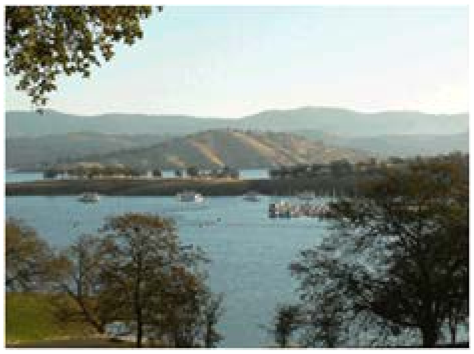
DON PEDRO HYDROELECTRIC PROJECT
FERC NO. 2299

FINAL LICENSE APPLICATION

EXHIBIT E – ENVIRONMENTAL REPORT



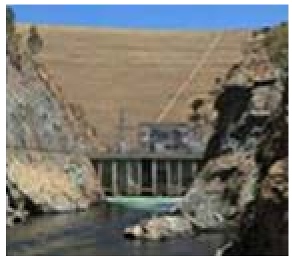


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Table of Contents

Section No.	Description	Page No.

List of Tables

List of Figures

List of Appendices

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.

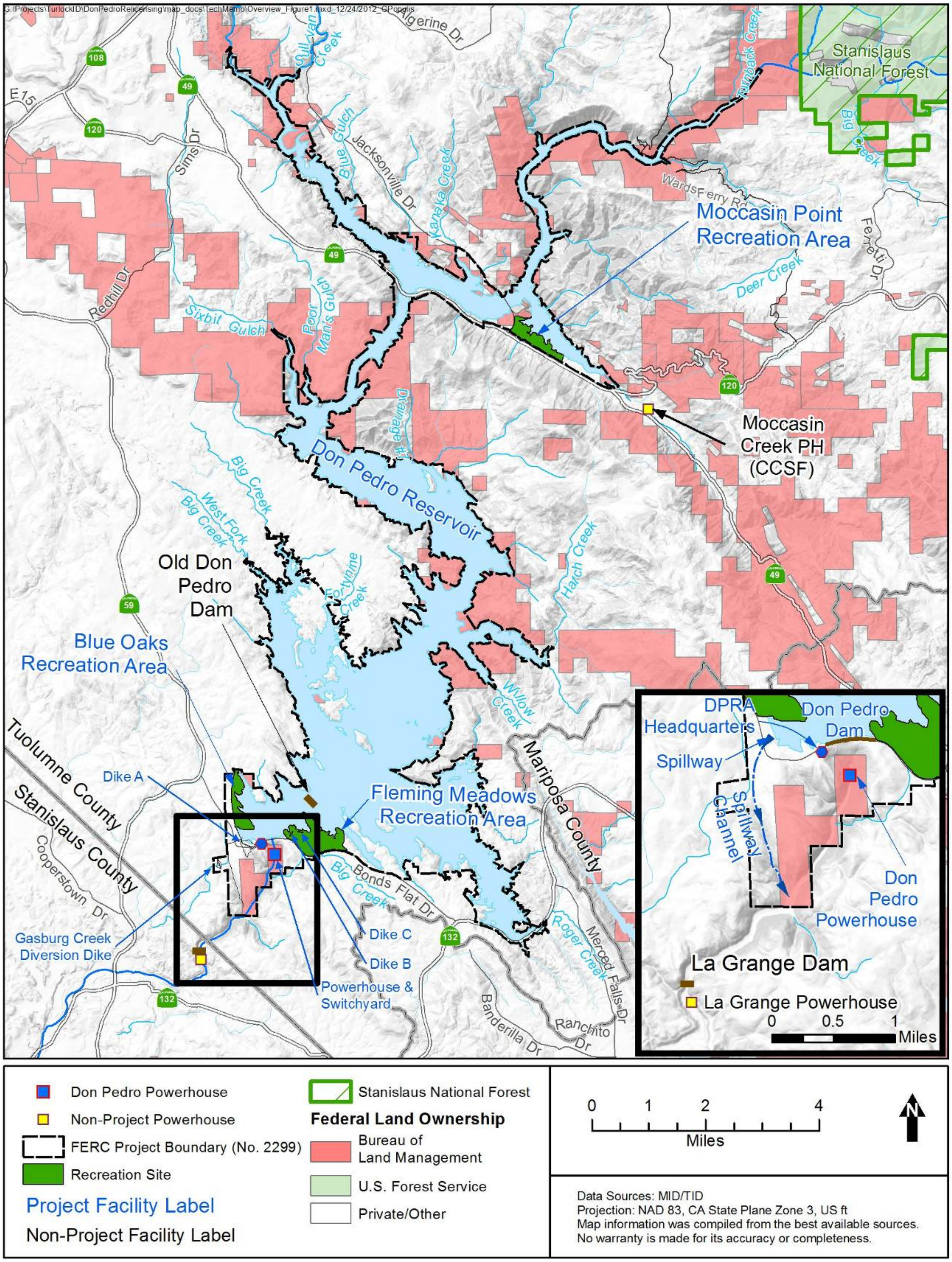


Figure 1.0-1. Don Pedro Project Boundary and major facilities.

