a log boom contraption to capture the large woody material and burns it on barren soil during fall and winter months. BLM is concerned that the Licensees' may be burning on the BLM land which requires a burn plan authorized by BLM. BLM desires a condition that allows large woody debris to pass through the dam and pass through LaGrange powerhouse so that it moves downstream where there is a deficiency of large woody debris material rather than burning it in place.	The Districts studies demonstrate that LWD collected in the reservoir is not of sufficient size to effectively serve as habitat for the lower Tuolumne River. In addition, the LWD is collected near the upper end of the reservoir in order to limit its being a public safety hazard for recreationists using the reservoir. DPRA does not believe the burn occurs on BLM lands but will further confirm if this is the case.
BLM	Visual Resource Plan: This plan will discuss the visual resource that have been studied and any future recommendations to remedy visual impacts.	The Visual Quality Study was conducted consistent with the methods in the Study Plan approved by FERC, and the Don Pedro Project has been evaluated for consistency with the BLM's visual objectives. Based on the results of the approved study, the Districts do not agree that there is a need for a Visual Resource Plan at this time.
BLM	Facilities and road maintenance: There should be no application of herbicides on BLM lands unless specific stipulations are met. BLM needs to have all roadways used by the Licensees' the public, or other authorized users, identified that are on BLM land that are both within and outside the project boundary.	On BLM lands, herbicide use will only be applied in full compliance with BLM standards. The Districts have provided a Draft Vegetation Management Plan with the FLA which addresses procedures for consultation regarding herbicide use and other vegetation management activities on BLM land.
BLM	Recreation Area Maintenance: There should be no application of herbicides on BLM lands unless specific stipulations are met, and will be included in the Terrestrial Invasive Species Management Plan. Burro Blasting may require additional authorizations.	See response directly above.
BLM	The Vegetation Management Plan should include the following: Revegetation Guidelines and Criteria, Revegetation Methods, Revegetation Monitoring and Consultation, VELB Management, General Vegetation Management for Facilities, Recreation Sites and Hazard Trees, Annual Consultation and Rare Plant Resurvey Requirements, and Sensitive Areas Protection including Special-status Plants mitigation.	A Draft Vegetation Management Plan has been provided with this FLA.
BLM	BLM agrees with the need to submit a Bald Eagle Management Plan as the licensees have suggested they will do in the FLA. This plan should include the following sections: Nest Surveys, Nest buffers (physical and temporal), Mitigation against disturbances, Annual awareness training, Annual consultation meeting, Reporting, Plan revisions	A draft Bald Eagle Management Plan has been provided with the FLA.
BLM	BLM is concerned with potential and existing disturbances for two endangered plant species: Layne's ragwort and California vervain.	A Draft Vegetation Management Plan that addresses these issues has been provided with this FLA.

Organization	Proposed Measure	Districts' Response
	Mitigations for impacts such as dispersed recreation near plants, noxious weed occurrences and cattle grazing will be addressed in the Vegetation Management Plan and Recreation Plan for those occurrences on BLM land.	
Multiple parties	Ward's Ferry Take-Out improvements	The Districts' study resulted in identifying a cost-effective option for river-egress which represents a substantial improvement over the current methods of egress and recognizes the physical constraints of the Ward's Ferry site. The proposal is detailed in the Recreation Resource Management Plan.

6.4 Consistency with Comprehensive Plans

The Districts have reviewed relevant comprehensive plans during conduct of relicensing studies and development of the proposed measures, and have included applicable information in this final license application. Section 6.4.1 below describes comprehensive plans that Section 10(a) of the FPA requires FERC to consider. These plans are referred to as Qualifying Comprehensive Plans. Section 6.4.2 references the Districts approach to addressing additional resource management plans related to resources in the vicinity of the Don Pedro Project.

6.4.1 Qualifying Comprehensive Plans

As described above, Section 10(a) of the FPA requires FERC to consider the extent to which a project is consistent with federal and state comprehensive plans for improving, developing, or conserving a waterway or waterways affected by the Project. On April 27, 1988, FERC issued Order No. 481-A which revised Order No. 481, issued October 26, 1987, establishing that FERC will accord FPA Section 10(a)(2)(A) comprehensive plan status to any federal or state plan that meets the following three criteria:

- Is a comprehensive study of one or more of the beneficial uses of a waterway or waterways,
- Specifies the standards, the data, and the methodology used to develop the plan, and
- Is filed with FERC.

A review of FERC's *Revised List of Comprehensive Plans* (December 2013) shows that 68 comprehensive plans have been filed with FERC specifically for the State of California and six plans that apply to multiple states have been filed by U.S. governmental agencies (FERC 2013). The Districts identified 17 of these qualifying comprehensive plans that have the potential to be related to the Don Pedro Project. Each of these plans is discussed below by resource area. It is important to note that all of the qualifying comprehensive plans that may apply to the Don Pedro Project were developed after project construction. . Consequently, the Don Pedro Project was an existing condition during each qualifying comprehensive plan's development. The comprehensive plans have been listed in the order they were presented in FERC's 2011 SD2.[21]

6.4.1.1 Restoring the Balance (California Advisory Committee on Salmon and Steelhead Trout 1988)

The California Advisory Committee on Salmon and Steelhead Trout was established by California legislation in 1983 to develop a strategy for the conservation and restoration of salmon and steelhead resources in California. To streamline its process, the committee divided California's steelhead and salmon resources into 11 groups—the Tuolumne River is located in the San Joaquin River System. The report focuses mostly on the Central Valley, and the Don Pedro Project Boundary was not specifically identified. The committee recommended among other things that California should seek to double its steelhead and salmon populations, and

[21] FERC's 2011 SD2 referenced FERC's January 2011 *List of Comprehensive Plans*; the Districts have reviewed FERC's most recent *List of Comprehensive Plans* from December 2013, and did not identify any additional qualifying plans.

recommended strategies to do so. Many of the recommendations were advanced and discussed in subsequent related publications described below.

6.4.1.2 Central Valley Salmon and Steelhead Restoration and Enhancement Plan (CDFG 1990)

This plan was released by CDFW in April 1990. This plan is intended to outline CDFW's restoration and enhancement goals for salmon and steelhead resources of the Sacramento and San Joaquin river systems and to provide direction for various CDFW programs and activities. This plan is also intended to provide the basis for the restoration and enhancement of the state's salmon and steelhead resources.

6.4.1.3 Restoring Central Valley Streams (CDFG 1993)

This plan was released by CDFG in November 1993. The goals of the plan, all targeted toward anadromous fish, are to restore and protect California's aquatic ecosystems that support fish and wildlife, to protect threatened and endangered species, and to incorporate the state legislature mandate and policy to double populations of anadromous fish in California. The plan encompasses only Central Valley waters accessible to anadromous fish, excluding the Sacramento-San Joaquin Delta.

6.4.1.4 Steelhead Restoration and Management Plan for California (CDFG 1996)

This plan was released by CDFG in February 1996. This plan focuses on restoration of native and naturally produced (wild) stocks because these stocks have the greatest value for maintaining genetic and biological diversity. Goals for steelhead restoration and management are: (1) increase natural production, as mandated by The Salmon, Steelhead Trout, and Anadromous Fisheries Program Act of 1988, so that steelhead populations are self-sustaining and maintained in good condition and (2) enhance angling opportunities and non-consumptive uses. Information presented in Sections 3.5 and 4.0 of this Exhibit E may be used to determine consistency with CDFW's restoration goals.

6.4.1.5 Public Opinions and Attitudes in Outdoor Recreation (CDPR 1998)

CDPR's Public Opinions and Attitudes in Outdoor Recreation survey (POAOR), the most recent version of which is 2002, provides information used in the development of the CDPR's CORP. The POAOR identifies: (1) California's attitudes, opinions, and values with respect to outdoor recreation; and (2) demand for and participation in 42 selected outdoor recreation activities.

6.4.1.6 California Outdoor Recreation Plan (CDPR 1994)

The objectives of California Department of Parks and Recreation (CDPR) California Outdoor Recreation Plan (CORP, the most recent version of which is 2008, are to determine outdoor recreation issues that are currently the problems and opportunities most critical in California, and to explore the most appropriate actions by which State of California, federal and local agencies might address these issues. The CORP also provides valuable information on the state's recreation policy, code of ethics, and statewide recreation demand, demographic, economic, political, and environmental conditions. The plan lists the following major issues: (1) improving resource stewardship; (2) serving a changing population; (3) responding to limited funding; (4) building strong leadership; (5) improving recreation opportunities through planning and research; (6) responding to the demand for trails; and (7) halting the loss of wetlands. The CORP applies to state and local parks and recreation agencies, and does not apply to federal and private-sector recreational providers.

Because the recreation facilities in the Project Boundary are not state or local parks, the CORP has little direct application other than general guidance. However, information on regional trends in recreation from the most recent version of the CORP was incorporated into the Recreation Facility Condition and Public Accessibility Assessment, and Recreation Use Assessment (TID/MID 2013).

6.4.1.7 California Water Plan (CDWR 1983) and California Water Plan Update (CDWR 1994)

The CDWR first published the California Water Plan in 1957. The plan focused on the quantity and quality of water available to meet the State of California's water needs, and management actions that could be implemented to improve the state's water supply reliability. Since then, CDWR has updated the plan numerous times including in 1983 (the reference used in FERC's July 2010 List of Comprehensive Plans for the California Water Plan) and 1994 (the reference used in FERC's July 2010 List of Comprehensive Plans for the California Water Plan Update). The most recent update was in March 2009. The Don Pedro Project is located in what the Water Plan calls the "San Joaquin River Hydrologic Region." The Don Pedro Reservoir represents a small portion of the water supply in the hydrologic region.

6.4.1.8 Final Programmatic Environmental Impact Statement/Environmental Impact Report for the CALFED Bay-Delta Program (CDWR 2000)

The California Water Policy Council and the Federal Ecosystem Directorate united in June 1994 to form CALFED. In June 1995, CALFED established its Bay-Delta Program (Program) to develop a long-term, comprehensive solution to environmental issues in the Sacramento-San Joaquin Delta and San Francisco Bay. The Program is a cooperative, interagency effort involving 15 state and federal agencies with management and regulatory responsibilities in the San Francisco Bay-San Joaquin Delta Estuary (Bay-Delta).

The Program was divided into three phases. In Phase I, completed in September 1996, the Program identified the problems confronting the Bay-Delta, developed a mission statement, and developed guiding principles. Following scoping, public comment, and agency review, the Program identified three preliminary alternatives to be further analyzed in Phase II. The three Phase II preliminary alternatives each included Program elements for levee system integrity, water quality improvements, ecosystem restoration, water use efficiency, and three differing approaches to conveying water through the Bay-Delta.

In Phase II, completed in July 2000, the Program refined the preliminary alternatives, conducted a comprehensive programmatic environmental review, and developed implementation strategies. The Program added greater detail to each of the Program elements and crafted frameworks for two Program elements: water transfers and watershed management. The Phase II report contains a general summary of the Program plans. More fundamentally, the report also describes the Program process, the fundamental Program concepts that have guided their development, and analyses that have contributed to Program development. Further, this report describes how this large, complex Program may be implemented, funded, and governed in the future. The following plans outline Program actions:

- Ecosystem Restoration Program Plan (Volumes 1, 2, and 3)
- Water Quality Program Plan
- Water Use Efficiency Program Plan
- Water Transfer Program Plan
- Levee System Integrity Program Plan
- Watershed Program Plan

The goals of the Water Quality and Watershed programs under CALFED include improving overall water quality by reducing the loadings of many constituents of concern that enter Bay-Delta tributaries from point and non-point sources. Principal targeted constituents include heavy metals (such as mercury), pesticide residues, salts, selenium, pathogens, suspended sediments, adverse temperatures, and disinfection byproduct precursors such as bromide and total organic carbon. The remaining Program plans include the:

- Implementation Plan
- Multi-species Conservation Strategy (MSCS)
- Comprehensive Monitoring, Assessment, and Research Program

Phase II was completed, with publication of the final programmatic EIS/EIR in July 2000.

Phase III is on-going and consists of implementation of the Preferred Program Alternative over 20-30 years. Information from the final programmatic EIS/EIR will be incorporated by reference into subsequent tiered environmental documents for specific projects in accordance with NEPA and California Environmental Quality Act (CEQA) guidelines. The Don Pedro Reservoir does not flow directly into the Bay-Delta. Agencies participating in the Bay-Delta plan are also participating in the relicensing. The Bay-Delta Plan is discussed further in the cumulative effects Section 4 of this Exhibit E.

6.4.1.9 Water Quality Control Plan Report (SWRCB 1995)

This reference is to the first edition of the water quality control plans adopted by the California SWRCB pursuant to the CWA. The nine plans, which apply to different areas of California, formally designate existing and potential beneficial uses and water quality objectives. The water quality control plan applicable to the Project area is the CVRWQCB Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (referred to as the Basin Plan in this document). The SWRCB has updated the water quality control plans a number of times since 1995 and details of the current plan relevant to the Don Pedro Project are included in Section 3.4 of this Exhibit E.

6.4.1.10 Recreation Needs in California (The Resources Agency 1983)

In response to the Roberti-Z'berg Urban Open Space and Recreation Program Act of 1976, the CDPR conducted a statewide recreational needs assessment. The report consisted of two major elements: (1) the Recreation Patterns Study that surveyed current participation and projected recreation demand; and (2) the Urban Recreation Case Studies that examined the leisure behavior and needs of seven underserved populations. The purpose of the needs analysis was to: (1) develop statewide recreation planning data; (2) analyze the recreation needs of California's urban residents; and (3) modify project selection criteria used in the administration of grants to local agencies under the Roberti-Z'berg Act.

In general, this report is a wide-ranging, programmatic document providing guidance for statewide planning. The urban-specific study has little relevance to the Project Boundary, which is mostly remote.

6.4.1.11 The Nationwide Rivers Inventory (NPS 1982)

The Nationwide Rivers Inventory (NRI) is a listing by the USDOI, NPS of more than 2,400 free-flowing river segments in the U.S. that are believed to possess one or more "outstandingly remarkable" natural or cultural values (ORV) judged to be of more than local or regional significance. In addition to these eligibility criteria, river segments are divided into three classifications: Wild, Scenic, and Recreational river areas. Under a 1979 Presidential Directive and related Council on Environmental Quality procedures, all federal agencies must seek to avoid or mitigate actions that would adversely affect one or more NRI segments. Such adverse impacts could alter the river segment's eligibility for listing and/or alter their classification. This Exhibit E includes information in Section 1 and Section 3.9 regarding Wild and Scenic designation in the upper Tuolumne River.

6.4.1.12 Water Quality Control Plans and Policies (SWRCB 1999)

This reference refers to an April 1999 submittal by the SWRCB to FERC of a listing of all SWRCB plans and policies. This submittal stated that all of the listed plans and policies are part of the "State Comprehensive Plan," even though it does not exist as a single plan. Relevant SWRCB plans are discussed in Section 3.4 of this Exhibit E.

6.4.1.13 Central Valley Habitat Joint Venture Implementation Plan (USFWS 1990) and North American Waterfowl Management Plan (USFWS 1986)

The California Central Valley Habitat Joint Venture (CCVHJV) is one of 12 current joint ventures charged with implementation of the North American Waterfowl Management Plan, an agreement between Canada, Mexico, and the U.S. to restore waterfowl populations through habitat protection, restoration, and enhancement (USFWS 1986). The CCVHJV was formally established by a working agreement signed in July 1988 and is guided by an Implementation Board comprised of representatives from the California Waterfowl Association, Defenders of Wildlife, Ducks Unlimited, National Audubon Society, Waterfowl Habitat Owners Alliance, and The Nature Conservancy. Technical Assistance is provided to the Board by the USDOI, USFWS, CDFG, CDFA, and other organizations and agencies.

The Central Valley of California is the most important wintering area for waterfowl in the Pacific Flyway, supporting 60 percent of the total population. Historically, the Central Valley contained more than four million acres of wetlands; however, only 291,555 acres remained in 1990 when the CCVHJV was first implemented. The primary cause of this wetland loss was conversion to agriculture, flood control, and navigation projects, and urban expansion.

When completed, the CCVHJV will (1) protect 80,000 acres of existing wetlands through the fee acquisition or conservation easement; (2) restore 120,000 acres of former wetlands; (3) enhance 291,555 acres of existing wetlands; (4) enhance waterfowl habitat on 443,000 acres of private agricultural land; and (5) secure 402,450 ac-ft of water for existing State Wildlife Areas, National Wildlife Refuges, and the Grasslands Resource Conservation District. These habitat conservation efforts are intended to result in a fall flight of one million ducks and 4.7 million wintering ducks. The wintering bird totals will include 2.8 million pintails, a species whose wintering population is vitally dependent on the Central Valley.

The CCVHJV is a regional approach to conservation and management of waterfowl populations in the Central Valley, but has no specific relevance to operation and management of the Don Pedro Project.

6.4.1.14 Final Restoration Plan for Anadromous Fish Restoration Program (USFWS 2001)

This plan was released by USFWS as a revised draft on May 30, 1997 and adopted as final on January 9, 2001. This plan identifies restoration actions that may increase natural production of anadromous fish in the Central Valley of California. This plan is split up into watersheds within the Central Valley and restoration actions are identified for each watershed. It also lists the involved parties, tools, priority rating, and evaluation of each restoration action. The plan encompasses only Central Valley waters accessible to anadromous fish, including the Sacramento-San Joaquin Delta.

6.4.1.15 The Recreational Fisheries Policy of the USFWS (USFWS Undated)

This is a 12-page policy signed by John F. Turner, then Director of the USFWS, on December 5, 1989. Its purpose is to unite all of the USFWS' recreational fisheries capabilities under a single policy to enhance the nation's recreational fisheries. Regional and Assistant directors are responsible for implementing the policy by incorporating its goals and strategies into planning and day-to-day management efforts. The USFWS carries out this policy relative to FERC-licensed hydroelectric projects through such federal laws as the Fish and Wildlife Coordination Act (FWCA), the CWA, the ESA, NEPA, and the FPA, among others.

6.4.2 Additional Resource Management Plans and Agreements

In addition to the FERC approved qualifying comprehensive plans, Section 4.0 -- Cumulative Effects Analysis -- includes discussion of a number of additional plans relevant to the assessment of cumulative impacts on the lower Tuolumne River.

7.0 LITERATURE CITED

Section 1.0: Introduction

California Energy Commission (CEC). 2011. Updated California Energy Demand Forecast 2011-2022. May 2011. CEC-200-2011-006-SD.

Department of Energy and Environmental Protection Agency. 2000. Carbon Dioxide Emissions from the Generation of Electric Power in the United States. 21pp. [Online] URL: http://tonto.eia.doe.gov/ftproot/environment/co2emiss00.pdf. (Accessed May 22, 2013.)

National Parks Service (NPS). 1982. The Nationwide Rivers Inventory. Available online at: A-M: http://www.nps.gov/ncrc/programs/rtca/nri/states/ca.html; N-Z: http://www.nps.gov/ncrc/programs/rtca/nri/states/ca2.html.

Stillwater Sciences. 2009. Lower Tuolumne River Instream Flow Studies – Final Study Plan. Prepared for Turlock Irrigation District and Modesto Irrigation District. [Online] URL: http://tuolumnerivertac.com.

_____. 2012. Lower Tuolumne River Instream Flow Study–Final Report. Prepared for Turlock Irrigation District and Modesto Irrigation District. [Online] URL: http://tuolumnerivertac.com.

_____. 2013. Pulse Flow Study Report. Prepared for Turlock Irrigation District and Modesto Irrigation District. [Online] URL: http://tuolumnerivertac.com.

Turlock Irrigation District and Modesto Irrigation District. 2013. Lower Tuolumne River Temperature Model Study Report (W&AR-16). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

U.S. Department of Agriculture (USDA). undated. Stanislaus National Forest - Recreation. [Online] URL: http://www.fs.usda.gov/recmain/stanislaus/recreation (Accessed November 1, 2013).

U.S. Department of Interior (USDOI), National Park Service. 1983. Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines in the Federal Register, September 29, 1983 (48FR44716). Department of the Interior, Washington, D.C.

Section 2.0: Proposed Action and Alternatives

No References Listed

Section 3.0: Environmental Analysis

Section 3.1: General Description of the Tuolumne River Basin and Don Pedro Project

DeLorme. 2003. Northern California Atlas and Gazetteer. Sixth Edition. DeLorme, Yarmouth, Maine.

National Park Service (NPS). 2010. Yosemite National Park Tuolumne River Plan / Tuolumne Meadows Plan Legislative Parameters. Original publication date unknown. U.S. Department of the Interior, National Park Service, Yosemite, California.

Stanislaus County . 2006. Stanislaus County General Plan. Stanislaus County Board of Supervisors, Modesto, California.

State of California, Employment Development Department. 2013. Major Employers in Tuolumne County. [Online] URL: http://www.labormarketinfo.edd.ca.gov/majorer/countymajorer.asp?CountyCode=000109 accessed March 26, 2013.

U.S. Department of Commerce, Census Bureau. 2013. North American Industry Classification System. [Online] URL: http://www.census.gov/eos/www/naics/. (Accessed September 10, 2013.)

U.S. Army Corps of Engineers (ACOE). 1972. Don Pedro Lake, Tuolumne River, California: Reservoir Regulation for Flood Control. Department of the Army, Sacramento, California.

Western Regional Climate Center. 2010. Historical Climatological data for Northern California. Western Regional Climate Center, Reno, Nevada. [Online] URL: http://www.wrcc.dri.edu/summary/ climsmnca.html. (Accessed August 2010.)

Section 3.2: Scope of Cumulative Effects Analysis

Federal Energy Regulatory Commission (FERC). 2008. Preparing Environmental Documents, Guidelines for Applicants, Contractors, and Staff. Office of Energy Projects Division of Hydropower Licensing, Washington, D.C.

_____. 2011. Scoping Document 2 for the Don Pedro Hydroelectric Project. Prepared by the Federal Energy Regulatory Commission, Office of Energy Projects, Washington, DC. July 25, 2011.

Section 3.3: Geology and Soils

Abrahamson, N.A. and W.J. Silva. 1997. Empirical response spectral attenuation relations for shallow crustal earthquakes: Seismological Research Letters, v. 68, no. 1, p. 94-127.

Bechtel Corporation. 1992. Don Pedro Dam Seismicity Update and Ground Motion Evaluation, Supplemental Information to 1991 Part 12 Report: Vol. 1, November 1992.

Bogen, N.L. 1985. Stratigraphic and sedimentologic evidence of a submarine island-arc volcano in the lower Mesozoic Penon Blanco and Jasper Point Formations: Geological Society of America Bulletin, v. 96, p. 1322-1331.

California Geological Survey (CGS). 2013. Map Sheet 49, Epicenters of and Areas Damaged by M>5 California Earthquakes, 1800-1999. [Online] URL: http://www.consrv.ca.gov/cgs/rghm/quakes/Pages/MS49.aspx

Clark, L.D. 1960. Foothills Fault System, western Sierra Nevada, California: Geological Society of America Bulletin, v. 71, p. 483-496.

_____. 1964. Stratigraphy and structure of a part of the western Sierran Nevada metamorphic belt: U.S. Geological Survey, Professional Paper 410, 70p.

Day, H.W., E.M. Moores, and A.C. Tuminas. 1985. Structure and tectonics of the northern Sierra Nevada: Geological Society of America Bulletin, v. 96, p. 436-450.

Don Pedro Recreation Agency (DPRA). 2001. Don Pedro Recreation Agency Rules & Regulations. Modesto, CA.

Hannah, J.L. and E.M. Moores. 1986. Age relations and depositional environment of Paleozoic strata, northern Sierra Nevada, California: Geological Society of America Bulletin, v. 97, p. 787-797.

Harden, D.R. 2004. California Geology: Pearson Education, Inc., Upper Saddle River, New Jersey 07458, 2nd Edition, 552p.

Hart, E.W., W.A. Bryant and T.C. Smith. 1984. Summary of Faults Evaluated, 1983 Area, Sierra Nevada Region. Department of Conservation, Division of Mines and Geology Open-File Report 84-52.

Harwood, D.S. 1988. Tectonism and metamorphism in the Northern Sierra Terrane, northern California, *in*, Ernst, W. G., ed., Metamorphism and Crustal Evolution of the Western United States: Englewood Cliffs, New Jersey, Prentice Hall, Inc., p. 764-788.

HDR Engineering and Geomatrix Consultants. 2000. Review of seismic sources and ground motions for Don Pedro Dam. Technical Memorandum prepared for Turlock Irrigation District., Turlock, CA.

Jennings, C.W. 1994. Fault activity map of California and adjacent Areas with locations and ages of recent volcanic eruptions: California Division of Mines and Geology, Geologic Data Map, No. 6, scale 1:750,000.

Kondolf, G.M. 1995. Geomorphological stream channel classification in aquatic habitat restoration: Uses and limitations. Aquatic Conservation: Marine and Freshwater Ecosystems 5: 127-141. Doi: 10.1002/aqc.3270050205.

McBain & Trush. 2004. Coarse sediment management plan for the lower Tuolumne River. Revised Final Report. Prepared by McBain and Trush, Arcata, California for Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation Districts, USFWS Anadromous Fish Restoration Program, and California Bay-Delta Authority.

Morgan, B.A. 1977. Geologic map of the Chinese Camp and Moccasin quadrangles, Tuolumne County, California: U.S. Geological Survey, Miscellaneous Field Studies, Map MF-840, scale 1:24,000.

Russell, C. 2013. Don Pedro Recreation Area Director. Personal communication with D. Malkin, Biologist, HDR. October 25, 2013.

Schweickert, R.A. and D.S. Cowan. 1975. Early Mesozoic tectonic evolution of the western Sierra Nevada, California: Geological Society of America Bulletin, v. 86, p. 1329-1336.

Sadigh, K., C.Y. Chang, J.A. Egan, F. Makdisi, and R.R. Youngs. 1997. Attenuation Relationships for shallow crustal earthquakes based on California strong motion data: Seismological Research Letters, v. 68, no. 1, p. 180-189.

Saleeby, J., W.D. Sharp, J. Schweickert, C. Merguerian, R. Kistler, O.Tobisch, and W.H. Wright, 1982, Age and tectonic significance of Paleozoic orthogneisses of Sierra Nevada Foothills Metamorphic Belt, California.

Tobisch, O.T., S.R. Paterson, S. Longiaru, and T. Bhattacharyya. 1987. Extent of the Nevadan orogeny, central Sierra Nevada, California: Geology, V. 15, p.132-135.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2011. Pre-Application Document. Don Pedro Project. FERC No. 2299. February 2011.

_____ 2013. Reservoir Temperature Model Study Report (W&AR-03). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

United States Geological Survey (USGS). 1984. CDMG Open-File Report 84-52. Western Region Geologic Publications. [Online] URL: http://geopubs.wr.usgs.gov/docs/wrgis/of-pre95.html#of84 (Accessed May 2010)

_____ 2013. Earthquake Hazards Program, [Online] URL: http://earthquake.usgs.gov/earthquakes/feed/v1.0/geojson.php

Wentworth, C.M. and M.D. Zoback. 1989. The style of later Cenozoic deformation at the eastern front of the California Coast Ranges: Tectonics, v. 8, p. 237-246.

Section 3.4: Water Resources

California Department of Public Health (CDPH). 2010. California Code of Regulations, Title 22, Division 4, Chapter 15, Domestic Water Quality and Monitoring Regulations.

Available online at: <http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Lawbook.aspx>.

California Department of Water Resources (CDWR). 2013. California Irrigation Management Information System (CIMIS) is a program in the Office of Water Use Efficiency (OWUE). [Online] URL: http://wwwcimis.water.ca.gov/cimis/frontMonthlyEToReport.do (Accessed October, 2013.)

Central Valley Regional Water Quality Control Board (CVRWQCB). 1998. The Water Quality Control Plan (Basin Plan) for the Sacramento River Basin and the San Joaquin River Basin. 4th ed. California Regional Water Quality Control Board, Central Valley Region. Revised in September 2009 with the Approved Amendments. Available online at: <http://www. waterboards.ca.gov/centralvalley/water_issues/basin_plans/>.

Eilers, J.M., P. Kanciruk, R.A. McCord, W.S. Overton, L. Hook, D.J. Blick, D.F. Brakke, P.E. Kellar, M.S. DeHaan, M.E. Silverstein, and D.H. Landers. 1987. Characteristics of Lakes in the Western United States. Volume II. Data Compendium for Selected Physical and Chemical Variables. EPA-600/3-86/054b, U.S. Environmental Protection Agency, Washington, D. C. January. 425 pp.

Hetch Hetchy Water and Power. 2006. Hetch Hetchy Restoration Study. Department of Water Resources, Department of Parks and Recreation.

Jayasundara, N. C., M. L. Deas, E. Sogutlugil, E. Miao, E. Limanto, A. Bale, Nd S. K. Tanaka. 2014. Tuolumne River flow and temperature model: without project assessment. Prepared by Watercourse Engineering, Inc., Davis, CA.

Marshack, J. 2008. A Compilation of Water Quality Goals. California Regional Water Quality Control Board, Central Valley Region, Rancho Cordova, California. Available online at: <http://www.swrcb.ca.gov/centralvalley/water_issues/water_quality_standards_limits/water_quality_goals/index.html>.

Office of Environmental Health Hazard Assessment (OEHHA). 2009. 2009 Update of California Sport Fish Advisories. California Environmental Protection Agency. Last updated March 18, 2009. URL: <www.oehha.ca.gov/fish/so_cal/index.html>.

PRISM Climate Group. 2006. United States Average Monthly or Annual Precipitation 1971 – 2000, <http://prism.oregonstate.edu>, Oregon State University, Created 12 Jun 2006.

State Water Resources Control Board (SWRCB). 2010. 2010 Integrated Report Clean Water Act Sections 303(d) and 305(b). Approved August 4, 2010. Board Resolution No. 2010-0040. Sacramento, California. Available online at: <http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml>

Turlock Irrigation District (TID). 2008. Turlock Groundwater Basin. Groundwater Management Plan. March 18.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2009. Don Pedro Reservoir Fish Mercury Study. Final Report. Prepared by Stillwater Sciences, Berkeley, California for Turlock Irrigation District and Modesto Irrigation District.

_____. 2011. Pre-Application Document. Don Pedro Project. FERC No. 2299. February 2011.

_____ 2013a. Water Quality Assessment Study Report (W&AR-01). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____ 2013b. Project Operations/Water Balance Model Study Report (W&AR-02). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____ 2013c. Reservoir Temperature Model Study Report (W&AR-03). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____ 2013d. Lower Tuolumne River Temperature Model Study Report (W&AR-16). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013e. Chinook Salmon Population Model Study Report (W&AR-06). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2014. *Oncorhynchus mykiss* Population Study Report (W&AR-10). April.

United States Environmental Protection Agency (EPA). 2000. Water Quality Standards; Establishment of Numeric Criteria for Priority Toxic Pollutants for the State of California. 40 CFR 131, pages 31682-31711. Federal Register May 18. Available online at: <http://www.epa.gov/fedrgstr/EPA-WATER/2000/ May/Day-18/w11106.pdf>.

_____ 2001. Water Quality Criterion for the Protection of Human Health: Methylmercury. Office of Science and Technology Office of Water. Washington, D.C. EPA-823-R-01-001. January 2001.

_____ 2003. Bacterial Water Quality Standards for Recreational Waters (Freshwater and Marine Waters). Office of Water Report No. EPA-823-R-03-008. June. Available online at: <http://www.epa.gov/waterscience/beaches/local/sum2.html>.

United States Geologic Survey (USGS). 2008. Water Resources Data - California, Water Year 2008: Volume 3 - Southern Central Valley Basins and the Great Basin from Walker River to Truckee River. Available online at: http://ca.water.usgs.gov/waterdata/.

_____ 2009. 1/3 Arc Second National Elevation Dataset, <http://seamless.usgs.gov>, USGS Earth Resources Observation & Science (EROS) Center, Sioux Falls, SD, Created 23 March 2009.

U.S. Army Corps of Engineers (ACOE). 1972. Don Pedro Lake, Tuolumne River, California: Reservoir Regulation for Flood Control. Department of the Army, Sacramento, California.

Wetzel, R.G. 1983. Limnology, 2"d Edition. Saunders College Publishing, Philadelphia, PA.

Western Regional Climate Center. 2006. Historical Climatological data for Northern California. Western Regional Climate Center, Reno, Nevada. [Online] URL: http://www.wrcc.dri.edu/summary/climsmnca.html. (Accessed September 2010.)

Section 3.5: Fish and Aquatic Resources

Barnett-Johnson, R., C.B. Grimes, C.F. Royer, and C.J. Donohoe. 2007. Identifying the contribution of wild and hatchery Chinook salmon (*Oncorhynchus tshawytscha*) to the ocean fishery using otolith microstructure as natural tags. Canadian Journal of Fisheries and Aquatic Sciences 64:1683-1692.

Beamesderfer, R.C.P., G. Kopp, and D. Demko. 2005. Review of the distribution, life history, and population dynamics of green sturgeon with reference to California's Central Valley. S.P. Cramer and Associates.

Bilby, R.E. and P.A. Bisson. 1998. Function and distribution of large woody debris. In River Ecology and Management. Naiman R.J. and R. E. Bilby (Eds.). New York, Springer, p. 324-346.

Bovee, K. D. 1982. A guide to stream habitat analysis using instream flow incremental methodology. Instream Flow Information Paper No. 12. Instream Flow Group. U.S. Fish and Wildlife Service, Fort Collins, Colorado. FWS/OBS- 82/26. 248 pp.

Brown, L. and P. B. Moyle. 2004. Native Fishes of the Sacramento-San Joaquin Drainage, California: a history of decline. Pages 75-98 in J. N. Rinne, R. M. Hughes, and B. Calamusso, editors. Historical Changes in Large River Fish Assemblages of the Americas. American Fisheries Society, Symposium 45, Bethesda, MD.

Bustard, D. R., and D. W. Narver. 1975. Aspects of the winter ecology of juvenile coho salmon (*Oncoryhnchus kisutch*) and steelhead trout (*Salmo gairdneri*). Journal of the Fisheries Research Board of Canada 32:667-680.

California Cooperative Oceanic Fisheries Investigations (CalCOFI). 2006. The State of the California Current, 2005-2006: Warm in the North, Cool in the South. CalCOFI Report, Vol. 47, 2006.

_____. 2007. The State of the California Current, 2006-2007: Regional and Local Processes Dominate. CalCOFI Report, Vol. 48, 2007.

California Invasive Plant Council (Cal-IPC). 2014. http://www.cal-ipc.org/ip/management/ipcw/pages/detailreport.cfm@usernumber=45&surveynumber=182.php.

California Department of Fish and Game (CDFG). 1946. Division of Fish and Game thirty-ninth biennial report for 1944-1946. California Department of Fish and Game.

California Department of Fish and Game and National Marine Fisheries Service (CDFG and NMFS). 2001. Final report of anadromous salmonid fish hatcheries in California. December. https://nrm.dfg.ca.gov/documents/ContextDocs.aspx?cat=Fisheries

California Department of Fish and Game and U. S. Fish and Wildlife Service (CDFG and USFWS). 2010. Hatchery and stocking program Environmental Impact Report/Environmental Impact Statement. Prepared for agencies by Jones and Stokes, Sacramento, California. [Online] URL: http://www.dfg.ca.gov/news/pubnotice/hatchery/. Accessed July 26, 2010.

California Department of Fish and Wildlife (CDFW). 2014. Striped bass biology (*Morone saxitilis*). http://www.dfg.ca.gov/fish/Resources/Striped_Bass/Biology.asp

Cohen, A. 2008. Potential Distribution of Zebra Mussels *(Dreissena polymorpha)* and Quagga Mussels *(Dreissena bugensis)* in California. Prepared for California Department of Fish and Game. Prepared by San Francisco Estuary Institute, Oakland, CA and Center for Research on Aquatic Bioinvasions, Richmond, CA.

Dill, W.A, and A.J. Cordone. 1997. History and status of introduced fishes in California, 1871-1996. California Department of Fish and Game Fish Bulletin 178. [Online] URL: http://www.escholarship.org/uc/item/5rm0h8qg#page-1. (Accessed August 2, 2010.).

Flagg, T., B. Berejikian, J. Colt, W. Dickhoff, L.W. Harrell, D.J. Maynard, C.E. Nash, M.S. Strom, R.N. Iwamoto, C.V.W. Mahnken. 2000. Ecological and behavioral impacts of artificial production strategies on the abundance of wild salmon populations. National Marine Fisheries Service. NOAA Technical Memorandum NMFS-NWFSC-41.

Ford, T. and L.R. Brown. 2001. Distribution and Abundance of Chinook Salmon and Resident Fishes of the Lower Tuolumne River, California. Fish Bulletin.

Ford, T., and S. Kirihara. 2010. Tuolumne River Oncorhynchus mykiss monitoring report. Prepared by Turlock Irrigation District/Modesto Irrigation District, California and Stillwater Sciences, Berkeley, California for Federal Energy Regulatory Commission, Washington, D.C.

Fry, D. H., Jr., and A. Petrovich, Jr. 1970. King salmon (*Oncorhynchus tshawytscha*) spawning stocks of the California Central Valley, 1953-1969. Anad. Fish. Admin. Rept. 70-11.

Garza, J.C., and D.E. Pearse. 2008. Population genetic structure of *Oncorhynchus mykiss* in the California Central Valley. Report to California Department of Fish and Game. Contract No. PO485303. University of California, Santa Cruz, and NOAA Southwest Fisheries Science Center, Santa Cruz, California.

Grant, J., and D. Kramer. 1990, Territory size as a predictor of the upper limit to population density of juvenile salmonids in streams: Canadian Journal Fisheries Aquatic Science, V. 47, No. 9, p. 1724–1737.

Houk, J.. 2002. Reservoir Biologist's Report, July 1, 2001 – June 30, 2002. Prepared for CDFW, Central Region, Fresno.

Houk, J. 2003. A summary and analysis of research data and assessment observations including electrofishing surveys, angler interview, habitat improvement projects and public relations conducted from July 1, 1998 – June 30, 2003 at New Melones, Don Pedro, McClure, Eastman, Hensley, Millerton, Pine Flat, Kaweah, Success, Isabella, Woolomes, San Luis, Bass Lake and Shaver Lake Reservoir. Prepared for CDFW, Central Region, Fresno.

Jackson, T. A. 2007. California Steelhead Report-Restoration Card: A Report to the Legislature California Department of Fish and Game. 46 p. plus appendices.

Jones, W.J., B.D. Quelvog, and G. Bernardi. 2002. Morphological and genetic analysis of the Red Hills roach (Cyprinidae: *Lavinia symmetricus*). Conservation Genetics 3:262-276. [Online] URL: http://bio.research.ucsc.edu/people/bernardi/Bernardi/Publications/2002RedHills.pdf. (Accessed July 21, 2010.).

Lee, D.P. 1999. Water Level Fluctuation Criteria for Black Bass in California Reservoirs. Reservoir Research Management Project: Informational Leaflet No. 12.

Lindley, S.T., R.S. Schick, E. Mora, P.B. Adams, J.J. Anderson, S. Greene, C. Hanson, B.P. May, D.R. McEwan, R.B. MacFarlane, C. Swanson, and J.G. Williams. 2007. Framework for assessing viability of threatened and endangered salmon and steelhead in the Sacramento- San Joaquin Basin. San Francisco Estuary and Watershed Science Volume 5, Issue 1 [February 2007], article 4.

McBain & Trush. 2000. Habitat restoration plan for the Lower Tuolumne River corridor, Final Report. Prepared by McBain and Trush, Arcata, California for the Tuolumne River Technical Advisory Committee with assistance from U.S. Fish and Wildlife Service Anadromous Fish Restoration Program.

_____. 2004. Coarse sediment management plan for the lower Tuolumne River. Revised Final Report. Prepared by McBain and Trush, Arcata, California for Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation Districts, USFWS Anadromous Fish Restoration Program, and California Bay-Delta Authority.

McBain & Trush and Stillwater Sciences. 2006. Lower Tuolumne River predation assessment final report. Prepared for the Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation districts, USFWS Anadromous Fish Restoration Program and California Bay-Delta Authority.

McEwan, D. 2001. Central Valley steelhead. *In* R. Brown, editor. Contributions to the biology of Central Valley salmonids, Volume 1. California Department of Fish and Game, Fish Bulletin 179. 43 pages.

McMillan, J. R., J. B. Dunham, G. H. Reeves, J. S. Mills, and C. E. Jordan. 2012. Individual condition and stream temperature influence early maturation of rainbow and steelhead trout, *Oncorhynchus mykiss*. Environmental Biology of Fishes 93:343–355.

Merced Irrigation District (Merced ID). 2012. Merced River Hydroelectric Project Final License Application. Merced Irrigation District, February 2012.

Mesick, C. 2009. The high risk of extinction for the natural fall-run Chinook salmon population in the Lower Tuolumne River due to insufficient instream flow releases. U.S. Fish and Wildlife Service, Exhibit No. FWS-50, to Proceeding of the Presiding Administrative Law Judge on Interim Measures for the Don Pedro Project.

Mesick, C.F. and D. Marston. 2007. Provisional Draft: Relationships between fall-run Chinook salmon recruitment to the major San Joaquin River tributaries and streamflow, Delta exports, the Head of the Old River Barrier, and tributary restoration projects from the early 1980s to 2003.

Mesick, C., J. McLain, D. Marston, and T. Heyne. 2008. Limiting factor analyses and recommended studies for fall-run Chinook salmon and rainbow trout in the Tuolumne River. Draft Report. Joint Report of the U.S. Fish and Wildlife Service (Anadromous Fish Restoration Program), National Marine Fisheries Service, Sacramento Office, and California Department of Fish and Game, Fresno Office. August 13, 2008.

Moyle, P.B. 1996. Potential Aquatic Diversity Management Areas. Ch. 57 In: Sierra Nevada Ecosystem Project: Final Report to Congress, vol. II, Assessments and Scientific Basis for Management Options. Davis: University of California, Centers for Water and Wildland Resources, Davis, California.

_____. 2002. Inland Fishes of California. Revised and expanded. Berkeley: University of California Press. 502 pp.

Moyle, P. B., R. M. Yoshiyama, J. E. Williams, and E. D. Wikramanayake. 1995. Fish species of special concern of California, second edition. Prepared by Department of Wildlife and Fisheries Biology, University of California, Davis, for the State of California The Resources Agency, Department of Fish and Game, Inland Fisheries Division. Rancho Cordova, California.

Moyle P. B., R.M. Yoshiyama, and R.A. Knapp. 1996. Status of fish and fisheries. In Sierra Nevada Ecosystem Project: Final report to Congress, vol. II, Chap 33. Davis: University of California, Centers for Water and Wildland Resources.

Moyle, P.B., R. D. Baxter, T. Sommer, T. C. Foin, and S. A. Matern. 2004. Biology and population dynamics of Sacramento Splittail (*Pogonichthys macrolepidotus*) in the San Francisco Estuary: a review. San Francisco Estuary and Watershed Science [online serial] 2(2):1-47. http://repositories.cdlib.org/jmie/sfews/

National Marine Fisheries Service (NMFS) 2009. What Caused the Sacramento River Fall Chinook Stock Collapse? NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-447. July 2009.

Nielson, J.L., S.A. Pavey. T. Wiacek, and I. Williams. 2005. Genetics of Central Valley O. mykiss populations: drainage and watershed scale analysis. San Francisco Estuary and Watershed Science [online serial] 3.

Orr, B.K. 1997. Ecosystem health and salmon restoration: a broader perspective. Pages 575-580 in S.S.Y. Wang, editor. Environmental and coastal hydraulics: protecting the aquatic habitat. Volume 1: Proceedings of Theme B. Water for a changing global community. The 27th Congress of the International Association for Hydraulic Research. American Society of Civil Engineers, New York. [Online] URL: http://www.stillwatersci.com/resources/1997orrsalmon.pdf. (Accessed July 27, 2010.).

Pearse D. E., S. A. Hayes, M. H. Bond, C. V. Hanson, E. C. Anderson, and J. C. Garza. 2009. Over the Falls? Rapid Evolution of Ecotypic Differentiation in Steelhead/Rainbow Trout (*Oncorhynchus mykiss*). Journal of Heredity 100:515–525.

Robichaud, D. and K. English. 2013. Analysis of Tuolumne River Rotary Screw Trap Data to examine the relationship between river flow and survival rates for Chinook smolts migrating between Waterford and Grayson (2006-12). Prepared by LGL Limited, Sidney, BC, Canada for the Turlock Irrigation District and Modesto Irrigation District.

Rombough, P. 1985. Initial egg weight, time to maximum alevin wet weight, and optimal ponding times for Chinook salmon (*Oncorhynchus tshawytscha*). Can. J. Fish. Aquat. Sci. 42: 287–291.

Roper, B. and D. Scarnecchia. 1999. Emigration of age-0 chinook salmon (*Oncorhynchus tshawytscha*) smolts from the upper South Umpqua River basin, Oregon, U.S.A. Canadian Journal of Fisheries and Aquatic Sciences. 56: 939-46.

Satterthwaite, W. H., M. P. Beakes, E. M. Collins, D. R. Swank, J. E. Merz, R. G. Titus, S. M. Sogard, and M. Mangel. 2010. State-dependent life history models in a changing (and regulated) environment: steelhead in the California Central Valley. Evolutionary Applications 3:221-243.

Sloat, M. 2013. Born to Run? Integrating Individual Behavior, Physiology, and Life Histories in Partially Migratory Steelhead and Rainbow trout (*Oncorhynchus mykiss*). PhD dissertation, Oregon State University, Corvalis, OR. March. 148 pp.

Speed, T. 1993. Modeling and managing a salmon population. Pages 265-290 in V. Barnett, and K.F. Turkman, editors. Statistics for the Environment, John Wiley & Sons.

State Board of Fish Commissioners. 1904. Eighth Biennial Report. Prepared by the State Board of Fish Commissioners of the State of California, for the years 1903 – 1904.

Stillwater Sciences. 2003. Subject: Preliminary assessment of physical habitat and temperature suitability for steelhead based on 1995 IFIM Study Results for the lower Tuolumne River. Memorandum from N. Hume and P. Baker, Stillwater Sciences, Berkeley, California to T. Ford, Turlock and Modesto Irrigation Districts, September 24.

_____. 2009a. Don Pedro Reservoir Fish Mercury Study. Final Report for Turlock Irrigation District and Modesto Irrigation District.

_____. 2009b. March and July 2009 population size estimates of *Oncorhynchus mykiss* in the Lower Tuolumne River. Appendix G: Fish Observation Data. Prepared by Stillwater Sciences, Berkeley, California, for Turlock Irrigation District, Turlock, California, and Modesto Irrigation District, Modesto, California. November.

_____. 2010. 2010 Lower Tuolumne River Annual Report. Report 2010-5: 2010 Snorkel Report and Summary Update. Prepared by Stillwater Sciences, Berkeley, California, for Turlock Irrigation District, Turlock, California, and Modesto Irrigation District, Modesto, California. November.

_____. 2012a. Lower Tuolumne River Instream Flow Studies: Pulse Flow Study Report. Final. Prepared by Stillwater Sciences, Berkeley, California for Turlock Irrigation District and Modesto Irrigation District, California.

_____. 2012b. Tuolumne River 2011 *Oncorhynchus mykiss* monitoring summary report. Prepared by Stillwater Sciences, Berkeley, California for the Turlock Irrigation District and Modesto Irrigation District.

_____. 2012c. September 2011 population size estimates of Oncorhynchus mykiss in the Lower Tuolumne River. Prepared by Stillwater Sciences, Berkeley, California for the Turlock Irrigation District and the Modesto Irrigation Districts, California. March.

_____. 2013. Lower Tuolumne River Instream Flow Study. Final Report. Prepared by Stillwater Sciences, Davis, California for Turlock and Irrigation District and Modesto Irrigation District, California. April 2013.

_____. 2014. Lower Tuolumne River Instream Flow Study - Pacific lamprey and Sacramento splittail 1-D PHABSIM habitat assessment. Prepared by Stillwater Sciences, Davis, California for Turlock and Irrigation District and Modesto Irrigation District, California. April 2014.

Taylor, T.L., P.B. Moyle, and D.G. Price. 1982. Fishes of Clear Lake Basin. Univ. Calif. Publ. Zool. 115: 171-224.

Turlock Irrigation District (TID). 2011. La Grange Reservoir Backwater Analysis. Prepared by HDR Engineering, Inc. December.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 1992a. Lower Tuolumne River spawning gravel availability and superimposition report. Appendix 6 in Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 39 of the License for the Don Pedro Project, No. 2299 Vol. VIII. Prepared by EA Engineering, Science, and Technology, Lafayette, California.

_____. 1992b. Lower Tuolumne River spawning gravel studies report. Appendix 8 in Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 39 of the License for the Don Pedro Project, No. 2299. Vol. IV. Prepared by EA Engineering, Science, and Technology, Lafayette, California.

_____. 1992c. Report of Turlock Irrigation District and Modesto Irrigation District pursuant to Article 39 of the license for the Don Pedro Project. Turlock, California. 8 Volumes. April.

_____. 1997. 1996 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. 6 Volumes. March.

_____. 2001. Report 2000-6: Tuolumne River Chinook salmon fry and juvenile stranding report. Prepared by Noah Hume and Jennifer Vick of Stillwater Ecosystem, Watershed & Riverine Sciences, Berkeley, CA. March 2001.

_____. 2005. 2005 Ten Year Summary Report. Pursuant to Paragraph (G) of the 1996 FERC Order issued July 31, 1996. Don Pedro Project, No. 2299. April.

_____. 2007a. 2006 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 39 of the License for the Don Pedro Project, No. 2299. 2 Volumes. March.

______.2007b. Report 2006-7: Survival to emergence study report. Prepared by Peter Baker, Noah Hume, A.J. Keith, Neil Lassetre, and Frank Ligon, Stillwater Ecosystem, Watershed & Riverine Sciences, Berkeley, CA. March 2007.

______.2010a. Report 2009-3: 2009 seine report and summary update. Prepared by Prepared by Tim Ford, Turlock and Modesto Irrigation Districts and Steve Kirihara, Stillwater Sciences, Berkeley, CA. June 2009.

______.2010b. Report 2009-4: 2009 rotary screw trap report. Prepared by Michele L. Palmer and Chrissy L. Sonke, FISHBIO Environmental, LLC, Oakdale, CA. February 2010.

______.2010c. Report 2009-5: 2009 snorkel report and summary update. Prepared by Tim Ford, Turlock and Modesto Irrigation Districts and Steve Kirihara, Stillwater Sciences, Berkeley, CA. March 2010.

______. 2010d. Report 2009-2: Spawning survey summary update. Prepared by Tim Ford, Turlock and Modesto Irrigation Districts and Steve Kirihara, Stillwater Sciences, Berkeley, CA. March 2010.

______.2010e. Report 2009-8: 2009 counting weir report. Prepared by Ryan Cuthbert, Andrea Fuller, and Sunny Snider, FISHBIO Environmental, LLC, Oakdale, CA. February 2010.

______.2010f. Report 2009-7: Aquatic invertebrate monitoring and summary update. Prepared by Stillwater Sciences, Berkeley, CA. March 2010.

______. 2011a. Pre-Application Document. Don Pedro Project. FERC No. 2299. February 2011.

______. 2011b. Fall/Winter Migration Monitoring at the Tuolumne River Weir – 2010 Annual Report. Prepared by FishBio, Oakdale, CA.

______. 2011c. 2011 Lower Tuolumne River Annual Report. Report 2011-5, 2011 Snorkel Report and Summary Update.

______. 2012a. Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project No. 2299 - 2012 Lower Tuolumne River Annual Report,. March 2013.

______. 2012b. Fall/winter Migration Monitoring at the Tuolumne River Weir – 2011 Annual Report. Prepared by FishBio, Oakdale, CA.

______. 2013a. Don Pedro Fish Population Survey Study Report (W&AR-17). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

______. 2013b. Fish Assemblage and Population Between Don Pedro Dam and La Grange Dam Study Report (W&AR-13). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

______. 2013c. Salmonid Population Information Integration and Synthesis Study Report (W&AR-05). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

______. 2013d. Spawning Gravel in the Lower Tuolumne River Study Report (W&AR-04). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

______. 2013e. Chinook Salmon Population Model Study Report (W&AR-06). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

______. 2013f. Predation Study Report (W&AR-07). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

______. 2013g. Salmonid Redd Mapping Study Report (W&AR-08). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

______. 2013ih. Chinook Salmon Otolith Study Progress Report (W&AR-11), Section 2.4.11 of the Don Pedro Hydroelectric Project Initial Study Report. January 2013.

______. 2013i. *Oncorhynchus mykiss* Habitat Survey Study Report (W&AR-12). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

______. 2013j. Temperature Criteria Assessment Progress Report (W&AR-14). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

______. 2013k. *Oncorhynchus mykiss* Scale and Age Determination Study Report (W&AR-20). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

______. 2013l. Lower Tuolumne River Floodplain Hydraulic Assessment Study Plan (W&AR-21). September 2013.

______. 2013m. Lower Tuolumne River Temperature Model Study Report (W&AR-16). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

______. 2013n. Lower Tuolumne River Riparian Information and Synthesis Study Report (W&AR-19). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

______. 2013o. Sturgeon Study Report (W&AR-18). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

______. 2013p. Lower Tuolumne River Lowest Boatable Flow Study (RR-03). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2014. *Oncorhynchus mykiss* Population Study Report (W&AR-10). April 2014.

U.S. Department of Interior, Bureau of Land Management (USDOI BLM). 2009. Red Hills of Tuolumne County. U.S. Department of Interior, Bureau of Land Management Mother Lode Field Office, El Dorado Hills, California. [Online] URL: http://www.blm.gov/ca/st/en/fo/folsom/redhillshomepg1.html. (Accessed July 16, 2010.)

U.S. Fish and Wildlife Service (USFWS). 1995. The relationship between instream flow and physical habitat availability for Chinook salmon in the lower Tuolumne River, California. Prepared by USFWS, Ecological Services Division, Sacramento, California for Turlock Irrigation District and Modesto Irrigation District, California.

_____. 2008. Flow-overbank inundation relationship for potential fall-run Chinook salmon and steelhead/rainbow trout juvenile outmigration habitat in the Tuolumne River. U.S. Fish and Wildlife Service, Sacramento, CA.

U.S. Geological Survey (USGS). 1899. Water supply and irrigation papers. No. 19. Government Printing Office, Washington D.C.

Yoshiyama, R.M., E.R. Gerstung, F.W. Fisher, and P.B. Moyle. 1996. Historical and present distribution of Chinook salmon in the Central Valley drainage of California. Sierra Nevada Ecosystem Project: final report to Congress. In: University of California, Center for Water and Wildlife Resources, Davis. Assessments, commissioned reports, and background information. p 309-362. [Online] URL: http://www.sierraforestlegacy.org/ Resources/Conservation/SierraNevadaWildlife/Chinook/CHYoshiyama-etal1996.pdf. (Accessed August 10, 2010.).

Zimmerman, C.E., G.W. Edwards, and K. Perry. 2008. Maternal Origin and Migratory History of *Oncorhynchus mykiss* captured on rivers of the Central Valley, California. California Department of Fish and Game.

_____. 2009. Maternal origin and migratory history of Oncorhynchus mykiss captured in rivers of the Central Valley, California. Final Report, Contract PO385300. Prepared for the California Department of Fish and Game.

Section 3.6: Botanical Resources

California Department of Fish and Game (CDFG). 2009. Protocols for Surveying and Evaluation Impacts to Special Status Native Plant Populations and Natural Communities.

_____. 2012. California Natural Diversity Database. Rarefind 4. Available online: <nrmsecure.dfg.ca.gov/cnddb/view/query.aspx>. Accessed February, 2012. Last updated February, 2012. California Department of Fish and Game, Sacramento, CA.

California Department of Food and Agriculture (CDFA). 2010. Pest Ratings of Noxious Weed Species and Noxious Weed Seed. Division of Plant Health and Pest Prevention Services. CDFA. Sacramento, CA.

_____. 2012. Encycloweedia: Data Sheets. Available online: <http://www.cdfa.ca.gov/phpps/ipc/weedinfo/winfo_table-commname.htm> Accessed June 21, 2012. CDFA. Sacramento, CA.

California Native Plant Society (CNPS). 2012. Inventory of Rare and Endangered Plants of California. Available online*:* <cnps.web.aplus.net/cgi-bin/inv/inventory.cgi>. Accessed February, 2012. Last updated February, 2012. California Native Plant Society, Sacramento, CA.

California Wetlands Monitoring Workgroup (CWMW). 2012. California Rapid Assessment Method (CRAM) for Wetlands and Riparian Areas, Version 6.0. 95 pp.

Jepson Flora Project, eds. 2013. *Jepson eFlora*. Available online: http://ucjeps.berkeley.edu/IJM.html. Accessed on June 3, 2013.

United States Department of Agriculture (USDA), Forest Service (USFS). 2009. Remote Sensing Lab, Ecosystem Planning. Vegetation Classification: CalVeg Zones and Alliances – Vegetation Descriptions. Available online: < http://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=stelprdb5347192 >. Accessed 2010. Last updated March 12, 2009. USDA, Forest Service. Sacramento, CA.

United States Department of the Interior, Bureau of Land Management (BLM). 2012. Special-status Plants. Available online: <http://www.blm.gov/ca/st/en/prog/ssp.html>. Last updated: September, 2012.

United States Department of the Interior, Fish and Wildlife Service (USFWS). 1987. National Wetland Inventory Mapping. USFWS Region 1, Portland, OR.

Western Regional Climate Center. 2013. Cooperative Climatological Data Summaries. Available online: http://www.wrcc.dri.edu/climatedata/climsum/. Accessed on June 5, 2013.

Section 3.7: Wildlife Resources

Ashton, D.T., A.J. Lind, and K.E. Schlick. 1997. Western Pond Turtle (*Clemmys marmorata*). Natural History. USDA Forest Service, Pacific Southwest Research Station, Arcata, California. Available online: <http://www.krisweb.com/biblio/gen_usfs_ashtonetal_1997_turtle.pdf>. Accessed July 2010.

Bureau of Land Management (BLM). 1980. Fisheries Inventory of Sierra Foothill Streams on Public Land in 1979 and 1980. U.S. Department of Interior, Bureau of Land Management Mother Lode Field Office, El Dorado Hills, California.

_____. 2006. California-BLM sensitive species list, updated September 2006. U.S. Department of the Interior, Bureau of Land Management Mother Lode Field office, El Dorado Hills, California. Available online: < http://www.blm.gov/>. Accessed July 2010.

California Department of Fish and Game (CDFG). 2000. The Status of Rare, Threatened, and Endangered Animals and Plants of California. Habitat Conservation Planning Branch. Sacramento, CA.

_____. 2008. California Wildlife Habitat Relationship system. Version 8.2 personal computer. California Interagency Wildlife Task Group. CDFG Sacramento, California.

California Department of Fish and Wildlife (CDFW). 2012. California Natural Diversity Database (CNDDB). RareFind Version . Available <onlinehttps://nrm.dfg.ca.gov/myaccount/login.aspx?ReturnUrl=%2fcnddb%2fview%2fquery.aspx>. Accessed August 7 , 2012. . California Department of Fish and Game, Biogeographic Data Branch. Sacramento, CA.

_____. 2013a. California Natural Diversity Database. Rarefind 4. Available online: < nrmsecure.dfg.ca.gov/cnddb/view/query.aspx>. Accessed May 2013.

_____. 2013b. Golden eagles in the state of California. Available online: <http://www.dfg.ca.gov/wildlife/nongame/raptors/goldeneagle/>. Accessed October 2013.

_____. 2013c. Swainson's Hawks in California. Available online: <http://www.dfg.ca.gov/wildlife/nongame/raptors/swha/>. Accessed May 2013.

Cranston, Peggy. 2012. Wildlife Biologist. Bureau of Land Management (BLM). Personal communication with Susan Imholt, wildlife biologist, HDR. March 9, 2012.

_____. 2013. Wildlife Biologist. Bureau of Land Management (BLM). 2013. Personal communication with Justin Tortosa, Senior Wildlife Biologist, HDR. June 13, 2013.

deBecker, S. and A. Sweet. 2005. Crosswalk between WHR and California vegetation classifications. Pages 21-39 *in*: K.E. Mayer and W.F. Laudenslayer, eds. 1988. A Guide to Wildlife Habitats of California. Update from 1988. The Resources Agency, Department of Forestry and Fire Protection, Sacramento, California. Available online: <http://www.dfg.ca.gov/biogeodata/cwhr/pdfs/XCalVeg.pdf>. Accessed August 2010.

ECORP Consulting, Inc. 2005. Draft results of the 2004 (Year 1) amphibian monitoring program for foothill yellow-legged frog and mountain yellow-legged frog. El Dorado Hydroelectric Project (FERC Project No. 184). Report to El Dorado Irrigation District. May 18, 2005.

Holland, D.C. 1991. A synopsis of the ecology and status of the western pond turtle (*Clemmys marmorata*) in 1991. Prepared for USFWS, National Ecology Research Center, San Simeon Field Station.

Holt, D.L. 1988. Nest site characteristics of the western pond turtle, *Clemmys marmorata*, at Fern Ridge Reservoir, in west central Oregon. M.S. thesis, Oregon State University.

International Union for the Conservation of Nature (IUCN). 2013. IUCN Red List of Threatened Species – *Rana muscosa*. Available online: <http://www.iucnredlist.org/details/19177/0>. Accessed October 2013.

Jackman, R.E., and J.M. Jenkins. 2004. Protocol for evaluating bald eagle habitat and populations in California. Prepared for U.S. Fish and Wildlife Service. Sacramento, CA.

Jennings, M. R., and M. P. Hayes. 1994. Amphibian and reptile species of special concern in California. Final Report to the California Department of Fish and Game, Inland Fisheries Division, Rancho Cordova, CA. 225 pp.

Jurek, R.M. 1988. Five-year Status Report, Bald Eagle. California Department of Fish and Game Nongame Bird and Mammal Section. Sacramento, CA.

Moyle, P.B. 1973. Effect of introduced bullfrogs, *Rana catesbeiana*, on the native frogs of the San Joaquin Valley, California. Copeia 1973:18-22.

NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available online: <http://www.natureserve.org/explorer>. Accessed April 2010.

Pagel, J.E., D.M. Whittington, and G.T. Allen. 2010. Interim golden eagle inventory and monitoring protocols; and other recommendations. U.S. Fish and Wildlife Service, Carlsbad, CA and Arlington, VA.

Randall, P.J. 1997. Distribution and ecology of fish and frogs in tributaries to the South Fork Yuba River. M.S. thesis, University of California, Davis.

Seltenrich, C. P. and A. C. Pool. 2002. A standardized approach for habitat assessments and visual encounter surveys for the foothill yellow-legged frog (*Rana boylii*). Pacific Gas and Electric Company. Available online: <http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&ved=0CDsQFjAA&url=http%3A%2F%2Fwww.canvamphibs.com%2Fpdf%2FFYLFMethods052002.pdf&ei=UlopUMWdJ4e9yQGZ3oC4Bw&usg=AFQjCNG9Uhw4ApBy_O9WOrpiJAXWqS1bzA>. Accessed February 2012.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2011. Pre-Application Document. Don Pedro Project. FERC No. 2299. February 2011.

_____. 2013a. Special-Status Amphibians and Aquatic Reptiles Study Report (TR-06). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013b. Bald Eagle Study Report (TR-10). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013c. Special-Status Bats Study Report (TR-09). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

United States Department of Agriculture, Forest Service. 2009. Vegetation Descriptions - Central Valley Ecological Province - CALVEG ZONE 5. U.S. Department of Agriculture, Forest Service. Available online: <http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev3_045936.pdf>. Accessed February 2011.)

United States Fish and Wildlife Service (USFWS). 2007. National bald eagle management guidelines. Available online: <http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/BaldEagle/NationalBaldEagleManagementGuidelines.pdf>.

Van Wagner, T. 1996. Selected life history and ecological aspects of a population of foothill yellow-legged frogs (*Rana boylii*) from Clear Creek, Nevada City, California. M.S. thesis, California State University Chico. 143 pp.

Western Bat Working Group (WBWG). 2005a. Species accounts pallid bat (*Antrozous pallidus*). Prepared by Rick Sherwin, updated by Daniela A. Rambaldini. Available online: <http://www.wbwg.org/speciesinfo/species_accounts/vespertilonidae/anpa.pdf> Accessed June 2013.

_____. 2005b. Species accounts Townend's big-eared bat (*Corynorhinus townsendii*). Prepared by Rick Sherwin, updated by Antoinette Piaggio. Available online: <http://www.wbwg.org/speciesinfo/species_accounts/vespertilonidae/coto.pdf> Accessed June 2013.

_____. 2005c. Species accounts spotted bat (*Euderma maculatum*). Prepared by Bob Luce, updated by Carol Chambers and Michael Herder. Available online: <http://www.wbwg.org/speciesinfo/species_accounts/vespertilonidae/euma.pdf> Accessed June 2013.

_____. 2005d. Species accounts western mastiff bat (*Eumops perotis*). Prepared by Elizabeth D. Pierson, updated by Melissa S. Siders. Available online: <http://www.wbwg.org/speciesinfo/species_accounts/molossidae/eupe.pdf> Accessed June 2013.

_____. 2005e. Species accounts western red bat (*Lasiurus blossevilli*). Prepared by Betsy C. Bolster. Available online: <http://www.wbwg.org/speciesinfo/species_accounts/vespertilonidae/labl.pdf> Accessed June 2013.

_____. 2005f. Species accounts long-eared myotis (Myotis evotis). Prepared by M. A. Bogan, E. W. Valdez, and K.W. Navo. Available online: <http://www.wbwg.org/speciesinfo/species_accounts/vespertilonidae/myev.pdf> Accessed June 2013.

_____. 2005g. Species accounts Yuma myotis (*Myotis yumanensis*). Prepared by M. A. Bogan, E. W. Valdez, and K. W. Navo. Available online: <http://www.wbwg.org/speciesinfo/species_accounts/vespertilonidae/myyu.pdf> Accessed June 2013.

Woodbridge, B. 1998. Swainson's Hawk (*Buteo swainsoni*). *In*: The Riparian Bird Conservation Plan: a strategy for reversing the decline of riparian-associated birds in California. California Partners in Flight. Available online: <http://www.prbo.org/calpif/htmldocs/riparian_v-2.html>. Accessed October 2013.

Section 3.8: Threatened and Endangered Species

Adams, M.J., C.A. Pearl, and R.B. Bury. 2003. Indirect facilitation of an anuran invasion by nonnative fishes. Ecology Letters 6:343-351.

Alvarez, J.A. 2004a. Use of Artificial Egg Laying Substrate to Detect California Tiger Salamanders (*Ambystoma californiense*). Herpetological Review 35:45-46.

_____. 2004b. Overwintering California Tiger Salamander (*Ambystoma californiense*) Larvae. Herpetological Review 35:344.

Baldwin, B. 2012. The Jepson Manual: Vascular Plants of California. University of California Press, Berkeley, CA.

Behler, J.L., and F.W. King. 1979. The Audubon Society field guide to North American reptiles and amphibians. Alfred A. Knopf, New York. 719 pp.

Bell, H. 1994. Analysis of habitat characteristics of San Joaquin kit fox in its northern range. Master's thesis, California State University, Hayward.

California Department of Fish and Game (CDFG). 2005. The Status of Rare, Threatened, and Endangered Plants and Animals of California: 2000-2004.

_____. 2009. Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities. Sacramento, CA.

California Department of Fish and Wildlife (CDFW). 2013. Biogeographic Data Branch. California Natural Diversity Database (CNDDB). Available online: < http://www.dfg.ca.gov/biogeodata/cnddb/mapsanddata.asp>. Accessed October 17, 2013. California Department of Fish and Game, Sacramento, CA.

Calflora. 2012. Information on California Plants for Education, Research and Conservation: The California Database. Available online: <http://www.calflora.org/>. Accessed May 21, 2013.

California Native Plant Society (CNPS). 2012. Inventory of Rare and Endangered Plants online edition. (v8). Available online: <http://www.rareplants.cnps.org/advanced.html>. Accessed May 21, 2013. California Native Plant Society. Sacramento, CA.

Collie, N. and E.W. Lathrop. 1976. Chemical characteristics of the standing water of a vernal pool on the Santa Rosa plateau, Riverside County, California.

DiTomaso, J.M. and E.A. Healy. 2007. Weeds of California and Other Western States. 2 vols. University of California. Agriculture and Natural Resources.

Egoscue, H. J. 1962. Ecology and life history of the kit fox in Tooele Conty, Utah. Ecology 43:481-497.

Eng, L., D. Belk, and C.H. Eriksen. 1990. California Anostraca: distribution, habitat, and status. Journal of Crustacean Biology 10: 247-277.

Eriksen, C.H, and D. Belk. 1999. Fairy shrimps of California's puddles, pools, and Playas. Mad River Press, Rureka, California.

Gallagher, S.P. 1996. Seasonal occurrence and habitat characteristics of some vernal pool branchiopoda in northern California, U.S.A. Journal of Crustacean Biology.

Gilliland, K. L. 2010. The presence of *Micropterus salmoides* (largemouth bass) Influences the populations of *Rana draytonii* (California red-legged Frog) and *Pseudacris regilla* (Pacific treefrog) in two Ponds in Santa Barbara County, California. Masters thesis, California State Polytechnic State University, San Luis Obispo.

Grinnell, J., J. S. Dixon, and J. M. Linsdale. 1937. Fur-bearing mammals of California. 2 Vols. Univ. California Press, Berkeley. 777pp.

Hall, E. R. 1946. Mammals of Nevada. Univ. California Press, Berkeley. xi +710 pp.

Hayes, M.P. and M.R. Jennings. 1988. Habitat correlates of distribution of the California red-legged frog (*Rana aurora draytonii*) and the foothill yellow-legged frog (*Rana boylii*): Implications for management. Pages 144-158. In: R.C. Szaro, K.E. Severson, and D.R. Patton (technical coordinators), Proceedings of the symposium on the management of amphibians, reptiles, and small mammals in North America. United States Department of Agriculture, Forest Service, General Technical Report (RM-166):1-458.

Helm, B.P. 1998. Biogeography of eight large branchiopods endemic to California. California Native Plant Society.

Jennings, M.R. and M.P. Hayes. 1994. Amphibian and reptile species of special concern in California. Final report submitted to the CDFG, Inland Fisheries Division, Rancho Cordova, CA, under contract number 8023.

Keeley, J.E. 1984. Photosynthetic characteristics of certain vernal pool species. Institute of Ecology University of California, Davis; Davis, California.

Keeley, J.E. and P.H. Zedler. 1998. Characterization and global distribution of vernal pools. California Native Plant Society.

Kruse, K.C. & Francis, M.G. 1977. A predation deterrent in larvae of the bullfrog, *Rana catesbeiana*. Trans. American Fisheries Society 106:248–252.

Laabs, D.M., M.L. Allaback, and S.G. Orloff. 2001. Pond and Stream Breeding Amphibians. Chapter 5. Pages 193 – 229 In: J.E. Vollmar (ed.) . Wildlife and Rare Plant Ecology of Eastern Merced County's Vernal Pool Grasslands, Merced County. UC Development Office, Merced, CA.

McCue, P., T. Kato, M. L. Sauls, T. P. O'Farrell. 1981. Inventory of San Joaquin kit fox on land proposed as Phase II, Kesterson Reservoir, Merced County, California. Topical Report EGG 1183-2426, EG&G, Santa Barbara Operations, U.S. Department of Energy, Goleta, California.

Morrell, S. 1972. Life history of the San Joaquin kit fox. Calif. Fish and Game. 58:162-174.

NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life. Version 6.1. Nature Serve, Arlington Virgina. [Online] URL: http://www.natureserve.org/explorer. (Accessed October 9, 2013.)

O'Farrell, T. P. and L. Gibertson. 1979. Ecological life history of the desert kit fox in the Mojave Desert of southern California (draft final report). U.S. Bureau of Land Manage., Riverside, CA. 96 pages. (CA-060-CT8-55 and CA-060-CT7-2779)

O'Farrell, T. P., T. T. Kato, P. M. McCue, and M. L. Sauls. 1980. Inventory of San Joaquin kit fox on BLM lands in southern and southwestern San Joaquin Valley. U.S. Department of Energy Topical Report, EG&G/EM Santa Barbara Operations Report No. EGG 1183-2400. 74 pages.

Orloff, S., F. Hall, and L. Spiegel. 1986. Distribution and habitat requirements of the San Joaquin kit fox in the northern extreme of their range. Trans. West. Sect. Wildl. Soc. 22:60-70.

Platenkamp, G.A. 1998. Patterns of vernal pool biodiversity at Beale Air Force Base. California Native Plant Society.

Syrdahl, R.L. 1993. Distribution patterns of some key macro-invertebrates in a series of vernal pools at Vina Plains Preserve in Tehama County, California. University of California, Chico, California.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2013a. ESA- and CESA-Listed Plants Study Report (TR-02). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013b. ESA-Listed Wildlife - Valley Elderberry Longhorn Beetle Study Report (TR-05). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013c. ESA-List Amphibians - California Tiger Salamander Study Report (TR-08). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013d. ESA-Listed Amphibians – California Red-Legged Frog Study Report (TR-07). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

Trenham, P.C. 2001. Terrestrial Habitat Use by Adult California Tiger Salamanders. Journal of Herpetology 35:343-346.

U.S. Fish and Wildlife Service (USFWS). 1980. Listing the Valley Elderberry Longhorn Beetle as a Threatened Species with Critical Habitat. 50 CFR Part 17. Federal Register Vol. 45, No. 155. Rules and Regulations. Available online: <http://ecos.fws.gov/docs/federal_register/fr449.pdf>. Accessed on August 6, 2013. USFWS, Sacramento, CA.

_____. 1984. Valley Elderberry Longhorn Beetle Recovery Plan. U.S. Fish and Wildlife Service. Portland, Oregon. [Online] URL: http://ecos.fws.gov/docs/recovery _plan/840628.pdf. (Accessed August 23, 2010).

_____. 1987. National Wetland Inventory (NWI) maps. US Department of the Interior, USFWS, Region 1. Portland, OR.

_____. 1996. Determination of endangered status for Four Plants and Threatened Status for One Plant From the Central Sierran Foothills of California. Federal Register 61: 54346.

_____. 1999. Conservation Guidelines for Valley Elderberry Longhorn Beetle, Sacramento, CA. Available online: <http://www.fws.gov/sfbaydelta/documents/velb_conservation.pdf>. Accessed May 21, 2013.

_____. 2002a. Recovery Plan for Gabbro Soil Plants of the Central Nevada Foothills. Portland, OR.

_____. 2002b. Recovery Plan for the California Red-legged Frog (*Rana aurora draytonii*). U.S. Fish and Wildlife Service, Portland, Oregon..

_____. 2003. Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander. October 2003. USFWS, Sacramento Fish and Wildlife Office, Region 8. 8 pp. Available online: www.fws.gov/sacramento/es/documents/cts_survey_protocol.pdf.

_____. 2005a. Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon. Available online: <http://www.fws.gov/sacramento/ed/recovery_plans/vp_recovery_plan_links.htm>

_____. 2005b. Revised guidance on site assessments and field surveys for California red-legged frog. August 2005.

_____. 2006a. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for Four Vernal Pool Crustaceans and Eleven Vernal Pool Plants. 71 FR 7118-7316. Available online: <htto://www.gpo.gov/fdsys/pklg/FR-2006-02-10/pdf/06-1080.pdf#page=1.>

_____. 2006b. Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the California Red-Legged Frog, and Special Rule Exemption Associated With Final Listing for Existing Routine Ranching Activities.

_____. 2009. Sacramento Fish and Wildlife Office Species Account: Valley Elderberry Longhorn Beetle. Available online: <http://www.fws.gov/sacramento/es/animal_spp_acct/valley_elderberry_longhorn_beetl. htm>.

_____. 2010. Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the California Red-Legged Frog. Federal Register Vol. 75, No. 51, Page 12816 - 12959.

_____. 2011. Endangered and Threatened Wildlife and Plants; 5-Year Reviews of Species in California, Nevada, and the Klamath Basin of Oregon. 76 FR 30377-30382. Available online: < http://www.gpo.gov/fdsys/pkg/FR-2011-05-25/pdf/2011-12861.pdf>.

_____. 2012a. Endangered Plant Species Accounts. <http://www.fws.gov/sacramento/es_species/Accounts/Plants/es_speciesaccounts_plants. htm>. Accessed July 25, 2012. United States Fish and Wildlife Service, Sacramento, CA.

_____. 2012b. Service Seeks Information on Proposal to Remove Endangered Species Act Protection for the Valley Elderberry Longhorn Beetle. U.S. Fish and Wildlife Service, Sacramento, California. October 2012. Available online:

<http://www.fws.gov/sacramento/outreach/2012/10-1/outreach_newsroom_2012-10-1.htm>.

_____. 2012c. Sacramento Fish and Wildlife Office Endangered Plant Species Accounts. <http://www.fws.gov/sacramento/es_species/Accounts/Plants/es_species-accounts_plants.htm>. Accessed July 25, 2012. United States Fish and Wildlife Service, Sacramento, CA.

_____. 2013. Species Lists. Available online: <http://www.fws.gov/sacramento/es/spp_list.htm>. Accessed October 23, 2013. United States Fish and Wildlife Service, Sacramento, CA.

Werner, E.E. & McPeek, M.A. 1994. Direct and indirect effects of predators on two anuran species along an environmental gradient. Ecology, 75, 1368–1382.

Williams, D.F., E. Cypher, P. Kelly, K., Miller, N. Norvell, S. Phillips, C. D. Johnson, and G.W. Colliver. 1998. Recovery Plan for Upland Species of the San Joaquin Valley, California. US Fish and Wildlife Service, Portland, OR.

Section 3.9: Recreation, Land Use, and Shoreline Management

Bechtel Corporation. 1970. New Don Pedro Project, Relocated County Road and Bridges, Ward's Ferry Bridge, Location and Vicinity Map. Drawing No 7352-3-00. Bechtel Corporation, San Francisco.

Bureau of Land Management (BLM). 2009. The Red Hills of Tuolumne County. [Online] URL: http://www.blm.gov/ca/st/en/fo/folsom/redhillshomepg1.html/. (Accessed September 2010.)

California Department of Fish and Game (CDFG). 2010a. California Freshwater Sport Fishing Regulations. [Online] URL: http://www.dfg.ca.gov/regulations/FreshFish/. (Accessed September 2010.)

_____. 2010b Schedule for fish stocking. California Department of Fish and Game website. [Online] URL: http://www.dfg.ca.gov/fish/Hatcheries/FishPlanting/Central.asp. (Accessed September 2010.)

California State Parks. 2008. 2008 California Outdoor Recreation Plan (CORP). Available online: <http://www.parks.ca.gov/pages/795/files/2009-2014 percent20corp.pdf> (Accessed Oct. 8, 2009).

_____. 2009. Turlock Lake State Recreation Area. Available online: <http://www.parks.ca.gov/?page_id=555> (Accessed Oct. 23, 2013).

_____. 2013. Off-Highway Motor Vehicle Recreation. Available online: <http://ohv. parks.ca.gov/> (Accessed Nov. 15, 2009).

California Whitewater. 2010. Guide to Rafting and Kayaking. [Online] URL: http://www.californiawhitewater.com/. (Accessed September 2010.)

Don Pedro Recreation Agency (DPRA). 2008. 2008 Davis-Grunsky Recreation Data. Unpublished data summary from Don Pedro Recreation Agency.

_____. 2010. Don Pedro Lake Website, fish stocking information. [Online] URL: http://donpedrolake.com/RecreationArea/Fishing/index.htm. (Accessed September 2010.)

Great Outdoor Recreation Pages (GORP). 2009. Tuolumne River. [Online] URL: http://www.gorp.com/parks-guide/travel-ta-tuolumne-river-california-sidwcmdev_068904.html. (Accessed September 2010.)

National Geographic Society. 2009. Shoreline Trail, Don Pedro Lake. [Online] URL: http://www.sierranevadageotourism.org/content/shoreline-trail,-don-pedro-lake-/sie174E88C8707B7D03B. (Accessed September 2010.)

National Park Service (NPS). 2010. Yosemite National Park Tuolumne River Plan. National Park Service. [Online] URL: http://www.nps.gov/yose/parkmgmt/trp.htm. (Accessed July 16, 2010.)

Stanislaus County. 2006. Stanislaus County General Plan. Stanislaus County Board of Supervisors, Modesto, California.

_____. 2010. River and Fishing Accesses. [Online] URL: http://www.co.stanislaus.ca.us/ER/Parks/pdf/RiverFishingAccesses.pdf. (Accessed September 2010.)

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2013a. Recreation Facility and Public Accessibility Assessment, and Recreation use Assessment Study Report (RR-01), Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013b. Whitewater Boating Take Out Improvement Feasibility Study Report (RR-02). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013c. Lower Tuolumne River Boatable Flow Study Report (RR-03). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013d. Project Operations/Water Balance Model Study Report (W&AR-02). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

U.S. Department of Agriculture (USDA). 2013. 1977-2012 Tuolumne Wild & Scenic River Use. (Summary data provided to the Districts January 31, 2013)

_____. Undated. Stanislaus National Forest. [Online] URL: http://www.fs.usda.gov/main/stanislaus/home. (Accessed September 2013).

Section 3.10: Aesthetic Resources

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2013a. Visual Quality Study Report (RR-04). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013b. Recreation Facility and Public Accessibility Assessment, and Recreation use Assessment Study Report (RR-01), Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

Section 3.11: Cultural Resources

Annear, M. L., H. C. Florcken, and Dr. H. Baker. 1950. *Section One of A Brief History of Stanislaus County, A Source Book for Secondary Schools*. Modesto, California: Stanislaus County Department, of Schools.

Arnold, J. F., M. R. Walsh, and S. E. Hollimon. 2004. The Archaeology of California. *Journal of Archaeological Research* 12(1):1-73.

Barnes, Dwight H. 1987. *The Greening of Paradise Valley, Where the Land Owns the Water and the Power. The First 100 Years of the Modesto Irrigation District*. Modesto Irrigation District, Modesto, California.

Baumhoff, M. A., and J. S. Byrne. 1959. Desert Side-notched Points as a Time Marker in California. *Reports of the University of California Archaeological Survey* 48:32-65.

Beard, Franklin. 1988. *Gold Fields to Grazing Fields.* Southern Mines Press, La Grange, California.

Bennyhoff, J. A. 1956. *An Appraisal of the Archaeological Resources of Yosemite National Park*. Reports of the University of California Archaeological Survey 34.

Bennyhoff, J. A., and R. F. Heizer. 1958. Cross-dating Great Basin Sites by California Shell Beads. In *Current Views on Great Basin Archaeology*, 42:60-92. University of California Archaeological Survey Reports.

Bennyhoff, J. A., and R. E. Hughes. 1987. *Shell Bead and Ornament Exchange Networks between California and the Western Great Basin*. Anthropological Papers of the American Museum of Natural History 64(2). American Museum of Natural History, New York.

Bettinger, R. L., and R. E. Taylor. 1974. Suggested Revisions in Archaeological Sequences in the Great Basin and the Interior of Southern California. *Nevada Archaeological Survey Research* Papers 5:1-26.

Branch, L.C. 1881. *History of Stanislaus County, California, with Illustrations Descriptive of its Scenery, Farms, Residences, Public Buildings, Factories, Hotels, Business H*

California Department of Parks and Recreation (CDPR). 1976. California Inventory of Historic Resources. On file, Central California Information Center, Turlock, California.

_____. 1996. California State Historic Landmarks. On file, Central California Information Center, Turlock, California.

Chartkoff, Joseph L., and K. K. Chartkoff. 1984. The Archaeology of California, Stanford University Press, Stanford.

Clark, Wm. C. 1970. Gold Districts of California. California Division of Mines Bulletin No. 193. California Division of Mines and Geology, Sacramento.

Clewlow, C. W., Jr. 1967. Time and Space Relations of Some Great Basin Projectile Points. *University of California Archaeological Survey Reports* 70:141-149.

Coleman, Charles M. 1952. *PG. and E. of California: The Centennial History of Pacific Gas and Electric Company, 1852-1952.* McGraw-Hill, New York.

Davis, James T. 1961. Trade Routes and Economic Exchange Among the Indians of California. *Reports of the University of California Archaeological Survey* 54. Berkeley. (Reprinted 1963 in *Aboriginal California: Three Studies in Culture History*, edited by Robert F. Heizer. University of California Press, Berkeley.)

Deane, Dorothy Newell. 1960. *Sierra Railway*. Howell-North. Berkeley, California.

Elias, Sol P.1924. *Stories of Stanislaus*. Reprinted by the McHenry Museum, Modesto, California.

Elston, R. G., J. O. Davis, A. Leventhal, and C. Covington. 1977. *The Archaeology of the Tahoe Reach of the Truckee River*. On file, Northern Division of the Nevada Archeological Survey, University of Nevada, Reno.

Federal Energy Regulatory Commission (FERC) and Advisory Council on Historic Preservation (ACHP). 2002. Guidelines for the Development of Historic Properties Management Plans for FERC Hydroelectric Projects. Washington D.C.

Foster, J. W., and J. C. Bingham. 1978. *Archaeology in Solution: Testing Inundation's Effects at Folsom Reservoir, California.* Submitted to Southwest Cultural Resources Center, National Park Service, Sacramento.

Foster, J.W., J.C. Bingham, C. Carter, K. Cooley-Reynolds, and J.L. Kelly. 1977. *The Effects of Inundation on the Pedersen Site, CA-ELD-201, Folsom Lake, California.* Submitted to the National Park Service, Sacramento.

Gudde, E. G. 1975. *California Gold Camps.* University of California Press, Berkeley.

Hamilton, Fletcher. 1915. *Mines and Mineral Resources of Amador County, Calaveras County, Tuolumne County*. California State Mining Bureau, San Francisco.

Heckendorn, John, and W.A. Wilson. 1856. *Miners & Business Men's Directory*. Heckendorn & Wilson, Columbia. Reprinted 1976 by the Donald I. Segerstrom Memorial Fund, Publication No. 2. Tuolumne County Historical Society, Sonora.

Heizer, R. F. 1951. An Assessment of Certain Nevada, California, and Oregon Radiocarbon Dates. In *Radiocarbon Dating*, Edited by F. Johnson, pp. 23-25. Memoirs No. 8, Society for American Archaeology, Washington, D.C.

Heizer, R. F., and M. A. Baumhoff. 1961. Wagon Jack Shelter. In *The Archaeology of Two Sites at Eastgate, Churchill County, Nevada,* pp. 119-138. University of California Anthropological Records 20(4).

Heizer, R. F., and T. R. Hester. 1978. *Great Basin Projectile Points: Forms and Chronology.* Ballena Press Publications in Archaeology, Ethnology and History.

Henn, W.G., and E. Sundahl. 1986. *Shasta Lake Archaeological Sites Project: Study of the Effects of Reservoir Drawdown*. U.S. Government Printing Office.

Hohenthal, Helen A., and others. Edited by John Edwards Caswell. 1972. *Streams in a Thirsty Land, A History of the Turlock Region*. City of Turlock, Turlock, California.

Hoover, M.B., H.E. Rensch, E.G. Rensch, and W.N. Abeloe. 1990. *Historic Spots in California*, 4th ed., revised by D.E. Kyle. Stanford University Press, Stanford, California.

Hull, K. C. 2007. The Sierra Nevada: Archaeology in the Range of Light. In *California Prehistory: Colonization, Culture, and Complexity,* edited by T. L. Jones and K. A. Klar, pp. 177-190, AltaMira Press, New York.

Jackson, Thomas L. 1971. Appendix C: Determination 0of the Source of Artifactual Lithic Material. In *A Study of the Prehistory of the Tuolumne River Valley, California*, edited by M.J. Moratto, pp. 167-180. Papers No. 9, Treganza Anthropology Museum, San Francisco State College, San Francisco, California.

Jackson, R. J., T. Jackson, C. Miksicek, K. Roper, and D. Simons. 1994. *Framework for Archaeological Research and Management, National Forests of the North Central Sierra Nevada*. BioSystems Analysis, Inc., Sacramento, California. Submitted to and on file at the Eldorado National Forest, Placerville, California.

Jenkins, Olaf P. 1948. *Geologic Guidebook Along Highway 49—Sierran Gold Belt, Bulletin 141, The Mother Lode Country (Centennial Edition).* California Division of Mines, San Francisco.

JRP Historical Consulting Services and Caltrans. 2000 *Water Conveyance Systems in California: Historic Context Development and Evaluation Procedures.* Caltrans Environmental Program/Cultural Studies Office; Sacramento, California.

La Jeunesse, R. M., and J. H. Pryor. 1996. Skyrocket Appendices. California State University, Fresno.

Lenihan, Daniel J, Toni Carrell, Stephen Fosberg, Larry Murphy, Sandra Rayl and John Ware 1981. The Final Report of the National Reservoir Inundation Study – Volume 1. National Park Service Library, Denver, Colorado.