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.

[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.

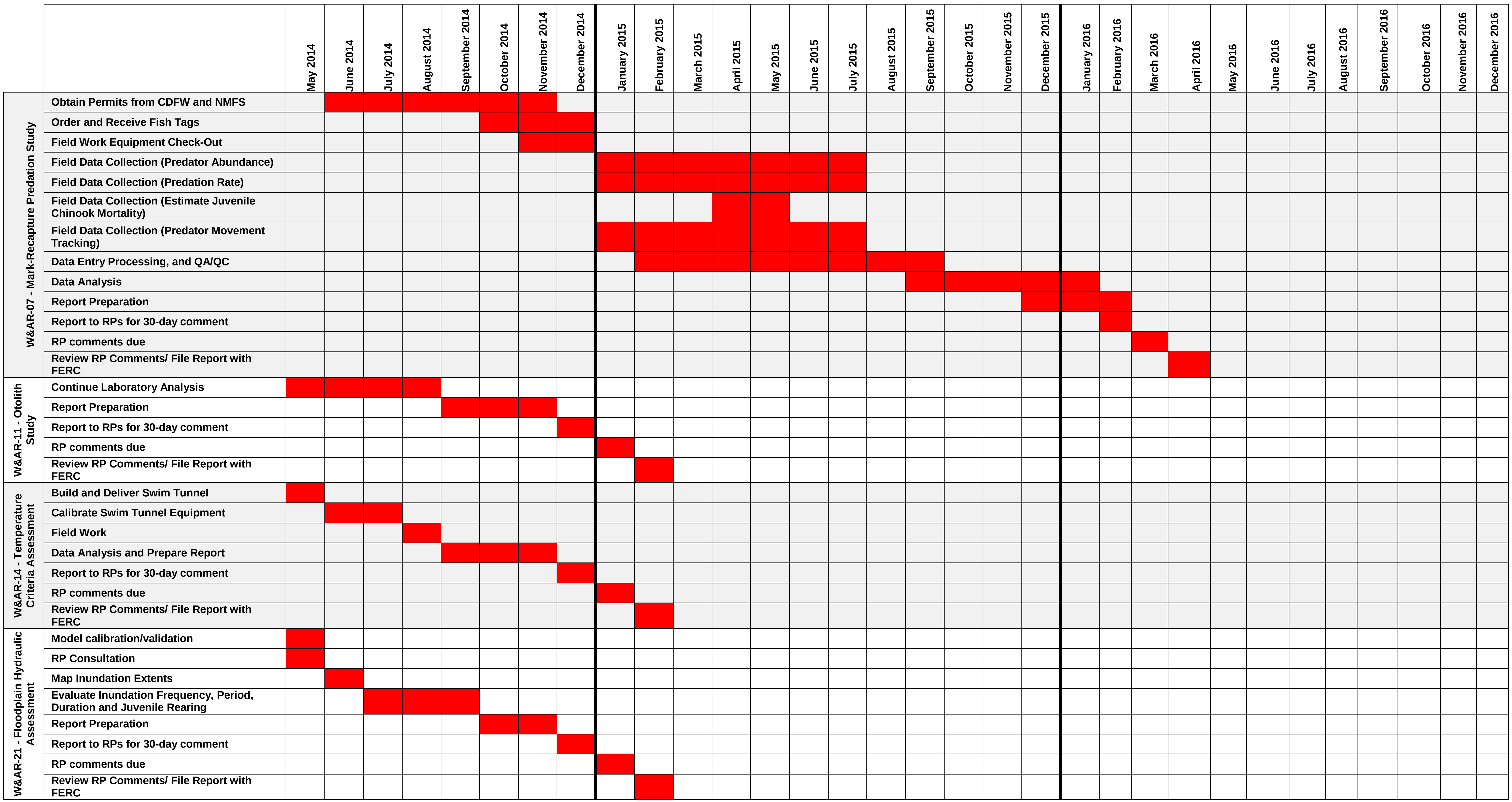
1.3.6 Post-Filing Consultation and Alternatives Analysis

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	January 2015	February 2015	March 2015	April 2015	May 2015	June 2015	July 2015	August 2015	September 2015	October 2015	November 2015	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

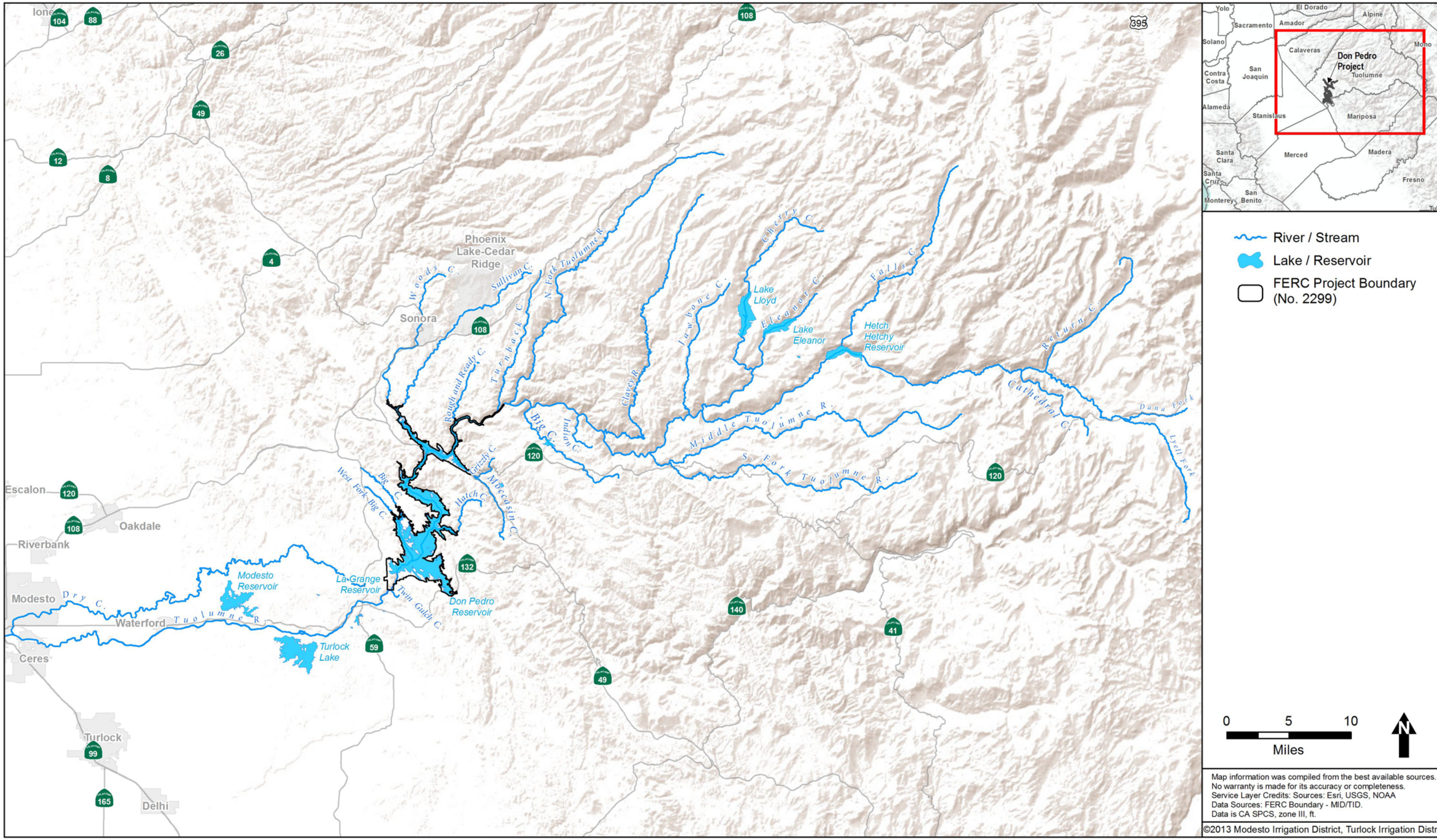


Figure 3.1-1. Location of tributaries to the Tuolumne River.

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.