Levy, Richard. 1978. Eastern Miwok. In *California*, edited by Robert F. Heizer, pp. 398-413. Vol. 8, *Handbook of North American Indians*, William C. Sturtevant, general editor. Smithsonian Institution, Washington, D.C.

Meikle, Roy, V., Chief Engineer. 1927. General Right of Way Map Don Pedro Reservoir Site. Turlock Irrigation District and Modesto Irrigation District, Turlock, California. On file, Turlock Irrigation District, Turlock.

Meyer, Jack. 2008. Volume IIa: Project-wide Geoarchaeological Study and Archaeological Investigations at Four Prehistoric Sites: CA-TUO-2640, -2643, -4556, and -4559. *Prehistory of the Sonora Region, Archaeological and Geoarchaeological Investigations for Stage 1 of the East Sonora Bypass Project, State Route 108, Tuolumne County, California.* Prepared for the California Department of Transportation, District 6 – Fresno. Far Western Anthropological Research Group, Inc.

_____. 2011. Holocene Landscape Evolution and the Archaeological Record at Sonora. In *A New Frame of Reference: Prehistoric Culture Chronology and Ecology in the North-Central Sierra Nevada,* edited by J. Rosenthal, pp. 67-80. Publication No. 16, Center for Archaeological Research at Davis, Davis, California.

Meyer, Jack, D. Bieling, S. Stewart, and C. Caputo. 2005. *Geoarchaeological Investigations and Archaeological Data Recovery at Four Prehistoric Sites (CA-TUO-2640, -2643, -4556, -4559) for the East Sonora Bypass Project (Stage 1) Tuolumne County, California*. Anthropological Studies Center, Sonoma State University, Rohnert Park, CA. Prepared for the California Department of Transportation, Stockton.

Meyer, Jack, and G. Dalldorf. 2004. *Geoarchaeological Investigations for State 2 of the East Sonora Bypass Project, State Route 108, Tuolumne County, California*. Anthropological Studies Center, Sonoma State University, Rohnert Park, CA. Prepared for the California Department of Transportation, Stockton.

Milliken, R., W. Bloomer, S. Stratton, J. Nelson, D. Furlong, D. C. Young, E. Wohlgemuth, J. Costello, P. Mikkelsen, T. Carpenter, and D. Jones. 1997. *The Taylors Bar Site (CA-CAL-1180/H): Archaeological and Ethnohistoric Investigations in Calaveras County, California.* Far Western Anthropological Research Group, Inc., Davis. Report submitted to and on file at Calaveras County Water District, San Andreas.

Moratto, M.J. 1971. A Study of Prehistory in the Tuolumne River Valley, California. Treganza Anthropology Museum Papers, Number 9. San Francisco State University.

_____. 1972. Study of Prehistory on the Southern Sierra Foothills, California. Unpublished Ph.D dissertation, Department of Anthropology, University of Oregon.

_____. 1984. California Archaeology. Academic Press, Orlando, Florida.

_____. 1999. Cultural Chronology, 1: Regional Context. In *Archaeological Synthesis and Research Design: Yosemite National Park, California*, Yosemite Research Center Publications in Anthropology No. 21, edited by K. L. Hull and M. J. Moratto, pp. 65-120, Submitted to USDI National Park Service, Contract No. 1443 CX80094 012. Copies available from INFOTEC Research, Inc., Fresno.

_____. 2002. Culture History of the New Melones Reservoir Area, Calaveras and Tuolumne Counties, California. In *Essays in California Archaeology: A Memorial to Franklin Fenenga*, edited by W. J. Wallace and F. A. Riddell. pp. 25-54. Contributions of the University of California Archaeological Research Facility, Berkeley.

Moratto, M. J., T. F. King, and W. B. Woolfenden. 1978. Archaeology and California's Climate. *The Journal of California Anthropology* 5(2):147-161.

Moratto, M.J., L.H. Shoup, and J.D. Tordoff. 1988. Culture Change in the Central Sierra Nevada, 8000 B.C.-A.D. 1950. Final Report of the New Melones Archaeological Project, edited by M.J. Moratto, 9:1-626. U.S. National Park Service and National Technical Information Service, Washington, D.C. (Also available from Coyote Press.)

National Park Service (NPS). 1983. Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines in the Federal Register, September 29, 1983 (48FR44716). Department of the Interior, Washington, D.C.

_____. 1995 *How to Apply the National Register Criteria for Evaluation.* National Register Bulletin. Department of the Interior, Washington, D.C.

Parker, P.L., and Thomas F.K. 1998. Guidelines for evaluating and documenting Traditional Cultural Properties. Revised. National Register Bulletin 38. U.S. Department of the Interior, National Park Service, National Register, History, and Education Division, Washington, D.C.

Paterson, Alan M. 1989. *Land, Water and Power, A History of the Turlock Irrigation District 1887-1987*. The Arthur H. Clark Company, Glendale, California.

Peak. A.S. and H. Crew. 1990. Cultural Resource Studies North Fork Stanislaus River Hydroelectric Development Project, Vol. II: An Archaeological Data Recovery Project at CA-Cal-S342, Clarks Flat, Calaveras County, California. Northern California Power Agency, Roseville, California.

Ragir, S. 1972. The Early Horizon in Central California Prehistory. *Contributions of the University of California Archaeological Research* Facility 15. Berkeley.

Rose, Al. 1970. *Map of Don Pedro Lake, California*. With hand written notations as to proposed names for geographical locations. Al—Rose Publications, Modesto, California. On file, Turlock Irrigation District, Turlock.

Rosenthal, J. S. 2008. *Prehistory of the Sonora Region, Archaeological and Geoarchaeological Investigations for Stage 1 of the East Sonora Bypass Project, State Route 108, Tuolumne County, California.* Far Western Anthropological Research Group, Inc., Davis, CA. Prepared for the California Department of Transportation, Central California Cultural Resources Branch, Fresno.

_____. 2011a. Projectile Point Typology and Chronology in the North-Central Sierra In *A New Frame of Reference: Prehistoric Culture Chronology and Ecology in the North-Central Sierra Nevada*, edited by J. S. Rosenthal, pp. 17-36. Publication No. 16, Center for Archaeological Research at Davis, Davis, California.

_____. 2011b. Building a New chronological Framework for the West-Central Sierra Nevada In *A New Frame of Reference: Prehistoric Culture Chronology and Ecology in the North-Central Sierra Nevada*, edited by J. S. Rosenthal, pp. 37-66. Publication No. 16, Center for Archaeological Research at Davis, Davis, California.

Rosenthal, Jeffrey (ed.). 2011. *A New Frame of Reference: Prehistoric Culture Chronology and Ecology in the North-Central Sierra Nevada.* Center for Archaeological Research at Davis Publication 16, University of California, Davis.

Rosenthal, J. S., J. King, K. R. McGuire, S. A. Waechter, J. Berg, and L. Leach-Palm. 2008. *Prehistory of the Sonora Region: Archaeological and Geoarchaeological Investigations for State I of the East Sonora Bypass Project, State Route 108, Tuolumne County, California. Volume IIb: Data Recovery Excavations at CA-TUO-2195/H, -4513, -4514, -4523, -4524, -4525, and Additional Analysis of TUO-2642.* Far Western Anthropological Research Group, Inc., Davis, CA. Prepared for the California Department of Transportation, Central California Cultural Resources Branch, Fresno.

Rosenthal, J. S., and K. McGuire. 2004. M*iddle Holocene Adaptations in the Central Sierra Nevada Foothills: Data Recovery Excavations at the Black Creek Site, CA-CAL-789.* Far Western Anthropological Research Group, Inc., Davis, California. Submitted to

California Department of Transportation, District 6, Fresno. On file, Central California Information Center, California State University, Stanislaus.

Rosenthal, J.S., and J. Meyer. 2004. Bodie Hills Obsidian Hydration Rates. In *Middle Holocene Adaptations in the Central Sierra Nevada Foothills: Data Recovery Excavations at the Black Creek Site, CA-CAL-789*. Far Western Anthropological Research Group, Inc., Davis, California. Submitted to California Department of Transportation, District 06, Fresno. On file, Central California Information Center, California State University, Stanislaus.

Rosenthal, J. S., G. G. White, and M. Q. Sutton. 2007. The Central Valley: A View from the Catbird's Seat. In *California Prehistory: Colonization, Culture, and Complexity,* edited by T. L. Jones and K. A. Klar, pp. 147-163, AltaMira Press, New York.

Stoddard, S. E., and David A. Fredrickson 1978. *Supplementary Investigations into the Effects of Freshwater Immersion on Cultural Resources of the Lake Mendocino Reservoir Basin, Mendocino County, California*. Submitted to the U.S. Army Corps of Engineers.

Thomas, David H. 1970. Archaeology's Operational Imperative: Great Basin Projectile Points as a Test Case. *University of California Archaeological Survey Annual Report* 12:27-60.

_____. 1981. How to Classify Projectile Points from Monitor Valley, Nevada. *Journal of Great Basin and California Anthropology* 3(1):7-43.

Tinkham, George H. 1921. History of Stanislaus County, California. Volume I. Historic Record Company, Los Angeles.

Tuolumne County Historical Society. 2013. Tuolumne County Railroad Transportation. Online document, http://www.tchistory.org/TCHISTORY/railroads.htm, accessed February 28, 2013.

Turlock Irrigation District (TID). 1975. Don Pedro Lake Place Names. List on file, Turlock Irrigation District, Turlock.

_____. 2013. TID Overview. Website, http://www.tid.org/about-tid/tid-overview, accessed July 30, 2013.

Turlock Irrigation District (TID) vs. Allen Zanker et al. 2006. Court of Appeal of California, Fifth District. Court Opinion. June 26, 2006.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2014a. Draft Historical Properties Study Report (CR-01). Prepared by HDR and Far Western Anthropological Research Group, with contributions from Foothill Research, Inc. and Applied EarthWorks, Inc. April.

_____. 2014b. Draft Native American Traditional Cultural Properties Study Report (CR-02). Prepared by Applied EarthWorks, Inc. April 2014.

Union Democrat, edited by J.A. Van Harlingen & Co. 1909. *Tuolumne County, California*. Issued by the *Union Democrat*, Sonora, California. Republished 1995 by the Tuolumne County Historical Society, Sonora. `

U.S. Department of Interior, National Park Service (NPS). 1983. Archaeology and Historic Preservation: Secretary of the Interior's Standards and Guidelines in the Federal Register, September 29, 1983 (48FR44716). Department of the Interior, Washington, D.C.

Wagner, Jack R. 1980. *Gold Mines of California*. Howell-North Books, San Diego, California.

Ware, J.A. 1989. *Archaeological Inundation Studies: Manual for Reservoir Managers.* Prepared for the U.S. Army Corps of Engineers, Washington D. C.

Whitaker, A., and J. Rosenthal. 2009. *Addendum Archaeological Survey and Phase II Evaluation for the East Sonora Bypass Stage II Project, Tuolumne County, California*. Far Western Anthropological Research Group, Inc., Davis, CA. Prepared for the California Department of Transportation, Central California Cultural Resources Branch, Fresno.

_____. 2010. *9,000 Years of Prehistory at the Poppy Hills Site: Data Recovery Report for CA-TUO-2797/H*. Prepared for the California Department of Transportation, Central California Cultural Resources Branch, Fresno, California. Far Western Anthropological Research Group, Inc., Davis, California.

Wirth Environmental Associates. 1985. *Mokelumne River Project, Cultural Resources Evaluation Program*. Report prepared for Pacific Gas and Electric, San Francisco. On file, Central California Information Center, California State University, Stanislaus.

Section 3.12: Socioeconomic Resources

California Chapter of the American Society of Farm Managers and Rural Appraisers. 2012. 2012 Trends in Agricultural Land & Lease Values.

Federal Energy Regulatory Commission (FERC). 2013. Market Oversight, California Annual Average Bilateral Prices. [Online] URL: http://www.ferc.gov/market-oversight/mkt-electric/california/2013/08-2013-elec-ca-archive.pdf. (Accessed April 17, 2013.)

Modesto Irrigation District (MID). 2013. Information provided by Jimi Netniss, MID, to Duane Paul, CardnoENTRIX, on April 16, 2013.

Turlock Irrigation District (TID). 2013. Information provided by Nancy J. Folly, TID, to Duane Paul, CardnoENTRIX, on April 17, 2013.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2013. Project Operations/Water Balance Model Study Report (W&AR-02). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2014. Socioeconomics Study Report (W&AR-15). April 2014.

Section 4.0: Cumulative Effects of the Proposed Action

Araki, H., B. Cooper and M. S. Blouin. 2007. Genetic effects of captive breeding cause a rapid, cumulative fitness decline in the wild. Science 318:100-103.

Baker, P. F., T. P. Speed, and F. K. Ligon. 1995. Estimating the influence of temperature on the survival of Chinook salmon smolts (Oncorhynchus tshawytscha) Migrating through the Sacramento-San Joaquin River Delta of California. Canadian Journal of Fisheries and Aquatic Science 52:855-863.

Barnett-Johnson, R., C. B. Grimes, C. F. Royer, and C. J. Donohoe. 2007. Identifying the contribution of wild and hatchery Chinook salmon (Oncorhynchus tshawytscha) to the ocean fishery using otolith microstructure as natural tags. Canadian Journal of Fisheries and Aquatic Sciences 64:1683-1692.

Berejikian, B. A., and M. J. Ford. 2004. Review of Relative Fitness of Hatchery and Natural Salmon. NOAA Technical Memorandum NMFS-NWFSC-61. December 2004. Seattle, Washington.

Boydstun, L.B. 2001. Ocean Salmon Fishery Management. Fish Bulletin No. 179, vol. 2, 2001, pp. 183-196.

Brown, L.R. 1996. Aquatic biology of the San Joaquin-Tulare basins, California: analysis of available data through 1992. Water-Supply Paper No. 2471. U. S. Geological Survey, Denver, Colorado.

Brown, L. R., and T. Ford. 2002. Effects of flow on the fish communities of a regulated California river: implications for managing native fishes. River Research and Applications 18:331-342.

Brown, L.R., and P.B. Moyle. 1993. Distribution, Ecology, and Status of the Fishes of the San Joaquin River Drainage. California Fish and Game: Conservation of Wildlife through Education, Volume 79, summer1993, Number 3, Page 96.

Brown, C.B., and E.M. Thorp. 1947. Reservoir sedimentation in the Sacramento–San Joaquin drainage basins, California, Special Report 10, Soil Conservation Service, Sedimentation Section, Office of Research, Washington, D.C.

Brown, L. R., J. K. Thompson, K. Higgins, and L. V. Lucas. 2007. Population density, biomass, and age-class structure of the invasive clam Corbicula fluminea in rivers of the lower San Joaquin River watershed, California. Western North American Naturalist 67: 572–586.

Brunell, M., G. M. Litton, J. C. Monroe & ICF International. 2010. Effects of the Head of Old River Barrier on flow and water quality in the San Joaquin River and Stockton Deep Water Ship Channel. Report to the Department of Water Resources.

Buttars, B. 2011. Central Valley Salmon and Steelhead Marking/Coded-wire Tagging Program 2012 Marking Season. Pacific States Marine Fisheries Commission. Redd Bluff, California.

Cain, J. R., R. P. Walkling, S. Beamish, E. Cheng, E. Cutter, and M. Wickland. 2003. San Joaquin Basin Ecological Flow Analysis. Prepared for the Bay-Delta Authority by the Natural Heritage Institute, Berkeley, California. August 2003.

California Cooperative Oceanic Fisheries Investigations (CalCOFI). 2006. The State of the California Current, 2005-2006: Warm in the North, Cool in the South. CalCOFI Report, Vol. 47, 2006.

California Energy Commission (CEC). 2011. Updated California Energy Demand Forecast 2011-2022. May 2011. CEC-200-2011-006-SD.

_____. 2007. The State of the California Current, 2006-2007: Regional and Local Processes Dominate. CalCOFI Report, Vol. 48, 2007.

California Department of Fish and Game (CDFG). 1990. Central Valley Salmon and Steelhead Restoration and Enhancement Plan. Sacramento, California. April 1990. 115 pages.

_____. 1993. Restoring Central Valley Streams: A Plan for Action. Sacramento, California. November 1993. 129 pages.

_____. 1996. Steelhead restoration and management plan for California. California Department of Fish and Game, Sacramento, California.

_____. 2011. Freshwater Sport Fishing Regulations. March 1, 2011 - February 29, 2012.

California Department of Fish and Wildlife (CDFW). 2012. California Hatchery Review Project. Appendix VIII. Mokelumne River Hatchery Steelhead Program Report. June. Available at http://cahatcheryreview.com/wp-content/uploads/2012/08/Mokelumne%20Steelhead%20Program%20Report%20June%202012.pdf

_____. 2013. Status of Fisheries Report. An Update through 2011. Report to the California Fish and Game Commission as directed by the Marine Life Management Act of 1998. Prepared by California Department of Fish and Wildlife Marine Region, January 2013.

_____. 2014. Fishing for Black Bass. [Online] URL: http://www.dfg.ca.gov/fish/Resources/ (Accessed April 23, 2014).

California Department of Water Resources (CDWR). 1994. San Joaquin River tributaries spawning gravel assessment: Stanislaus, Tuolumne, Merced rivers. Draft memorandum prepared by the Department of Water Resources, Northern District for the California Department of Fish and Game. Contract number DWR 165037.

_____. 2013. California Data Exchange Center. On-line Database. http://cdec.water.ca.gov/cdecapp/resapp/getResGraphsMain.action. (Accessed March 2014.)

California Department of Water Resources (CDWR), U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, and National Marine Fisheries Service. 2013. Environmental Impact Report/ Environmental Impact Statement for the Bay Delta Conservation Plan. Administrative Draft. March. (ICF 00674.12.) Prepared by ICF International, Sacramento, CA.

California Environmental Protection Agency (CEPA). 2006. Climate Action Team Report to Governor Schwarzenegger and the Legislature, March 2006, 107 pages.

California Regional Water Quality Control Board (CRWQCB). 2006. Executive Officer's Report 26/27 October 2006. California Regional Water Quality Control Board, Central Valley Region, USA.

California State Lands Commission (CSLC). 2012. Final Environmental Impact Report (EIR) for the San Francisco Bay and Delta Sand Mining Project. Project Clearinghouse Number 2007072036, CSLC EIR NO. 742.

City and County of San Francisco (CCSF). 2006. Tuolumne River System and HHWP Fact sheet. San Francisco, California.

Clark K., M. Bowen, R. Mayfield, K. Zehfuss, J. Taplin, C. Hanson. 2009. Quantification of pre-screen loss of juvenile steelhead in Clifton Court Forebay. Department of Water Resources, the California Natural Resources Agency.

Cohen, A. N., and J. T. Carlton. 1995. Non-indigenous aquatic species in a United States estuary: a case study of the biological invasions of the San Francisco Bay and Delta. Prepared for U. S. Fish and Wildlife Service, Washington, D. C. and The National Sea Grant College Program, Connecticut Sea Grant.

Dill, W. A. and A. J. Cordone. 1997. History and status of introduced fishes in California, 1871-1996. California Department of Fish and Game Fish Bulletin 178. [Online] URL: http://www.escholarship.org/uc/item/5rm0h8qg#page-1. (Accessed August 2, 2010.).

Dubrovsky, N. M., C. R. Kratzer, L. R. Brown, J. M. Gronberg, and K. R. Burow. 1998. Water Quality in the San Joaquin-Tulare Basins, California, 1992-95. U.S. Geological Survey, Sacramento, California. [Online] URL: http://pubs.usgs.gov/circ/circ1159/circ1159.pdf.

Durand, J. 2008. Delta foodweb conceptual model. Delta Regional Ecosystem Restoration Implementation Plan. Sacramento, California. http://www.science.calwater.ca.gov/pdf/drerip/DRERIP_food_web_conceptual_model_final_120208.pdf

Evans, A. F., D. D. Roby, K. Collis, B. M. Cramer, J. A. Sheggeby, L. J. Adrean, D. S. Battaglia, and D. E. Lyons. 2011. Recovery of coded wire tags at a Caspian tern colony in San Francisco Bay: A technique to evaluate impacts of avian predation on juvenile salmonids. North America Journal of Fisheries Management 31:79-87.

Fausch, K. D. 1993. Experimental analysis of microhabitat selection by juvenile steelhead (Oncorhynchus mykiss) and coho salmon (O. kisutch) in a British Columbia stream. Canadian Journal of Fisheries and Aquatic Sciences 50: 1198–1207.

Federal Energy Regulatory Commission (FERC). 1996. Order Amending License and Dismissing Rehearing Request, California. FERC Project No. 2299-024, FERC, Office of Hydropower Licensing, Washington, D.C.

_____. 2008. Preparing Environmental Documents, Guidelines for Applicants, Contractors, and Staff. Office of Energy Projects Division of Hydropower Licensing, Washington, D.C.

Feyrer, F, T. R. Sommer, and W. Harrell. 2006. Importance of flood dynamics versus intrinsic physical habitat in structuring fish communities: evidence from two adjacent engineered floodplains on the Sacramento River, California. North American Journal of Fisheries Management 26:408-417.

Flagg, T., B. Berejikian, J. Colt, W. Dickhoff, L. W. Harrell, D. J. Maynard, C. E. Nash, M. S. Strom, R. N. Iwamoto, C. V. W. Mahnken. 2000. Ecological and behavioral impacts of artificial production strategies on the abundance of wild salmon populations. National Marine Fisheries Service. NOAA Technical Memorandum NMFS-NWFSC-41.

Ford, T., and L. R. Brown. 2001. Distribution and abundance of Chinook salmon and resident fishes of the lower Tuolumne River, California. Pages 253-303 in R.L. Brown, editor. Contributions to the biology of Central Valley salmonids. Fish Bulletin 179: Volume 2. California Department of Fish and Game, Sacramento.

Galloway, D.L., and Riley, F.S., 1999, San Joaquin Valley, California—Largest human alteration of the Earth's surface: *in* Land Subsidence in the United States, Galloway, D.L., Jones, D.R., and Ingebritsen, S.E., eds., U.S. Geological Survey Circular 1182, pp. 23-34.

Garza, J. C., and D. E. Pearse. 2008. Population genetic structure of Oncorhynchus mykiss in the California Central Valley. Report to California Department of Fish and Game. Contract No. PO485303. University of California, Santa Cruz, and NOAA Southwest Fisheries Science Center, Santa Cruz, California.

Gingras, M. 1997. Mark/recapture experiments at Clifton Court Forebay to estimate prescreening loss to juvenile fishes: 1976-1993. Interagency Ecological Program for the San Francisco Bay/Delta Estuary. Technical Report. http://198.31.87.66/pdf/MarkRecaptureCliftonCourt.pdf

Grant, G. E., J. C. Schmidt, and S. L. Lewis. 2003. A geological framework for interpreting downstream effects of dams on rivers. Pages 209–225 in J. E. O'Connor and G. E. Grant, editors. A peculiar river: geology, geomorphology, and hydrology of the Deschutes River, Oregon. Water Science and Application Series No. 7. American Geophysical Union, Washington, D.C.

Hallock, R. J., R. F. Elwell, and D. H. Fry, Jr. 1970. Migrations of adult king salmon Oncorhynchus tshawytscha in the San Joaquin Delta as demonstrated by the use of sonic tags. State of California, The Resources Agency, Department of Fish and Game. Fish Bulletin 151.

Hansen, J. A., J. C. A. Marr, J. Lipton, D. Cacela, and H. L. Bergman. 1999. Differences in neurobehavioral responses of Chinook salmon (Oncorhynchus tshawytscha) and rainbow trout (Oncorhynchus mykiss) exposed to copper and cobalt: behavioral avoidance. Environmental Toxicology and Chemistry 18(9):1972-1978.

HDR. 2012. Don Pedro Reservoir Bathymetric Study Report. Prepared for Turlock Irrigation District and Modesto Irrigation District. October 2012.

Herren, J. R. and S. S. Kawasaki. 2001. Inventory of Water Diversions in Four Geographic Areas in California's Central Valley. In R. L. Brown, (ed.), Contributions to Biology of Central Valley Salmonids, Vol. 2. CDFG Fish Bulletin 179: 343–355.

Higgins, T., and D. L. Dupras. 1993. Mineral land classification of Stanislaus County, California, California Department of Conservation, Division of Mines and Geology. 174 pages.

ICF International. 2010. Effects of the Head of Old River Barrier on Flow and Water Quality in the San Joaquin River and Stockton Deep Water Ship Channel. ICF 01111.07, Sacramento, CA. Prepared for Department of Water Resources, Sacramento, CA.

ICF Jones & Stokes. 2010. Hatchery and Stocking Program Environmental Impact Report/Environmental Impact Statement. Final. January. (ICF J&S 00264.08) (SCH #2008082025). Sacramento, CA. Prepared for the California Department of Fish and Game and U.S. Fish and Wildlife Service, Sacramento, CA.

Imre, I., J. W. A. Grant, and E. R. Keeley. 2002. The effect of visual isolation on territory size and population density of juvenile rainbow trout (Oncorhynchus mykiss). Canadian Journal of Fisheries and Aquatic Sciences, 59:303-309.

ISAB (Independent Scientific Advisory Board). 2003. Review of salmon and steelhead supplementation. June 4, 2003. Independent Scientific Advisory Board for the Northwest Power Planning Council, the National Marine Fisheries Service, and the Columbia River Basin Indian Tribes, Portland, Oregon.

Jackson, T. A. 2007. California Steelhead Report-Restoration Card: a Report to the Legislature California Department of Fish and Game. 46 pages plus appendices.

Jayasundara, N. C., M. L. Deas, E. Sogutlugil, E. Miao, E. Limanto, A. Bale, Nd S. K. Tanaka. 2014. Tuolumne River flow and temperature model: without project assessment. Prepared by Watercourse Engineering, Inc., Davis, CA.

Johnson, R., P. K. Weber, J. D. Wikert, M. L. Workman, R. B. MacFarlane, M. J. Grove and A. K. Schmitt. 2011. Managed metapopulations: do salmon hatchery 'sources' lead to in-river 'sinks' in conservation? PLoS ONE 7(2):e28880.

Joint Hatchery Review Committee (JHRC). 2001. Final Report on Anadromous Salmonid Fish Hatcheries in California. December 3, 2001. California Department of Fish and Game and National Marine Fisheries Service, Southwest Region.

Katibah, E. F. 1984. A brief history of the riparian forests in the central valley of California. in: Warner, R.E.; Hendrix, K.M., editors. California riparian systems: ecology conservation and productive management. Berkeley, CA: University of California Press; 23-29.

Kelley, R. L. 1989. Battling the inland sea: floods, public policy, and the Sacramento Valley, 1985-1986. University of California Press, Berkeley.

Kuminoff, N. and D.A. Sumner. 2001. What drives farmland conversion: farm returns versus urban factors? Presentation at American Agricultural Economics Association Annual Meeting, August 5-8, Chicago, IL.

Kimmerer, W., L. Brown, S. Culberson, P. Moyle, M. Nobriga, and J. Thompson. 2008. Aquatic ecosystems. Pages 55-72 in M. Healey, M. Dettinger, and R. Norgaard, editors. The State of Bay-Delta Science 2008. CALFED Science Program, Sacramento, California.

Kohler, S. 2006. Aggregate Availability in California. Department of Conservation, California Geological Survey.

Kondolf, G. M. 1995. Geomorphological stream channel classification in aquatic habitat restoration: Uses and limitations. Aquatic Conservation: Marine and Freshwater Ecosystems 5: 127-141. Doi: 10.1002/aqc.3270050205.

Koschmann, A. H., and M. H. Bergendahl. 1968. Principal Gold-Producing Districts of the United States, USGS Professional Paper 610.

Kostow, K. E. 2004. Differences in juvenile phenotypes and survival between hatchery stocks and a natural population provide evidence for modified selection due to captive breeding. Canadian Journal of Fisheries and Aquatic Sciences 61:577-589.

Kuivala K. and C. Foe. 1995. Concentrations, transport, and biological effects of dormant spray pesticides in the San Francisco Estuary, California. Environmental Toxicology and Chemistry 14:1141-1150.

Laird, A. 2005. Gasburg Creek fine sediment reduction and habitat restoration project, La Grange, Stanislaus County, California. Prepared by River Planner, Arcata, California for Turlock Irrigation District, Turlock, California and California Department of Fish and Game, Region 1, Fresno, California.

Lindley, S. T., R. S. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. R. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2007. Framework for assessing viability of threatened and endangered salmon and steelhead in the Sacramento- San Joaquin Basin. San Francisco Estuary and Watershed Science Volume 5, Issue 1 [February 2007], article 4.

Lund, J., E. Hanak, W. Fleenor, R. Howitt, J. Mount, and P. Moyle. 2007. Envisioning futures for the Sacramento–San Joaquin Delta. Public Policy Institute of California, San Francisco. February 2007.

Mather, M. E. 1998. The role of context-specific predation in understanding patterns exhibited by anadromous salmon. Canadian Journal of Fisheries and Aquatic Sciences 55(Supplement 1):232-246.

McBain & Trush. 2000. Habitat restoration plan for the lower Tuolumne River corridor. Prepared for Tuolumne River Technical Advisory Committee (TRTAC) by McBain and Trush, Arcata, with assistance from U. S. Fish and Wildlife Service Anadromous Fish restoration Program (AFRP).

McBain & Trush, Inc. (eds.), 2002. San Joaquin River Restoration Study Background Report. Prepared for Friant Water Users Authority, Lindsay, California, and Natural Resources Defense Council, San Francisco, California.

_____. 2004. Coarse sediment management plan for the lower Tuolumne River. Revised Final Report. Prepared by McBain and Trush, Arcata, California for Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation Districts, USFWS Anadromous Fish Restoration Program, and California Bay-Delta Authority.

_____. 2007. Gasburg Creek fine sediment reduction project: summary of project accomplishments. Final Technical Memorandum. Prepared by McBain & Trush, Arcata, California for W. Fryer, Turlock Irrigation District, Turlock, California.

_____. 2008. Monitoring the impacts on the Tuolumne River from Peaslee Creek erosion and runoff events of January 2008. Prepared by McBain and Trush, Arcata, California for T. Ford, Aquatic Biologist, Turlock Irrigation District, Turlock, California.

McBain & Trush and Stillwater Sciences. 2006. Lower Tuolumne River predation assessment final report. Prepared for the Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation districts, USFWS Anadromous Fish Restoration Program and California Bay-Delta Authority.

McEwan, D., and T. A. Jackson. 1996. Steelhead restoration and management plan for California. Management Report. California Department of Fish and Game, Inland Fisheries Division, Sacramento, California.

Mesick, C. 2001. The effects of San Joaquin River flows and Delta export rates during October on the number of adult San Joaquin Chinook salmon that stray. Pages 139-162 in R.L. Brown, editor. Contributions to the biology of Central Valley salmonids, California Department of Fish and Game, Fish Bulletin 179.

Mesick, C. F. and D. Marston. 2007. Provisional Draft: Relationships between fall-run Chinook salmon recruitment to the major San Joaquin River tributaries and streamflow, Delta exports, the Head of the Old River Barrier, and tributary restoration projects from the early 1980s to 2003.

Mesick, C., J. McLain, D. Marston, and T. Heyne. 2008. Limiting factor analyses and recommended studies for fall-run Chinook salmon and rainbow trout in the Tuolumne River. Draft Report. Joint Report of the U.S. Fish and Wildlife Service (Anadromous Fish Restoration Program), National Marine Fisheries Service, Sacramento Office, and California Department of Fish and Game, Fresno Office. August 13, 2008.

Merced Irrigation District (MID). 2012. Merced River Hydroelectric Project Final License Application. Merced Irrigation District Merced Irrigation District, February 2012.

Mintier Harnish Planning Consultants, Planning Partners, Morton & Pitalo, Dowling Associates, Economic Planning Systems, Mead & Hunt, EDAW/AECOM, and Amy Skewes-Cox Environmental Planning. 2009

Moore, J., and R. Shlemon. 2008. Levee system fragility. Pages 103-120 in M. C. Healey, M.D. Dettinger, and R.B. Norgaard, editors. The State of Bay-Delta Science, 2008. CALFED Science Program, Sacramento, California. http://www.science.calwater.ca.gov/publications/sbds.html

Mount J. and S. Purdy. 2010. Confluence: a natural and human history of the Tuolumne River watershed. Department of Geology and Center for Watershed Sciences, University of California, Davis, version 1.0, 189 pages.

Moyle, P. B. 2002. Inland fishes of California, revised and expanded. University of California Press, Berkeley, California.

Moyle, P. B., P. K. Crain, and K. Whitener. 2007. Patterns in the Use of a Restored California Floodplain by Native and Alien Fishes. San Francisco Estuary and Watershed Science, 5(3). Retrieved from: http://www.escholarship.org/uc/item/6fq2f838.

Myrick, C. A., and J. J. Cech, Jr. 2001. Temperature effects on Chinook salmon and steelhead: a review focusing on California's Central Valley populations. Bay-Delta Modeling Forum Technical Publication 01-1.

Naiman, R. J., H. Decamps, and M. E. McClain. 2005. Riparia: ecology, conservation, and management of streamside communities. Academic Press, New York, New York.

Newcomb, J., and L. Pierce. 2010. Low Dissolved oxygen levels in the Stockton deep water shipping channel: adverse effects on salmon and steelhead and potential beneficial effects of raising dissolved oxygen levels with the aeration facility. Bay-Delta Office, Department of Water Resources.

Newman, K. B. and D. G. Hankin. 2004. Statistical Procedures for Detecting the CVPIA natural Chinook salmon Production Doubling Goal and Determining Sustainability of Production Increases. USFWS, May 2004.

National Marine Fisheries Service and California Department of Fish and Game (NMFS and CDFG). 2001. Final report of anadromous salmonid fish hatcheries in California. December. https://nrm.dfg.ca.gov/documents/ContextDocs.aspx?cat=Fisheries

National Marine Fisheries Service (NMFS). 2009. Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead. Sacramento Protected Resources Division. October 2009.

NPS (National Park Service). 2006. Tuolumne Wild and Scenic River Outstandingly Remarkable Values Draft Report. National Park Service. Available online at: http://www.nps.gov/yose/parkmgmt/ upload/2006%20DRAFT%20ORV%20REPORT_Final-2.pdf.

Orr, B. K. 1997. Ecosystem health and salmon restoration: a broader perspective. Pages 575-580 in S.S.Y. Wang, editor. Environmental and coastal hydraulics: protecting the aquatic habitat. Volume 1: Proceedings of Theme B. Water for a changing global community. The 27th Congress of the International Association for Hydraulic Research. American

Society of Civil Engineers, New York. [Online] URL: http://www.stillwatersci.com/ resources/1997orrsalmon.pdf. (Accessed July 27, 2010.).

Pearcy, W.G. 1992. Ocean Ecology of North Pacific Salmonids. University of Washington, Seattle.

Pacific Fishery Management Council (PFMC). 2013. Review of 2012 Ocean Salmon Fisheries. February 2013. 7700 NE Ambassador Place, Portland, OR 97220-1384.

Pacific Watershed Associates (PWA). 2004. Subject: Gasburg Creek sediment control plan and cost estimate. Memorandum from W. Weaver, PhD, Pacific Watershed Associates, Arcata, California to C. Braudrick, Stillwater Sciences, Berkeley, California. 12 March 2004.

Reid, L.M., and T. Dunne. 1996. Rapid evaluation of sediment budgets. Catena Verlag, GMBH, Reiskirchen, Germany.

Robichaud, D. and K. English. 2013. Analysis of Tuolumne River rotary screw trap data to examine the relationship between river flow and survival rates for smolts migrating between Waterford and Grayson (2006–2012). Attachment C in Chinook Salmon Population Model Study – Draft Report prepared by Stillwater Sciences. 23 p.

Scholz, N. L., N. Truelove, B. L. French, B. A. Berejikian, T. P. Quinn, E. Casillas, and T. K. Collier. 2000. Diazinon disrupts antipredator and homing behaviors in Chinook salmon (Oncorhynchus tshawytscha). Canadian Journal of Fisheries and Aquatic Sciences 57:1911-1918.

Scordino, J. 2010. West Coast Pinniped Program Investigations on California Sea Lion and Pacific Harbor Seal Impacts on Salmonids and Other Fishery Resources. Pacific States Marine Fisheries Commission. Portland, OR.

San Francisco Public Utilities Commission (SFPUC). 2007. Program Environmental Impact Report for the SFPUC Water System Improvement Program. San Francisco Public Utilities Commission, San Francisco, California.

San Joaquin River Restoration Program (SJRRP). 2011. Program Environmental Impact Report. Draft April 2011.

Snyder, N.P., D.M. Rubin, C.N. Alpers, J.R. Childs, J.A. Curtis, L.E. Flint, and S.A. Wright. 2004. Estimating accumulation rates and physical properties of sediment behind a dam: Englebright Lake, Yuba River, northern California. Water Resource Research 40.

Speed, T. 1993. Modeling and managing a salmon population. Pages 265-290 in V. Barnett, and K. F. Turkman, editors. Statistics for the Environment, John Wiley & Sons.

Stanislaus County. 2006. Stanislaus County General Plan. Stanislaus County Board of Supervisors, Modesto, California.

Stillwater Sciences. 2001. Merced River Restoration Baseline Studies: Volume II: Geomorphic and Riparian Vegetation Investigations Report. Final Report. Berkeley, CA.

_____. 2002. Subject: Results of summer 2001 snorkel surveys of fine sediment deposits in the Lower Tuolumne River. Technical Memorandum from M. Trso and N. Hume, Stillwater Sciences, Berkeley, California to McBain and Trush, Arcata, California. 5 January 2002.

_____. 2004. Gasburg Creek sediment source analysis. Technical Report. Prepared for the Tuolumne River Technical Advisory Committee.

_____. 2006. Subject: 2002–2003 fine sediment monitoring results for Lower Dominici Creek. Technical Memorandum from N. Lassettre, W. Swaney, and N. Hume, Stillwater Sciences, Berkeley, California to W. Fryer. 16 November 2006.

_____. 2012a. Lower Tuolumne River Instream Flow Studies: Pulse Flow Study Report. Final. Prepared by Stillwater Sciences, Berkeley, California for Turlock Irrigation District and Modesto Irrigation District, California.

_____. 2012b. Tuolumne River 2011 Oncorhynchus mykiss monitoring summary report. Prepared by Stillwater Sciences, Berkeley, California for the Turlock Irrigation District and Modesto Irrigation District.

Stillwater Sciences and McBain & Trush. 2006. Lower Tuolumne River Predation Assessment Final Report. Prepared for the Tuolumne River Technical Advisory Committee, Turlock and Modesto Irrigation Districts, USFWS Anadromous Fish Restoration Program, and the California Bay-Delta Authority. Prepared by Stillwater Sciences, Berkeley, CA, and McBain & Trush, Inc., Arcata, CA. June.

Sommer, T .R., M. L. Nobriga, W. C. Harrell, W. Batham, and W. J. Kimmerer. 2001. Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Science 58:325–333.

Sommer, T. R., W. C. Harrell, and M. L. Nobriga. 2005. Habitat use and stranding risk of juvenile Chinook salmon on a seasonal floodplain. North American Journal of Fisheries Management 25:1493-1504.

State Board of Fish Commissioners. 1904. Eighth Biennial Report. Prepared by the State Board of Fish Commissioners of the State of California, for the years 1903 – 1904.

SWRCB (California State Water Resources Control Board). 2010. Final 2010 Integrated Report CWA Section 303(d) List / 305(b) Report. Available: <http://www.waterboards.ca.gov/water_issues/programs/tmdl/2010state_ir_reports/category5_report.shtml>.

Thompson, K. 1961. Riparian forests of the Sacramento Valley, California. Annals of the Association of American Geographers 51: 294–315.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 1992. Report of Turlock Irrigation District and Modesto Irrigation District pursuant to Article 39 of the license for the Don Pedro Project. Turlock, California. 8 Volumes. April.

_____. 1997. 1996 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. 6 Volumes. March.

_____. 2000. 1999 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. 2 Volumes. March.

_____. 2001. 2000 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. 2 Volumes. March.

_____. 2005. 2005 Ten Year Summary Report. Pursuant to Paragraph (G) of the 1996 FERC Order issued July 31, 1996. Don Pedro Project, No. 2299. April.

_____. 2007. 2006 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. March.

_____. 2007. 2006 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. March.

_____. 2010. 2009 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. March.

_____. 2011. Pre-Application Document. Don Pedro Project. FERC No. 2299. February 2011.

_____. 2012. 2011 Report of Turlock Irrigation District and Modesto Irrigation District Pursuant to Article 58 of the License for the Don Pedro Project, No. 2299. March.

_____. 2013a. Project Operations/Water Balance Model Study Report (W&AR-02). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013b. Lower Tuolumne River Riparian Information and Synthesis Study Report (W&AR-19). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013c. Salmonid Population Information Integration and Synthesis Study Report (W&AR-05). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013d. Fish Assemblage and Population Between Don Pedro Dam and La Grange Dam Study Report (W&AR-13). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013e. *Oncorhynchus mykiss* Habitat Survey Study Report (W&AR-12). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013f. Spawning Gravel in the Lower Tuolumne River Study Report (W&AR-04). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013g. Predation Study Report (W&AR-07). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013h. Water Quality Assessment Study Report (W&AR-01). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

_____. 2013i. Reservoir Temperature Model Study Report (W&AR-03). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013j. Lower Tuolumne River Temperature Model Study Report (W&AR-16). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2013k. Tuolumne River Chinook Salmon Population Model Study Report (W&AR-06). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

_____. 2014. In-River Diurnal Temperature Variation Study Report. April 2014.

Tierney, K. B., D. H. Baldwin, T. J. Hara, P. S. Ross, N. L. Scholz, C. J. Kennedy. 2010. Olfactory Toxicity in Fishes. Aquatic Toxicology, 96:2-26.

U.S. Bureau of Reclamation and California Department of Water Resources (USBR and CDWR). 2005. Draft Environmental Impact Statement/Environmental Impact Report South Delta Improvements Program. Prepared for the California Resources Agency, Sacramento, CA.

U.S. Bureau of Reclamation (USBR). 2008. Biological assessment on the continued long-term operations of the Central Valley Project and the State Water Project. U.S. Department of the Interior Bureau of Reclamation Mid-Pacific Region Sacramento, California. August.

_____. 2011. Central Valley Project Water Contractors 2011 Allocation. Available: <http://www.usbr.gov/mp/PA/water/CVP_Water_Contracts_with_2011_Allocation.pdf>.

USDA Forest Service (USFS). 2013. Rim Fire burned area report. Reference FSH 2509.13, September 2013.

U.S. Fish and Wildlife Service (USFWS). 2001. Final Restoration Plan for the Anadromous Fish Restoration Program: A Plan to Increase Natural Production of Anadromous Fish in the Central Valley of California. U.S. Fish and Wildlife Service, Anadromous Fish Restoration Program (U.S.). Core Group, 100 pages.

U.S. Geological Survey (USGS). 1999. Water Resources Data – California, Water Year 1999: Volume 3 – Southern Central Valley Basins and the Great Basin from Walker River to Truckee River. Available online at: http://ca.water.usgs.gov/waterdata/.

Werner, I., S. Anderson, K. Larsen, and J. Oram. 2008. Chemical stressors conceptual model. Delta Regional Ecosystem Restoration Implementation Plan, Sacramento, California. http://www.science.calwater.ca.gov/pdf/drerip/DRERIP_chemical_stressors_conceptual_model_final_012808.pdf

Whipple A. A., R. M. Grossinger, D. Rankin, B. Stanford, and R. A. Askevold. 2012. Sacramento-San Joaquin Delta historical ecology investigation: exploring pattern and process. Prepared for the California Department of Fish And Game and Ecosystem Restoration Program. A report of SFEI-ASC's Historical Ecology Program, Publication #672, San Francisco Estuary Institute-Aquatic Science Center, Richmond, California.

Williams, J. G. 2006. Central Valley salmon: a perspective on Chinook and steelhead in the Central Valley of California. San Francisco Estuary and Watershed Science 4(3).

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher and P. B. Moyle. 2001. Historical distribution and abundance of chinook salmon in the Central Valley Drainage of California. California Department of Fish and Game, Fish Bulletin No. 179: 71-176.

Zimmerman, C. E., G. W. Edwards, and K. Perry. 2009. Maternal origin and migratory history of steelhead and rainbow trout captured in rivers of the Central Valley, California. Transactions of the American Fisheries Society 138(2):280–291.

Section 5.0: Developmental Analysis

EPA. 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards. EPA 910-B-03-002. Region 10 Office of Water, Seattle, WA.

EPA. 2011, October 11. USEPA's final approval letter and enclosure for California's 2010 303(d) List (http://www.swrcb.ca.gov/rwqcb5/water_issues/tmdl/impaired_waters_list/index.shtml)

Section 6.0: Conclusions

California Advisory Committee on Salmon and Steelhead Trout.1988. Restoring the balance: 1988 annual report. Sausalito, California.