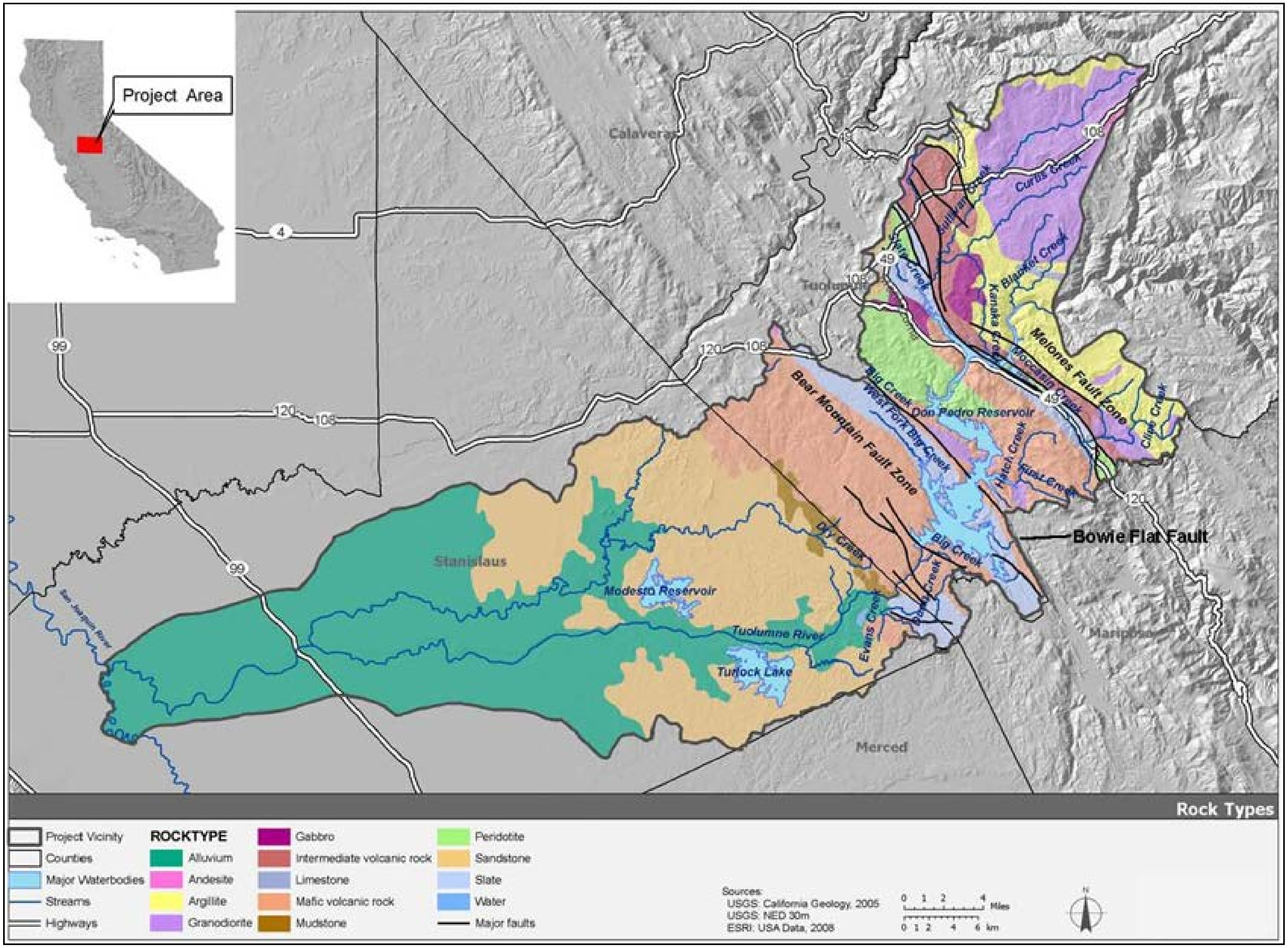


Figure 3.3-1. **Rock types in the Don Pedro Project vicinity.**