California Department of Fish and Game (CDFG). 1990. Central Valley Salmon and Steelhead Restoration and Enhancement Plan. Sacramento, California. April 1990. 115 pages.

_____. 1993. Restoring Central Valley Streams: A Plan for Action. Sacramento, California. November 1993. 129 pages.

_____. 1996. Steelhead restoration and management plan for California. California Department of Fish and Game, Sacramento, California.

California Department of Parks and Recreation (CDPR). 1994. California Outdoor Recreation Plan (SCORP). Sacramento, California. April 1994.

_____. 1998. Public opinions and attitudes on outdoor recreation in California. Sacramento, California. March 1998.

California Department of Water Resources (CDWR). 1983. The California water plan: projected use and available water supplies to 2010. Bulleting 160-83. Sacramento, California. December 1983.

_____. 1994. San Joaquin River tributaries spawning gravel assessment: Stanislaus, Tuolumne, Merced rivers. Draft memorandum prepared by the Department of Water Resources, Northern District for the California Department of Fish and Game. Contract number DWR 165037.

_____. 2000. Final programmatic environmental impact statement/environmental impact report for the CALFED Bay-Delta Program. Sacramento, California. July 2000. CD Rom, including associated plans.

Federal Energy Regulatory Commission (FERC). 2013. List of Comprehensive Plans. Office of Energy Projects. Washington, D.C. 20426. http://www.ferc.gov/industries/hydropower/gen-info/licensing/complan.pdf

National Parks Service (NPS). 1982. The Nationwide Rivers Inventory. Available online at: A-M: http://www.nps.gov/ncrc/programs/rtca/nri/states/ca.html; N-Z: http://www.nps.gov/ncrc/programs/rtca/nri/states/ca2.html.

California State Water Resources Control Board (SWRCB). 1995. Water quality control plan report. Sacramento, California. Nine volumes.

_____. 1999. Water quality control plans and policies adopted as part of the State comprehensive plan. April 1999.

The Resources Agency. 1983. Department of Parks and Recreation. 1983. Recreation needs in California. Sacramento, California. March 1983.

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2013. Recreation Facility and Public Accessibility Assessment, and Recreation use Assessment Study Report (RR-01), Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

U.S. Fish and Wildlife Service. Canadian Wildlife Service. 1986. North American waterfowl management plan. Department of the Interior. Environment Canada. May 1986.

U.S. Fish and Wildlife Service. 1990. Central Valley habitat joint venture implementation plan: a component of the North American waterfowl management plan. February 1990.

U.S. Fish and Wildlife Service. 2001. Final restoration plan for the anadromous fish restoration program. Department of the Interior, Sacramento, California. January 9, 2001.

8.0 CONSULTATION RECORD

The following excerpt from the Code of Federal Regulations (CFR) at 18 CFR § 5.18(b)(5)(G) describes the required content of the Consultation Record.

> *5.18(b)(5)(G) Consultation Documentation. Include a list containing the name, and address of every Federal, state, and interstate resource agency, Indian tribe, or member of the public with which the applicant consulted in preparation of the Environmental Document.*

The Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts) have established and maintained an extensive Relicensing Participants Email Group, which has been used to keep all relicensing participants, including agencies, tribes, non-governmental organizations (NGOs), and interested members of the public, advised of all relicensing activities. The current list of participants, by name and affiliation, is contained in Attachment B to this license application.

The total relicensing Consultation Record, to date, consists of:

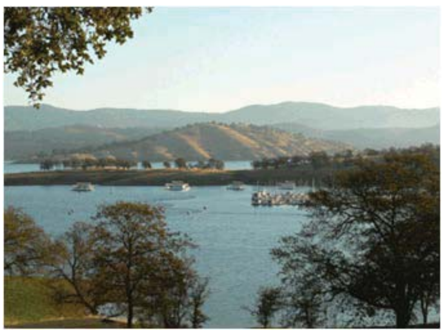
- Previously filed with FERC:
  - Consultation Record filed as Appendix A to the PAD on February 10, 2011
  - Consultation Workshops Record filed as Attachment A to the Draft License Application on November 26, 2013
- Filed with this license application as Attachment B:
  - Relicensing Participants Consultation Record
  - Agency Consultation Record
  - Relicensing Website Announcements Record

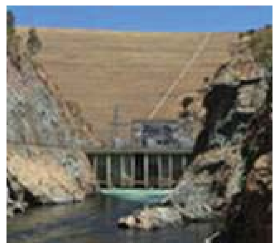
DON PEDRO HYDROELECTRIC PROJECT
FERC NO. 2299

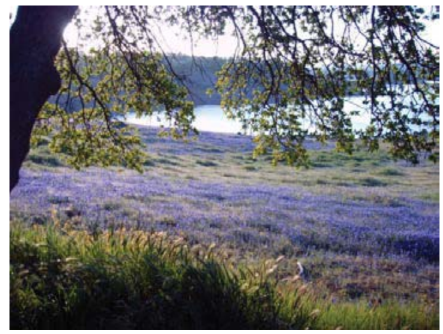
FINAL LICENSE APPLICATION

EXHIBIT E – ENVIRONMENTAL REPORT

APPENDIX E-1
DRAFT VEGETATION MANAGEMENT PLAN







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Prepared by:
Turlock Irrigation District
P.O. Box 949
Turlock, CA 95381

and

Modesto Irrigation District
P.O. Box 4060
Modesto, CA 95352

April 2014

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List of Acronyms

ac ....acres
ACEC ....Area of Critical Environmental Concern
ACHP ....Advisory Council for Historic Preservation
ACOE.........................U.S. Army Corps of Engineers
ADA ....Americans with Disabilities Act (ADA/ABAAG)
AF ....acre-feet
AGS............................Annual Grasslands
ALJ.............................Administrative Law Judge
APE ....Area of Potential Effect
APEA ....Applicant-Prepared Environmental Assessment
ARMR........................Archaeological Resource Management Report
AWQC ....Ambient Water Quality Criteria
BA ....Biological Assessment
BDCP ....Bay-Delta Conservation Plan
BLM ...........................U.S. Department of the Interior, Bureau of Land Management
BLM-S ....Bureau of Land Management – Sensitive Species
BMI ....Benthic macroinvertebrates
BMP ....Best Management Practices
BO ....Biological Opinion
BOW ....Blue Oak Woodland
ºC...............................celsius
CalCOFI.....................California Cooperative Oceanic Fisheries Investigations
CalEPPC ....California Exotic Pest Plant Council
CalSPA.......................California Sportfishing Protection Alliance
CAS............................California Academy of Sciences
CBDA ....California Bay-Delta Authority
CCC............................Criterion Continuous Concentrations
CCIC ....Central California Information Center
CCSF..........................City and County of San Francisco
CD ....Compact Disc
CDBW........................California Department of Boating and Waterways

CDEC.........................California Data Exchange Center
CESA.........................California Endangered Species Act
CDFA.........................California Department of Food and Agriculture
CDFG.........................California Department of Fish and Game (as of January 2013, CDFW)
CDFW........................California Department of Fish and Wildlife
CDMG........................California Division of Mines and Geology
CDOF.........................California Department of Finance
CDPH.........................California Department of Public Health
CDPR.........................California Department of Parks and Recreation
CDSOD......................California Division of Safety of Dams
CDWR........................California Department of Water Resources
CE.............................California Endangered Species
CEC............................California Energy Commission
CEII............................Critical Energy Infrastructure Information
CEQA.........................California Environmental Quality Act
CESA.........................California Endangered Species Act
CFR............................Code of Federal Regulations
cfs..............................cubic feet per second
CGS............................California Geological Survey
cm..............................centimeters
CMAP........................California Monitoring and Assessment Program
CMC..........................Criterion Maximum Concentrations
CNDDB......................California Natural Diversity Database
CNPS..........................California Native Plant Society
CORP.........................California Outdoor Recreation Plan
CPUC.........................California Public Utilities Commission
CPUE.........................Catch Per Unit Effort
CRAM........................California Rapid Assessment Method
CRC............................Chamise-Redshank Chaparral
CRLF..........................California Red-Legged Frog
CRRF.........................California Rivers Restoration Fund
CSAS..........................Central Sierra Audubon Society
CSBP..........................California Stream Bioassessment Procedure

CSU............................California State University
CT ....California Threatened Species
CTR............................California Toxics Rule
CTS ....California Tiger Salamander
CVP............................Central Valley Project
CVRWQCB ....Central Valley Regional Water Quality Control Board
CWA ....Clean Water Act
CWD ....Chowchilla Water District
CWHR........................California Wildlife Habitat Relationship
CZMA ....Coastal Zone Management Act
DDT ....dichlorodiphenyltrichloroethane
Districts ....Turlock Irrigation District and Modesto Irrigation District
DLA ....Draft License Application
DO..............................Dissolved Oxygen
DOI ....Department of Interior
DPRA.........................Don Pedro Recreation Agency
DPS ....Distinct Population Segment
DSE............................Chief Dam Safety Engineer
EA ....Environmental Assessment
EBMUD ....East Bay Municipal Utilities District
EC ....Electrical Conductivity
EFH............................Essential Fish Habitat
EIR ....Environmental Impact Report
EIS..............................Environmental Impact Statement
Elev or el ....Elevation
ENSO ....El Niño Southern Oscillation
EPA............................U.S. Environmental Protection Agency
ESA............................Federal Endangered Species Act
ESRCD.......................East Stanislaus Resource Conservation District
ESU............................Evolutionary Significant Unit
EVC............................Existing Visual Condition
EWUA........................Effective Weighted Useable Area
°F................................fahrenheit

FERC..........................Federal Energy Regulatory Commission
FFS............................Foothills Fault System
FL...............................Fork length
FLA............................Final License Application
FMP............................Fishery Management Plan
FMU...........................Fire Management Unit
FOT............................Friends of the Tuolumne
FPA............................Federal Power Act
FPC............................Federal Power Commission
FPPA..........................Federal Plant Protection Act
ft.................................feet
ft/mi............................feet per mile
FWCA........................Fish and Wildlife Coordination Act
FWUA........................Friant Water Users Authority
FYLF..........................Foothill Yellow-Legged Frog
g..................................grams
GIS............................Geographic Information System
GLO...........................General Land Office
GORP.........................Great Outdoor Recreation Pages
GPS............................Global Positioning System
HCP............................Habitat Conservation Plan
HSC............................Habitat Suitability Criteria
HHWP........................Hetch Hetchy Water and Power
HORB........................Head of Old River Barrier
hp................................horsepower
HPMP.........................Historic Properties Management Plan
IFIM...........................Instream Flow Incremental Methodology
ILP..............................Integrated Licensing Process
in................................inches
ISR.............................Initial Study Report
ITA.............................Indian Trust Assets
IUCN..........................International Union for the Conservation of Nature
KOPs..........................Key Observation Points

kV..............................kilovolt
kVA...........................kilovolt-amperes
kW.............................kilowatt
LWD ....large woody debris
m ....meters
mm ....millimeter
M&I...........................Municipal and Industrial
MCL..........................Maximum Contaminant Level
mg/kg ....milligrams/kilogram
mg/L..........................milligrams per liter
mgd ....million gallons per day
MGR ....Migration of Aquatic Organisms
MHW ....Montane Hardwood
mi ....miles
mi^2.............................square miles
MID...........................Modesto Irrigation District
MOA ....Memorandum of Agreement
MOU ....Memorandum of Understanding
MPN..........................Most Probable Number
MPR ....market price referents
MSCS.........................Multi-Species Conservation Strategy
msl.............................mean sea level
MUN ....municipal and domestic supply
MVA ....Megavolt-ampere
MW ....megawatt
MWh ....megawatt hour
mya............................million years ago
NAE ....National Academy of Engineering
NAHC ....Native American Heritage Commission
NAS............................National Academy of Sciences
NAVD 88...................North American Vertical Datum of 1988
NAWQA ....National Water Quality Assessment
NCCP ....Natural Community Conservation Plan

NGVD29 ....National Geodetic Vertical Datum of 1929
NEPA ....National Environmental Policy Act
NERC ....North American Electric Reliability Corporation
NGOs ....Non-Governmental Organizations
NHI ....Natural Heritage Institute
NHPA.........................National Historic Preservation Act
NISC ....National Invasive Species Council
NMFS.........................National Marine Fisheries Service
NOAA ....National Oceanic and Atmospheric Administration
NOI ....Notice of Intent
NPS ............................U.S. Department of the Interior, National Park Service
NRCS ....National Resource Conservation Service
NRHP ....National Register of Historic Places
NRI.............................Nationwide Rivers Inventory
NTU ....Nephelometric Turbidity Unit
NWI............................National Wetland Inventory
NWIS ....National Water Information System
NWR ....National Wildlife Refuge
O&M ....operation and maintenance
OEHHA......................Office of Environmental Health Hazard Assessment
OID ....Oakdale Irrigation District
ORV ....Outstanding Remarkable Value
OSHA.........................Occupational Safety and Health Administration
PA ....Programmatic Agreement
PAD............................Pre-Application Document
PDAW........................Project Demand of Applied Water
PDO............................Pacific Decadal Oscillation
PEIR ....Program Environmental Impact Report
PGA............................Peak Ground Acceleration
PG&E ....Pacific Gas and Electric
PHABSIM..................Physical Habitat Simulation System
PHG............................Public Health Goal
PM&E ....Protection, Mitigation and Enhancement

PMF............................Probable Maximum Flood
POAOR......................Public Opinions and Attitudes in Outdoor Recreation
ppb.............................parts per billion
ppm ....parts per million
PSP.............................Proposed Study Plan
PWA...........................Public Works Administration
QA..............................Quality Assurance
QC..............................Quality Control
RA..............................Recreation Area
RBP............................Rapid Bioassessment Protocol
REC-1 ....water contact recreation
REC-2 ....water non-contact recreation
Reclamation ...............U.S. Department of the Interior, Bureau of Reclamation
RM ....River Mile
RMP...........................Resource Management Plan
RP...............................Relicensing Participant
rpm.............................Rotations per minute
RPS ....Renewable Portfolio Standard
RSP ....Revised Study Plan
RST ....Rotary Screw Trap
RWG..........................Resource Work Group
RWQCB.....................Regional Water Quality Control Board
SC...............................State candidate for listing under CESA
SCADA......................Supervisory Control and Data Acquisition
SCD............................State candidate for delisting under CESA
SCE ....State candidate for listing as endangered under CESA
SCT ....State candidate for listing as threatened under CESA
SD1 ....Scoping Document 1
SD2 ....Scoping Document 2
SE...............................State Endangered Species under the CESA
SEED..........................U.S. Bureau of Reclamation's Safety Evaluation of Existing Dams
SFP.............................State Fully Protected Species under CESA
SFPUC ....San Francisco Public Utilities Commission

SHPO ....State Historic Preservation Officer

SJRA ....San Joaquin River Agreement

SJRGA ....San Joaquin River Group Authority

SJTA ....San Joaquin River Tributaries Authority

SM.............................Standard Method

SMUD ....Sacramento Municipal Utility District

SPAWN.....................spawning, reproduction and/or early development

SPD ....Study Plan Determination

SRA...........................State Recreation Area

SRMA ....Special Recreation Management Area or Sierra Resource Management Area (as per use)

SRMP........................Sierra Resource Management Plan

SRP ....Special Run Pools

SSC ....State species of special concern

ST..............................California Threatened Species under the CESA

STORET ....Storage and Retrieval

SWAMP....................Surface Water Ambient Monitoring Program

SWE ....Snow-Water Equivalent

SWP ....State Water Project

SWRCB.....................State Water Resources Control Board

TAC...........................Technical Advisory Committee

TAF ....thousand acre-feet

TCP ....Traditional Cultural Properties

TCWC ....Tuolumne County Water Company

TDS ....Total Dissolved Solids

TID ....Turlock Irrigation District

TMDL ....Total Maximum Daily Load

TOC...........................Total Organic Carbon

TRT ....Tuolumne River Trust

TRTAC ....Tuolumne River Technical Advisory Committee

UC ....University of California

USBR ........................U.S. Bureau of Reclamation

USDA........................U.S. Department of Agriculture

USDOC ......................U.S. Department of Commerce
USDOI .......................U.S. Department of the Interior
USFS ..........................U.S. Department of Agriculture, Forest Service
USFWS ......................U.S. Department of the Interior, Fish and Wildlife Service
USGS .........................U.S. Department of the Interior, Geological Survey
USR............................Updated Study Report
UTM...........................Universal Transverse Mercator
VAMP ....Vernalis Adaptive Management Plan
VELB ....Valley Elderberry Longhorn Beetle
VES ....visual encounter surveys
VRM ....Visual Resource Management
VRO ....Visual Resource Objective
WBWG ....Western Bat Working Group
WECC ....Western Electricity Coordinating Council
WPA...........................Works Progress Administration
WPT ....Western Pond Turtle
WQCP ....Water Quality Control Plan
WSA...........................Wilderness Study Area
WSIP ....Water System Improvement Program
WSNMB ....Western Sierra Nevada Metamorphic Belt
WUA ....weighted usable area
WWTP ....Wastewater Treatment Plant
WY.............................water year
yd^3 ....cubic yard
yr ....year
µS/cm ....microSeimens per centimeter
µg/L............................micrograms per liter
µmhos.........................micromhos

PREFACE

The Don Pedro Project provides water storage for irrigation and municipal and industrial (M&I) use, flood control, hydroelectric generation, recreation, and natural resource protection (hereinafter, the "Don Pedro Project"). The study area used for the terrestrial resource studies conducted in support of the relicensing considered potential effects of all components, facilities, operations, and maintenance that make up the Don Pedro Project. The Don Pedro Project was originally conceived as a water supply project. The Don Pedro Project was constructed for the following primary purposes: (1) to provide water supply for the co-licensees, Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts), for irrigation of over 200,000 acres (ac) of Central Valley farmland and for M&I use, (2) to provide flood control benefits along the Tuolumne and San Joaquin rivers, and (3) to provide a water banking arrangement for the benefit of the City and County of San Francisco (CCSF) and its 2.6 million Bay Area water customers. The original license was issued in 1966. In 1995, the Districts entered into an agreement with a number of parties which resulted in greater flows to the lower Tuolumne River for the protection of aquatic resources.

Hydroelectric generation is a secondary purpose of the Don Pedro Project. Hereinafter, the hydroelectric generation facilities and operations will be referred to as the "Don Pedro Hydroelectric Project", or the "Project". With this license application to FERC, the Districts are seeking a new license to continue generating hydroelectric power. Based on the information contained in this application, and other sources of information on the record, FERC will consider whether, and under what conditions, to issue a new license for the continued generation of hydropower at the Districts' Don Pedro Project. The Districts are providing a complete description of the facilities and operation of the Don Pedro Project so the effects of the operation and maintenance of the Don Pedro hydroelectric facilities can be distinguished from the effects of the operation and maintenance activities of the overall Don Pedro Project's flood control and water supply/consumptive use purposes.

Being able to differentiate the effects of the hydropower operations from the effects of the flood control and consumptive use purposes and needs of the Don Pedro Project will aid in defining the scope and substance of reasonable protection, mitigation, and enhancement (PM&E) alternatives to be considered in relicensing. As FERC states in Scoping Document 2 in a discussion related to alternative project operation scenarios: "…alternatives that address the consumptive use of water in the Tuolumne River through construction of new structures or methods designed to alter or reduce consumptive use of water are…alternative mitigation strategies that could not replace the Don Pedro *hydroelectric* project [emphasis added]. As such, these recommended alternatives do not satisfy the NEPA purpose and need for the proposed action and are not reasonable alternatives for the NEPA analysis."

1.0 INTRODUCTION

Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts) are the co-licensees of the 168-megawatt (MW) Don Pedro Hydroelectric Project (the Project) located on the Tuolumne River in western Tuolumne County in the Central Valley region of California. This document presents the Draft Vegetation Management Plan (the Plan) for the Don Pedro Project, describing the Districts' proposed resource measures addressing noxious weed management, special-status plant management, Valley Elderberry Longhorn Beetle (VELB) host plant management, and revegetation following ground-disturbing activities. The Draft Vegetation Management Plan is organized into five main sections:

Section 1 - Describes the Don Pedro Project and the Draft Vegetation Management Plan;

Section 2 - Defines noxious weed species addressed under the Draft Vegetation Management Plan, provides noxious weed prevention guidelines for the Don Pedro Project, and describes noxious weed management efforts to be conducted by the Districts;

Section 3 - Defines special-status plant species addressed under the Draft Vegetation Management Plan and describes special-status plant protection and monitoring efforts to be conducted by the Districts;

Section 4 - Describes the Districts' proposals regarding VELB host plants; and

Section 5 – Describes bi-annual employee trainings, biennial agency consultation, and periodic review of noxious weed and special-status plant lists.

1.1 General Description of the Don Pedro Project

The Districts are the co-licensees of the 168-megawatt (MW) Project located on the Tuolumne River in western Tuolumne County, in the Central Valley region of California. Don Pedro Dam is located at river mile (RM) 54.8 and the Don Pedro Reservoir, formed by the dam, extends 24 miles upstream at the normal maximum water surface elevation of 830 feet (ft) above mean sea level (msl; NGVD 29). At elevation 830 ft, the reservoir stores over 2,000,000 acre-feet (AF) of water and has a surface area slightly less than 13,000 acres (ac). The watershed above Don Pedro Dam is approximately 1,533 square miles (mi^2).

The Project Boundary extends from approximately one mile downstream of the dam to approximately RM 80.8 upstream of the dam. Upstream of the dam, the Project Boundary runs generally along the 845 ft contour interval. The top of the Don Pedro Dam is at elevation 855 ft. The Project Boundary encompasses approximately 18,370 ac with 74 percent of the lands owned jointly by the Districts and the remaining 26 percent (approximately 4,802 ac) owned by the United States and administered as a part of the U.S. Bureau of Land Management (BLM) Sierra Resource Management Area.

The primary Don Pedro Project facilities include the 580-foot-high Don Pedro Dam and Reservoir completed in 1971; a four-unit powerhouse situated at the base of the dam; related facilities including the Project spillway, outlet works, and switchyard; four dikes (Gasburg Creek Dike and Dikes A, B, and C); and three developed recreational facilities (Fleming Meadows, Blue Oaks, and Moccasin Point Recreation Areas). The location of the Don Pedro Project and its primary facilities is shown in Figure 1.1-1.

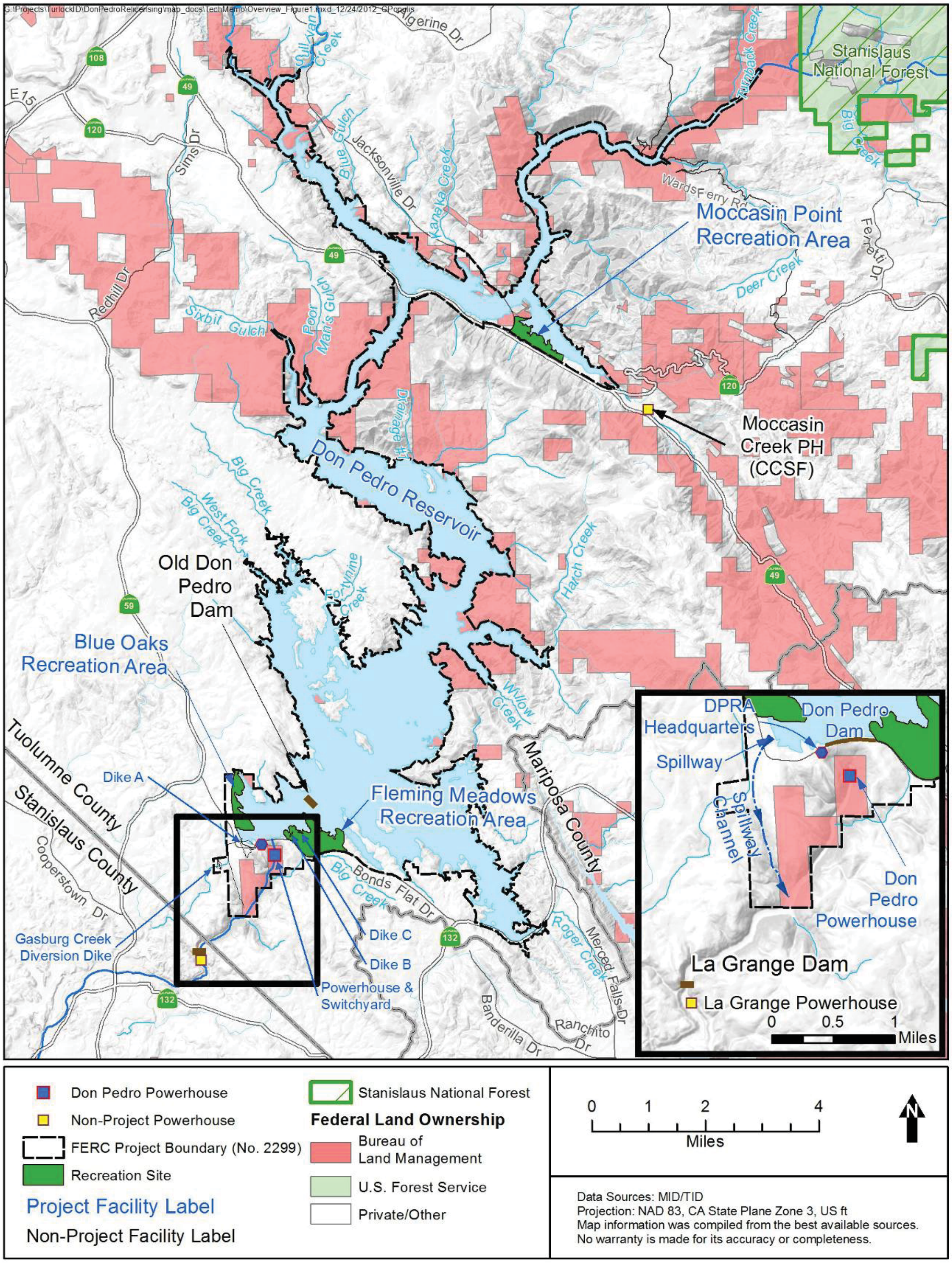

Figure 1.1-1. Don Pedro Project site location map.

1.2 General Description of Current Vegetation Management Activities

The Districts conduct vegetation management, including noxious weed management, as part of routine activities. These vegetation management activities include:

- mechanical vegetation trimming along roads and recreation trails in the road/trail right-of-way for continued access and line-of-sight safety,
- mechanical vegetation trimming along paths parallel to canals to keep paths clear and for safety,
- mechanical vegetation trimming and herbicide use clearing to maintain bare ground adjacent to Don Pedro Project buildings and structures,
- mechanical vegetation trimming and herbicide use at switchyards and structures for fire safety,
- vegetation removal on dams to keep clear of woody vegetation and grasses for dam safety purposes, and
- mechanical maintenance of bare ground in recreation areas where bare ground currently occurs and is desired.
- prescribed burns within the limitations of timing, weather conditions, and frequency set by the Districts' prescribed burn program.

These routine activities will be conducted in accordance with Best Management Practices (BMPs) listed in Section 2.0, and use restrictions listed in Section 3.0, but are not otherwise considered components of the Draft Vegetation Management Plan.

2.0 NOXIOUS WEEDS

The Districts' proposed noxious weed prevention and management measures are provided below for all BLM-administered lands and lands under the Districts' ownership within the Project Boundary. For the purposes of the Draft Vegetation Management Plan, noxious weeds are defined as plant species that are:

- listed as "noxious" under the Federal Plant Protection Act,
- listed as "noxious" and with a pest rating of A, B or C by the California Department of Food and Agriculture (CDFA), or
- identified as noxious during annual consultation with the BLM.

2.1 Best Management Practices

The Districts will conduct their routine recreation, facilities, and lands management activities consistent with the objective of minimizing the potential for the introduction and spread of noxious weeds. Specifically, the following prevention guidelines will be used by the Districts' personnel, Don Pedro Recreation Agency (DPRA) or contractors working within lands addressed by the Draft Vegetation Management Plan; however, exceptions may occur in unusual or time-sensitive circumstances (e.g., emergency maintenance).

- Thoroughly clean all heavy construction equipment and vehicles that have been used off-road before entering the Project Boundary to reasonably ensure that seeds of noxious weeds are not introduced.
- Minimize ground disturbance during routine operations and management activities. When ground disturbance is required, dispose of any resulting spoils on-site if feasible, grading to match local contours and reseeding with a certified weed-free mix of native species. If fill is required, use fill collected on-site whenever possible, and reseed the disturbed area with a certified weed-free mix of native species.
- For ground disturbances larger than 0.25 ac in size, conduct revegetation in accordance with BLM Manual Handbook-1745-1, Use of Native Plant Materials in California, as periodically updated by the BLM (Attachment A).
- Use weed-free straw and native plant species for all construction, erosion control, or restoration needs.
- Restrict travel to established roads when possible, and avoid entering areas with existing noxious weed occurrences. If entering such areas is required, conduct work in uninfested areas first.

2.2 Noxious Weed Surveys

Beginning in the second year following license issuance, and every fifth year thereafter, the Districts will conduct a noxious weed survey of BLM-administered lands within the Red Hills Area of Critical Environmental Concern as well as lands within the Project Boundary that are subject to operations and maintenance activities, including Don Pedro Project facilities and the Moccasin Point, Blue Oaks, and Fleming Meadows recreation areas. Surveys will be conducted at an appropriate intensity to determine the nature and distribution of noxious weed occurrences in the survey areas, and will focus on developed habitats, along roads, adjacent to facilities, and similar areas most likely to be prone to noxious weed infestations. Surveyors will record noxious weed species composition, location, and relative abundance, and will collect the following Global Positioning System (GPS) data:

- For A- and B-listed noxious weeds, use GPS to delineate a polygon for occurrences >0.1 acre in size, or a linear feature for linear occurrences >100 ft (e.g., along roads); smaller occurrences to be mapped by a single GPS point taken near the center of the occurrence.
- For C-listed or other noxious weeds, distribution of the species to be described generally, but with reference to Don Pedro Project features when feasible. Smaller or discrete occurrences will be mapped by a single GPS point taken near the center of the occurrence.

Data from survey efforts will be provided to the BLM in the biennial report as part of agency consultation (see below).

2.3 Noxious Weed Management Guidelines

On BLM-administered lands and lands under the Districts' ownership within the Project Boundary, noxious weeds will be managed according to the degree of threat posed to other resources (e.g., special-status plant occurrences) and the current weed status and feasibility of control as detailed in Table 2.3-1.

Table 2.3-1. Noxious weed management guidelines for the Don Pedro Project.

Current Weed Status	Typical CDFA Listing [1]	Plan Priority	Example Management Method
Not currently present, potential to invade	A, B	High	**Prevention**: implementation of noxious weed prevention guidelines, periodic survey efforts.
Present, localized	A and B and new occurrences of some C-listed weeds	High (A and B) or Moderate (C)	**Control:** intensive treatment including eradication of List A occurrences, consideration of treatment for new, small occurrences of List C, control and/or eradication of List B occurrences. **Containment:** education, implementation of weed prevention guidelines.
Present, widespread	C	Moderate or Low	**Containment:** implementation of noxious weed prevention guidelines; consideration of localized treatment near sensitive resources.

[1] CDFA Listings:
A: An organism of known economic importance subject to state action involving: eradication, quarantine, containment, rejection, or other holding action.
B: An organism of known economic importance subject to: eradication, containment, control or other holding action.
C: An organism subject to no state-enforced action outside of nurseries except to retard spread.

When warranted within these guidelines, the Districts will implement individual noxious weed management activities for certain noxious weed occurrences or species. Prior to implementation, each noxious weed management activity will be described as part of biennial agency consultation with the BLM, including the following information:

- current distribution and location of target noxious weed occurrence,
- proposed management method, duration, schedule, and specific application plans,
- desired future condition and criteria for success, and
- follow-up monitoring methods and schedule.

On BLM-administered lands, herbicide use will be in compliance with BLM standards. Only those herbicides approved for use will be applied to BLM lands.

2.4 Management of Existing Occurrences

Two Class B noxious weeds are currently known to occur within the Project Boundary. In accordance with the noxious weed management guidelines described above, the Districts' proposed management for these occurrences is provided in Table 2.4-1.

Herbicides and adjuvants used during management will be drawn from the BLM's list of approved chemicals, and used in compliance with labeling. Specific application rates and frequency and timing of application will be developed for each occurrence upon implementation of the Plan.

Table 2.4-1. Class A and B noxious weed occurrences known from lands addressed by the Draft Vegetation Management Plan.

Occurrence No.	General Location	Property Owner	Percent Cover	Class[1]	Proposed Treatment[2]
Barbed goatgrass (*Aegilops triuncialis*)					
283	Recreation Bay	TID/MID	Concentrated	I	Herbicide application.
668	Sixbit Gulch	BLM	Diffuse	I	Herbicide application.
669	Sixbit Gulch	BLM and Private	Diffuse	III	Herbicide application, excepting hand/ mechanical treatment only where within 50 feet of ESA/CESA-listed plant occurrence.
961	Poor Man's Gulch	BLM	Concentrated	I	Herbicide application.
963	Poor Man's Gulch	BLM	Diffuse	IV	Hand/ mechanical treatment only where within 50 feet of ESA/CESA-listed plant occurrence.
Smooth distaff thistle (*Carthamus creticus*)					
109	Kanaka Point	TID/MID	Diffuse	II	Herbicide application, excepting hand/mechanical treatment only where within 50 feet of ESA/CESA-listed plant occurrence.
216	Kanaka Point	BLM	Concentrated	I	
229	Kanaka Point	TID/MID	Concentrated	I	
239	Kanaka Point	TID/MID	Concentrated	I	
248	Jacksonville Rd.	TID/MID	Diffuse	I	
249	Jacksonville Rd.	TID/MID	Concentrated	I	
250	Jacksonville Rd.	BLM, TID/MID	Concentrated	III	

Occurrence No.	General Location	Property Owner	Percent Cover	Class[1]	Proposed Treatment[2]
		and Private			
251	Jacksonville Rd.	BLM	Concentrated	I	
266	Moccasin Point Recreation Area	BLM	Diffuse	I	
268	Moccasin Point Recreation Area	BLM	Diffuse	I	
269	Moccasin Point Recreation Area	BLM	Diffuse	II	
270	Jacksonville Rd.	TID/MID	Diffuse	I	
285	Woods Creek Arm	TID/MID	Diffuse	I	
671	Kanaka Point	TID/MID	Concentrated	I	
672	Kanaka Point	TID/MID	Concentrated	I	
Tamarisk (*Tamarix* sp.)					
259	Moccasin Point Recreation Area	TID/MID	Concentrated	I	Mechanical removal of single plant.

1 Class I: 0-0.1 acre, Class II: 0.1-0.25 acre, Class III: 0.25-4.0 acres, Class IV: >4.0 acres
2 Specific herbicides, application rates, frequency, and timing will be developed upon implementation of the Plan.

3.0 SPECIAL-STATUS PLANTS

The Districts' proposed special-status plant monitoring and protection measures are provided below for all BLM-administered lands and lands under the Districts' ownership within the Project Boundary. For the purposes of the Draft Vegetation Management Plan, special-status plants are those species that are any of the following:

- found on BLM-managed lands and listed by the BLM as Sensitive Species (BLM-S),
- listed as threatened or endangered under the Endangered Species Act (ESA), including as Proposed or a Candidate for listing as endangered or threatened species,
- listed as threatened or endangered under the State of California Endangered Species Act (CESA), including those proposed for listing, or
- included on the California Department of Fish and Wildlife's list of California Rare species listed under the Native Species Plant Protection Act of 1977.

3.1 Special-status Plant Monitoring

Beginning in the second year of license issuance and every fifth year thereafter, known occurrences of ESA-listed special-status plant species on BLM-administered lands and lands under the Districts' ownership will be located and observed for monitoring purposes. At each located occurrence, surveyors will record data required for completion of California Natural Diversity Database forms, including sensitive plant species composition, GPS-determined location, relative abundance, phenology, habitat description, habitat condition, observable threats, and noxious weed presence. Data from survey efforts will be provided to the BLM in the biennial report as part of agency consultation (see below).

Additional monitoring or site-specific management efforts may be considered if monitoring or other data indicate substantial species decline, specific potential for Don Pedro Project effects on special-status plants, or a need to evaluate individual activities. Any such efforts will be developed in coordination with the BLM during biennial consultation efforts.

3.2 Special-status Plant Protection

The Districts will consult with the BLM to develop specific usage plans for areas surrounding known occurrences of special-status plants with the potential for being directly affected by activities within the Project Boundary (Table 3.2-1). Until specific usage plans are developed, these occurrences will be excluded from routine Don Pedro Project activities.

In addition to these efforts, site-specific surveys for special-status plants will be conducted prior to new ground-disturbing activities affecting more than 0.5 acre, if such surveys are determined to be warranted during pre-activity review and consultation with the BLM.

Table 3.2-1. Special-status plant occurrences with the potential to be affected by Don Pedro Project activities.

Occurrence No.	General Location	Property Owner	Plant Count	Location of Occurrence
Red Hills onion (*Allium tuolumnense*)				
88	Moccasin Point Recreation Area	BLM	50-75	Proximate to road
Mariposa clarkia (*Clarkia biloba* ssp. *australis*)				
83	Moccasin Point Recreation Area	TID/MID	18	Recreation area
84	Moccasin Point Recreation Area	TID/MID	>100	Burn pile and recreation area
92	Moccasin Point Recreation Area	BLM	±200	Proximate to road in recreation area
369	Rogers Creek Arm	TID/MID	500	Proximate to road
373	Rogers Creek Arm	TID/MID	30	Proximate to road
378	Rogers Creek Arm	TID/MID	±1000	Proximate to road
385	Rogers Creek Arm	TID/MID	3000	Proximate to road
386	Rogers Creek Arm	TID/MID	500	Proximate to road
Mariposa cryptantha (*Cryptantha mariposae*)				
86	Moccasin Point Recreation Area	BLM	1000	Within storage area

4.0 VELB HOST PLANT GUIDELINES

The Districts will follow U.S. Department of the Interior, Fish and Wildlife Service (USFWS) Conservation Guidelines for management of VELB and VELB host plants (elderberry [*Sambucus* sp.]) within the Project Boundary (Attachment B). These guidelines direct practitioners to avoid and protect VELB host plants whenever possible. The guidelines further state that "complete avoidance (i.e., no adverse effects) can be assumed when a 100-foot (or wider) buffer is established and maintained around elderberry plants containing stems measuring 1.0 inch or greater in diameter at ground level." Accordingly, the Districts will not engage in ground disturbing activities within 100 ft of a VELB host plant (as mapped during relicensing studies and updated during periodic consultation) without prior authorization from the USFWS.

5.0 BIENNIAL ACTIVITIES AND CONSULTATION

5.1 Employee and Contractor Training

Beginning the second calendar year after license issuance, the Districts will provide for biennial (once every two years) environmental training for staff and contractors working on the Don Pedro Project. The training will be designed to familiarize the Districts' and DPRA staff and contractors with the components and requirements of the Draft Vegetation Management Plan, including identification of special-status plants and noxious weeds, planned management activities, and reporting procedures. At minimum, the training will include information on the following:

- recognition of special-status plants,
- recognition of high-priority noxious weed species (based on guidelines described above),
- noxious weed prevention guidelines,
- planned management activities in the coming two years, and
- reporting procedures for special-status plants and noxious weeds.

5.2 Agency Consultation

Beginning the second calendar year after license issuance, the Districts will provide a written report or otherwise consult biennially with the BLM and other resource agencies regarding the Draft Vegetation Management Plan. During this consultation, the Districts will notify the BLM of all planned Vegetation Management Plan activities to be conducted in the coming two years, and will provide the results of prior activities. Additionally, the Districts will specify whether O&M activities are planned within 100 ft of a known special-status plant or VELB host plant occurrence.

5.3 List Review

Beginning the second calendar year after license issuance, the Districts will biennially review current resource agency lists of special-status plants potentially occurring within the Project Boundary. In the event a species is newly listed, the Districts will confer with the appropriate resource agency to determine if the species or un-surveyed suitable habitat for the species is likely to occur on BLM-administered lands affected by Don Pedro Project-related operations or maintenance activities, or on lands affected by ground-disturbing activities planned in the next two-year period. In that event, the Districts will conduct an assessment of the potential for the species to be affected planned maintenance or other ground-disturbing activities, and to recommend appropriate surveys or resource protection measures. Assessment results and findings will be included in the Districts' biennial agency consultation efforts.

Additionally, beginning the second calendar year after license issuance, the Districts will biennially review BLM and CDFA noxious weed lists. In the event a noxious weed species is newly added to the BLM list and is also a CDFA A- or B-listed noxious weed, the Districts will conduct an assessment of the potential for the species to occur or invade lands in the Project Boundary, and to recommend appropriate surveys or resource protection measures. Assessment results and findings will be included in the Districts' biennial agency consultation report.

DRAFT VEGETATION MANAGEMENT PLAN

ATTACHMENT A

BLM MANUAL HANDBOOK-1745-1, USE OF NATIVE PLANT MATERIALS IN CALIFORNIA

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
CALIFORNIA STATE OFFICE
MANUAL TRANSMITTAL SHEET

Release: 1-243

Date: 09/13/2001

Subject: H- 1745 -1 - Native Plant Materials Handbook

1. Explanation of Material Transmitted: This release transmits the Bureau of Land Management's (BLM) CA-Handbook-Use of Native Plant Materials in California. It provides policy and guidance specific to the use of native plant and plant seed in restoration and other revegetation projects, to ensure the preservation of healthy and productive ecosystems. It directs the use of local plant materials for vegetation projects whenever feasible and appropriate, and gives guidance on improved techniques for native plant restoration. It also provides guidance to prevent the introduction of undesirable vegetation, while emphasizing the use of local genetic composition when restoring native plant communities

2. Reports Required: None

3. Materials Superseded: None

4. Filing Instructions: File as directed below.

REMOVE:	INSERT: Release 1-243
None	H-1745
	(Total: 8 sheets, double-sided)

James Wesley Abbott

State Director

USE OF NATIVE PLANT MATERIALS IN CALIFORNIA

Festuca californica Photo By: G.F. Hrusa, Ca. Dept. of Food and Ag

BLM MANUAL HANDBOOK-1745 -1

H-1745-1-NATIVE PLANT MATERIALS HANDBOOK

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H-1745-1-NATIVE PLANT MATERIALS HANDBOOK

CHAPTER I

I. INTRODUCTION

This handbook provides direction on the use of native plants and plant seed in restoration and other revegetation projects. The maintenance of diverse native plant communities on a long-term basis is an essential part of preserving ecosystem health and productivity, and the introduction of persistent non-native plants is clearly contrary to this goal. The handbook expands on the policy elaborated in California BLM Manual Supplement 1745 and establishes the procedures to be used in complying with that policy.

Whenever plant materials are used in management activities such as erosion control, water quality, or restoration projects (including reclamation and rehabilitation), consideration needs to be given to long-term plant community stability and integrity. The selection of genetically appropriate native seeds and plants which achieve the purpose of the planting is therefore a concern. These guidelines establish policy on the use of native plant materials on BLM lands under the jurisdiction of the California State Office.

H-1745-1-NATIVE PLANT MATERIALS HANDBOOK

CHAPTER II

II. GENERAL GUIDELINES

A. Planning Stage:

1. Vegetation projects must be planned and evaluated early - preferably several years before the project start date. Seed set may not occur every year, or it may be sparse, so seed collection and stockpiling should begin as early as possible. If nursery grown seedlings are required, allow plenty of time for seed stratification and growing out. Early consideration should also be given to soil stockpiling, erosion control methods, and on-site planting and maintenance activities.

2. Determine the purpose of the planting and set your revegetation goals. If the disturbance has not yet occurred, take measurements of plant composition, density, and cover. Use soil surveys, if available, and look at soil series and ecological sites within the project area as well as the potential natural communities of the site. If this baseline information is not available for the project area, try to find a reference area that is undisturbed and ecologically similar to the project area. Decide what sort of progress can realistically be made toward the desired plant community, and what time-scale you will use to measure progress reports being used to record methodology and results.

3. Determine the desired plant species, the collection method (seeds or cuttings), the amount needed, and the planting method (seeding or transplanting). If nursery services are required, keep in mind that some nurseries require a year or more advance notification.

4. Determine through literature review and personal contacts techniques applicable to the life form you are collecting material from, transplanting, and/or seeding.

5. Develop quality standards for collecting, storing, growing, and outplanting.

6. Develop plans for long-term maintenance and yearly monitoring of the restored area.

7. Develop a contingency plan in case the plant materials become unavailable or fail to survive in the field. Seed availability may be a limiting factor for some species, so several different species should be considered. It is wise to try a variety of restoration methods to increase the odds of success and to determine the best overall method.

8. Maintain an ongoing stock of seed or vegetative materials from frequently used local species in each elevation band within a subsection (see II.D.1, below) if possible, in order to aid in the success of unexpected restoration projects. Meticulous records must be kept on the source

of all materials. A central collection facility may be more advantageous if the source areas are carefully controlled and monitored.

B. Project Review:

All restoration planning efforts must include coordination with Field Office Restoration Coordinators to ensure that the project is feasible and the appropriate plants and methods are used. Coordination with State Office Restoration Coordinators and knowledgeable individuals in other Federal and State agencies and the academic community is also highly desirable.

C. Natural Regeneration:

If there is an ample seed source and suitable conditions, natural regeneration should be encouraged. Topsoil should be salvaged and re-spread if possible, as native seeds and microbiota can often be preserved (if storage length is limited). Erosion control can often be achieved in the interim stage through the use of weed-free mulches such as native grass straw, barley straw, rice hulls, bark, and almond shells.

D. Plant Material Collection:

1. Local Plant Source: To the maximum extent possible, seeds and plants used in restoration, erosion control, fire rehabilitation, forage enhancement, and other projects shall originate from local sources. Local sources often possess genotypes that are adapted to the local environment, leading to higher short-term and long-term success rates. "Local" refers to sources within or as close as possible to the project area and within the same subsection (as shown on the Ecological Units of California map; see definitions), and elevation band (within 500') as the project area. Collections should also be made within the same vegetation series and general soil type.

If the plant population is known to be genetically rare, occurs on an unusual soil (e.g., serpentine), is found in an extreme environment (high temperature, low precipitation, etc.), or has distinct morphological characteristics that may be genetically based, then seeds/cuttings shall only be taken from these local variants. For example, a restoration effort on serpentine soil would use only seeds/cuttings collected on serpentine soil from within the same subsection and elevation band. In addition, disjunct plant populations may be genetically distinct and seeds/cuttings should be taken from within the disjunct population. Riparian species should be collected from riparian areas immediately upstream or downstream, or within sub-watersheds within the same subsection and at similar elevations. If a locally rare species is desired for use in revegetation and can only be collected from the wild, consider whether the local populations can support the impacts of collecting seed or propagules.

These guidelines can and should be tailored to individual species. Variation observed within a species is not always due to population differences; it could be a result of individual plant differences, individual seed differences (from the same plant), and collection date differences. The use of common gardens, outplantings, and genetic analysis can be helpful in determining the presence and distribution of ecotypes, and should be done by experienced personnel. Large phenotypic plasticity would indicate that wide seed collection zones would be allowable, while large genetic variability would indicate the use of local ecotypes. Research on the genetic variability of commonly used revegetation species is therefore recommended and encouraged. (Extreme caution should be used in interpreting the results of 1) an isozyme study alone or 2) poorly researched taxa.) As ecotype information becomes available, restoration coordinators should develop seed collection "eco-zones" that will be incorporated into future versions of this policy.

2. Semi-local Plant Source: If sufficient numbers of widely-spaced source plants are unavailable within the same subsection, additional collection should occur in several well distributed sub-populations that have similar environments and are within adjacent subsections within the same section as the project area. Semi-local collection sites should be matched carefully to the project area in terms of elevation, vegetation series, aspect, slope, rainfall, annual temperature patterns, frost dates, and soil type. If plant materials are not available within the same section, consider postponing the project until native sources become available.

3. General: Try to use several (~ 50 or more) unrelated (spaced at least 1/4 mile apart) source plants within the collection area in order to maximize genetic diversity. Collect in areas that match the ecological characteristics of the project area. Only use healthy source plants. Collect seed when it is mature and still on the plant (if possible). For those plants that disperse their seed quickly at maturity, spreading sheets beneath the parent plant is advised. Obtain cuttings at the appropriate time of year and from material that is not too soft. Rapidly growing soft tissue is high in nitrogen and will not produce the auxins needed to root as opposed to more mature, woodier tissue that contains higher ratios of stored carbohydrates. Try to collect an equal number of seeds/cuttings from each source plant. Document the location of all source populations, track the plant materials taken from each population until they reach the field, and monitor the performance of each collection over time. This applies to commercial sources as well. When contracting out for seed collection, make sure the collector is well known, knowledgeable, and respected, and only pay for pounds of PURE LIVE SEED. If collected seeds are grown out in a nursery, make sure that the contract states that the seeds are government property, and cannot be used for commercial purposes. No federally-listed or proposed species shall be used for revegetation without proper coordination with the Fish and Wildlife Service. Consult with the California Department of Fish and Game if state-listed species are being considered for use.

E. Commercial Sources:

If local or semi-local plant sources are unavailable, commercial sources of native plants may be used. Plant materials should be bred and/or grown under environmental conditions that are similar to the project area. Ideally, plant sources should be within the same section as the project area. Plant materials should only be moved from one section to another after careful evaluation. Only use commercial sources if the genetic origin is known. Above all, make sure to ask seed companies where the seed was collected, instead of telling them where you need it from! Be sure that nursery produced native seed was not grown under conditions that could have allowed hybridization with other species or other collections of the same species. Commercial sources should be used as an interim measure, using short-lived species, while adequate supplies of local or semi-local plant materials are being collected or grown.

F. Non-Natives:

Although native plants should always be given first consideration, there are certain situations where non-natives may be desired. For example, on highly disturbed sites that have had their physical characteristics altered so that native vegetation can no longer survive, it may be necessary to use non-natives to help restore site stability. Other examples that have been cited include noxious weed control and emergency situations. In cases where the use of non-native vegetation is desired, a justification shall be submitted for approval by the State Director (as outlined in BLM Manual 1745 - Introduction, Transplant, Augmentation, and Reestablishment of Fish, Wildlife, and Plants). All non-native vegetation used should be non-invasive and ideally be short-lived, have low reproductive capabilities, or be self-pollinating in order to prevent gene flow into the native community. One good example is sterile oats, which provide erosion control and will fade out in one year without cultivation (although they do release seed if disturbed). Non-native vegetation should not compete with the naturally occurring native plant community, invade plant communities outside the target area, persist in the target ecosystem over the long term, or exchange genetic material with local native plant species. One approach to selecting such species may be to use genera that do not occur in the target area as there is less likelihood of genetic exchange between genera than between species within a genus. The use of non-natives should be considered as an interim measure only, while local or semi-local sources are developed. Cultivars of native plants produced outside of California require the same justification as non-natives. Non-natives listed in the Department of Food and Agriculture's Noxious Weed Species list or the California Exotic Pest Plant Council's list of wildland weeds shall not be considered for use under any circumstances.

G. Seed Quality:

All seeds/plants used for BLM projects shall be tested for weeds, pests and diseases, and shall be processed, stored, and conditioned properly. Due to the threat of complete project failure, 0% weed species and other crop species is required in seed mixtures (see BLM Manual 9015 - Integrated Weed Management). However, if it can be shown that a certain percent of contamination of a weed species or other crop species does not interfere with native plant establishment and is not persistent in the environment, then this level will be raised on a species basis.

H. Seed Storage:

Seed storage requirements are highly variable for each species. Generally, each 1% reduction in seed moisture and each 10 ° F reduction in seed temperature doubles the life of the seed. If you wish to store the seeds for 3-5 years at ambient temperatures, dry the seeds to between 5-8% moisture content before tightly sealing in durable containers. For longer storage, dry to 2.5-5% moisture. Make sure you properly label each container with information on species, location of source plant, environmental information, date of collection, and the collector, as a minimum.

I. Planting and Maintenance:

1. If direct seeding, consider using pits or imprinted areas to improve germination, mulches to improve survival, and cracked wheat to reduce granivory. High seeding rates are usually recommended, since direct seeding success rates are lower than transplanting.

2. If transplanting, consider using a variety of container sizes, and try to transplant quickly (preferably in one day). If containers are limited, place more near the windward side of the project area to maximize effectiveness.

3. Plant at an optimal time - usually at the start of the rainy season. A knowledgeable restoration specialist should be consulted if irrigation will be necessary.

4. Permits for projects involving restoration must contain a requirement for maintenance and monitoring of the restored area.

5. Track the success or failure of all restoration projects. An annual report on the status of all restoration projects is required. Even failed efforts yield useful information.

H-1745-1-NATIVE PLANT MATERIALS HANDBOOK

CHAPTER III

III. ANNUAL REVIEW

This policy will be reviewed by Field Office and State Restoration coordinators on at least an annual basis, at which time the annual reports will be reviewed as well. The current guidelines for seed collection zones and seed purity are general, and future revisions will be needed to outline regional or species-specific standards.

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CHAPTER IV

IV. DEFINITIONS

Ecological Units of California: Map developed by the Forest Service and Natural Resource Conservation Service in 1994. Subsection units have similar surficial geology. lithology, geomorphic process, soil groups. Subregional climate, and potential natural communities.

Exotic or Non-native Species: One that was introduced through human activity.

Genetically Local Source: Plant material that originated at or within the same subsection and elevation band as the project site.

Native Plant: One that occurs and has evolved naturally in California, and in the project area, as determined by climate, soil, and biotic factors, and that was not introduced by human activity.

Revegetation: A general term for renewing the vegetation on a project site, which may include restoration and rehabilitation.

Stand: Aggregation of individual plants separated rom other such aggregations so that cross fertilization rarely occurs (if at all).

Undesirable Plant: May be a non-native species, non-adapted source, genetically changed through selection in a foreign dissimilar environment, or possesses trait(s) that conflict with accomplishment of objectives.

DRAFT VEGETATION MANAGEMENT PLAN

ATTACHMENT B

CONSERVATION GUIDELINES FOR THE VALLEY ELDERBERRY LONGHORN BEETLE

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825

Conservation Guidelines for the Valley Elderberry Longhorn Beetle
9 July 1999

The following guidelines have been issued by the U.S. Fish and Wildlife Service (Service) to assist Federal agencies and non-federal project applicants needing incidental take authorization through a section 7 consultation or a section 10(a)(1)(B) permit in developing measures to avoid and minimize adverse effects on the valley elderberry longhorn beetle. The Service will revise these guidelines as needed in the future. The most recently issued version of these guidelines should be used in developing all projects and habitat restoration plans. The survey and monitoring procedures described below are designed to avoid any adverse effects to the valley elderberry longhorn beetle. Thus a recovery permit is not needed to survey for the beetle or its habitat or to monitor conservation areas. If you are interested in a recovery permit for research purposes please call the Service's Regional Office at (503) 231-2063.

Background Information

The valley elderberry longhorn beetle (Desmocerus californicus dimorphus), was listed as a threatened species on August 8, 1980 (Federal Register 45: 52803-52807). This animal is fully protected under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). The valley elderberry longhorn beetle (beetle) is completely dependent on its host plant, elderberry (Sambucus species), which is a common component of the remaining riparian forests and adjacent upland habitats of California's Central Valley. Use of the elderberry by the beetle, a wood borer, is rarely apparent. Frequently, the only exterior evidence of the elderberry's use by the beetle is an exit hole created by the larva just prior to the pupal stage. The life cycle takes one or two years to complete. The animal spends most of its life in the larval stage, living within the stems of an elderberry plant. Adult emergence is from late March through June, about the same time the elderberry produces flowers. The adult stage is short-lived. Further information on the life history, ecology, behavior, and distribution of the beetle can be found in a report by Barr (1991) and the recovery plan for the beetle (USFWS 1984).

Surveys

Proposed project sites within the range of the valley elderberry longhorn beetle should be surveyed for the presence of the beetle and its elderberry host plant by a qualified biologist. The beetle's range extends throughout California's Central Valley and associated foothills from about the 3,000-foot elevation contour on the east and the watershed of the Central Valley on the west (Figure 1). All or portions of 31 counties are included: Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Fresno, Glenn, Kern, Kings, Lake, Madera, Mariposa, Merced, Napa, Nevada, Placer, Sacramento, San Benito, San Joaquin, San Luis Obispo, Shasta, Solano, Stanislaus, Sutter, Tehama, Tulare, Tuolumne, Yolo, Yuba.

If elderberry plants with one or more stems measuring 1.0 inch or greater in diameter at ground level occur on or adjacent to the proposed project site, or are otherwise located where they may be directly or indirectly affected by the proposed action, minimization measures which include planting replacement habitat (conservation planting) are required (Table 1).

All elderberry shrubs with one or more stems measuring 1.0 inch or greater in diameter at ground level that occur on or adjacent to a proposed project site must be thoroughly searched for beetle exit holes (external evidence of beetle presence). In addition, all elderberry stems one inch or greater in diameter at ground level must be tallied by diameter size class (Table 1). As outlined in Table 1, the numbers of elderberry seedlings/cuttings and associated riparian native trees/shrubs to be planted as replacement habitat are determined by stem size class of affected elderberry shrubs, presence or absence of exit holes, and whether a proposed project lies in a riparian or non-riparian area.

Elderberry plants with no stems measuring 1.0 inch or greater in diameter at ground level are unlikely to be habitat for the beetle because of their small size and/or immaturity. Therefore, no minimization measures are required for removal of elderberry plants with no stems measuring 1.0 inch or greater in diameter at ground level with no exit holes. Surveys are valid for a period of two years.

Avoid and Protect Habitat Whenever Possible

Project sites that do not contain beetle habitat are preferred. If suitable habitat for the beetle occurs on the project site, or within close proximity where beetles will be affected by the project, these areas must be designated as avoidance areas and must be protected from disturbance during the construction and operation of the project. When possible, projects should be designed such that avoidance areas are connected with adjacent habitat to prevent fragmentation and isolation of beetle populations. Any beetle habitat that cannot be avoided as described below should be considered impacted and appropriate minimization measures should be proposed as described below.

Avoidance: Establishment and Maintenance of a Buffer Zone

Complete avoidance (i.e., no adverse effects) may be assumed when a 100-foot (or wider) buffer is established and maintained around elderberry plants containing stems measuring 1.0 inch or greater in diameter at ground level. Firebreaks may not be included in the buffer zone. In buffer areas construction-related disturbance should be minimized, and any damaged area should be promptly restored following construction. The Service must be consulted before any disturbances within the buffer area are considered. In addition, the Service must be provided with a map identifying the avoidance area and written details describing avoidance measures.

Protective Measures

1. Fence and flag all areas to be avoided during construction activities. In areas where encroachment on the 100-foot buffer has been approved by the Service, provide a minimum setback of at least 20 feet from the dripline of each elderberry plant.

2. Brief contractors on the need to avoid damaging the elderberry plants and the possible penalties for not complying with these requirements.

3. Erect signs every 50 feet along the edge of the avoidance area with the following information: "This area is habitat of the valley elderberry longhorn beetle, a threatened species, and must not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to prosecution, fines, and imprisonment." The signs should be clearly readable from a distance of 20 feet, and must be maintained for the duration of construction.

4. Instruct work crews about the status of the beetle and the need to protect its elderberry host plant.

Restoration and Maintenance

1. Restore any damage done to the buffer area (area within 100 feet of elderberry plants) during construction. Provide erosion control and re-vegetate with appropriate native plants.

2. Buffer areas must continue to be protected after construction from adverse effects of the project. Measures such as fencing, signs, weeding, and trash removal are usually appropriate.

3. No insecticides, herbicides, fertilizers, or other chemicals that might harm the beetle or its host plant should be used in the buffer areas, or within 100 feet of any elderberry plant with one or more stems measuring 1.0 inch or greater in diameter at ground level.

4. The applicant must provide a written description of how the buffer areas are to be restored, protected, and maintained after construction is completed.

5. Mowing of grasses/ground cover may occur from July through April to reduce fire hazard. No mowing should occur within five (5) feet of elderberry plant stems. Mowing must be done in a manner that avoids damaging plants (e.g., stripping away bark through careless use of mowing/trimming equipment).

Transplant Elderberry Plants That Cannot Be Avoided

Elderberry plants must be transplanted if they can not be avoided by the proposed project. All elderberry plants with one or more stems measuring 1.0 inch or greater in diameter at ground level must be transplanted to a conservation area (see below). At the Service's discretion, a plant that is unlikely to survive transplantation because of poor condition or location, or a plant that would be extremely difficult to move because of access problems, may be exempted from transplantation. In cases where transplantation is not possible the minimization ratios in Table 1 may be increased to offset the additional habitat loss.

Trimming of elderberry plants (e.g., pruning along roadways, bike paths, or trails) with one or more stems 1.0 inch or greater in diameter at ground level, may result in take of beetles. Therefore, trimming is subject to appropriate minimization measures as outlined in Table 1.

1. Monitor. A qualified biologist (monitor) must be on-site for the duration of the transplanting of the elderberry plants to insure that no unauthorized take of the valley elderberry longhorn beetle occurs. If unauthorized take occurs, the monitor must have the authority to stop work until corrective measures have been completed. The monitor must immediately report any unauthorized take of the beetle or its habitat to the Service and to the California Department of Fish and Game.

2. Timing. Transplant elderberry plants when the plants are dormant, approximately November through the first two weeks in February, after they have lost their leaves. Transplanting during the non-growing season will reduce shock to the plant and increase transplantation success.

3. Transplanting Procedure.

    a. Cut the plant back 3 to 6 feet from the ground or to 50 percent of its height (whichever is taller) by removing branches and stems above this height. The trunk and all stems measuring 1.0 inch or greater in diameter at ground level should be replanted. Any leaves remaining on the plant should be removed.

b. Excavate a hole of adequate size to receive the transplant.

c. Excavate the plant using a Vemeer spade, backhoe, front end loader, or other suitable equipment, taking as much of the root ball as possible, and replant immediately at the conservation area. Move the plant only by the root ball. If the plant is to be moved and transplanted off site, secure the root ball with wire and wrap it with burlap. Dampen the burlap with water, as necessary, to keep the root ball wet. Do not let the roots dry out. Care should be taken to ensure that the soil is not dislodged from around the roots of the transplant. If the site receiving the transplant does not have adequate soil moisture, pre-wet the soil a day or two before transplantation.

d. The planting area must be at least 1,800 square feet for each elderberry transplant. The root ball should be planted so that its top is level with the existing ground. Compact the soil sufficiently so that settlement does not occur. As many as five (5) additional elderberry plantings (cuttings or seedlings) and up to five (5) associated native species plantings (see below) may also be planted within the 1,800 square foot area with the transplant. The transplant and each new planting should have its own watering basin measuring at least three (3) feet in diameter. Watering basins should have a continuous berm measuring approximately eight (8) inches wide at the base and six (6) inches high.

e. Saturate the soil with water. Do not use fertilizers or other supplements or paint the tips of stems with pruning substances, as the effects of these compounds on the beetle are unknown.

f. Monitor to ascertain if additional watering is necessary. If the soil is sandy and well-drained, plants may need to be watered weekly or twice monthly. If the soil is clayey and poorly-drained, it may not be necessary to water after the initial saturation. However, most transplants require watering through the first summer. A drip watering system and timer is ideal. However, in situations where this is not possible, a water truck or other apparatus may be used.

Plant Additional Seedlings or Cuttings

Each elderberry stem measuring 1.0 inch or greater in diameter at ground level that is adversely affected (i.e., transplanted or destroyed) must be replaced, in the conservation area, with elderberry seedlings or cuttings at a ratio ranging from 1:1 to 8:1 (new plantings to affected stems). Minimization ratios are listed and explained in Table 1. Stock of either seedlings or cuttings should be obtained from local sources. Cuttings may be obtained from the plants to be transplanted if the project site is in the vicinity of the conservation area. If the Service determines that the elderberry plants on the proposed project site are unsuitable candidates for transplanting, the Service may allow the applicant to plant seedlings or cuttings at higher than the stated ratios in Table 1 for each elderberry plant that cannot be transplanted.

Plant Associated Native Species

Studies have found that the beetle is more abundant in dense native plant communities with a mature overstory and a mixed understory. Therefore, a mix of native plants associated with the elderberry plants at the project site or similar sites will be planted at ratios ranging from 1:1 to 2:1 [native tree/plant species to each elderberry seedling or cutting (see Table 1)]. These native plantings must be monitored with the same survival criteria used for the elderberry seedlings (see below). Stock of saplings, cuttings, and seedlings should be obtained from local sources. If the parent stock is obtained from a distance greater than one mile from the conservation area, approval by the Service of the native plant donor sites must be obtained prior to initiation of the revegetation work. Planting or seeding the conservation area with native herbaceous species is encouraged. Establishing native grasses and forbs may discourage unwanted non-native species from becoming established or persisting at the conservation area. Only stock from local sources should be used.

Examples

Example 1
The project will adversely affect beetle habitat on a vacant lot on the land side of a river levee. This levee now separates beetle habitat on the vacant lot from extant Great Valley Mixed Riparian Forest (Holland 1986) adjacent to the river. However, it is clear that the beetle habitat located on the vacant lot was part of a more extensive mixed riparian forest ecosystem extending farther from the river's edge prior to agricultural development and levee construction. Therefore, the beetle habitat on site is considered riparian. A total of two elderberry plants with at least one stem measuring 1.0 inch or greater in diameter at ground level will be affected by the proposed action. The two plants have a total of 15 stems measuring over 1.0 inch. No exit holes were found on either plant. Ten of the stems are between 1.0 and 3.0 inches in diameter and five of the stems are greater than 5.0 inches in diameter. The conservation area is suited for riparian forest habitat. Associated natives adjacent to the conservation area are box elder (Acer negundo californica), walnut (Juglans californica var. hindsii), sycamore (Platanus racemosa), cottonwood (Populus fremontii), willow (Salix gooddingii and S. laevigata), white alder (Alnus rhombifolia), ash (Fraxinus latifolia), button willow (Cephalanthus occidentalis), and wild grape (Vitis californica).

Minimization (based on ratios in Table 1):

- Transplant the two elderberry plants that will be affected to the conservation area.

- Plant 40 elderberry rooted cuttings (10 affected stems compensated at 2:1 ratio and 5 affected stems compensated at 4:1 ratio, cuttings planted:stems affected)

- Plant 40 associated native species (ratio of associated natives to elderberry plantings is 1:1 in areas with no exit holes):
  - 5 saplings each of box elder, sycamore, and cottonwood
  - 5 willow seedlings
  - 5 white alder seedlings
  - 5 saplings each of walnut and ash
  - 3 California button willow
  - 2 wild grape vines
  - Total: 40 associated native species

- Total area required is a minimum of 1,800 sq. ft. for one to five elderberry seedlings and up to 5 associated natives. Since, a total of 80 plants must be planted (40 elderberries and 40 associated natives), a total of 0.33 acre (14,400 square feet) will be required for conservation plantings. The conservation area will be seeded and planted with native grasses and forbs, and closely monitored and maintained throughout the monitoring period.

Example 2
The project will adversely affect beetle habitat in Blue Oak Woodland (Holland 1986). One elderberry plant with at least one stem measuring 1.0 inch or greater in diameter at ground level will be affected by the proposed action. The plant has a total of 10 stems measuring over 1.0 inch. Exit holes were found on the plant. Five of the stems are between 1.0 and 3.0 inches in diameter and five of the stems are between 3.0 and 5.0 inches in diameter. The conservation area is suited for elderberry savanna (non-riparian habitat). Associated natives adjacent to the conservation area are willow (Salix species), blue oak (Quercus douglasii), interior live oak (Q. wislizenii), sycamore, poison oak (Toxicodendron diversilobum), and wild grape.

Minimization (based on ratios in Table 1):

- Transplant the one elderberry plant that will be affected to the conservation area.

- Plant 30 elderberry seedlings (5 affected stems compensated at 2:1 ratio and 5 affected stems compensated at 4:1 ratio, cuttings planted:stems affected)

• Plant 60 associated native species (ratio of associated natives to elderberry plantings is 2:1 in areas with exit holes):

20 saplings of blue oak, 20 saplings of sycamore, and 20 saplings of willow, and seed and plant with a mixture of native grasses and forbs

• Total area required is a minimum of 1,800 sq. ft. for one to five elderberry seedlings and up to 5 associated natives. Since, a total of 90 plants must be planted (30 elderberries and 60 associated natives), a total of 0.37 acre (16,200 square feet) will be required for conservation plantings. The conservation area will be seeded and planted with native grasses and forbs, and closely monitored and maintained throughout the monitoring period.

Conservation Area—Provide Habitat for the Beetle in Perpetuity

The conservation area is distinct from the avoidance area (though the two may adjoin), and serves to receive and protect the transplanted elderberry plants and the elderberry and other native plantings. The Service may accept proposals for off-site conservation areas where appropriate.

1. Size. The conservation area must provide at least 1,800 square feet for each transplanted elderberry plant. As many as 10 conservation plantings (i.e., elderberry cuttings or seedlings and/or associated native plants) may be planted within the 1800 square foot area with each transplanted elderberry. An additional 1,800 square feet shall be provided for every additional 10 conservation plants. Each planting should have its own watering basin measuring approximately three feet in diameter. Watering basins should be constructed with a continuous berm measuring approximately eight inches wide at the base and six inches high.

   The planting density specified above is primarily for riparian forest habitats or other habitats with naturally dense cover. If the conservation area is an open habitat (i.e., elderberry savanna, oak woodland) more area may be needed for the required plantings. Contact the Service for assistance if the above planting recommendations are not appropriate for the proposed conservation area.

   No area to be maintained as a firebreak may be counted as conservation area. Like the avoidance area, the conservation area should connect with adjacent habitat wherever possible, to prevent isolation of beetle populations.

   Depending on adjacent land use, a buffer area may also be needed between the conservation area and the adjacent lands. For example, herbicides and pesticides are often used on orchards or vineyards. These chemicals may drift or runoff onto the conservation area if an adequate buffer area is not provided.

2. Long-Term Protection. The conservation area must be protected in perpetuity as habitat for the valley elderberry longhorn beetle. A conservation easement or deed restrictions to protect the conservation area must be arranged. Conservation areas may be transferred to a resource agency or appropriate private organization for long-term management. The Service must be provided with a map and written details identifying the conservation area; and the applicant must receive approval from the Service that the conservation area is acceptable prior to initiating the conservation program. A true, recorded copy of the deed transfer, conservation easement, or deed restrictions protecting the conservation area in perpetuity must be provided to the Service before project implementation.

   Adequate funds must be provided to ensure that the conservation area is managed in perpetuity. The applicant must dedicate an endowment fund for this purpose, and designate the party or entity that will be responsible for long-term management of the conservation area. The Service must be provided with written documentation that funding and management of the conservation area (items 3-8 above) will be provided in perpetuity.

3. Weed Control. Weeds and other plants that are not native to the conservation area must be removed at least once a year, or at the discretion of the Service and the California Department of Fish and Game. Mechanical means should be used; herbicides are prohibited unless approved by the Service.

4. Pesticide and Toxicant Control. Measures must be taken to insure that no pesticides, herbicides, fertilizers, or other chemical agents enter the conservation area. No spraying of these agents must be done within one 100 feet of the area, or if they have the potential to drift, flow, or be washed into the area in the opinion of biologists or law enforcement personnel from the Service or the California Department of Fish and Game.

5. Litter Control. No dumping of trash or other material may occur within the conservation area. Any trash or other foreign material found deposited within the conservation area must be removed within 10 working days of discovery.

6. Fencing. Permanent fencing must be placed completely around the conservation area to prevent unauthorized entry by off-road vehicles, equestrians, and other parties that might damage or destroy the habitat of the beetle, unless approved by the Service. The applicant must receive written approval from the Service that the fencing is acceptable prior to initiation of the conservation program. The fence must be maintained in perpetuity, and must be repaired/replaced within 10 working days if it is found to be damaged. Some conservation areas may be made available to the public for appropriate recreational and educational opportunities with written approval from the Service. In

these cases appropriate fencing and signs informing the public of the beetle's threatened status and its natural history and ecology should be used and maintained in perpetuity.

7. Signs. A minimum of two prominent signs must be placed and maintained in perpetuity at the conservation area, unless otherwise approved by the Service. The signs should note that the site is habitat of the federally threatened valley elderberry longhorn beetle and, if appropriate, include information on the beetle's natural history and ecology. The signs must be approved by the Service. The signs must be repaired or replaced within 10 working days if they are found to be damaged or destroyed.

Monitoring

The population of valley elderberry longhorn beetles, the general condition of the conservation area, and the condition of the elderberry and associated native plantings in the conservation area must be monitored over a period of either ten (10) consecutive years or for seven (7) years over a 15-year period. The applicant may elect either 10 years of monitoring, with surveys and reports every year; or 15 years of monitoring, with surveys and reports on years 1, 2, 3, 5, 7, 10, and 15. The conservation plan provided by the applicant must state which monitoring schedule will be followed. No change in monitoring schedule will be accepted after the project is initiated. If conservation planting is done in stages (i.e., not all planting is implemented in the same time period), each stage of conservation planting will have a different start date for the required monitoring time.

Surveys. In any survey year, a minimum of two site visits between February 14 and June 30 of each year must be made by a qualified biologist. Surveys must include:

1. A population census of the adult beetles, including the number of beetles observed, their condition, behavior, and their precise locations. Visual counts must be used; mark-recapture or other methods involving handling or harassment must not be used.

2. A census of beetle exit holes in elderberry stems, noting their precise locations and estimated ages.

3. An evaluation of the elderberry plants and associated native plants on the site, and on the conservation area, if disjunct, including the number of plants, their size and condition.

4. An evaluation of the adequacy of the fencing, signs, and weed control efforts in the avoidance and conservation areas.

5. A general assessment of the habitat, including any real or potential threats to the beetle and its host plants, such as erosion, fire, excessive grazing, off-road vehicle use, vandalism, excessive weed growth, etc.

The materials and methods to be used in the monitoring studies must be reviewed and approved by the Service. All appropriate Federal permits must be obtained prior to initiating the field studies.

Reports. A written report, presenting and analyzing the data from the project monitoring, must be prepared by a qualified biologist in each of the years in which a monitoring survey is required. Copies of the report must be submitted by December 31 of the same year to the Service (Chief of Endangered Species, Sacramento Fish and Wildlife Office), and the Department of Fish and Game (Supervisor, Environmental Services, Department of Fish and Game, 1416 Ninth Street, Sacramento, California 95814; and Staff Zoologist, California Natural Diversity Data Base, Department of Fish and Game, 1220 S Street, Sacramento, California 95814). The report must explicitly address the status and progress of the transplanted and planted elderberry and associated native plants and trees, as well as any failings of the conservation plan and the steps taken to correct them. Any observations of beetles or fresh exit holes must be noted. Copies of original field notes, raw data, and photographs of the conservation area must be included with the report. A vicinity map of the site and maps showing where the individual adult beetles and exit holes were observed must be included. For the elderberry and associated native plants, the survival rate, condition, and size of the plants must be analyzed. Real and likely future threats must be addressed along with suggested remedies and preventative measures (e.g. limiting public access, more frequent removal of invasive non-native vegetation, etc.).

A copy of each monitoring report, along with the original field notes, photographs, correspondence, and all other pertinent material, should be deposited at the California Academy of Sciences (Librarian, California Academy of Sciences, Golden Gate Park, San Francisco, CA 94118) by December 31 of the year that monitoring is done and the report is prepared. The Service's Sacramento Fish and Wildlife Office should be provided with a copy of the receipt from the Academy library acknowledging receipt of the material, or the library catalog number assigned to it.

Access. Biologists and law enforcement personnel from the California Department of Fish and Game and the Service must be given complete access to the project site to monitor transplanting activities. Personnel from both these agencies must be given complete access to the project and the conservation area to monitor the beetle and its habitat in perpetuity.

Success Criteria

A minimum survival rate of at least 60 percent of the elderberry plants and 60 percent of the associated native plants must be maintained throughout the monitoring period. Within one year of discovery that survival has dropped below 60 percent, the applicant must replace failed plantings to bring survival above this level. The Service will make any determination as to the applicant's replacement responsibilities arising from circumstances beyond its control, such as plants damaged or killed as a result of severe flooding or vandalism.

Service Contact

These guidelines were prepared by the Endangered Species Division of the Service's Sacramento Fish and Wildlife Office. If you have questions regarding these guidelines or to request a copy of the most recent guidelines, telephone (916) 414-6600, or write to:

U.S. Fish and Wildlife Service
Ecological Services
2800 Cottage Way, W-2605
Sacramento, CA 95825

Figure 1: Range of the Valley Elderberry Longhorn Beetle

Literature Cited

Barr, C. B. 1991. The distribution, habitat, and status of the valley elderberry longhorn beetle Desmocerus californicus dimorphus. U.S. Fish and Wildlife Service; Sacramento, California.

Holland, R.F. 1986. Preliminary descriptions of the terrestrial natural communities of California. Unpublished Report. State of California, The Resources Agency, Department of Fish and Game, Natural Heritage Division, Sacramento, California.

USFWS. 1980. Listing the valley elderberry longhorn beetle as a threatened species with critical habitat. Federal Register 45:52803-52807.

USFWS. 1984. Recovery plan for the valley elderberry longhorn beetle. U.S. Fish and Wildlife Service, Endangered Species Program; Portland, Oregon.

Table 1: Minimization ratios based on location (riparian vs. non-riparian), stem diameter of affected elderberry plants at ground level, and presence or absence of exit holes.

Location	Stems (maximum diameter at ground level)	Exit Holes on Shrub Y/N (quantify)[1]	Elderberry Seedling Ratio[2]	Associated Native Plant Ratio[3]
non-riparian	stems > = 1" & = < 3"	No:	1:1	1:1
		Yes:	2:1	2:1
non-riparian	stems > 3" & < 5"	No:	2:1	1:1
		Yes:	4:1	2:1
non-riparian	stems >= 5"	No:	3:1	1:1
		Yes:	6:1	2:1
riparian	stems > = 1" & = < 3"	No:	2:1	1:1
		Yes:	4:1	2:1
riparian	stems > 3" & < 5"	No:	3:1	1:1
		Yes:	6:1	2:1
riparian	stems > = 5"	No:	4:1	1:1
		Yes:	8:1	2:1

[1] All stems measuring one inch or greater in diameter at ground level on a single shrub are considered occupied when exit holes are present anywhere on the shrub.

[2] Ratios in the *Elderberry Seedling Ratio* column correspond to the number of cuttings or seedlings to be planted per elderberry stem (one inch or greater in diameter at ground level) affected by a project.

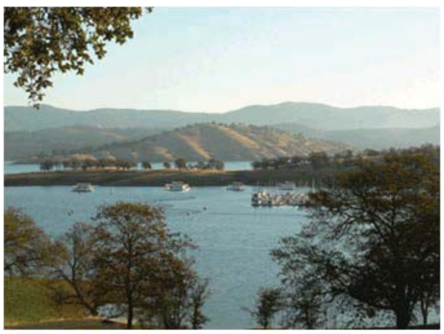
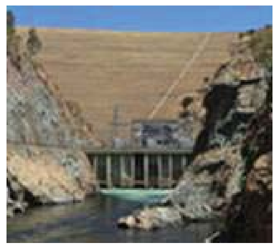
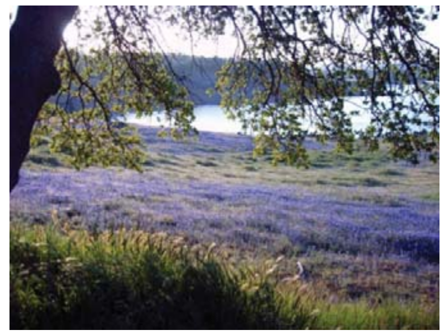
[3] Ratios in the *Associated Native Plant Ratio* column correspond to the number of associated native species to be planted per elderberry (seedling or cutting) planted.

DON PEDRO HYDROELECTRIC PROJECT
FERC NO. 2299

FINAL LICENSE APPLICATION

EXHIBIT E – ENVIRONMENTAL REPORT

APPENDIX E-2
DRAFT BALD EAGLE MANAGEMENT PLAN

Prepared by:
Turlock Irrigation District
P.O. Box 949
Turlock, CA 95381

and

Modesto Irrigation District
P.O. Box 4060
Modesto, CA 95352

April 2014

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List of Acronyms

ac ....acres
ACEC ....Area of Critical Environmental Concern
ACHP ....Advisory Council for Historic Preservation
ACOE.........................U.S. Army Corps of Engineers
ADA ....Americans with Disabilities Act (ADA/ABAAG)
AF ....acre-feet
AGS............................Annual Grasslands
ALJ.............................Administrative Law Judge
APE ....Area of Potential Effect
APEA ....Applicant-Prepared Environmental Assessment
ARMR........................Archaeological Resource Management Report
AWQC ....Ambient Water Quality Criteria
BA ....Biological Assessment
BDCP ....Bay-Delta Conservation Plan
BGEPA ....Bald and Golden Eagle Protection Act
BLM ...........................U.S. Department of the Interior, Bureau of Land Management
BLM-S ....Bureau of Land Management – Sensitive Species
BMI ....Benthic macroinvertebrates
BMP ....Best Management Practices
BO ....Biological Opinion
BOW ....Blue Oak Woodland
ºC................................celsius
CalCOFI.....................California Cooperative Oceanic Fisheries Investigations
CalEPPC ....California Exotic Pest Plant Council
CalSPA.......................California Sportfishing Protection Alliance
CAS............................California Academy of Sciences
CBDA ....California Bay-Delta Authority
CCC............................Criterion Continuous Concentrations
CCIC ....Central California Information Center
CCSF..........................City and County of San Francisco
CD ....Compact Disc

CDBW........................California Department of Boating and Waterways

CDEC.........................California Data Exchange Center

CESA ....California Endangered Species Act

CDFA.........................California Department of Food and Agriculture

CDFG.........................California Department of Fish and Game (as of January 2013, CDFW)

CDFW........................California Department of Fish and Wildlife

CDMG........................California Division of Mines and Geology

CDOF.........................California Department of Finance

CDPH.........................California Department of Public Health

CDPR.........................California Department of Parks and Recreation

CDSOD......................California Division of Safety of Dams

CDWR........................California Department of Water Resources

CE ....California Endangered Species

CEC............................California Energy Commission

CEII............................Critical Energy Infrastructure Information

CEQA.........................California Environmental Quality Act

CESA ....California Endangered Species Act

CFR............................Code of Federal Regulations

cfs...............................cubic feet per second

CGS............................California Geological Survey

cm...............................centimeters

CMAP ....California Monitoring and Assessment Program

CMC...........................Criterion Maximum Concentrations

CNDDB......................California Natural Diversity Database

CNPS..........................California Native Plant Society

CORP ....California Outdoor Recreation Plan

CPUC ....California Public Utilities Commission

CPUE ....Catch Per Unit Effort

CRAM........................California Rapid Assessment Method

CRC............................Chamise-Redshank Chaparral

CRLF..........................California Red-Legged Frog

CRRF ....California Rivers Restoration Fund

CSAS..........................Central Sierra Audubon Society

CSBP..........................California Stream Bioassessment Procedure
CSU............................California State University
CT ....California Threatened Species
CTR............................California Toxics Rule
CTS ....California Tiger Salamander
CVP............................Central Valley Project
CVRWQCB ....Central Valley Regional Water Quality Control Board
CWA ....Clean Water Act
CWD ....Chowchilla Water District
CWHR........................California Wildlife Habitat Relationship
CZMA ....Coastal Zone Management Act
DDT ....dichlorodiphenyltrichloroethane
Districts ....Turlock Irrigation District and Modesto Irrigation District
DLA ....Draft License Application
DO..............................Dissolved Oxygen
DOI ....Department of Interior
DPRA.........................Don Pedro Recreation Agency
DPS ....Distinct Population Segment
DSE............................Chief Dam Safety Engineer
EA ....Environmental Assessment
EBMUD ....East Bay Municipal Utilities District
EC ....Electrical Conductivity
EFH............................Essential Fish Habitat
EIR ....Environmental Impact Report
EIS..............................Environmental Impact Statement
Elev or el ....Elevation
ENSO ....El Niño Southern Oscillation
EPA ............................U.S. Environmental Protection Agency
ESA ....Federal Endangered Species Act
ESRCD.......................East Stanislaus Resource Conservation District
ESU ....Evolutionary Significant Unit
EVC............................Existing Visual Condition
EWUA........................Effective Weighted Useable Area

°F...............................fahrenheit
FERC..........................Federal Energy Regulatory Commission
FFS............................Foothills Fault System
FL...............................Fork length
FLA............................Final License Application
FMP...........................Fishery Management Plan
FMU...........................Fire Management Unit
FOT............................Friends of the Tuolumne
FPA............................Federal Power Act
FPC............................Federal Power Commission
FPPA..........................Federal Plant Protection Act
ft.................................feet
ft/mi............................feet per mile
FWCA........................Fish and Wildlife Coordination Act
FWUA........................Friant Water Users Authority
FYLF..........................Foothill Yellow-Legged Frog
g.................................grams
GIS.............................Geographic Information System
GLO...........................General Land Office
GORP.........................Great Outdoor Recreation Pages
GPS............................Global Positioning System
HCP............................Habitat Conservation Plan
HSC............................Habitat Suitability Criteria
HHWP........................Hetch Hetchy Water and Power
HORB........................Head of Old River Barrier
hp...............................horsepower
HPMP.........................Historic Properties Management Plan
IFIM...........................Instream Flow Incremental Methodology
ILP.............................Integrated Licensing Process
in................................inches
ISR.............................Initial Study Report
ITA.............................Indian Trust Assets
IUCN..........................International Union for the Conservation of Nature

KOPs..........................Key Observation Points
kV..............................kilovolt
kVA...........................kilovolt-amperes
kW.............................kilowatt
LWD ....large woody debris
m ....meters
mm ....millimeter
M&I...........................Municipal and Industrial
MBTA ....Migratory Bird Treaty Act
MCL...........................Maximum Contaminant Level
mg/kg ....milligrams/kilogram
mg/L..........................milligrams per liter
mgd ....million gallons per day
MGR ....Migration of Aquatic Organisms
MHW ....Montane Hardwood
mi ....miles
mi^2.............................square miles
MID...........................Modesto Irrigation District
MOA ....Memorandum of Agreement
MOU ....Memorandum of Understanding
MPN...........................Most Probable Number
MPR ....market price referents
MSCS.........................Multi-Species Conservation Strategy
msl.............................mean sea level
MUN ....municipal and domestic supply
MVA ....Megavolt-ampere
MW ....megawatt
MWh ....megawatt hour
mya............................million years ago
NAE ....National Academy of Engineering
NAHC ....Native American Heritage Commission
NAS............................National Academy of Sciences
NAVD 88 ....North American Vertical Datum of 1988

NAWQA ....National Water Quality Assessment
NCCP ....Natural Community Conservation Plan
NGVD29 ....National Geodetic Vertical Datum of 1929
NEPA ....National Environmental Policy Act
NERC ....North American Electric Reliability Corporation
NGOs ....Non-Governmental Organizations
NHI ....Natural Heritage Institute
NHPA ....National Historic Preservation Act
NISC ....National Invasive Species Council
NMFS ....National Marine Fisheries Service
NOAA ....National Oceanic and Atmospheric Administration
NOI ....Notice of Intent
NPS ............................U.S. Department of the Interior, National Park Service
NRCS ....National Resource Conservation Service
NRHP ....National Register of Historic Places
NRI ....Nationwide Rivers Inventory
NTU ....Nephelometric Turbidity Unit
NWI ....National Wetland Inventory
NWIS ....National Water Information System
NWR ....National Wildlife Refuge
O&M ....operation and maintenance
OEHHA ....Office of Environmental Health Hazard Assessment
OID ....Oakdale Irrigation District
ORV ....Outstanding Remarkable Value
OSHA ....Occupational Safety and Health Administration
PA ....Programmatic Agreement
PAD ....Pre-Application Document
PDAW ....Project Demand of Applied Water
PDO ....Pacific Decadal Oscillation
PEIR ....Program Environmental Impact Report
PGA ....Peak Ground Acceleration
PG&E ....Pacific Gas and Electric
PHABSIM ....Physical Habitat Simulation System

PHG............................Public Health Goal
PM&E ....Protection, Mitigation and Enhancement
PMF............................Probable Maximum Flood
POAOR ....Public Opinions and Attitudes in Outdoor Recreation
ppb.............................parts per billion
ppm ....parts per million
PSP.............................Proposed Study Plan
PWA...........................Public Works Administration
QA..............................Quality Assurance
QC..............................Quality Control
RA..............................Recreation Area
RBP............................Rapid Bioassessment Protocol
REC-1 ....water contact recreation
REC-2 ....water non-contact recreation
Reclamation ...............U.S. Department of the Interior, Bureau of Reclamation
RM ....River Mile
RMP...........................Resource Management Plan
RP...............................Relicensing Participant
rpm.............................Rotations per minute
RPS ....Renewable Portfolio Standard
RSP ....Revised Study Plan
RST ....Rotary Screw Trap
RWG..........................Resource Work Group
RWQCB.....................Regional Water Quality Control Board
SC...............................State candidate for listing under CESA
SCADA......................Supervisory Control and Data Acquisition
SCD............................State candidate for delisting under CESA
SCE ....State candidate for listing as endangered under CESA
SCT ....State candidate for listing as threatened under CESA
SD1 ....Scoping Document 1
SD2 ....Scoping Document 2
SE...............................State Endangered Species under the CESA
SEED..........................U.S. Bureau of Reclamation's Safety Evaluation of Existing Dams

SFP............................State Fully Protected Species under CESA

SFPUC.......................San Francisco Public Utilities Commission

SHPO.........................State Historic Preservation Officer

SJRA..........................San Joaquin River Agreement

SJRGA.......................San Joaquin River Group Authority

SJTA..........................San Joaquin River Tributaries Authority

SM.............................Standard Method

SMUD........................Sacramento Municipal Utility District

SPAWN.....................spawning, reproduction and/or early development

SPD............................Study Plan Determination

SRA............................State Recreation Area

SRMA........................Special Recreation Management Area or Sierra Resource Management Area (as per use)

SRMP.........................Sierra Resource Management Plan

SRP............................Special Run Pools

SSC............................State species of special concern

ST..............................California Threatened Species under the CESA

STORET....................Storage and Retrieval

SWAMP.....................Surface Water Ambient Monitoring Program

SWE...........................Snow-Water Equivalent

SWP...........................State Water Project

SWRCB.....................State Water Resources Control Board

TAC............................Technical Advisory Committee

TAF............................thousand acre-feet

TCP............................Traditional Cultural Properties

TCWC........................Tuolumne County Water Company

TDS............................Total Dissolved Solids

TID............................Turlock Irrigation District

TMDL........................Total Maximum Daily Load

TOC............................Total Organic Carbon

TRT............................Tuolumne River Trust

TRTAC......................Tuolumne River Technical Advisory Committee

UC..............................University of California

USBR ........................U.S. Bureau of Reclamation
USDA........................U.S. Department of Agriculture
USDOC .....................U.S. Department of Commerce
USDOI ......................U.S. Department of the Interior
USFS .........................U.S. Department of Agriculture, Forest Service
USFWS .....................U.S. Department of the Interior, Fish and Wildlife Service
USGS ........................U.S. Department of the Interior, Geological Survey
USR...........................Updated Study Report
UTM..........................Universal Transverse Mercator
VAMP ....Vernalis Adaptive Management Plan
VELB ....Valley Elderberry Longhorn Beetle
VES ....visual encounter surveys
VRM ....Visual Resource Management
VRO ....Visual Resource Objective
WBWG ....Western Bat Working Group
WECC ....Western Electricity Coordinating Council
WPA..........................Works Progress Administration
WPT ....Western Pond Turtle
WQCP ....Water Quality Control Plan
WSA..........................Wilderness Study Area
WSIP ....Water System Improvement Program
WSNMB ....Western Sierra Nevada Metamorphic Belt
WUA ....weighted usable area
WWTP ....Wastewater Treatment Plant
WY ....water year
yd^3 ....cubic yard
yr ....year
µS/cm ....microSeimens per centimeter
µg/L...........................micrograms per liter
µmhos........................micromhos

PREFACE

The Don Pedro Project provides water storage for irrigation and municipal and industrial (M&I) use, flood control, hydroelectric generation, recreation, and natural resource protection (hereinafter, the "Don Pedro Project"). The study area used for the terrestrial resource studies conducted in support of the relicensing considered potential effects of all components, facilities, operations, and maintenance that make up the Don Pedro Project. The Don Pedro Project was originally conceived as a water supply project. The Don Pedro Project was constructed for the following primary purposes: (1) to provide water supply for the co-licensees, TID and MID (collectively, the Districts), for irrigation of over 200,000 acres (ac) of Central Valley farmland and for M&I use, (2) to provide flood control benefits along the Tuolumne and San Joaquin rivers, and (3) to provide a water banking arrangement for the benefit of the City and County of San Francisco (CCSF) and its 2.6 million Bay Area water customers. The original license was issued in 1966. In 1995, the Districts entered into an agreement with a number of parties which resulted in greater flows to the lower Tuolumne River for the protection of aquatic resources.