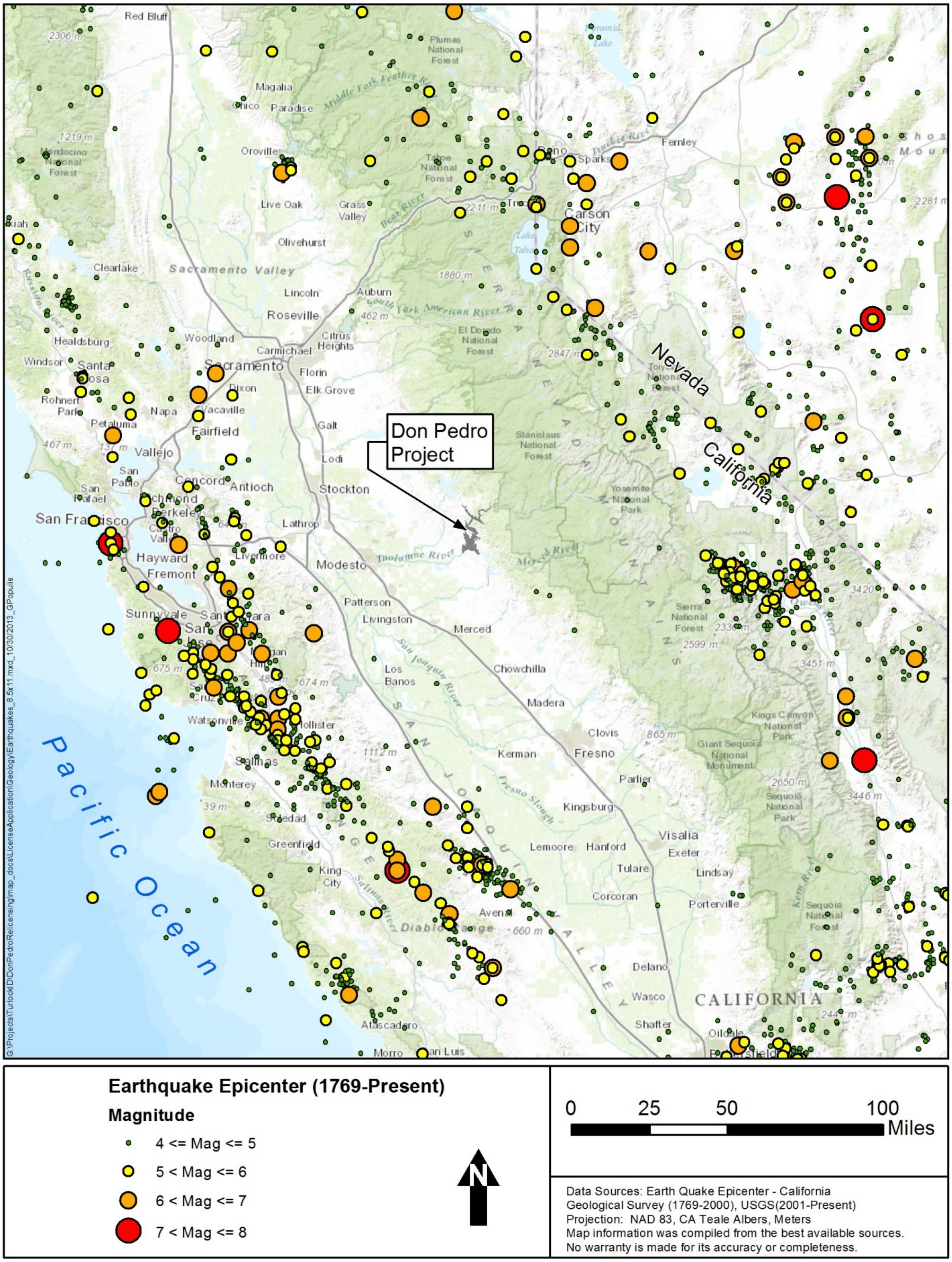


Figure 3.3-2. Historical Seismicity 1769 to 2013.

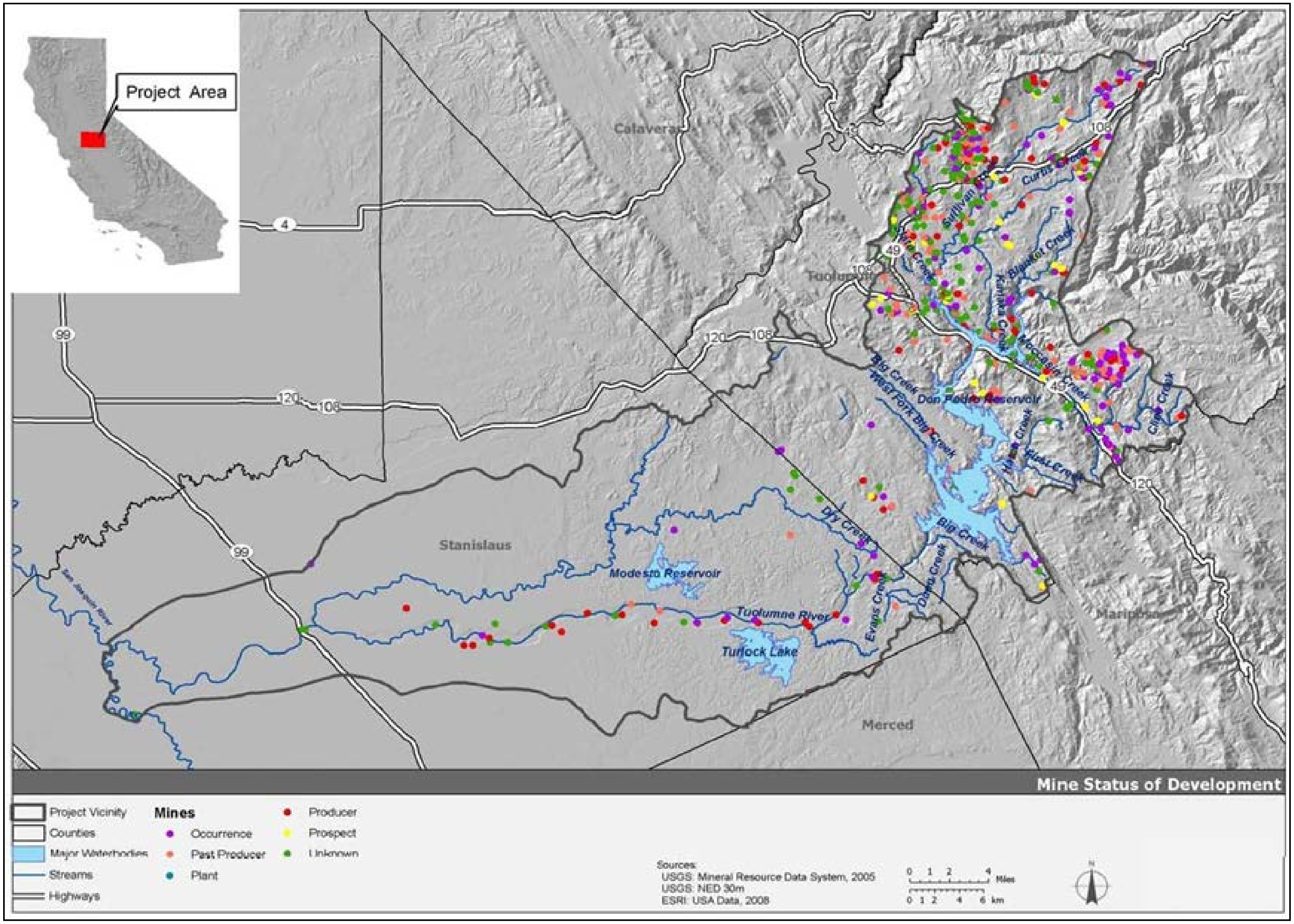


Figure 3.3-3. Past and present mines in the general vicinity of the Project Boundary.

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.

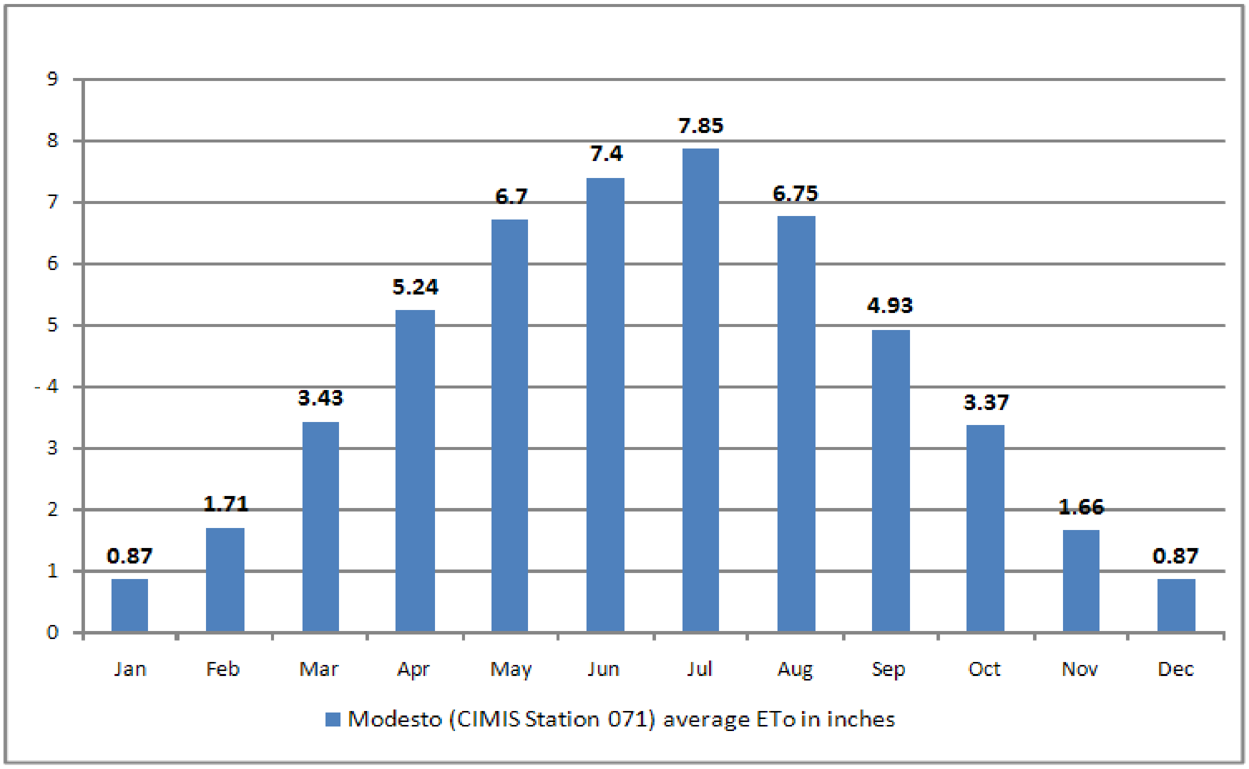


Figure 3.4-1. Modesto monthly average evapotranspiration rates (ETo in inches), June 1987 to present.

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.