Hydroelectric generation is a secondary purpose of the Don Pedro Project. Hereinafter, the hydroelectric generation facilities and operations will be referred to as the "Don Pedro Hydroelectric Project", or the "Project". With this license application to FERC, the Districts are seeking a new license to continue generating hydroelectric power. Based on the information contained in this application, and other sources of information on the record, FERC will consider whether, and under what conditions, to issue a new license for the continued generation of hydropower at the Districts' Don Pedro Project. The Districts are providing a complete description of the facilities and operation of the Don Pedro Project so the effects of the operation and maintenance of the Don Pedro hydroelectric facilities can be distinguished from the effects of the operation and maintenance activities of the overall Don Pedro Project's flood control and water supply/consumptive use purposes.

Being able to differentiate the effects of the hydropower operations from the effects of the flood control and consumptive use purposes and needs of the Don Pedro Project will aid in defining the scope and substance of reasonable protection, mitigation, and enhancement (PM&E) alternatives to be considered in relicensing. As FERC states in Scoping Document 2 in a discussion related to alternative project operation scenarios: "…alternatives that address the consumptive use of water in the Tuolumne River through construction of new structures or methods designed to alter or reduce consumptive use of water are…alternative mitigation strategies that could not replace the Don Pedro *hydroelectric* project [emphasis added]. As such, these recommended alternatives do not satisfy the NEPA purpose and need for the proposed action and are not reasonable alternatives for the NEPA analysis."

1.0 INTRODUCTION

Pursuant to Sections 5.17 and 5.18 of Title 18 of the Code of Federal Regulations, Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts) filed an application for a new license for the Don Pedro Hydroelectric Project (Project) with the Federal Energy Regulatory Commission (FERC) in April 2014. The Districts developed the Bald Eagle Management Plan (Plan) to provide guidance for the protection of bald eagles

(*Haliaetus leucocephalus*) that could be affected by, or with the potential to be affected by, activities within the Project Boundary. The Plan focuses on the protection of nesting bald eagles by focusing on the reduction of disturbances within or adjacent to occupied nests.

The Districts performed surveys in 2012 and 2013 to locate nesting bald eagles. The Plan is focused on known and newly established nesting territories within the Project Boundary with the potential to be affected by Don Pedro Project-related activities.

The goal of the Plan is to ensure that operations and maintenance (O&M) activities, as well as Don Pedro Project-related recreation activities, do not unduly disturb birds. This is accomplished by implementing the measures described herein, all of which are consistent with federal and State of California guidelines.

1.1 Background

The Districts are the co-licensees of the 168-megawatt (MW) Project located on the Tuolumne River in western Tuolumne County, in the Central Valley region of California. Don Pedro Dam is located at river mile (RM) 54.8 and the Don Pedro Reservoir, formed by the dam, extends 24 miles upstream at the normal maximum water surface elevation of 830 feet (ft) above mean sea level (msl; NGVD 29). At elevation 830 ft, the reservoir stores over 2,000,000 acre-feet (AF) of water and has a surface area slightly less than 13,000 acres (ac). The watershed above Don Pedro Dam is approximately 1,533 square miles (mi^2).

The Project Boundary extends from RM 53.2, which is one mile below the Don Pedro powerhouse, upstream to RM 80.8 at a water surface elevation of 845 ft (31 FPC ¶ 510 [1964]). The Project Boundary encompasses approximately 18,370 ac with 74 percent of the lands owned jointly by the Districts and the remaining 26 percent (approximately 4,802 ac) owned by the United States and administered as a part of the U.S. Bureau of Land Management (BLM) Sierra Resource Management Area.

1.2 Relicensing Process

The original FERC license for the Project expires on April 30, 2016. The Districts began the relicensing process by filing a Notice of Intent and Pre-Application Document (PAD) with FERC on February 10, 2011, following the regulations governing the Integrated Licensing Process. The Districts' PAD included descriptions of the Project facilities, operations, license requirements, and Project lands as well as a summary of the extensive existing information available on Project area resources. The Districts convened a series of Resource Work Group meetings, engaging agencies and other relicensing participants in a collaborative study plan development process culminating in the Districts' Proposed Study Plan (PSP) and Revised Study Plan (RSP) filings to FERC on July 25, 2011 and November 22, 2011, respectively.

On December 22, 2011, FERC issued its Study Plan Determination (SPD), approving, or approving with modifications, 34 studies proposed in the RSP that addressed Cultural and Historical Resources, Recreational Resources, Terrestrial Resources, and Water and Aquatic Resources. In addition, as required by the SPD, the Districts filed three new study plans

(W&AR-18, W&AR-19, and W&AR-20) on February 28, 2012, and one modified study plan (W&AR-12) on April 6, 2012. Prior to filing these plans with FERC, the Districts consulted with relicensing participants on drafts of the plans. FERC approved or approved with modifications these four studies on July 25, 2012.

Reports for each study describe the objectives, methods, and results as implemented by the Districts in accordance with FERC's SPD and subsequent study modifications and clarifications. The Bald Eagle Study Report (TR-10) contains information pertinent to this Bald Eagle Management Plan.

2.0 BALD EAGLE

On March 11, 1967 the southern bald eagle (*Haliaeetus leucocephalus leucocephalus*) was listed as Endangered under the Endangered Species Act (ESA) of 1966[1] due to a population decline caused by dichlorodiphenyltrichloroethane (DDT) (32 FR 4001). On February 14, 1978, the United States Department of the Interior, Fish and Wildlife Service (USFWS) ruled to delete the subspecific names for the southern and northern subspecies (*Haliaeetus leucocephalus alascanus*), which resulted in the designation of a single species *Haliaeetus leucocephalus* (43 FR 6230). The February 14, 1978 ruling also listed bald eagle as endangered in 43 of the 48 contiguous States. Bald eagle in the remaining five States (i.e., Washington, Oregon, Minnesota, Wisconsin, and Michigan) was listed as threatened (43 FR 6230). On July 12, 1995, all bald eagles listed as endangered in the 43 States were reclassified as threatened, while the status of threatened remained in effect for the five other States (60 FR 36000). On August 8, 2007, the USFWS ruled to delist the bald eagle (72 FR 37346). In the ruling, USFWS indicated that a reduction or elimination of threats such as DDT, as well as habitat protection led to an increase in breeding pairs from an estimated 487 in 1963 to approximately 9,789 in 2007 in the 48 contiguous States (72 FR 37346).

Since delisting, protection of bald eagle has continued under the Migratory Bird Treaty Act of 1918 (MBTA) (16 U.S.C. 703-712; Ch. 128; July 13, 1918; 40 Stat 755) as amended, and the Bald and Golden Eagle Protection Act (BGEPA) (16 U.S.C. 668-668c) as amended. The MBTA protects migratory birds and includes agreements between the United States, Great Britain (on behalf of Canada), Mexico, Japan and Soviet Union (now Russia) for the protection of such birds. In short, the MBTA, unless permitted by regulation, prohibits:

> *"...pursuit, hunt, capture, take, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation of carriage, or export at any time, or in any manner, any migratory bird, included in the terms of the convention…for the protection of migratory birds…or any part, nest, or egg of such bird." (16 U.S.C. 703)*

The BGEPA protects bald and golden eagles (*Aquila chrysaetos*), except under specific conditions, from take and includes their parts (feathers), nests or eggs.[2] Take is defined as "pursue, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." Furthermore, disturb is defined as:

[1] Endangered Species Preservation Act of 1966 was amended in 1969 by the Endangered Species Conservation Act of December 5, 1969 (P.L. 91-135, 83 Stat. 275), which was repealed by the Endangered Species Act of 1973 (16 U.S.C. 1531-1544).

[2] Bald Eagle Protection Act of 1940 was amended in 1978 (P.L. 95-616 (92 Stat. 3114) to include golden eagles.

> *"…to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding or sheltering behavior." (16 U.S.C. 668-668c)*

Violation of the BGEPA can result in criminal penalties that can result in a fine of $100,000 for an individual ($200,000 for organizations), imprisonment for one year, or both, for a first offense. Penalties increase for additional offenses, and a second offense is a felony.

Within California, the bald eagle was listed under that California Endangered Species Act (CESA) as Endangered on June 27, 1971. Protection under CESA mirrors the federal ESA. In 1971 the State of California also assigned the status of Fully Protected Birds to bald eagle (California Fish and Game Code §3511). Section 3511 of the California Fish and Game Code states:

> *"Except as provided in Section 2081.7 or 2835, fully protected birds or parts thereof may not be taken or possessed at any time. No provision of this code or any other law shall be construed to authorize the issuance of permits or licenses to take any fully protected bird, and no permits or licenses heretofore issued shall have any force or effect for that purpose. However, the department may authorize the taking of those species for necessary scientific research, including efforts to recover fully protected, threatened, or endangered species, and may authorize the live capture and relocation of those species pursuant to a permit for the protection of livestock."*

According to Section 86 in F.G.C:

> *"Take" means hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill.*

Additional protections for bald eagle in California exist under California Fish and Game Code §3503, 3503.5, and 3513, which make it unlawful to take, possess, or needlessly destroy birds' nests or eggs; take possess, or destroy raptors and their eggs and nests; and take or possess any migratory nongame bird of pert thereof, designated in the MBTA, respectively.

2.1 Don Pedro Project Bald Eagle Surveys

The Districts performed bald eagle surveys in 2012 and 2013 with the goal of gathering information regarding bald eagles associated with the Don Pedro Reservoir and associated stream reaches, and Project recreation features or activities. As described in the study plan, the study area consisted of a 1,000-foot area around Don Pedro Reservoir and Project facilities, including those portions of the Tuolumne River that are within the Project Boundary.

A review of historical records from the BLM and California Natural Diversity Database for bald eagles in the study area showed seven previously documented nests. Table 2.1-1 provides the location, nest status as of the 2012 surveys, historical nesting success, and nest tree type. Figure 2.1-1 shows the locations of historical bald eagle nest sites on Don Pedro Reservoir.

Table 2.1-1. Historical bald eagle nests on Don Pedro Reservoir.

Location	UTM-N	UTM-E	Status of Nest in 2012[1]	Historical Nesting Successes	Nest Tree
Rogers Creek Arm (Penole Peak)	4174998	733076	Nest Absent	--	--
South Bay (Blank Peak)	4175463	731891	Occupied, Not Successful	2002, 2007, 2009	Gray pine (*Pinus sabiniana*)
Woods Creek Arm	4196433	726850	Not Occupied, unrepaired	2006, 2007	Undetermined snag
Mine Island	4179132	729011	Nest No Longer Exists	--	--
Big Creek Arm	4181780	728062	Not Occupied, unrepaired	--	Gray pine
Jenkins Hill	4177769	730742	Not Occupied, unrepaired	--	Gray pine
Tuolumne River Arm	4195642	734932	Not Occupied, unrepaired	--	Gray pine

[1] Not Occupied - no nesting activity and no adults in a nesting territory.
Unrepaired – remnant of nest still visible, but no repairs have been made and the nest appears dilapidated.
Nest Absent – No nest visible at indicated site.

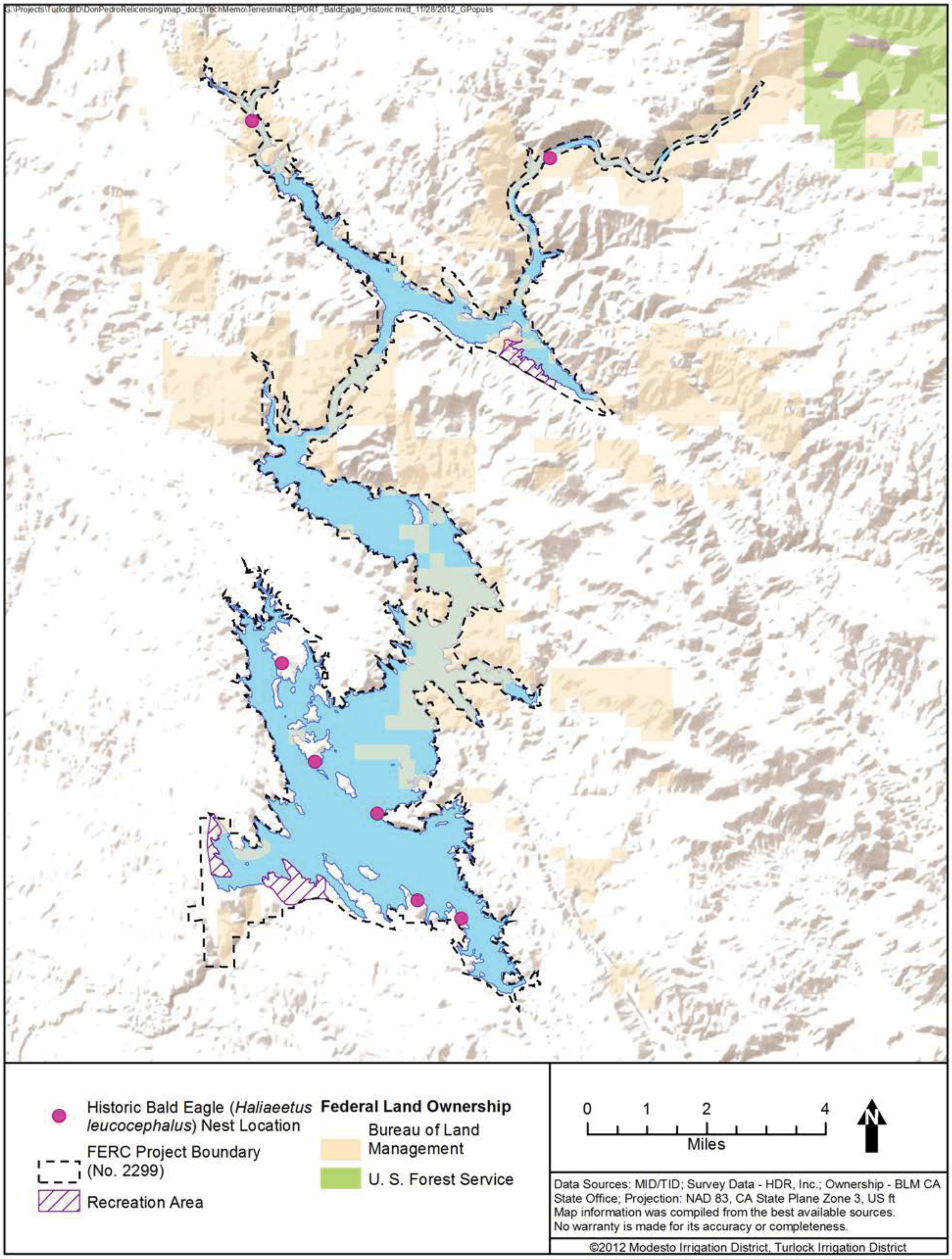


Figure 2.1-1. Historical bald eagle nests on Don Pedro Reservoir.

2.1.1 2012 and 2013 Bald Eagle Nesting Survey

During the 2012 initial nesting survey (March 19 and 20, 2012) the survey team located nine bald eagle nests. Of those, five had been previously documented by the BLM, and four are considered to be new or previously undocumented by the BLM. The five previously documented nests were located: (1) on the northern flank of Blank Peak near the entrance to the Rodgers Creek Arm; (2) on the western flank of Jenkins Hill at the southern entrance to Middle Bay; (3) on the eastern shoreline of the Big Creek Arm; (4) near the confluence of Slate Creek and Woods Creek in the Woods Creek Arm; and (5) near the inflow of Rough and Ready Creek to the Tuolumne River Arm. The four new or previously undocumented nests were located: (1) near the northeast corner of Mine Island; (2) on the northern flank of an unnamed peak in the southwestern corner of the Upper Bay; (3) in the upper reach of the Woods Creek Arm; and (4) near the middle reach of the Woods Creek Arm. Furthermore, the survey team was unable to locate two of the seven historical nests reported by the BLM. It is suspected that the two "missing" nests were destroyed prior to the 2012 nesting surveys and not reconstructed. These two nests were located: (1) approximately one mi southeast of Blank Peak in the Rodgers Creek Arm; and (2) along the southern shoreline of Mine Island.

Of the nine nests documented during the initial nesting survey, three were found to be occupied by a single adult tending to eggs. These three nests were located: (1) on the northern flank of Blank Peak; (2) near the northeast corner of Mine Island; and (3) near the upper reach of the Woods Creek Arm. The remaining six nests were unoccupied.

During the second nesting survey on May 8 and 9, 2012 the survey team found that the Mine Island nest and the Woods Creek Arm nest continued to be occupied by at least one adult and contained nestlings. It is unknown if the observed nestlings later fledged from either nest so these two nests were considered to be Occupied, Success Unknown.

With respect to the Blank Peak nest, the survey team found it to be absent of adults and without nestlings. This nest was classified as Occupied, Not Successful. The remaining six nests continued to be unoccupied.

During the first 2013 visit (May 8 and 9), two occupied and eight unoccupied bald eagle nests were found. The occupied nests were the Woods Creek Arm Nest No. 1 and Mine Island Nest, both of which were also occupied in 2012. At the Woods Creek Arm Nest No. 1 an adult female was observed in the nest along with a single nestling estimated to be eight weeks old. The adult male bald eagle associated with the Woods Creek Arm Nest No. 1 was absent during the initial visit. At the Mine Island Nest an adult female was present in the nest along with two nestlings that were estimated to be six to seven weeks old. An adult male bald eagle was perched in a gray pine (*Pinus sabiniana*) 150 feet south of the Mine Island Nest. Shortly after surveyor arrival, the male flew from his perch and began pursuing a juvenile bald eagle north of Mine Island.

During the second 2013 visit (June 17 and 18), both adults from the Woods Creek Arm Nest No. 1 were perched together in a gray pine immediately adjacent to the nest. The single nestling observed during the initial visit was not observed. At the Mine Island Nest, both parents were perched together in a gray pine 300 feet north of the nest, and two nestlings were perched on the edge of the nest.

Table 2.1-2 summarizes 2012 and 2013 observations of bald eagle nests, including location, success and nest tree. Figure 2.1-2 shows of the location of each nests found during the 2012 and 2013 surveys.

Table 2.1-2. Results of the 2012 bald eagle nesting surveys.

Nest	UTM-N	UTM-E	2012 Survey Results[1,3]	2013 Survey Results[1]	Notes
Woods Creek Arm Nest No. 1	4195157	727484	OSU	OS	Single nestling, given approximate age during first visit, likely fledged prior to second visit.
Woods Creek Arm Nest No. 2	4196433	726850	NO	NO	Nest was in disrepair during 2012 surveys and was not present in 2013.
Woods Creek Arm Nest No. 3	4193446	729257	NO	NO	Occupied by osprey in 2013.
Upper Bay Nest	4184371	731272	NO	NO	Nest tree fell prior to second visit in 2013.
Big Creek Arm Nest	4181780	728062	NO	NO	No repairs made since 2012 survey.
Mine Island Nest	4179687	729276	OSU	OS	Two fledged.
Jenkins Hill Nest	4177769	730742	NO	NO	No repairs made since 2012 survey.
South Bay Nest No. 1 (Blank Peak)	4175463	731891	ONS	NO	No repairs made since 2012 survey.
South Bay Nest No. 2[2]	4174790	733215	--	NO	New nest, not occupied.
Tuolumne River Arm	4195642	731894	NO	NO	No repairs made since 2012 survey.

1 OSU = Occupied Success Unknown
NO = Not Occupied
ONS = Occupied Not Successful
OS = Occupied Successful
2 South Bay Nest No. 2 was not present during 2012 surveys, but was reported by BLM as a historic nest.
3 2012 survey results obtained from Turlock Irrigation District and Modesto Irrigation District 2013.

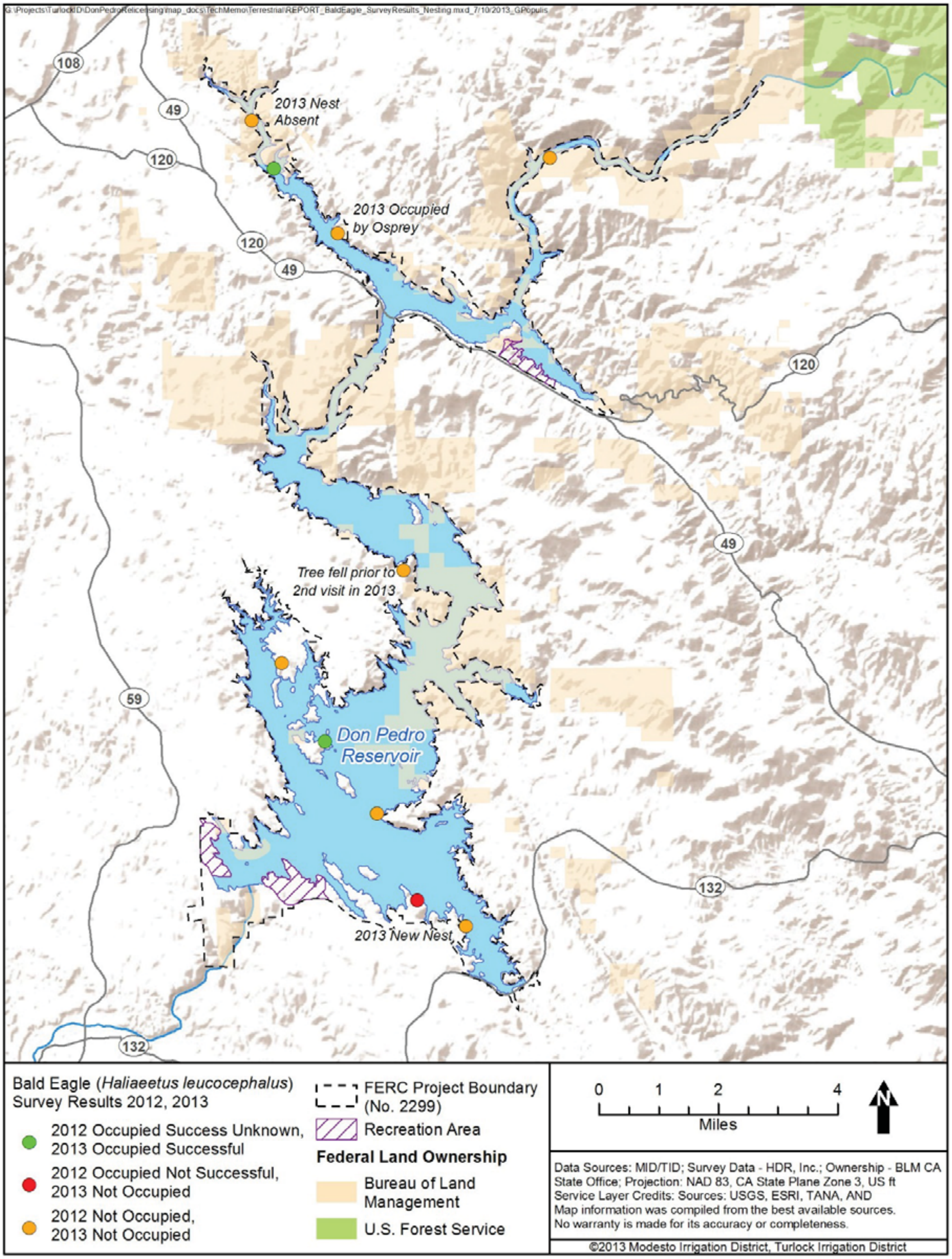


Figure 2.1-2. Results and incidental sightings of the 2012 and 2013 bald eagle nesting surveys.

3.0 MANAGEMENT FOR BALD EAGLE

The goal of this plan is to prevent O&M and recreation activities at the Don Pedro Project from disturbing bald eagles nesting at Don Pedro Reservoir. This plan provides guidance to the Districts for the periodic monitoring of existing nests, identification of new nests, as well as implementing measures to protect them. Historical information and the Districts' 2012 and 2013 nesting surveys suggest a baseline of two occupied nesting territories at Don Pedro Reservoir, specifically Woods Creek Arm and Mine Island.

3.1 Protection of Bald Eagles

3.1.1 Nest surveys

Bald eagle nest surveys will begin the first full calendar year after license issuance, and will be performed by qualified biologists. Surveys will be repeated once every two years for the first five years following license issuance. This will allow the Districts to monitor the effectiveness of protection measures (described below), at active nesting territories. After the fifth year, survey frequency will be reduced to once every five years. Surveys will be performed in accordance with the *Bald Eagle Breeding Survey Instructions* (CDFG 1999) and the *Protocol for Evaluating Bald Eagle Habitat and Populations in California* (Jackman and Jenkins 2004). Each bald eagle nesting survey consists of three visits to Don Pedro Reservoir between early March and mid-June of the same year. All data collected during nesting surveys will be recorded on the California Department of Fish and Wildlife (CDFW) California Bald Eagle Nesting Territory Survey Form (Attachment A). This data will serve as the basis for development of the survey reports described in Section 5.0 Each visit is described below:

- <u>Visit 1: Determine Occupancy of Territories, Identify New Nests, and Early Incubation.</u> Occupancy of known territories (e.g., Mine Island) and a search for new nests will be performed in early March, as weather conditions allow. Data collected at each site will consist of: (1) presence of adults; (2) courtship behavior; (3) evidence of nest repair or construction; (4) incubation; (5) observation of old nests. Surveys will be performed from a boat. GPS coordinates will be recorded, and photographs will be taken for all nests observed.
- <u>Visit 2: Confirm Occupancy of Territories and Nests, and Presence of Eggs/Nestlings.</u> Visit 2 will be conducted in late April or early May to determine whether the breeding pair(s) observed in March is still tending the nest (e.g., incubating eggs or tending nestlings). The number of eggs/nestlings, bird behavior, and any other relevant observations will be recorded. Visit 2 surveys will be conducted from a boat.
- <u>Visit 3: Determine Nest Success.</u> Visit 3 will be conducted in mid-June to determine how many nestlings are approaching fledgling age. Visit 3 surveys will be conducted from a boat.

3.1.2 Bald Eagle Protection Measures

The Districts will make reasonable efforts to protect bald eagles that have the potential to be affected by O&M activities, including the reduction of disturbances to nesting birds. The Districts' or Don Pedro Recreation Agency's (DPRA) activities associated with maintaining Don

Pedro Project safety; normal water supply operations and maintenance, flood protection, and hydropower maintenance; with life-threatening or imminent loss of facilities; and emergency situations are exempt from the restrictions imposed by the Limited Operating Period (LOP) described below.

3.1.2.1 Establishment of Buffers

Upon completion of the first nest survey (first visit will occur in March of the first full calendar year following license issuance), and for all active nests identified after the initial nest survey, the Districts will establish a buffer around all occupied bald eagle nests. Buoys and signs will be used to delineate the buffer, which will encompass all land and water that fall within an approximate 660 ft radius of an occupied nest or logical topographical boundary.[3]

Beginning January 1 through August 31 of each year thereafter, the Districts will institute a LOP around all known active bald eagle nests for O&M activities and recreation activities (e.g., boating, camping, hiking) within the buffer areas (described above), unless such restrictions materially affect the normal water supply, flood control, or hydropower operations at the Don Pedro Project. As needed, the Districts will work with the BLM and the DPRA to implement appropriate administrative closures on BLM lands and Districts' lands, respectively.

Nest buffers may be removed, adjusted, or new buffers established if subsequent nesting surveys demonstrate that a nesting territory is no longer occupied or new nests are identified. Additionally, any information provided to the Districts by CDFW, BLM, or USFWS regarding previously unidentified or existing nests will be used to inform the establishment of, or adjustment to, nest buffers. Removal of nest buffers will be done in consultation with the appropriate agency (depending on jurisdiction), and may include CDFW, BLM, or USFWS.

3.1.2.2 Annual Employee Training

Annual training will be provided to DPRA O&M personnel regarding the protection of bald eagles. Training will focus on this Plan and will include:

- protection afforded bald eagle,
- location of nest buffers and duration of LOPs; and their application to daily and seasonal O&M activities, and
- identification and reporting of new bald eagle nests.

[3] The Districts selected the largest buffer defined for six of the eight activity categories (A, B, C, D, E, and F) presented in the USFWS 2007, National Bald Eagle Management Guidelines. The activities covered under those six categories are the most applicable to O&M and recreation activities that could occur within the Project Boundary. The remaining two categories, G and H, are specific to aircraft use, explosives and other loud intermittent noises, and are not anticipated by the Districts.

3.1.2.3 Protection of Nests

Under no circumstances shall a known bald eagle nest be removed without consultation and approval of CDFW, BLM and USFWS. Any tree removal shall be in compliance with Fish and Game Code § 3503 and BGEPA.

3.1.2.4 Use of Rodenticides

The DPRA has used targeted rodenticides in recreation areas in the past; however, no uses have occurred since the 2009-2010 season. However, if the need to use rodenticides within the Project Boundary arises, the Districts and DPRA will do so in accordance with federal and State law, and prior to application will consult with the CDFW, BLM, and USFWS on the type and location of use.

4.0 COMMUNICATION AND REPORTING

The Districts will provide CDFW, BLM and USFWS, and file with FERC, reports of its bald eagle surveys by December 31 of the year the surveys were conducted. The reports will be tabular in format and will include the coordinates for each nest observed (active and inactive) and nest success. The report will be accompanied by a map that includes the reservoir, all Don Pedro Project facilities including recreation areas, symbology depicting each nest observed and a line feature delineating each nest buffer.

5.0 LITERATURE CITED

California Department of Fish and Game (CDFG). 1999. Bald eagle breeding survey instructions. November 1999. Sacramento, CA.

Jackman, R.E., and J.M. Jenkins. 2004. Protocol for evaluating bald eagle habitat and populations in California. Prepared for U.S. Fish and Wildlife Service. Sacramento, CA.

United States Fish and Wildlife Service (USFWS). 2007. National bald eagle management guidelines. Available online: http://www.fws.gov/midwest/Eagle/guidelines/NationalBaldEagleManagementGuidelines.pdf.

DRAFT BALD EAGLE MANAGEMENT PLAN

ATTACHMENT A
CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE (CDFW)
CALIFORNIA BALD EAGLE NESTING TERRITORY SURVEY FORM

DON PEDRO HYDROELECTRIC PROJECT (FERC No. 2299)
BALD EAGLE NESTING SURVEY DATA SHEET

Date: __________ **Visit** ____ **of 3** **Pg** ___ **of** ___

Reservoir: ______________________

Observers: _________ **Map No.**: ________

Time Start: ________ **Time End**: _________

Weather (circle one): Clear / Partly Cloudy / Overcast / Rain / Snow

Wind (circle one): Calm / Slight Breeze / Breezy / Windy

Temperature (^{o}C):______

QA/QC:

- **Data Entered by: ____________________ on ______________**
- **Checked by: ____________________ on __________________**

Observation	1	2	3	4	5	6	7	8
General Location								
UTM E								
UTM N								
Distance from H_2O(m)								
Habitat								
Nest Tree Species								
Active? (Y/N)								
Adult(s) Present? (Y/N)								
Juvenile(s) Present in nest? (Y/N)								

Observation	9	10	11	12	13	14	15	16
General Location								
UTM E								
UTM N								
Distance from H_2O(m)								
Habitat								
Nest Tree Species								
Active? (Y/N)								
Individual(s) Present? (Y/N)								
Juvenile(s) Present in nest? (Y/N)								

COMMENTS:

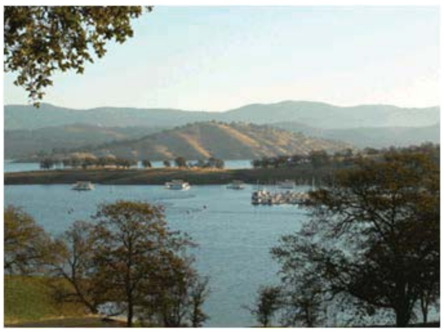
Bald Eagle Nesting Data Sheet Page _____of_____ Date: ________ Location: ___________________

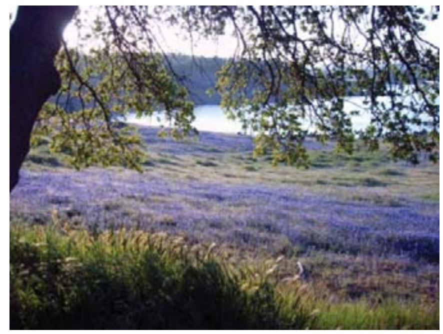
DON PEDRO HYDROELECTRIC PROJECT
FERC NO. 2299

FINAL LICENSE APPLICATION

EXHIBIT E – ENVIRONMENTAL REPORT

APPENDIX E-3
DRAFT RECREATION RESOURCE MANAGEMENT PLAN





Prepared by:
Turlock Irrigation District
P.O. Box 949
Turlock, CA 95381

and

Modesto Irrigation District
P.O. Box 4060
Modesto, CA 95352

April 2014

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List of Acronyms

ac ....acres

ACEC.........................Area of Critical Environmental Concern

ACHP.........................Advisory Council for Historic Preservation

ACOE.........................U.S. Army Corps of Engineers

ADA...........................Americans with Disabilities Act (ADA/ABAAG)

AF ....acre-feet

AGS............................Annual Grasslands

ALJ.............................Administrative Law Judge

APE............................Area of Potential Effect

APEA ....Applicant-Prepared Environmental Assessment

ARMR........................Archaeological Resource Management Report

AWQC ....Ambient Water Quality Criteria

BA ....Biological Assessment

BDCP ....Bay-Delta Conservation Plan

BLM...........................U.S. Department of the Interior, Bureau of Land Management

BLM-S ....Bureau of Land Management – Sensitive Species

BMI............................Benthic macroinvertebrates

BMP ....Best Management Practices

BO ....Biological Opinion

BOW ....Blue Oak Woodland

ºC...............................celsius

CalCOFI.....................California Cooperative Oceanic Fisheries Investigations

CalEPPC ....California Exotic Pest Plant Council

CalSPA.......................California Sportfishing Protection Alliance

CAS............................California Academy of Sciences

CBDA ....California Bay-Delta Authority

CCC............................Criterion Continuous Concentrations

CCIC ....Central California Information Center

CCSF..........................City and County of San Francisco

CD ....Compact Disc

CDBW........................California Department of Boating and Waterways

CDEC..........................California Data Exchange Center
CESA ....California Endangered Species Act
CDFA.........................California Department of Food and Agriculture
CDFG.........................California Department of Fish and Game (as of January 2013, CDFW)
CDFW........................California Department of Fish and Wildlife
CDMG........................California Division of Mines and Geology
CDOF.........................California Department of Finance
CDPH.........................California Department of Public Health
CDPR.........................California Department of Parks and Recreation
CDSOD......................California Division of Safety of Dams
CDWR........................California Department of Water Resources
CE ....California Endangered Species
CEC............................California Energy Commission
CEII............................Critical Energy Infrastructure Information
CEQA.........................California Environmental Quality Act
CESA ....California Endangered Species Act
CFR............................Code of Federal Regulations
cfs...............................cubic feet per second
CGS............................California Geological Survey
cm...............................centimeters
CMAP ....California Monitoring and Assessment Program
CMC...........................Criterion Maximum Concentrations
CNDDB......................California Natural Diversity Database
CNPS..........................California Native Plant Society
CORP ....California Outdoor Recreation Plan
CPUC ....California Public Utilities Commission
CPUE ....Catch Per Unit Effort
CRAM........................California Rapid Assessment Method
CRC............................Chamise-Redshank Chaparral
CRLF..........................California Red-Legged Frog
CRRF ....California Rivers Restoration Fund
CSAS..........................Central Sierra Audubon Society
CSBP..........................California Stream Bioassessment Procedure

CSU............................California State University
CT ....California Threatened Species
CTR............................California Toxics Rule
CTS ....California Tiger Salamander
CVP............................Central Valley Project
CVRWQCB ....Central Valley Regional Water Quality Control Board
CWA ....Clean Water Act
CWD ....Chowchilla Water District
CWHR........................California Wildlife Habitat Relationship
CZMA ....Coastal Zone Management Act
DDT ....dichlorodiphenyltrichloroethane
Districts ....Turlock Irrigation District and Modesto Irrigation District
DLA ....Draft License Application
DO..............................Dissolved Oxygen
DOI ....Department of Interior
DPRA ....Don Pedro Recreation Agency
DPS ....Distinct Population Segment
DSE............................Chief Dam Safety Engineer
EA ....Environmental Assessment
EBMUD ....East Bay Municipal Utilities District
EC ....Electrical Conductivity
EFH............................Essential Fish Habitat
EIR ....Environmental Impact Report
EIS..............................Environmental Impact Statement
Elev or el ....Elevation
ENSO ....El Niño Southern Oscillation
EPA ............................U.S. Environmental Protection Agency
ESA ....Federal Endangered Species Act
ESRCD.......................East Stanislaus Resource Conservation District
ESU ....Evolutionary Significant Unit
EVC............................Existing Visual Condition
EWUA........................Effective Weighted Useable Area
°F................................fahrenheit

FERC..........................Federal Energy Regulatory Commission
FFS............................Foothills Fault System
FL..............................Fork length
FLA............................Final License Application
FMP...........................Fishery Management Plan
FMU...........................Fire Management Unit
FOT............................Friends of the Tuolumne
FPA............................Federal Power Act
FPC............................Federal Power Commission
FPPA..........................Federal Plant Protection Act
ft................................feet
ft/mi...........................feet per mile
FWCA........................Fish and Wildlife Coordination Act
FWUA........................Friant Water Users Authority
FYLF..........................Foothill Yellow-Legged Frog
g.................................grams
GIS............................Geographic Information System
GLO...........................General Land Office
GORP.........................Great Outdoor Recreation Pages
GPS............................Global Positioning System
HCP...........................Habitat Conservation Plan
HSC...........................Habitat Suitability Criteria
HHWP........................Hetch Hetchy Water and Power
HORB........................Head of Old River Barrier
hp...............................horsepower
HPMP.........................Historic Properties Management Plan
IFIM...........................Instream Flow Incremental Methodology
ILP.............................Integrated Licensing Process
in...............................inches
ISR............................Initial Study Report
ITA............................Indian Trust Assets
IUCN..........................International Union for the Conservation of Nature
KOPs..........................Key Observation Points

kV..............................kilovolt
kVA............................kilovolt-amperes
kW.............................kilowatt
LWD ....large woody debris
m ....meters
mm ....millimeter
M&I............................Municipal and Industrial
MCL...........................Maximum Contaminant Level
mg/kg ....milligrams/kilogram
mg/L...........................milligrams per liter
mgd ....million gallons per day
MGR ....Migration of Aquatic Organisms
MHW ....Montane Hardwood
mi ....miles
mi^2..............................square miles
MID............................Modesto Irrigation District
MOA ....Memorandum of Agreement
MOU ....Memorandum of Understanding
MPN...........................Most Probable Number
MPR ....market price referents
MSCS.........................Multi-Species Conservation Strategy
msl.............................mean sea level
MUN ....municipal and domestic supply
MVA ....Megavolt-ampere
MW ....megawatt
MWh ....megawatt hour
mya.............................million years ago
NAE ....National Academy of Engineering
NAHC ....Native American Heritage Commission
NAS............................National Academy of Sciences
NAVD 88...................North American Vertical Datum of 1988
NAWQA ....National Water Quality Assessment
NCCP ....Natural Community Conservation Plan

NGVD29 .... National Geodetic Vertical Datum of 1929
NEPA .... National Environmental Policy Act
NERC .... North American Electric Reliability Corporation
NGOs .... Non-Governmental Organizations
NHI .... Natural Heritage Institute
NHPA .... National Historic Preservation Act
NISC .... National Invasive Species Council
NMFS .... National Marine Fisheries Service
NOAA .... National Oceanic and Atmospheric Administration
NOI .... Notice of Intent
NPS .... U.S. Department of the Interior, National Park Service
NRCS .... National Resource Conservation Service
NRHP .... National Register of Historic Places
NRI .... Nationwide Rivers Inventory
NTU .... Nephelometric Turbidity Unit
NWI .... National Wetland Inventory
NWIS .... National Water Information System
NWR .... National Wildlife Refuge
O&M .... operation and maintenance
OEHHA .... Office of Environmental Health Hazard Assessment
OID .... Oakdale Irrigation District
ORV .... Outstanding Remarkable Value
OSHA .... Occupational Safety and Health Administration
PA .... Programmatic Agreement
PAD .... Pre-Application Document
PDAW .... Project Demand of Applied Water
PDO .... Pacific Decadal Oscillation
PEIR .... Program Environmental Impact Report
PGA .... Peak Ground Acceleration
PG&E .... Pacific Gas and Electric
PHABSIM .... Physical Habitat Simulation System
PHG .... Public Health Goal
PM&E .... Protection, Mitigation and Enhancement

PMF............................Probable Maximum Flood
POAOR......................Public Opinions and Attitudes in Outdoor Recreation
ppb.............................parts per billion
ppm ....parts per million
PSP.............................Proposed Study Plan
PWA...........................Public Works Administration
QA..............................Quality Assurance
QC..............................Quality Control
RA..............................Recreation Area
RBP............................Rapid Bioassessment Protocol
REC-1 ....water contact recreation
REC-2 ....water non-contact recreation
Reclamation ...............U.S. Department of the Interior, Bureau of Reclamation
RM.............................River Mile
RRMP ....Recreation Resource Management Plan
RMP...........................Resource Management Plan
RP..............................Relicensing Participant
rpm............................Rotations per minute
RPS ....Renewable Portfolio Standard
RSP ....Revised Study Plan
RST ....Rotary Screw Trap
RWG..........................Resource Work Group
RWQCB.....................Regional Water Quality Control Board
SC...............................State candidate for listing under CESA
SCADA......................Supervisory Control and Data Acquisition
SCD............................State candidate for delisting under CESA
SCE ....State candidate for listing as endangered under CESA
SCT ....State candidate for listing as threatened under CESA
SD1 ....Scoping Document 1
SD2 ....Scoping Document 2
SE...............................State Endangered Species under the CESA
SEED..........................U.S. Bureau of Reclamation's Safety Evaluation of Existing Dams
SFP.............................State Fully Protected Species under CESA

SFPUC ....San Francisco Public Utilities Commission
SHPO ....State Historic Preservation Officer
SJRA ....San Joaquin River Agreement
SJRGA ....San Joaquin River Group Authority
SJTA ....San Joaquin River Tributaries Authority
SM.............................Standard Method
SMUD........................Sacramento Municipal Utility District
SPAWN.....................spawning, reproduction and/or early development
SPD ....Study Plan Determination
SRA............................State Recreation Area
SRMA ....Special Recreation Management Area or Sierra Resource Management Area (as per use)
SRMP.........................Sierra Resource Management Plan
SRP ....Special Run Pools
SSC ....State species of special concern
ST ....California Threatened Species under the CESA
STORET ....Storage and Retrieval
SWAMP.....................Surface Water Ambient Monitoring Program
SWE ....Snow-Water Equivalent
SWP ....State Water Project
SWRCB.....................State Water Resources Control Board
TAC...........................Technical Advisory Committee
TAF ....thousand acre-feet
TCP ....Traditional Cultural Properties
TCWC........................Tuolumne County Water Company
TDS ....Total Dissolved Solids
TID.............................Turlock Irrigation District
TMDL ....Total Maximum Daily Load
TOC............................Total Organic Carbon
TRT ....Tuolumne River Trust
TRTAC ....Tuolumne River Technical Advisory Committee
UC ....University of California
USBR .........................U.S. Bureau of Reclamation

USDA........................U.S. Department of Agriculture
USDOC.....................U.S. Department of Commerce
USDOI......................U.S. Department of the Interior
USFS.........................U.S. Department of Agriculture, Forest Service
USFWS.....................U.S. Department of the Interior, Fish and Wildlife Service
USGS........................U.S. Department of the Interior, Geological Survey
USR...........................Updated Study Report
UTM..........................Universal Transverse Mercator
VAMP.......................Vernalis Adaptive Management Plan
VELB........................Valley Elderberry Longhorn Beetle
VES...........................visual encounter surveys
VRM.........................Visual Resource Management
VRO..........................Visual Resource Objective
WBWG.....................Western Bat Working Group
WECC.......................Western Electricity Coordinating Council
WPA..........................Works Progress Administration
WPT..........................Western Pond Turtle
WQCP.......................Water Quality Control Plan
WSA..........................Wilderness Study Area
WSIP.........................Water System Improvement Program
WSNMB...................Western Sierra Nevada Metamorphic Belt
WUA.........................weighted usable area
WWTP......................Wastewater Treatment Plant
WY............................water year
yd^3.............................cubic yard
yr...............................year
µS/cm........................microSeimens per centimeter
µg/L...........................micrograms per liter
µmhos........................micromhos

PREFACE

The Don Pedro Project provides water storage for irrigation and municipal and industrial (M&I) use, flood control, hydroelectric generation, recreation, and natural resource protection (hereinafter, the "Don Pedro Project"). The study area for the recreation resource studies conducted in support of relicensing considered all components, facilities, operations, and maintenance that make up the Don Pedro Project. The Don Pedro Project was originally conceived as a water supply project. The Don Pedro Project was constructed for the following primary purposes: (1) to provide water supply for the co-licensees, Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts), for irrigation of over 200,000 acres (ac) of Central Valley farmland and for M&I use, (2) to provide flood control benefits along the Tuolumne and San Joaquin rivers, and (3) to provide a water banking arrangement for the benefit of the City and County of San Francisco (CCSF) and its 2.6 million Bay Area water customers. The original license was issued in 1966. In 1995, the Districts entered into an agreement with a number of parties which resulted in greater flows to the lower Tuolumne River for the protection of aquatic resources.