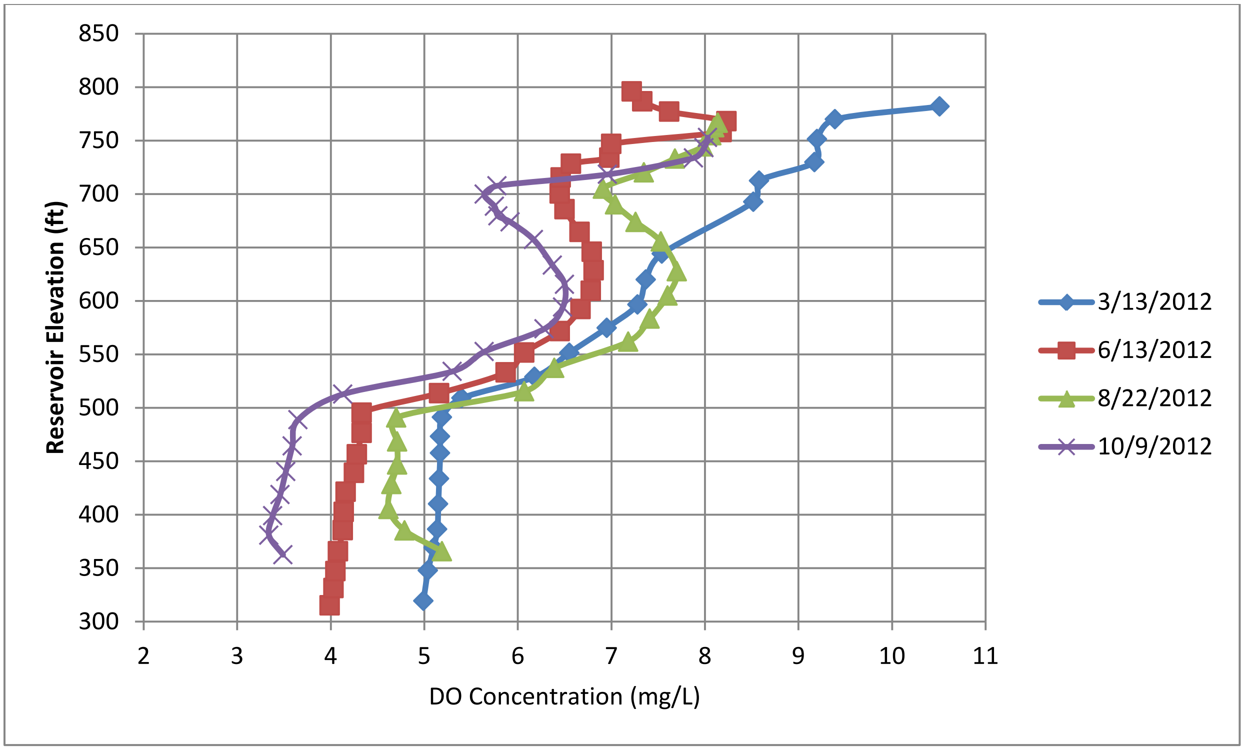


Figure 3.4-2. Dissolved oxygen profiles collected in Don Pedro Reservoir near the dam during 2012.