Hydroelectric generation is a secondary purpose of the Don Pedro Project. Hereinafter, the hydroelectric generation facilities and operations will be referred to as the "Don Pedro Hydroelectric Project", or the "Project". With this license application to FERC, the Districts are seeking a new license to continue generating hydroelectric power. Based on the information contained in this application, and other sources of information on the record, FERC will consider whether, and under what conditions, to issue a new license for the continued generation of hydropower at the Districts' Don Pedro Project. The Districts are providing a complete description of the facilities and operation of the Don Pedro Project so the effects of the operation and maintenance of the Don Pedro hydroelectric facilities can be distinguished from the effects of the operation and maintenance activities of the overall Don Pedro Project's flood control and water supply/consumptive use purposes.

Being able to differentiate the effects of the hydropower operations from the effects of the flood control and consumptive use purposes and needs of the Don Pedro Project will aid in defining the scope and substance of reasonable protection, mitigation, and enhancement (PM&E) alternatives to be considered in relicensing. As FERC states in Scoping Document 2 in a discussion related to alternative project operation scenarios: "…alternatives that address the consumptive use of water in the Tuolumne River through construction of new structures or methods designed to alter or reduce consumptive use of water are…alternative mitigation strategies that could not replace the Don Pedro *hydroelectric* project [emphasis added]. As such, these recommended alternatives do not satisfy the NEPA purpose and need for the proposed action and are not reasonable alternatives for the NEPA analysis."

1.0 INTRODUCTION

The Districts developed the Recreation Resource Management Plan (RRMP or Plan) to guide the management and maintenance of public recreation within the Project Boundary. The Plan describes the existing measures and facilities to be continued and maintained and new measures or facilities proposed by the Districts for the purposes of creating, preserving, and enhancing recreational opportunities, and for safeguarding the public during use of the Don Pedro Reservoir.

Throughout the recreation season of 2012, the Districts performed a Facility Condition, Public Accessibility, and Recreation Use Assessment (Study RR-01) to collect information related to the use, maintenance and improvement of existing recreation facilities to support current and future demand for public recreation. In 2012 and 2013, the Districts performed a Whitewater Boating Take-Out Feasibility Study (RR-02) to assess the engineering feasibility of improving the current river-egress used by whitewater boaters at the upstream end of the Don Pedro Reservoir at the Ward's Ferry Bridge.

1.1 General Description of Facilities

The Districts are the co-licensees of the 168-megawatt (MW) Don Pedro Hydroelectric Project located on the Tuolumne River in western Tuolumne County in the Central Valley region of California. The Don Pedro Dam is located at river mile (RM) 54.8 and the Don Pedro Reservoir formed by the dam extends 24 miles upstream at the normal maximum water surface elevation of 830 feet (ft) above mean sea level (msl; NGVD 29). At elevation 830 ft, the reservoir stores over 2,000,000 acre-feet (AF) of water and has a surface area slightly less than 13,000 acres (ac). The watershed above Don Pedro Dam is approximately 1,533 square miles (mi^2).

Both TID and MID are local public agencies authorized under the laws of the State of California to provide water supply for M&I uses and to provide retail electric service. The Don Pedro Project is a multi-purpose water resource development providing water storage for the beneficial use of irrigation of over 200,000 acres of prime Central Valley farmland and for use by the City of Modesto's municipal and industrial water customers. Consistent with agreements between the Districts and CCSF, the Don Pedro Reservoir also includes a 570,000 AF "water bank" CCSF uses to improve the reliability of water supply from its Hetch Hetchy water system while meeting the senior water rights of the Districts. The water bank within Don Pedro Reservoir provides significant water supply benefits for the 2.6 million customers in the San Francisco Bay Area served by CCSF. The Don Pedro Project also provides storage for flood control purposes in accordance with U.S. Army Corps of Engineers (ACOE) Flood Control Manual.

Recreation facilities at Don Pedro Reservoir are operated by the Don Pedro Recreation Agency (DPRA). DPRA, which is operationally a department within TID, is sponsored and governed by an agreement between the Districts and CCSF. DPRA manages the use of all lands within the Project Boundary. DPRA also manages the campsite reservation system, entry-gate administration, and maintenance of all associated facilities, such as the drinking water plant, filtration plant, and wastewater treatment plants. DPRA maintains a visitor's center and headquarters building overlooking Don Pedro Reservoir.

DPRA has 16 full-time employees and up to 35 seasonal employees from May to September. As part of its management of the recreation use at Don Pedro, DPRA rangers hold First Responder medical, wildland firefighting, and limited law enforcement certifications as appropriate for a lake that receives the amount and types of use experienced at Don Pedro Reservoir. DPRA maintains a website at www.donpedrolake.com that provides information on available recreation opportunities, schedules of operations, and an interactive system for camping reservations. DPRA also is responsible for oversight of concessionaires licensed to provide certain services on the reservoir. Concessionaire-run facilities are currently operated by Forever Resorts, LLC. DPRA activities also include certain non-recreational management duties such as debris management at the upstream end of the reservoir by collecting, corralling, and wintertime disposal of sticks, wood, and debris in the area where the Tuolumne River flows into the reservoir.

As a storage reservoir, Don Pedro Reservoir water levels are cyclic and can be subject to large annual fluctuations as water is captured during the runoff season for later use for irrigation and M&I water and for carry-over storage. Flood management at the Don Pedro Project, which assists in controlling flood flows in the Tuolumne and San Joaquin rivers, also contributes to reservoir level fluctuations.

The Project Boundary extends from approximately one mile downstream of Don Pedro Dam to approximately RM 80.8 upstream of the dam, corresponding to a water surface elevation of 845 ft (Figure 1.1-1). The top of Don Pedro Dam is at elevation 855 ft. The Project Boundary encompasses approximately 18,370 ac of land with 74 percent of the lands owned jointly by the Districts, and the remaining 26 percent (approximately 4,800 ac) owned by the United States and managed as a part of the Bureau of Land Management (BLM) Sierra Resource Management Area.

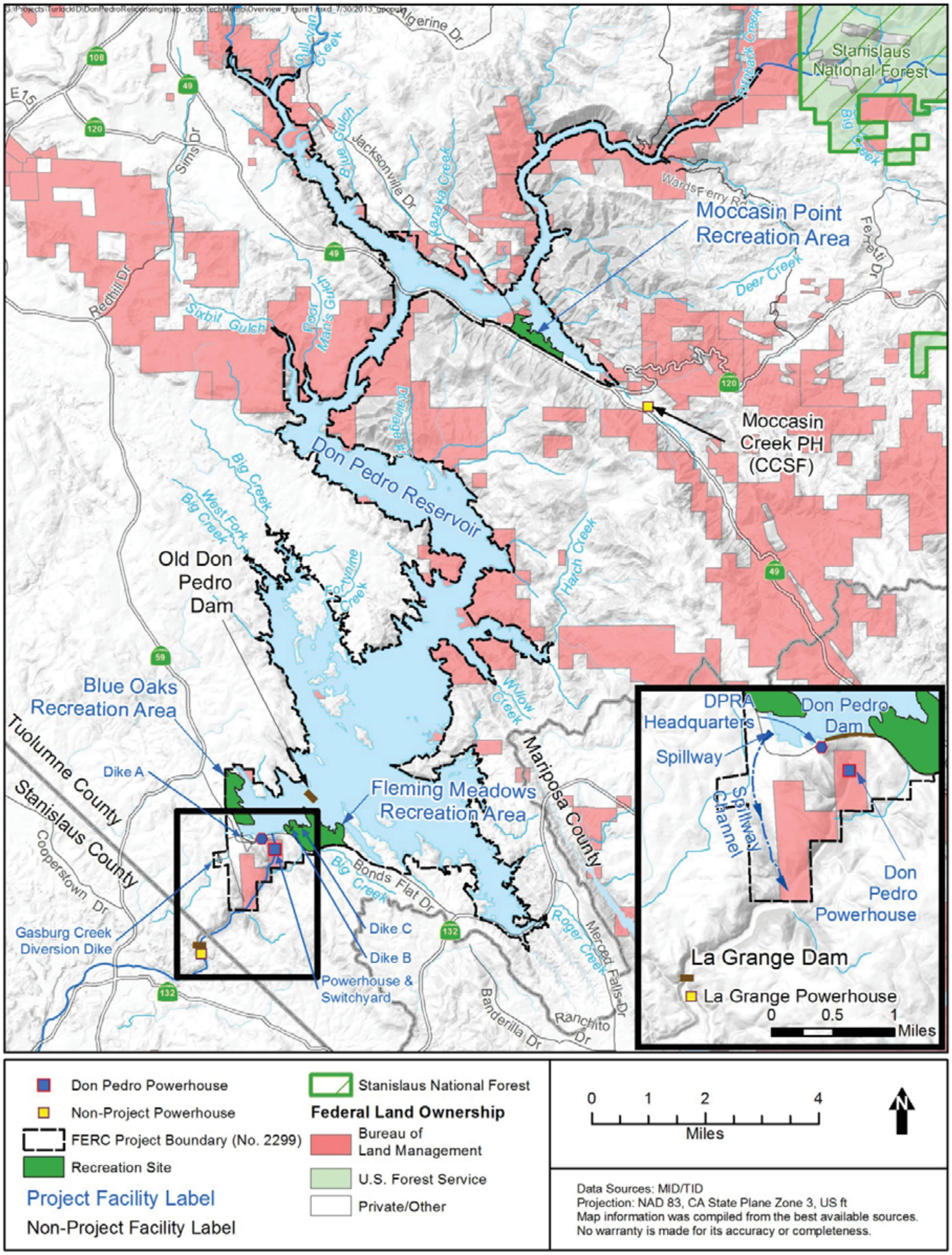

Figure 1.1-1. Don Pedro Project site location map.

1.2 Relicensing Process

The current FERC license for the Project expires on April 30, 2016, and the Districts will apply for a new license no later than April 30, 2014. The Districts began the relicensing process by filing a Notice of Intent and Pre-Application Document (PAD) with FERC on February 10, 2011, following the regulations governing the Integrated Licensing Process (ILP). The Districts' PAD included descriptions of all Don Pedro Project facilities, operations, license requirements, and lands as well as a summary of the extensive existing information available on area resources. The Districts convened a series of Resource Work Group meetings, engaging agencies and other relicensing participants in a collaborative study plan development process culminating in the Districts' Proposed Study Plan (PSP) and Revised Study Plan (RSP) filings to FERC on July 25, 2011 and November 22, 2011, respectively. On December 22, 2011, FERC issued its Study Plan Determination (SPD) for the Project, approving, or approving with modifications, 34 studies proposed in the RSP that addressed Cultural and Historical Resources, Recreational Resources, Terrestrial Resources, and Water and Aquatic Resources.

Reports for each study are included with this license application; each describes the objectives, methods, and results as implemented by the Districts in accordance with FERC's SPD and subsequent study modifications and clarifications. Study reports relevant to the RRMP are the Recreation Facility Condition, Public Accessibility, and Recreation Use Assessment (RR-01) and Whitewater Boating Take-Out Feasibility Study (RR-02).

1.3 Study Results

The Districts conducted recreation studies in 2012 and 2013 with the goal to gather information regarding the use of developed and dispersed recreation opportunities at the Don Pedro Project. The scope of study included investigations of facility carrying capacity; preferences, attitudes, and characteristics of recreation users; current recreation activities and future demand for activities; and the engineering feasibility of improving the existing take-out used by whitewater boaters at Ward's Ferry Bridge (RM 78.4) and potential alternative river-egress locations in the vicinity of the Ward's Ferry Bridge.

1.3.1 Recreation Facility Condition, Public Accessibility, and Recreation Use Assessment

The objectives of the Recreation Facility Condition, Public Accessibility, and Recreation Use Assessment were to evaluate the condition of existing developed recreation facilities and dispersed use areas on Don Pedro Reservoir; estimate the present capacity of recreation facilities to support present and future demand for public recreation (i.e., facility carrying capacity); describe the preferences, attitudes, and characteristics of recreation users; collect information about current recreation activities and future demand for activities; and undertake a creel survey in coordination with Study Plan W&AR-17: Reservoir Fish Population Study. As described in the RR-01 study report (TID/MID 2013a), the study area consisted of developed recreation sites and facilities at the three developed recreation areas: Fleming Meadows, Blue Oaks, and Moccasin Point recreation areas on Don Pedro Reservoir, as well as 12 remote facilities where toilets are maintained (Table 1.3-1 and Figure 1.3-1). Undeveloped shoreline areas within the

Project Boundary where informal use is known to occur were also examined to assess potential impacts of recreation use on shoreline resources.

Table 1.3-1. Summary of recreation facilities and other on-site amenities at developed recreation areas.

Amenities	Moccasin Point RA	Blue Oaks RA	Fleming Meadows RA
Project Recreation Facilities			
Camping Units - Total	96	195	267
With water and electric hookups[1]	18	34	90
Picnic Areas -Total	2	1	2
Group Picnic Sites	1	1	1
Boat Launch Ramp	1	1	1
Fish Cleaning Stations	1	1	1
Comfort Stations - Total	8	11	14
With hot showers	3	5	5
Concession Store	Yes	No	Yes
Swimming Lagoon	No	No	Yes
Marina	Yes	No	Yes
Amphitheatre	No	No	Yes
Houseboat Mooring	Yes	No	Yes
Boat Rentals	Yes	No	Yes
Houseboat Rentals	Yes	No	Yes
Boat Repair Yard	No	Yes	No
Gas and Oil	Yes	No	Yes
Sewage Dump Station	Yes	Yes	Yes

[1] Water service at Moccasin Point and Fleming Meadows recreation areas includes sewer hook-ups.

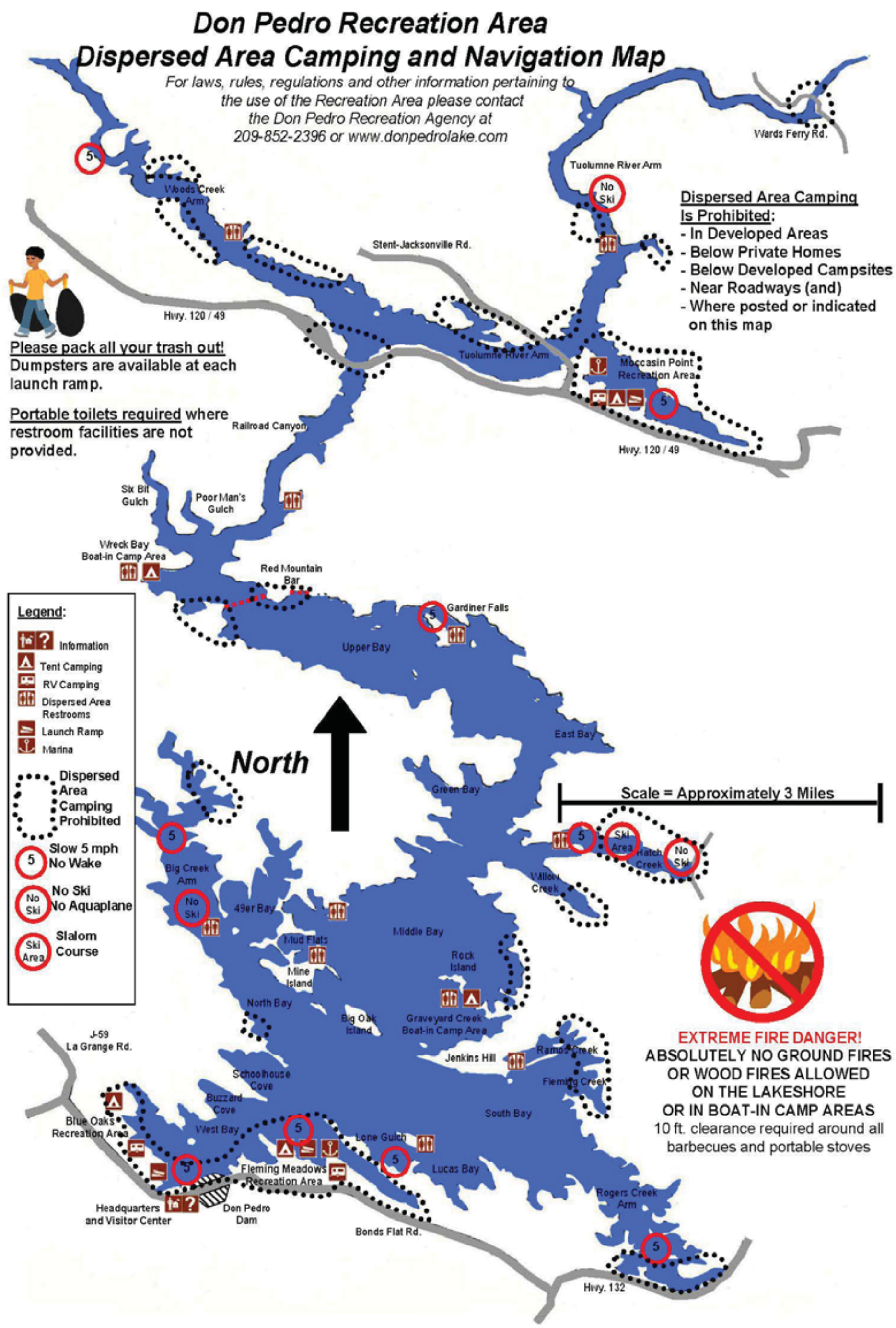

Figure 1.3-1. **Developed facilities inventoried and evaluated as part of the recreation facility condition and public accessibility assessment, and recreation use assessment.**

1.3.1.1 Fleming Meadows Recreation Area

Fleming Meadows Recreation Area consists of 267 campsites, one group picnic area, one swim lagoon, one boat launch ramp, one fish cleaning station, and 14 toilet buildings (five with showers). Figure 1.3-2 identifies the existing recreation facilities of the Fleming Meadows Recreation Area. All of these facilities, as well as the condition of roads and parking facilities were evaluated.

Overall, roads and parking areas are in good to excellent condition, with only the marina parking area in fair condition. Campground features are also in good to excellent condition with a few exceptions including campsite shelters of wood construction in Campground Area A, and water faucets, which were identified as being in fair condition. With respect to day-use areas, overall, facilities are good to excellent conditions, with the exception of tables and faucets, which were found to be in fair condition.

The site buildings (toilet facilities, the entrance and fish cleaning stations) exteriors and roofs are in good to excellent condition, with interiors rated as fair to good overall. Just over half of the signs are new and constructed of synthetic materials in excellent condition. The remaining signs are constructed of wood and in good condition.

An accessibility evaluation of compliance with the ADA and Architectural Barriers Act Accessibility Guidelines (ABAAG) was completed in accordance with guidelines developed by the U.S. Access Board (USAB 2004). The accessibility at each facility in the campground and day-use areas at Fleming Meadows was categorized as inaccessible, partially accessible, or accessible (TID/MID 2013a). Fleming Meadows facilities are partially accessible with at least some accessible features, such as trash bins, toilets, and parking spaces while other buildings and facilities, including campsites and water spigots, are not accessible.

With the exception of the houseboat marina parking facility, use levels through 2050 at Fleming Meadows Recreation Area are not projected to exceed the capacity of the campgrounds, picnic areas, and parking areas (including boat launch, marina, and overflow lots). The houseboat marina parking facility experienced over 80 percent occupancy on weekends in 2012. Based on population and general recreation use projections, weekend use is projected to exceed capacity by 2020 and overall use is projected to exceed capacity by 2040 as marina users continue to seek to park as close to the marina as possible. It is notable that this parking facility is used primarily by visitors to the marina slips; therefore, future parking demand will be driven by the number of marina slips. No marina expansion is proposed at this time. Use of the Overflow Parking Lot is projected to remain below capacity through 2050.

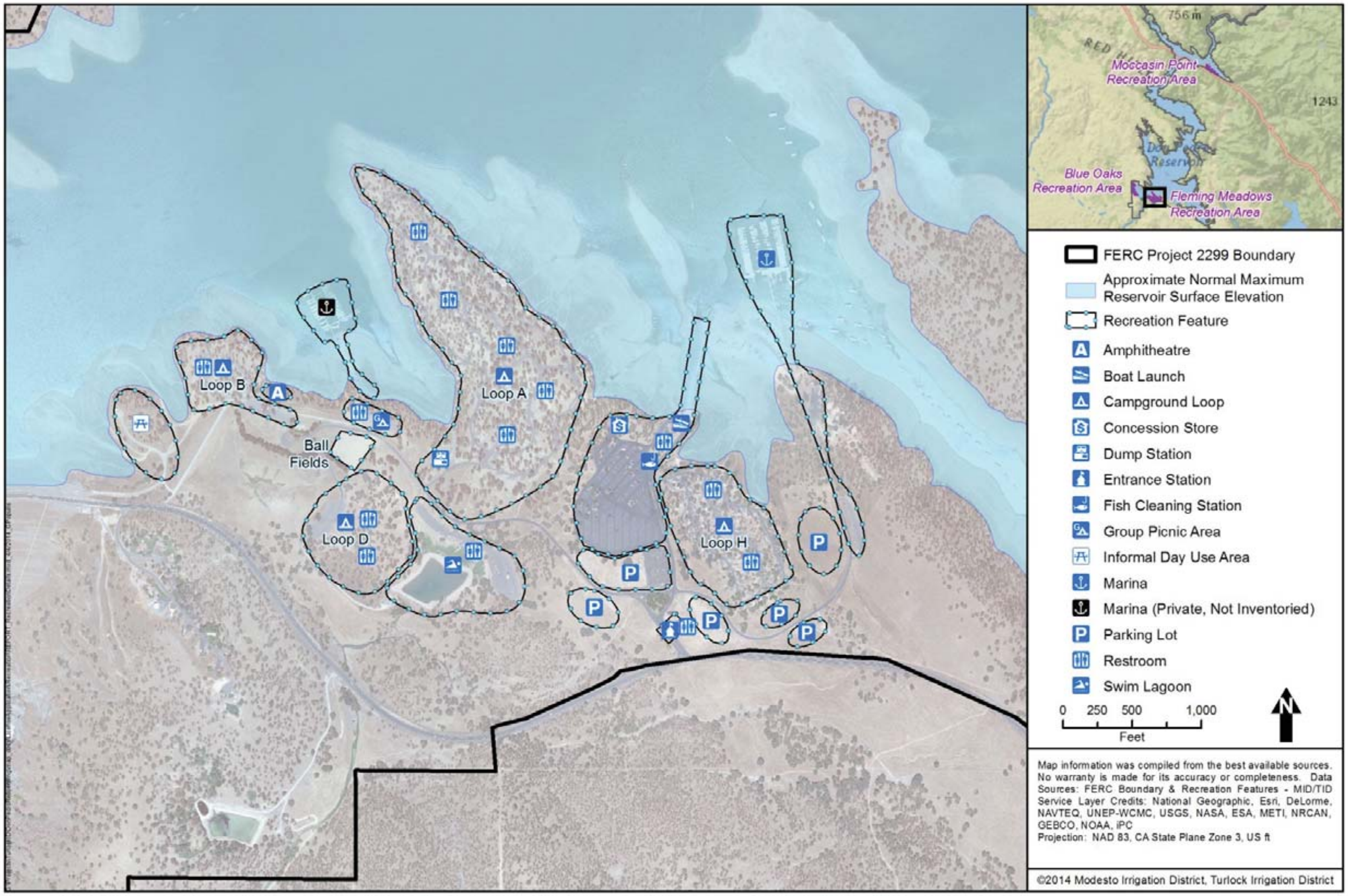

Figure 1.3-2. Recreation facilities at the Fleming Meadows Recreation Area.

1.3.1.2 Blue Oaks Recreation Area

Blue Oaks Recreation Area consists of 195 campsites, one group picnic area, one boat launch ramp, one fish cleaning station, 11 toilet buildings (five with showers), and one sewage dump station facility. Figure 1.3-3 identifies the existing recreation facilities of the Blue Oaks Recreation Area. The evaluation included all of these facilities and site elements, as well as the condition of roads and parking facilities.

Overall, roads and parking areas are in good to excellent condition. Campground features are in good condition overall. The asphalt at the boat ramp main lot was the only parking area found to be in fair condition. With respect to day-use areas, the parking and roads are in excellent condition.

All of the campground facility features are in good or excellent condition, with the exception of a few wood campsite shelters, water faucets, and some trash receptacles in fair condition. Similar to Fleming Meadows, day-use facilities are in good or excellent condition, with the exception of tables and water faucets at the group picnic area and the boat launch, which are in fair condition.

With respect to the site buildings (toilet buildings and the entrance station), the condition assessments were similar to Fleming Meadows. With respect to toilet facilities, the exteriors are in good to excellent condition, while the interiors are in fair to good condition.

Signs within the Blue Oaks Recreation Area are generally in good to excellent condition. The signs constructed of synthetic materials are newer and in excellent condition; the signs constructed of wood material are in good condition overall.

Blue Oaks facilities are partially accessible with at least some accessible features, such as trash bins, toilets, and parking spaces while other buildings and facilities, including water spigots and most campsites, are not accessible.

Use levels through 2050 at Blue Oaks Recreation Area are not projected to exceed the capacity of the campgrounds, picnic areas, and parking areas (including boat launch and group picnic area parking).

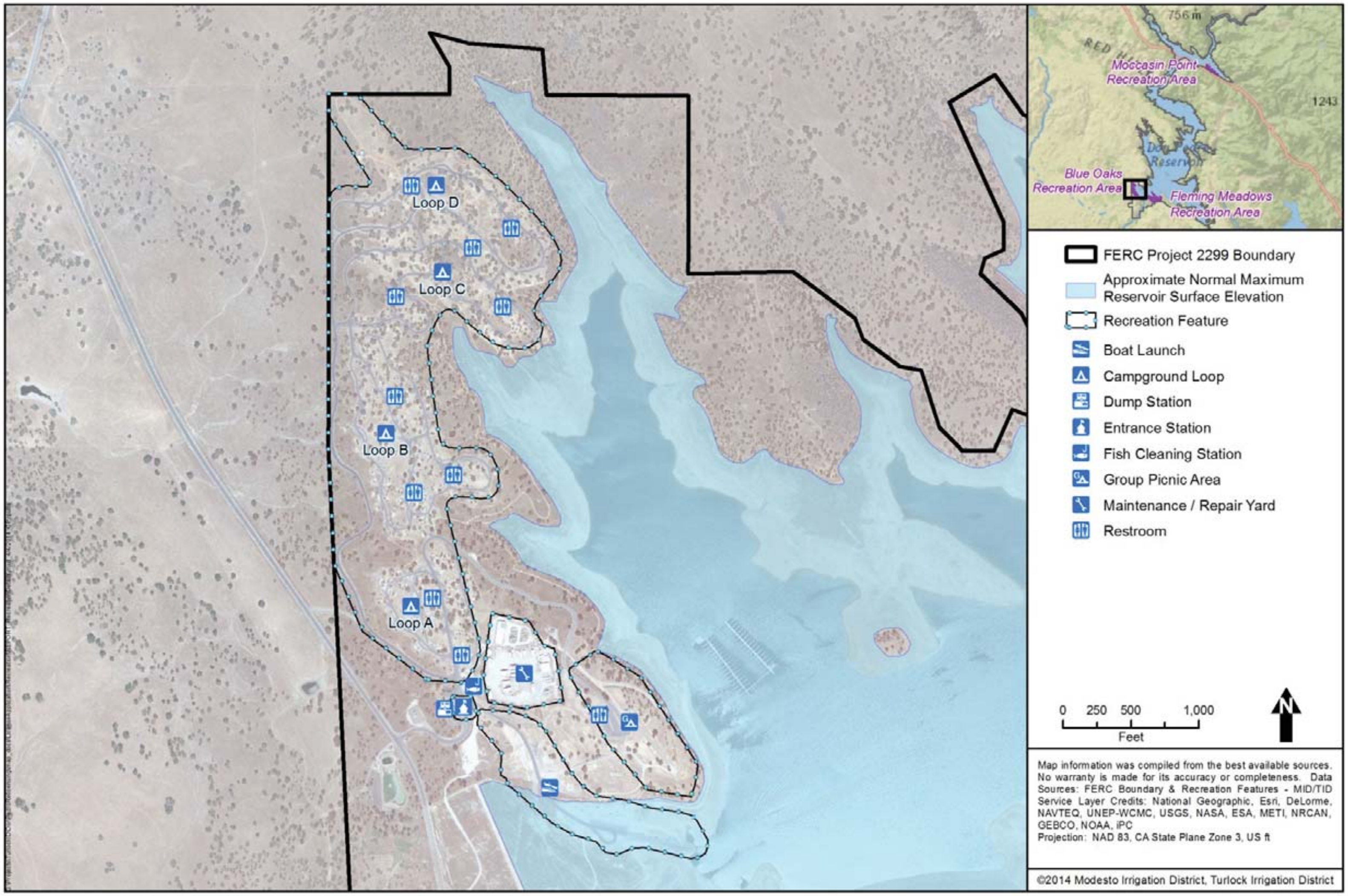

Figure 1.3-3. Recreation facilities at the Blue Oaks Recreation Area.

1.3.1.3 Moccasin Point Recreation Area

Moccasin Point Recreation Area consists of 96 campsites, two group picnic areas, one boat launch ramp, one fish cleaning station, and eight toilet buildings (two with showers). Figure 1.3-4 identifies the existing recreation facilities of the Moccasin Point Recreation Area. The evaluation included all of these facilities and site elements, as well as the condition of roads and parking facilities.

Overall, roads and parking areas are in good to fair condition. The parking areas are generally in good condition, with the gravel parking area (marina lower lot) in fair condition. The Boat Launch Overflow Parking Lot is recently constructed and in excellent condition. Campground features are also in good to excellent condition with one exception, food lockers in Campground areas B and C, some water faucet features in area B, and trash receptacles in area A, which were identified as being in fair condition. Similar to both Fleming Meadows and Blue Oaks, day-use area facilities overall are in good to excellent condition, with the exception of the trash facilities at the boat launch and group picnic area, which were found to be in fair condition.

The site buildings (toilet facilities, the entrance and fish cleaning stations, the marina store/office) exteriors and roofs are in good to excellent condition, with interiors also rated as good to excellent, with the exception of fair at Campground A. Signs within the recreation area were also inventoried and assessed. Unlike the other recreation areas, signs at Moccasin Point have not been replaced in some time. Most of the signs are constructed of wood and were found to be in fair condition overall. The signs constructed of metal were in good condition overall.

Moccasin Point facilities are partially accessible with at least some accessible features, such as trash bins, toilets, and parking spaces while other buildings and facilities, including campsites, water spigots, and toilets in the campground, are not accessible.

Use levels projected through 2050 at Moccasin Point Recreation Area will not exceed the capacity of the campgrounds, picnic areas, and parking areas (including boat launch, marina, and overflow lots), except for the marina and group picnic parking facilities. The marina parking facility experienced over 100 percent occupancy on holidays and weekends in 2012, and overall use is projected to exceed capacity by 2020 as marina users seek to park as close to the marina as possible. Use of the entrance overflow and main lot overflow parking lot are projected to remain below capacity through 2050.

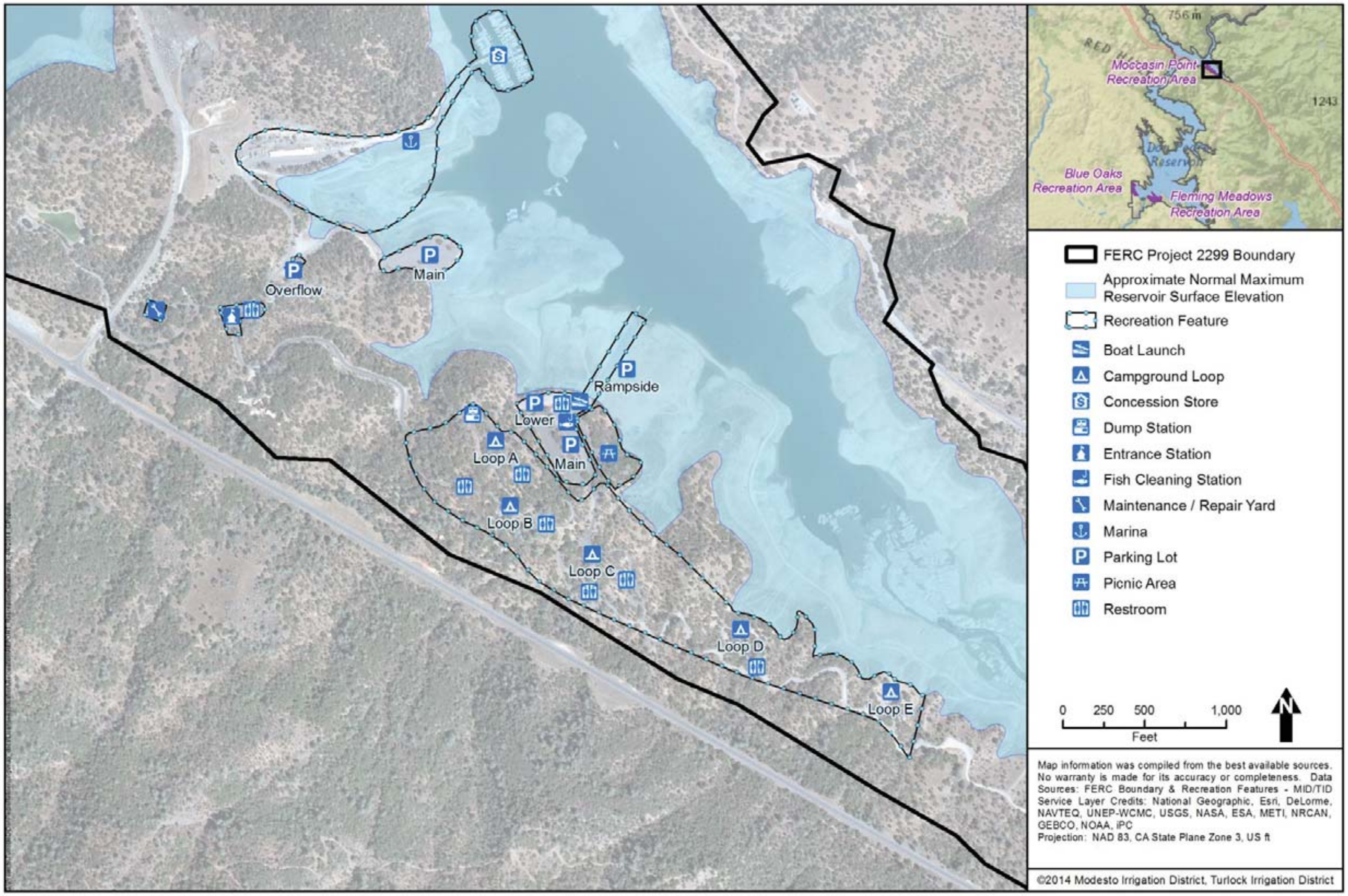

Figure 1.3-4. Recreation facilities of the Moccasin Point Recreation Area.

1.3.1.4 Ward's Ferry Bridge Whitewater Boating Take-Out Area

The whitewater boating take-out site at Ward's Ferry Bridge consists of a vault toilet, unimproved trails to the river, and undeveloped parking areas. The vault toilet was found in good condition and the parking areas along the road were found to be in fair condition. The site received a high use impact rating due to the observed presence of graffiti, general litter, and toilet paper litter.

1.3.1.5 Dispersed Shoreline Recreation Areas

The study team inventoried and evaluated the recurrent-use dispersed recreation locations along the Don Pedro reservoir shoreline. These areas are outside the developed recreation facilities, but within the FERC Project Boundary. Twenty-three recreational use sites were identified, and impact assessments were conducted at these sites. The majority of these sites (70%) exhibited low impacts; with 22 percent exhibiting moderate impact; and, two sites experiencing high impact. The two high impact sites had signs of high use and widespread impacts such as frequent signs of toilet paper, user created trails, compacted ground, trampled vegetation, and fire rings without adequate clearances. All 23 sites were mapped for continued reference and monitoring by DPRA as part of its routine maintenance and recreation management patrols.

1.3.1.6 Regional Uniqueness and Demand for Various Activities

Respondents generally felt that the developed recreation facilities at Don Pedro Reservoir were relatively unique, offered easy access, natural conditions, had a great staff and facilities, good fishing, and were less congested than comparable recreation facilities in central California.

In summary, the majority of respondents to the 2012 survey did not identify unmet demand for any recreational activities due to lack of availability. Camping, houseboating, reservoir boating, fishing, and hiking/walking were the primary activities identified.

1.3.2 Whitewater Boating Take-Out Improvement Feasibility Study

The primary goal of the Whitewater Boating Take-Out Improvement Feasibility Study was to assess the engineering feasibility of improving the efficiency and public safety of river-egress at the existing location used by commercial whitewater rafters and individual boaters for river-egress at the Ward's Ferry Bridge (TID/MID 2013c) The Ward's Ferry Bridge is the first public road access encountered by boaters using the whitewater reach of the Tuolumne River upstream of the Project Boundary. The engineering feasibility of implementing physical improvements at the Ward's Ferry Bridge location to increase the efficiency and safety of river-egress was evaluated, as was the availability of potential alternative take-out locations at Moccasin Point, Buchanan Road, Deer Creek, and Deer Flats. The feasibility study area encompassed the upstream reaches of the Don Pedro Reservoir in the Tuolumne River and Moccasin Creek arms, and the Tuolumne River mainstem up to approximately RM 82, near the North Fork confluence (Figure 1.3-5).

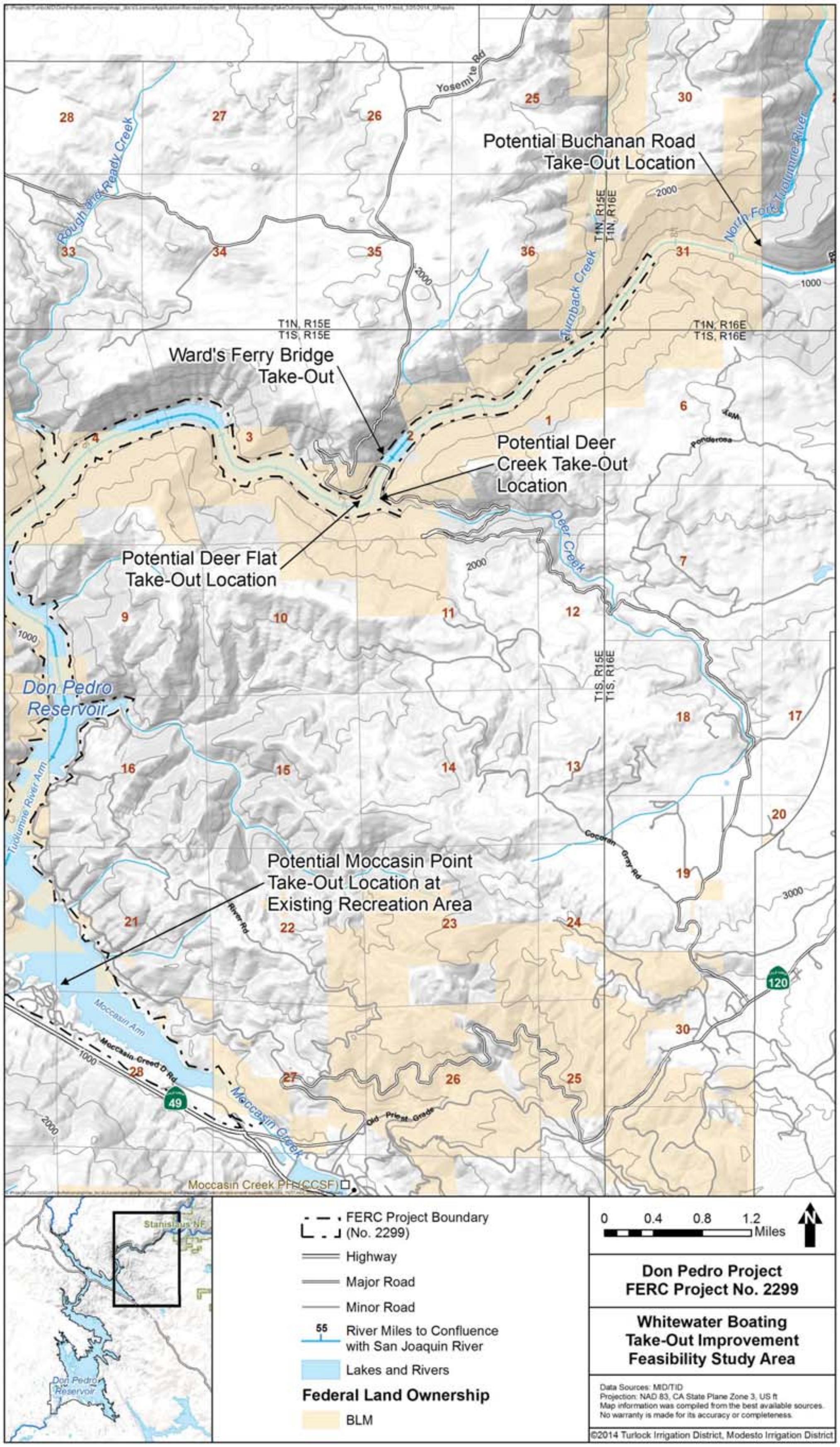

Figure 1.3-5. Whitewater boating take-out improvement feasibility study area.

Based on the study results, improving the efficiency and safety of river-egress for whitewater boaters at the existing Ward's Ferry location on river right appears to be technically feasible and preferable over other options that were studied. Advantages of the river right option include:

- It is located near the terminus of the whitewater run, i.e., far enough downstream to include all of the whitewater upstream of the Project Boundary and far enough upstream to minimize flatwater paddling on the reservoir.
- It is accessible via existing public roads.
- It is usable over the normal range of reservoir levels.
- The area has been previously disturbed and contains no sensitive resources.
- Vehicles with trailers will be able to turn around in the area of the old abutment, minimizing the need for backing up.
- Pedestrian and vehicle access to the shoreline on river right can be accommodated with a 15-ft wide access way and separated at the old bridge abutment to reduce conflicts among users. Pedestrians could also continue to use the existing trails on river left to avoid conflicts with whitewater boaters.
- The existing toilet facility would remain in place, avoiding cost of relocation.

2.0 RRMP OBJECTIVES

The purpose of the RRMP is to:

- address existing recreation resource needs within the Project Boundary,
- address future recreation resource needs within the Project Boundary,
- provide adequate and safe public access for recreation purposes,
- preserve and enhance recreation resources, and
- promote timely recreation planning over the term of the new license.

Taken as a whole, this RRMP represents a comprehensive list of recreation resource provisions and enhancements for the Project and describes the Districts' roles and responsibilities associated with providing recreation opportunity for the term of the new FERC license. The RRMP is consistent with the requirements described in the Code of Federal Regulations at 18 CFR § 2.7, Recreational Development at (FERC) Licensed Projects, which outlines licensees' responsibility for providing recreation at licensed projects. In addition to defining the Districts' roles and responsibilities for public recreation resources, the RRMP describes in Table 2.0-1 below the Districts' approach to meeting the requirements of 18 CFR § 2.7.

Table 2.0-1. Overview of 18 CFR § 2.7 requirements and Districts' measures within the Don Pedro Project Boundary.

18 CFR 2.7 Requirement	Measure
Acquire in fee and include within the Project boundary enough land to assure optimum development of the recreational resources afforded by the Project. To the extent consistent with the other objectives of the license, such lands to be acquired in fee for recreational purposes shall include the lands adjacent to the exterior margin of any project reservoir plus all other Project lands specified in any approved recreational use plan for the Project.	Because of the extensive federal and District ownership, no new land purchases will be necessary. This RRMP identifies BLM-managed and District-owned locations for existing and new recreation facilities. All non-federal lands are owned in-fee title by the Districts.
Develop suitable public recreational facilities upon Project lands and waters and make provisions for adequate public access to such Project facilities and waters and include therein consideration of the needs of physically handicapped individuals in the design and construction of such project facilities and access.	Recreation amenities are accessible in accordance with the Americans With Disabilities Act (ADA) guidelines. Maintenance and renovation of facilities will be undertaken with consideration of ADA guidelines.
Encourage and cooperate with appropriate local, state, and federal agencies and other interested entities in the determination of public recreation needs and cooperate in the preparation of plans to meet these needs, including those for sport fishing and hunting.	Relicensing studies identified public recreation opportunities and needs in the Project area. The Districts will continue to direct the DPRA and coordinate with BLM to maintain public access. The Districts will seek cooperating partners and grant awards when feasible for facility development.

18 CFR 2.7 Requirement	Measure
Encourage governmental agencies and private interests, such as operators of user-fee facilities, to assist in carrying out plans for recreation, including operation and adequate maintenance of recreational areas and facilities.	This RRMP includes taking certain recreation-related actions through partnerships and/or cost sharing with private recreation providers, government agencies, or other land managers for the development of new facilities to benefit the general public and improve the overall recreation experience.
Cooperate with local, state, and federal Government agencies in planning, providing, operating, and maintaining facilities for recreational use of public lands administered by those agencies adjacent to the Project area.	The Districts will continue to cooperate with BLM for facility development and operations and maintenance on federal lands within the Project Boundary.
Comply with federal, state and local regulations for health, sanitation, and public safety, and cooperate with law enforcement authorities in the development of additional necessary regulations for such purposes.	This RRMP identifies a detailed program to monitor recreational impacts, including sanitation, safety, and enforcement issues. The Districts' recreation facilities are designed and maintained with safety as a primary consideration. The Districts will continue to cooperate with local law enforcement officials.
Provide either by itself or through arrangement with others for facilities to process adequately sewage, litter, and other wastes from recreation facilities including wastes from watercraft, at recreation facilities maintained and operated by the Licensee or its concessionaires.	All DPRA-managed recreation facilities are designed, constructed, and maintained to meet relevant health and sanitation requirements, including permitted sewage facilities at highly developed recreation areas, vault and floating toilets in less developed locations, and solid waste management.
Ensure public access and recreational use of Project lands and waters without regard to race, color, sex, religious creed or national origin.	This RRMP defines recreation measures and programs designed to provide public access to, and use of, water bodies and shorelines without regard to race, color, sex, religious creed or national origin.
Inform the public of the opportunities for recreation at licensed projects, as well as of rules governing the accessibility and use of recreational facilities.	This RRMP describes the website and signage that are maintained to inform visitors and potential visitors of recreation facilities and opportunities, and educate visitors about sensitive resources and appropriate behavior through regulatory and informational signage and other written material.

3.0 RECREATION FACILITY DEVELOPMENT

DPRA's Recreation Facility Development Program is intended to help address existing and future recreation facility needs identified by upgrading existing facilities and constructing new facilities, where appropriate, based on regular monitoring of recreation use and trends. The program also defines the current capital construction-related plans of the Districts, identifies proposed recreation development projects and their estimated costs, and provides conceptual diagrams of the locations of anticipated improvements.

The Recreation Facility Development Program addresses needs identified by relicensing recreation studies, including the current desire for improved river-egress for whitewater boaters at the Ward's Ferry Bridge location.

3.1 Ward's Ferry Improvement Project

As stated in Section 1.2.2, the Districts identified technically feasible improvements to accommodate river-egress for whitewater boaters at Ward's Ferry Bridge (Figure 1.3-5) to improve safe, efficient use of the site by commercial and individual boaters exiting the river. Under this RRMP, the improvements to the whitewater boating take-out at the Ward's Ferry Bridge presented and described below will be implemented within five years of the effective date of the new FERC license. The estimated cost of design and construction is $1.1 million. Attachment A contains a preliminary capital cost estimate for the Ward's Ferry Bridge whitewater boating take-out improvements. To recover their costs, the Districts will charge a user fee of $10/boater, payable by the commercial rafting companies. At this rate, cost recovery by the Districts will likely exceed 35 years.

A new access road/water access ramp will be constructed starting at the river-right abutment of the Ward's Ferry Bridge and extending upstream to the water's edge (Figures 3.1-1; 3.1-2; 3.1-3; and 3.1-4). Mechanically Stabilized Earth wall construction is the preferred alternative to eliminate the need for blasting or cutting into the existing steep hillside. The upper section of the access road will be paved 15-ft wide from the bridge to the old bridge abutment at approximately elevation 830 ft to accommodate both pedestrian and vehicle traffic with visual delineation (e.g., painted line) designating the pedestrian portion. The upper road section will include a Mechanically Stabilized Earth retaining wall for its lower half and guard rail along its upper half. A new 10-foot wide access road/ramp will be constructed to descend from the abandoned bridge abutment to low-water's edge at about elevation 770 ft in an upstream direction (Figure 3.1-4). This lower new road section will provide vehicle access to the shoreline at low reservoir elevation conditions and would include construction of a Mechanically Stabilized Earth wall for most its length. The new road will be designed and constructed to withstand inundation of reservoir levels up to elevation 830 ft.

At the abandoned bridge abutment, a vehicle turn around area will be constructed (Figure 3.1-3). Vehicles without trailers will be able to turn around at this location and back down to the water's edge to retrieve equipment. Operators of vehicles with trailers will be able to use this area to disconnect the trailers and turn their vehicles around before re-hitching the trailer, then backing down to the water's edge. Alternatively, rafts and other equipment could be carried up the short distance to the abandoned bridge abutment as the vehicle is being turned around. While this configuration accommodates only one vehicle at a time, it is a feasible, reasonable solution given the topographic and geotechnical engineering challenges of the site.

The existing user-defined pedestrian trail that descends in a downstream direction from the old bridge abutment will be upgraded to provide improved pedestrian access to the shoreline at low reservoir elevation conditions. The trail will be expanded to a width of four feet by grading, placement, and spreading of granular fill, combined with the use of cross-drainage and erosion control. As with the road described above, the trail will be constructed to withstand inundation that occurs at this location.

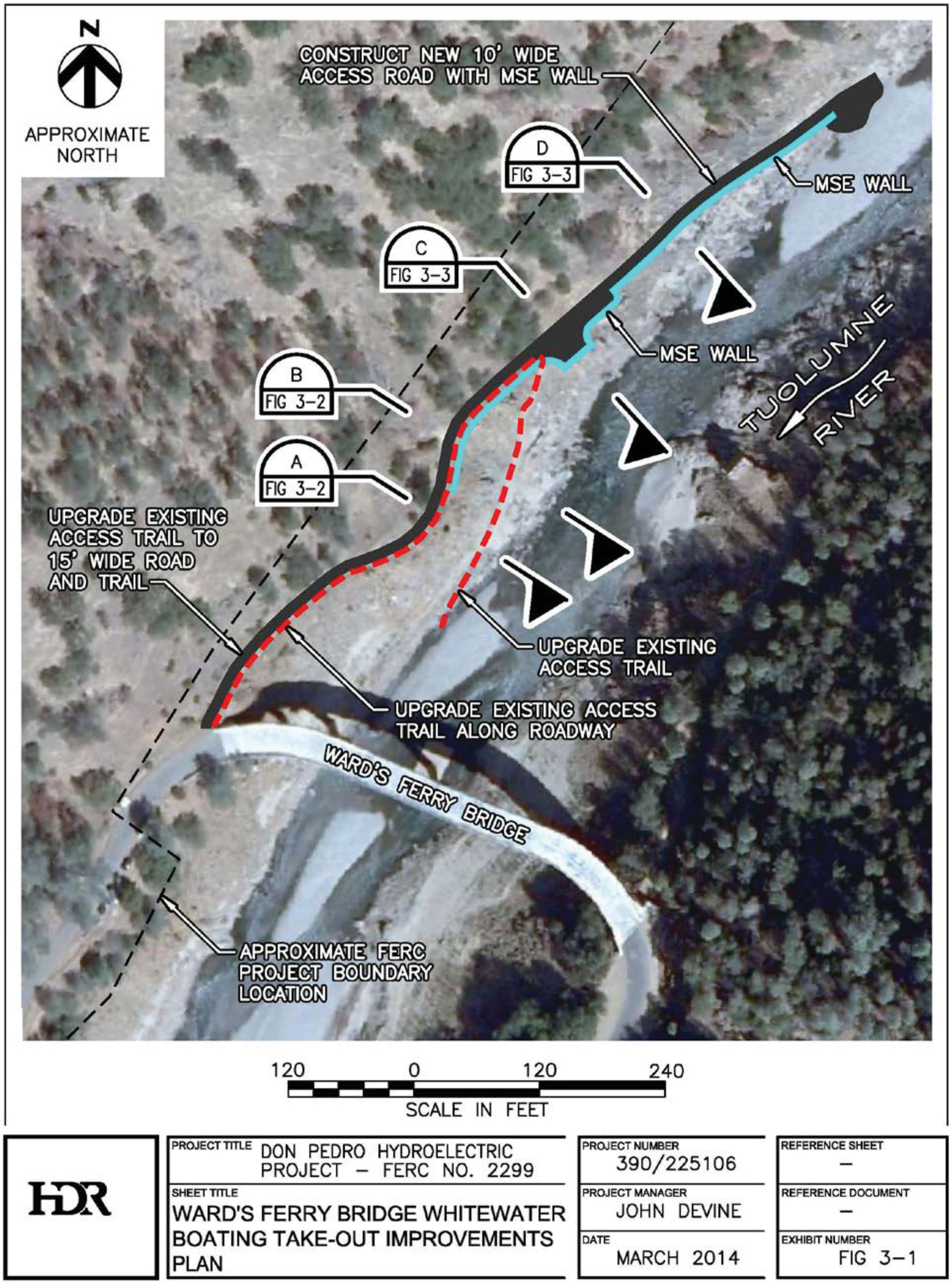

Figure 3.1-1. Ward's Ferry Bridge whitewater boating take-out improvements – plan view.

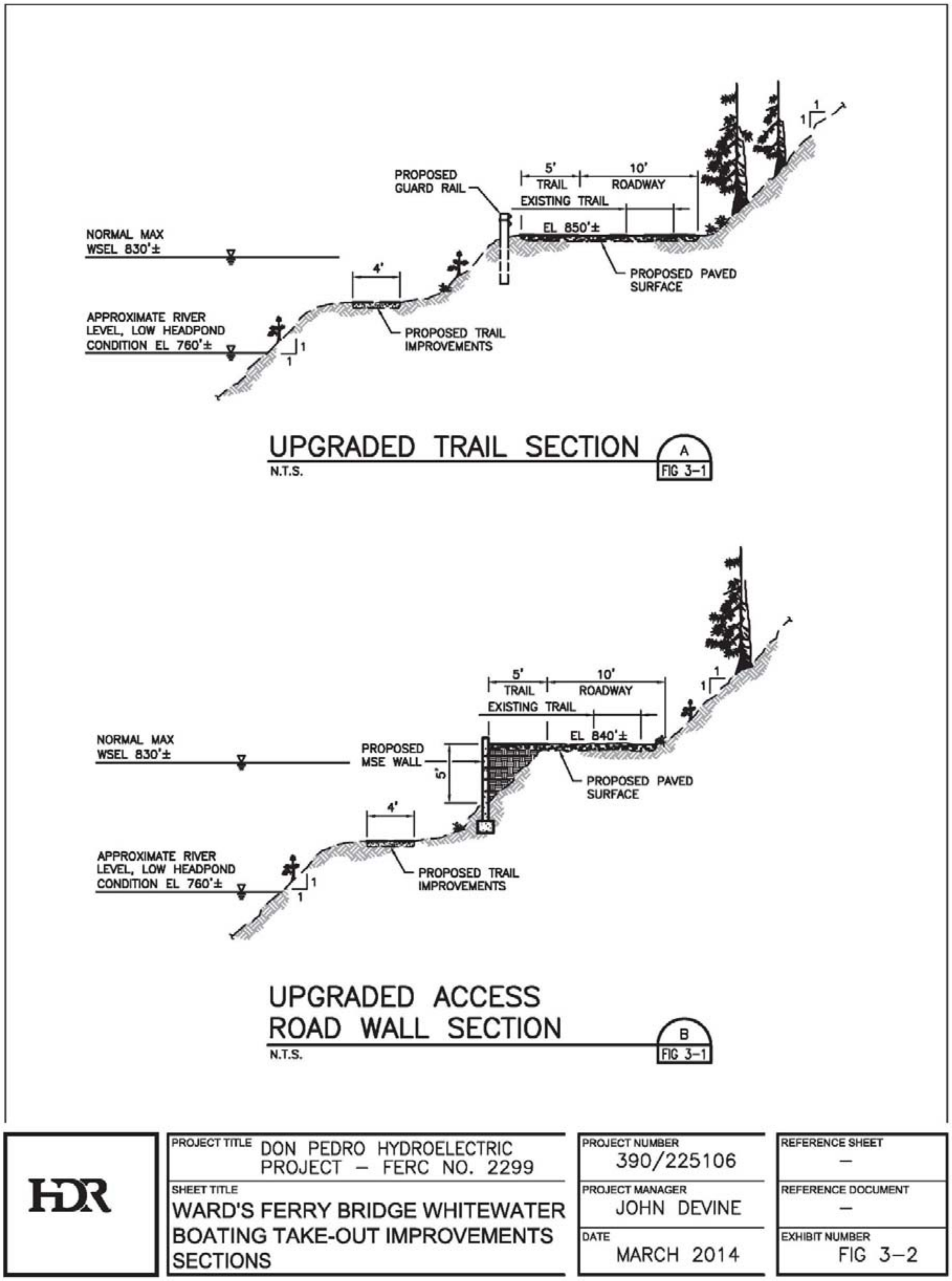

Figure 3.1-2. Ward's Ferry Bridge whitewater boating take-out improvements -- sections.

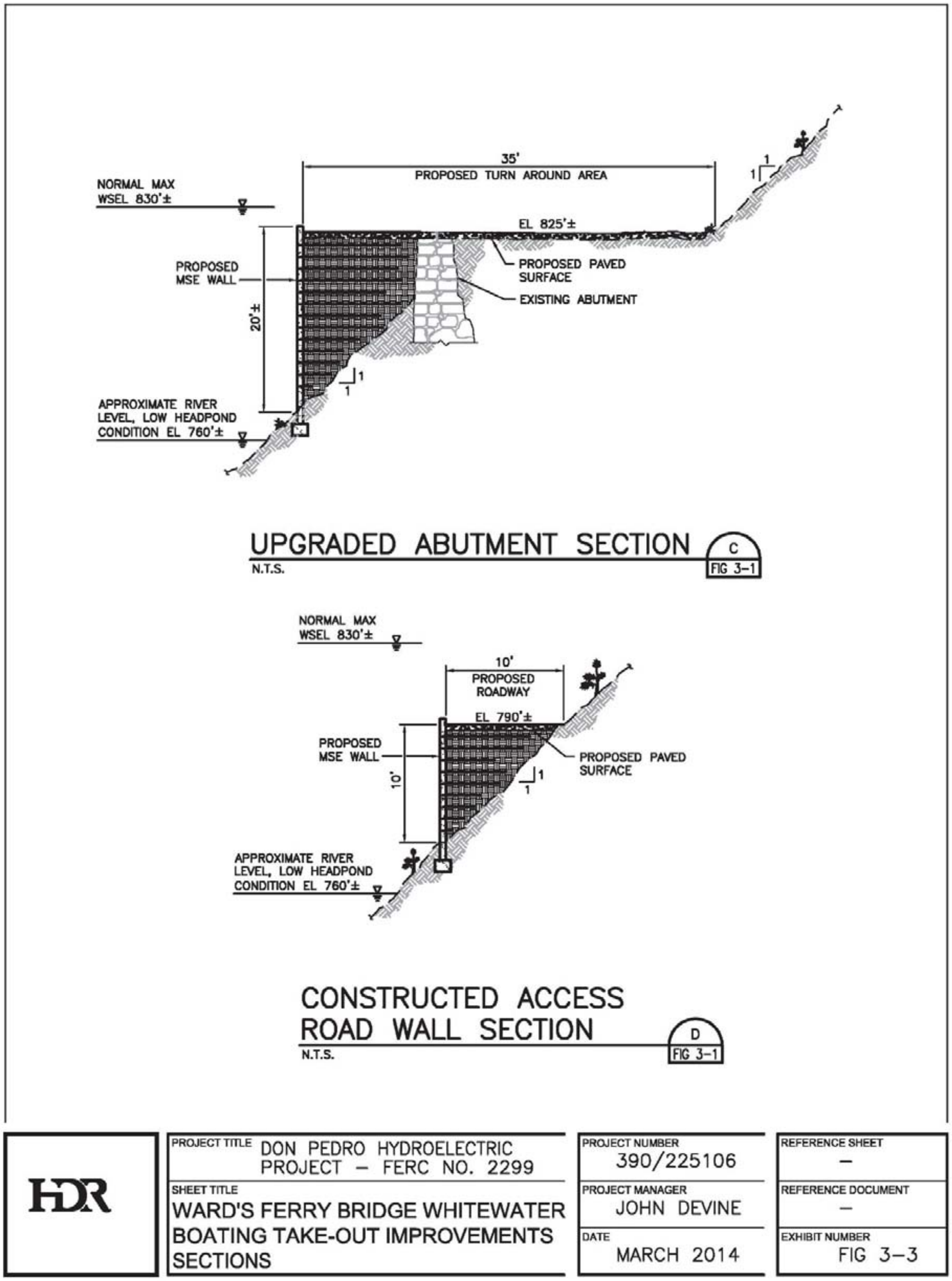

Figure 3.1-3. Ward's Ferry Bridge whitewater boating take-out improvements -- sections.

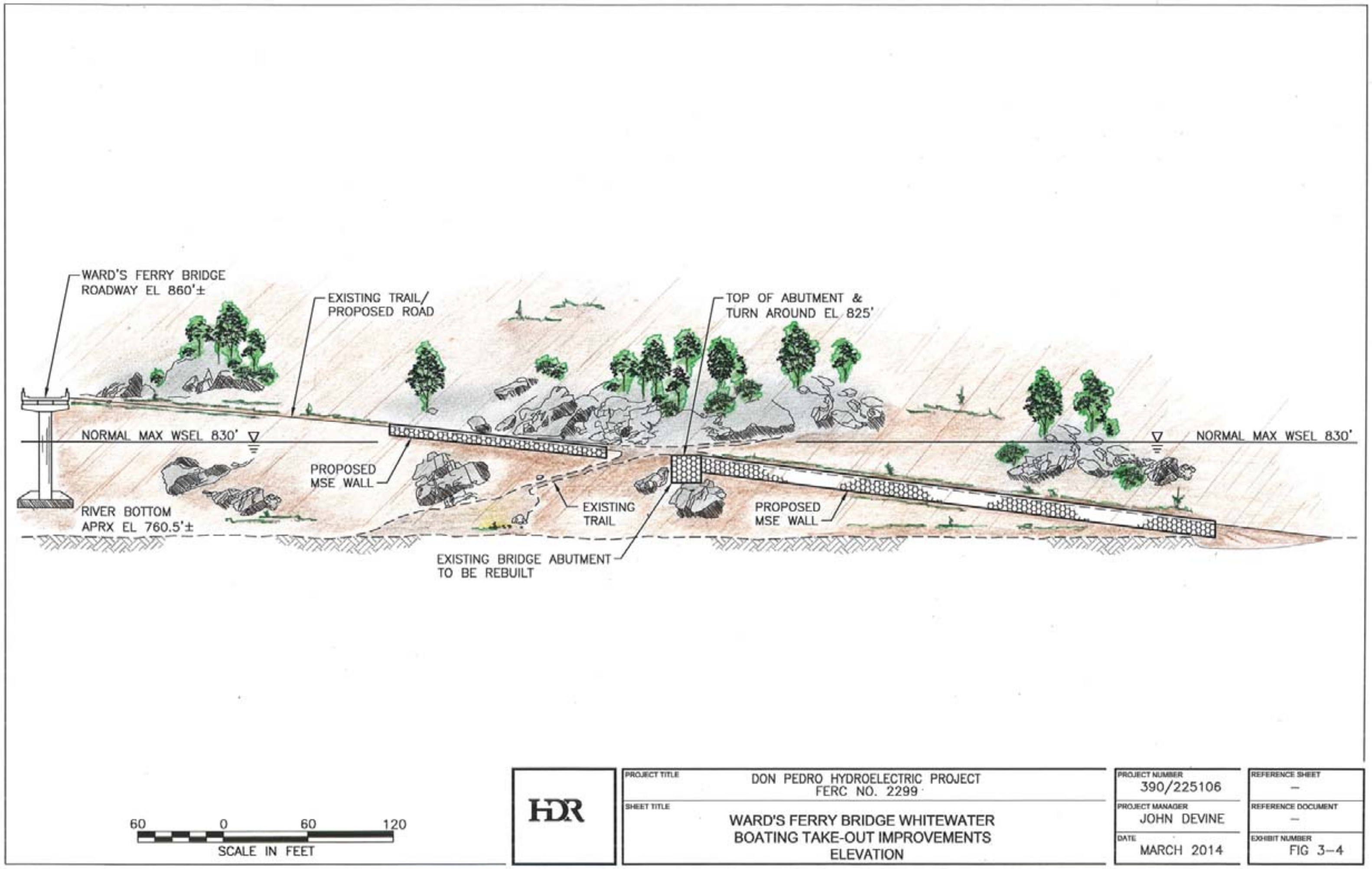

Figure 3.1-4. Ward's Ferry Bridge whitewater boating take-out improvements -- elevation view.

3.2 Potential Future Recreation Facility Development

The Recreation Facility Development Program will be reviewed periodically and revised as appropriate to continue to address new recreation needs within the Project Boundary as they evolve throughout the term of the license. The monitoring of recreation use and the determination of the type and timing of new facilities is discussed below in Section 6.0.

4.0 RECREATION FACILITIES OPERATIONS AND MAINTENANCE

Effective operation and maintenance (O&M) of existing and future recreation facilities are key elements of a successful recreation resource management program. The Districts will continue to provide through DPRA the measures described below. The Districts and DPRA maintain a five-year budget plan that is updated annually (see Attachment B). The current five-year DPRA recreation maintenance and operation budget projection for 2014-2018 averages $269,000 per year.

4.1 Operation and Maintenance of Developed Multi-Use Recreation Facilities

DPRA is responsible for operation and maintenance of the three developed multi-use recreation facilities: Fleming Meadows Recreation Area, Blue Oaks Recreation Area, and Moccasin Point Recreation Area (Figures 1.3-2 through 1.3-4). The Districts and DPRA may contract with concessionaires for the administration, operation, and maintenance of these recreation areas.

Operational maintenance activities keep recreation facilities in functioning, efficient operating condition. Examples of regular or routine operational maintenance activities include, but are not limited to, cleaning, mowing and other vegetation maintenance, repair, replacement, servicing, inspecting, and painting. Maintenance activities may include work needed to meet applicable laws, regulations, and codes (such as compliance with the Americans with Disabilities Act, or ADA). Operational maintenance does not require prior FERC approval or agency consultation.

DPRA and concessionaires will routinely monitor the three developed multi-purpose recreation facilities to identify maintenance needs as they arise. Needs identified through monitoring may be addressed immediately (e.g., collecting litter, replacing light bulbs, cleaning bathroom areas), or flagged for inclusion in upcoming scheduled routine maintenance activities (e.g., emptying large trash containers, repairing plumbing).

The Special-Status Wildlife – Bat Study conducted in relicensing (TID/MID 2013b) identified evidence of bat night roosting at certain campground facilities that persisted throughout the study, suggesting that disturbance to night roosts in general is not adversely affecting bat use of the area. The disturbance associated with recreation use of is unlikely to result in abandonment of roosts by bats. However, the small cinderblock structure[1] near the A2 restroom in the Blue Oak campground, used by pallid bats as a night roost, was found to have burn marks on the interior walls of the structure and broken glass on the floor. It is notable that DPRA patrol records and staff anecdotal recollections support that this building has never been the source of any incidences or patrol contacts, day or night. Nonetheless, the direct nature of the disturbance to this structure suggests that future disturbances occurring at night could lead to a reduction of use or abandonment by special-status bats. Therefore, to prevent visitor activities from disrupting pallid bat use of this building, routine maintenance patrols at Blue Oaks campground will include

[1] The building appears to be a small shed for storing explosives that was part of Guy F. Atkinson Company's construction camp during the construction of the new Don Pedro Dam in the late 1960s and early 1970s.

direct observation of the cinderblock structure to ensure that visitors are not entering the building or otherwise disturbing pallid bat night roosting. These patrols will be conducted periodically during the day to determine any evidence of human use and at night to directly observe and prevent any use that may be occurring during the time that pallid bats use the building. If DPRA determines that human use is occurring at night in spite of patrols, physical measures will be taken to exclude humans from the building while still accommodating pallid bat use (e.g., partially boarding the doorway).

4.2 Operation and Maintenance of Recreation Areas with Limited-Facility Infrastructure

DPRA is responsible for operation and maintenance of the limited-facility infrastructure at one primitive boat-in camping area (Wreck Bay) and 12 developed toilet only facilities (eight floating toilets and four dispersed shoreline toilets) (Figure 4.2-1). One of the toilet facilities is located at Ward's Ferry, where additional improvements are proposed to be constructed during the term of the new license (Section 3.2). Routine maintenance activities keep the limited-facility infrastructure in functioning, efficient operating condition. Examples of regular or routine maintenance activities include, but are not limited to, cleaning, vegetation maintenance, repair, replacement, servicing, and inspecting. Additionally, DPRA may relocate, remove, or add floating toilets at the identified locations and other locations as deemed necessary to maintain sanitary conditions and provide toilet services where they are needed by recreationists. Figure 4.2-1 of this RRMP will be revised and maintained over time to reflect current locations of floating toilets. Maintenance activities may include work needed to meet applicable laws, regulations, and codes. Maintenance, including the relocation, addition, or removal of floating toilets, does not require prior FERC approval or agency consultation.

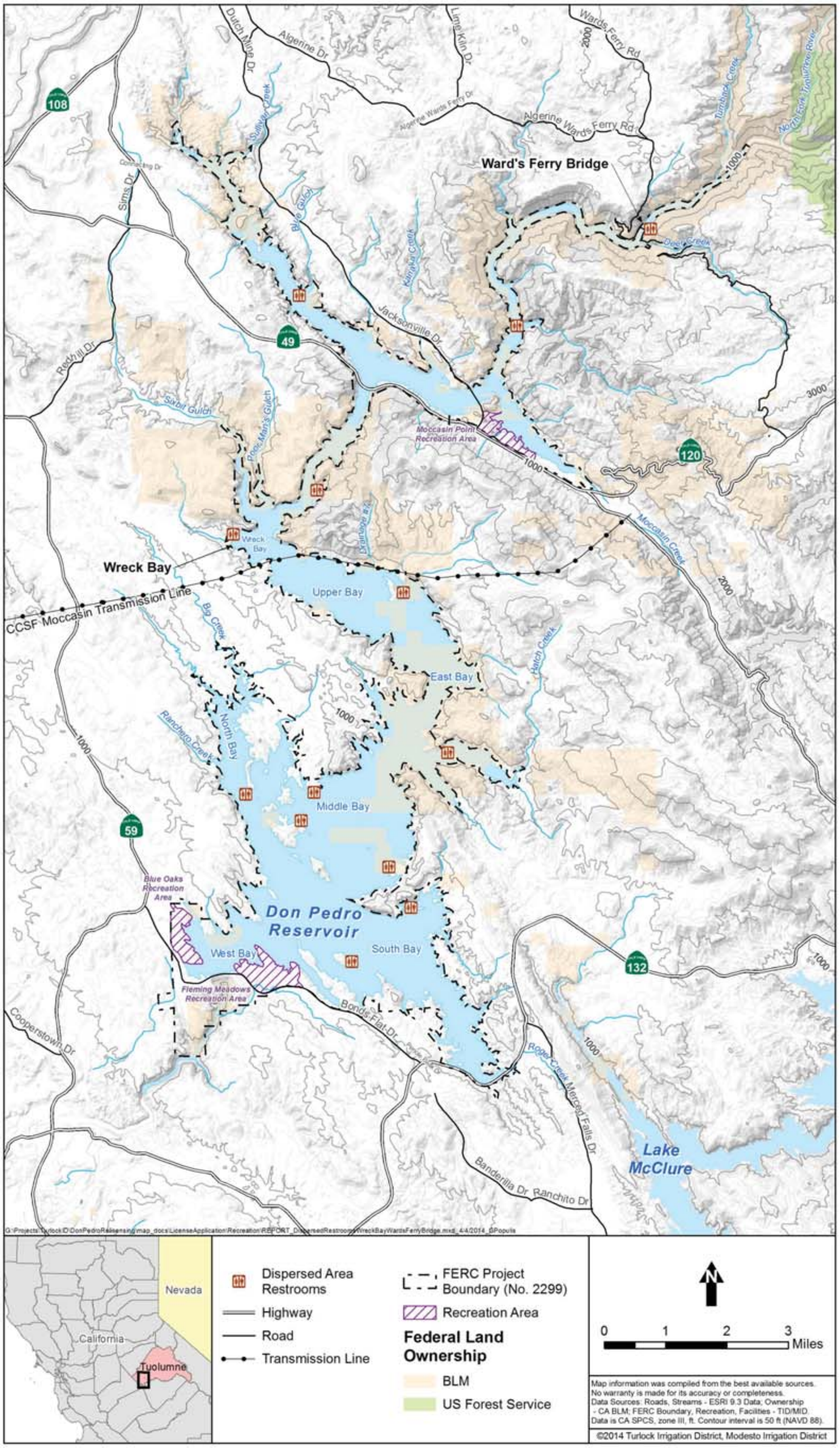

Figure 4.2-1. Remote and limited-facility infrastructure locations.

4.3 Maintenance of User-Defined Dispersed Recreation Areas with No Facility Infrastructure

DPRA will periodically monitor and cleanup public shoreline dispersed areas identified in Figure 4.3-1. If monitoring reveals resource damage at any of these locations due to significant visitor use impacts, appropriate actions will be proposed in cooperation with adjoining landowners or resource agencies. Options to consider may include site closure, new use restrictions, or new "hardened" recreation facilities. Hardened facilities may include tent pads, picnic tables, moorage, designated hunting blinds, and/or toilets for increased resource protection (on a case-by-case basis). If additional public shoreline dispersed areas are identified within the Project Boundary over time, they will be included in this program. Figures 4.2-1 and 4.3-1 of this RRMP will be revised and maintained over time to reflect current locations of limited infrastructure and the dispersed recreation areas monitored under the RRMP.

DPRA provides surveillance of areas where vehicular traffic has potential direct access to the Project Boundary and the reservoir shoreline. DPRA will continue its practice of monitoring and installing barriers and signs (as needed) where vehicles attempt to access shoreline areas. DPRA's actions in this regard protect against shoreline damage and disturbance.

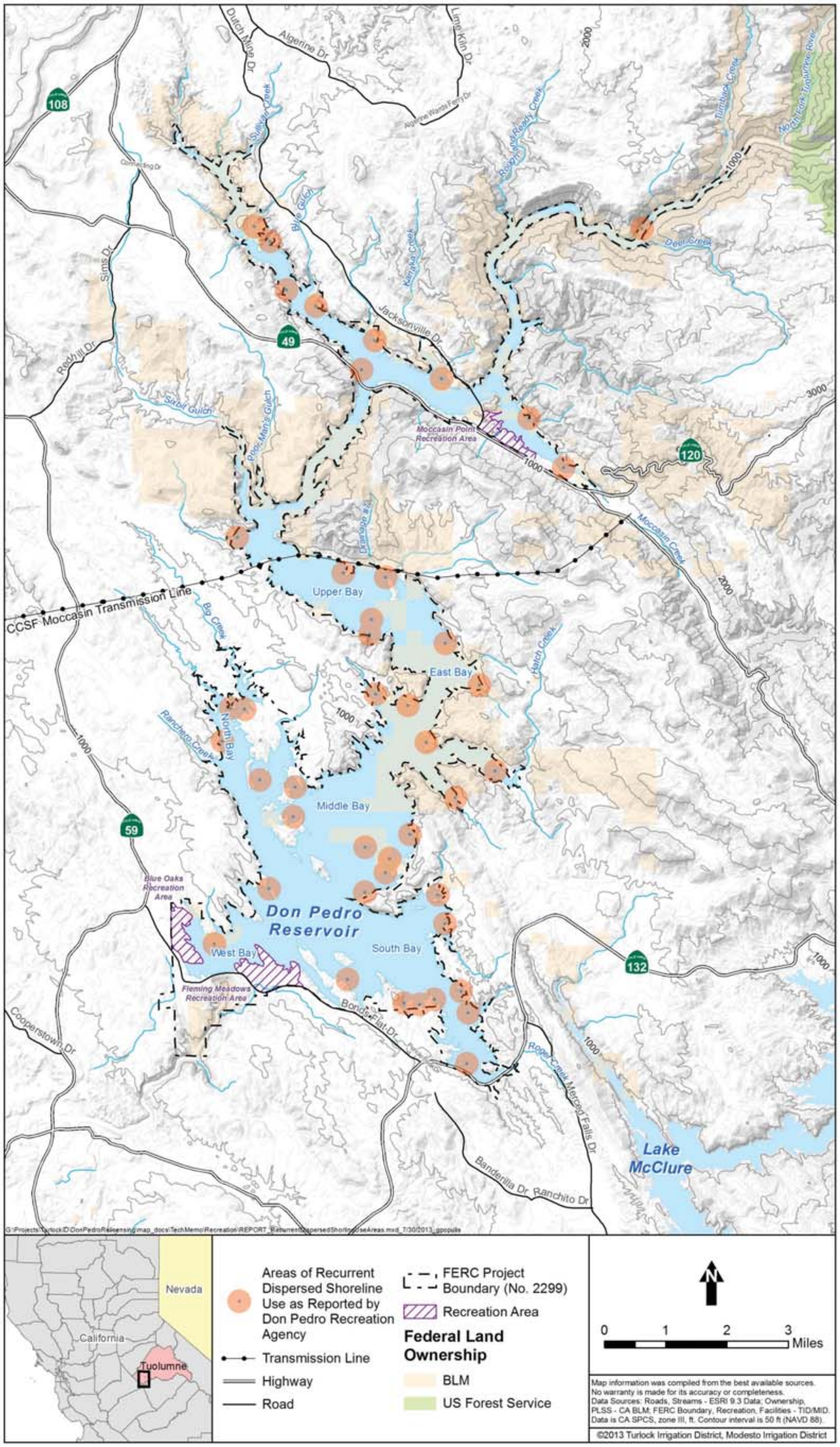

Figure 4.3-1. Dispersed recreation areas.

5.0 RECREATION USE MONITORING PROGRAM

The Recreation Use Monitoring Program is designed to measure recreation use levels, recreation use impacts, visitor tolerances for impacts (crowding, conflict, use impacts, facility conditions, etc.) and management actions that may be used to address identified "impact problems." Combined, this information will allow DPRA and the Districts to determine if the RRMP's objectives are being achieved.

The Recreation Use Monitoring Program defines the Districts' intended recreation-related monitoring activities over the term of the new license. The program defines the Districts' role in collecting and analyzing recreation data, and proposes how the data might be used to guide planning related to recreation management and capital facility improvements.

As described below, the Districts will collect basic recreation use data every year beginning in the year following FERC approval of this RRMP. A report summarizing the annual data and discussing any notable trends will be submitted to FERC with the Form 80 filings every six years beginning with the year 2020 Form 80. Should FERC's requirement for filing Form 80s be eliminated or revised, the Districts will revise the RRMP to reflect FERC's new reporting schedule or requirements.

Every 12 years beginning in 2026, the Districts will undertake a comprehensive assessment of recreation use as discussed in Section 5.2.

5.1 Annual Use Estimates and Form 80 Reporting

Each year, the Districts will collect and compile entrance fee information at developed multi-use recreation facilities, observational data during routine maintenance at dispersed sites, and relevant information available from secondary sources (e.g., upper Tuolumne River whitewater boating use estimates). Counts will be compared over the years to identify any change in the amount and/or location of use. Estimates of the recreational activity at dispersed sites will be based on instantaneous counts and/or vehicle counts during routine maintenance[2]. This information will form the basis of use estimates, allow for tracking of trends over time, and support the examination of correlations among those trends.

A report summarizing the annual data collected over the previous six years and discussing any notable trends will be submitted to FERC with the Form 80 filings beginning with the year 2020 as described in Section 5.1. Should FERC's requirement for filing Form 80s be eliminated or revised, this RMP will be deemed changed to reflect FERC's new reporting schedule or requirements.

5.2 Twelve-Year Monitoring

Every twelve years beginning in 2026, the Districts will develop and file with FERC a Recreation Monitoring Report. Methods for gathering data to develop this report will include

[2] The Districts may substitute over-the-road vehicle traffic counters in lieu of instantaneous counts.

administration of a visitor survey to determine if existing recreation facilities and opportunities are adequate to meet user preferences for recreation facilities and opportunities.

6.0 CONSULTATION, REPORTING, AND PLAN REVIEW AND REVISION

Over the term of the new license, additional consultation may occur as necessary to ensure that the objectives of the RRMP are being met and the proposed measures are implemented. Consultation activities conducted during the new license terms will include periodic reporting of recreation use and facility condition as described below.

6.1 Recreation Use and Condition Survey Report

The Districts will prepare a Recreation Report every six years to be submitted to FERC with the Form 80. The report will include the following information:

- Summary of previous six years of Project recreation fee/occupancy indicator information,
- Form 80,
- Trend analysis from comparing existing monitoring report results to previous monitoring report results,
- Summary of recreation related impacts presented in other Project resource monitoring plans from the previous six years, and
- Current 5-year budget and planning forecast.

The report will be submitted with the Form 80 filings every six years beginning with the year 2020 Form 80.

6.2 Visitor Survey Report

Every 12 years, the Districts will complete a recreation questionnaire survey report aimed to determine if existing recreation facilities and opportunities are adequate to meet user preferences for recreation facilities and opportunities. Based on the survey, the Districts will prepare a report including objectives, methods, results, recommended reasonable resource management measures (which will include any need for recreation facility modification, closure, or new facilities) where appropriate, and a schedule of implementation for recommended resource management measures. The Districts will implement those measures approved by FERC. The Districts will consult with Bureau of Land Management, National Park Service, California Department of Parks and Recreation, California Department of Boating and Waterways, and California Department of Fish and Wildlife as part of the preparation of the reports prior to filing them with FERC. The first report will be filed with FERC on December 1, 2027 (allowing time for report development and consultation after the Districts' submission of the 2026 Form 80 and recreation report described in Section 6.1). The 12-year report will include:

- Annual recreation use estimates,
- A discussion of the adequacy of existing recreation facilities at the project to meet recreation demand,

- A description of the methodology used to collect all study data,
- If there is a need for additional facilities, a revised plan and schedule to accommodate recreation needs at the Project,
- The entity or entities responsible for constructing, operating, and maintaining the facilities,
- Documentation of agency consultation and agency comments on the revised report after it has been prepared and provided to the agencies, and
- Specific descriptions of how the agencies' comments are accommodated by the revised report.

6.3 Revisions to the Plan

In conjunction with the development of the 12-year visitor survey report, the Districts will review the RRMP. The Plan will be updated and/or revised if the Districts determine the data collected in the preceding 12 years indicates significant changes in recreation use/conditions or substantial differences in recreation use versus facility capacity of the existing recreation areas. During the 12 year reviews, changes or revisions to the RRMP will be considered if recreation use patterns or resource conditions have changed. Any revisions to the RRMP will be developed with consideration for economic feasibility and public interest with the purpose of continuing to provide reasonable public access to and use of Don Pedro Project lands and waters.

Any updates to the Plan would be prepared in coordination and consultation with stakeholders, as appropriate. If the Districts do not adopt a particular recommendation, the filing would include the reasons for not doing so, based on recommendation-specific information.

7.0 LITERATURE CITED

Turlock Irrigation District and Modesto Irrigation District (TID/MID). 2013a. Recreation Facility and Public Accessibility Assessment, and Recreation use Assessment Study Report (RR-01), Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

____. 2013b. Special-Status Bats Study Report (TR-09). Attachment to Don Pedro Hydroelectric Project Draft License Application. December 2013.

____. 2013c. Whitewater Boating Take Out Improvement Feasibility Study Report (RR-02). Attachment to Don Pedro Hydroelectric Project Updated Study Report. December 2013.

U.S. Access Board (USAB). 2004. Americans with Disabilities Act and Architectural Barriers Act Accessibility Guidelines (ABAAG). Washington, D.C. 304 pp. http://www.accessboard. gov/ada-aba/final.cfm.