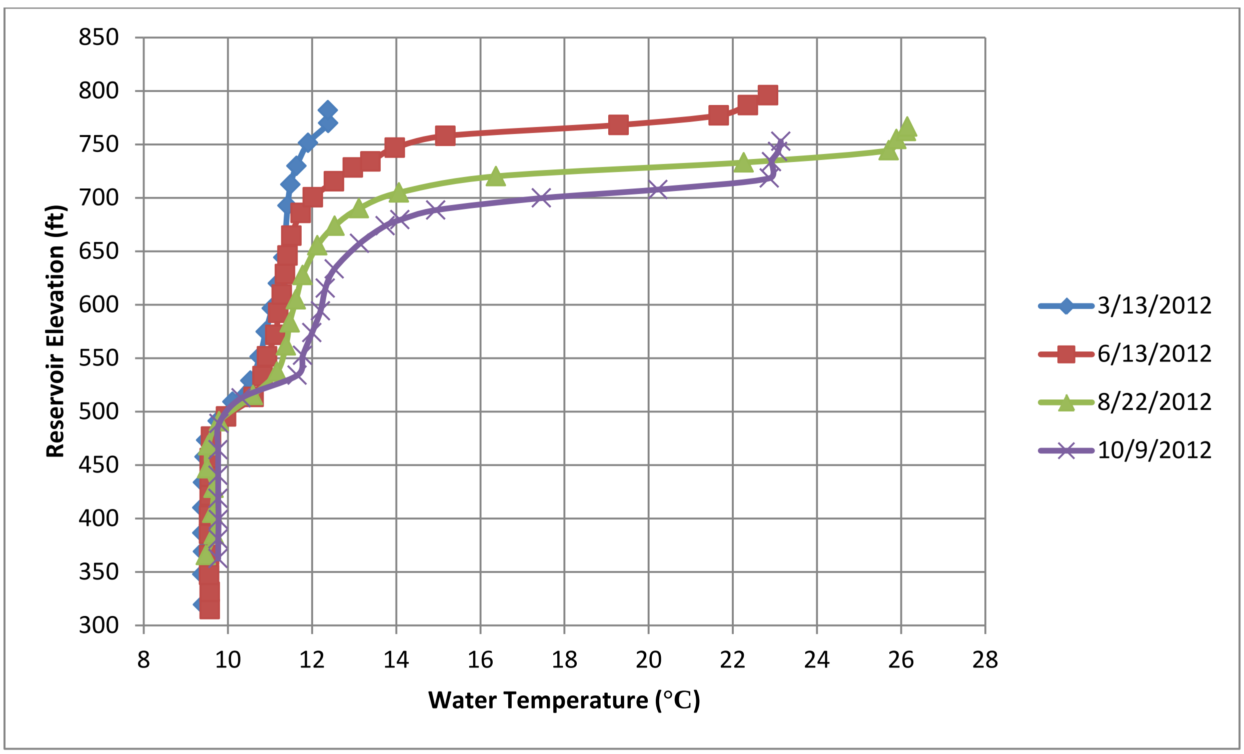


Figure 3.4-3. Water temperature profiles collected in Don Pedro Reservoir near the dam during 2012.

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.

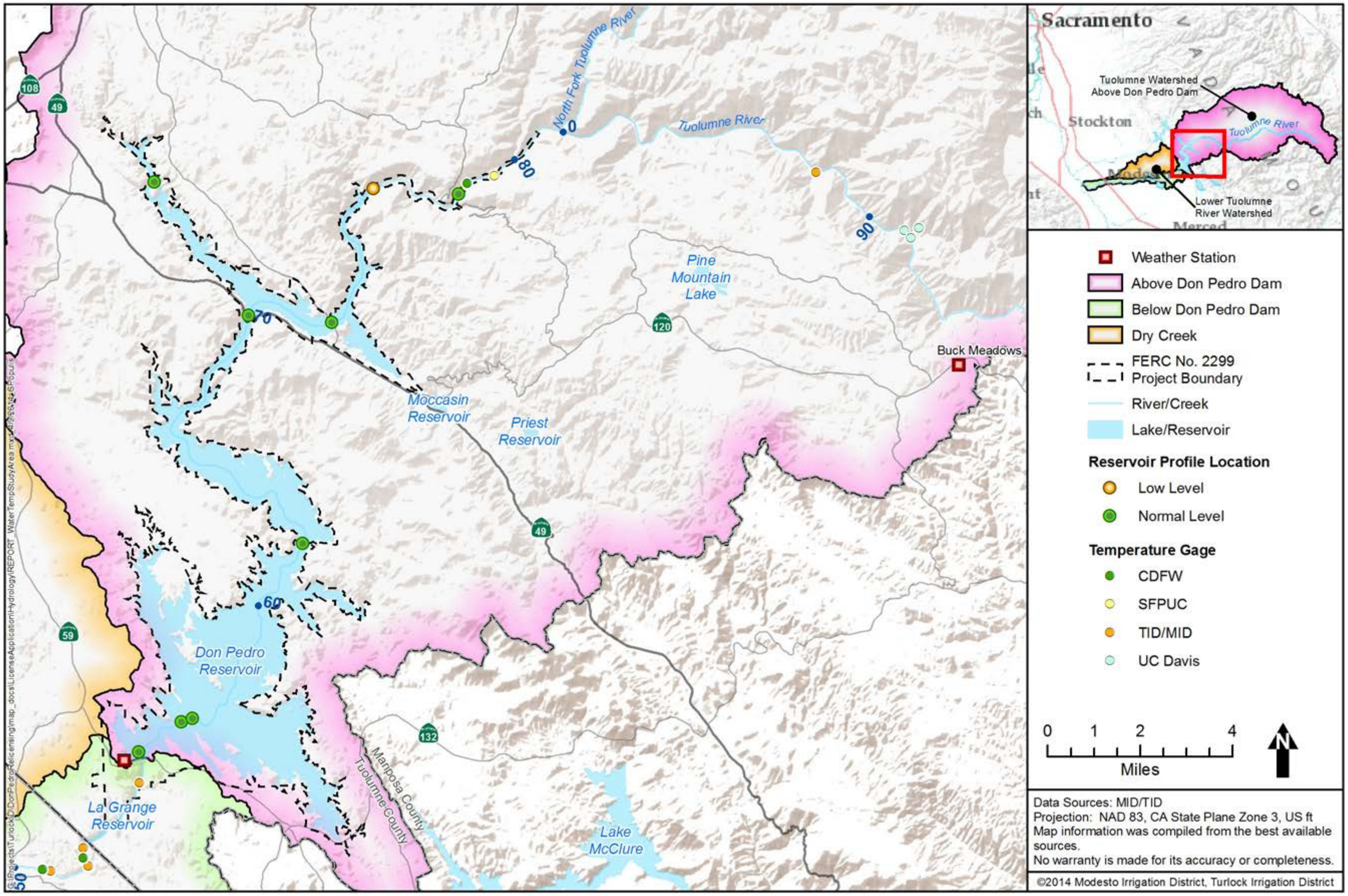


Figure 3.4-4. Don Pedro Reservoir temperature profile locations.

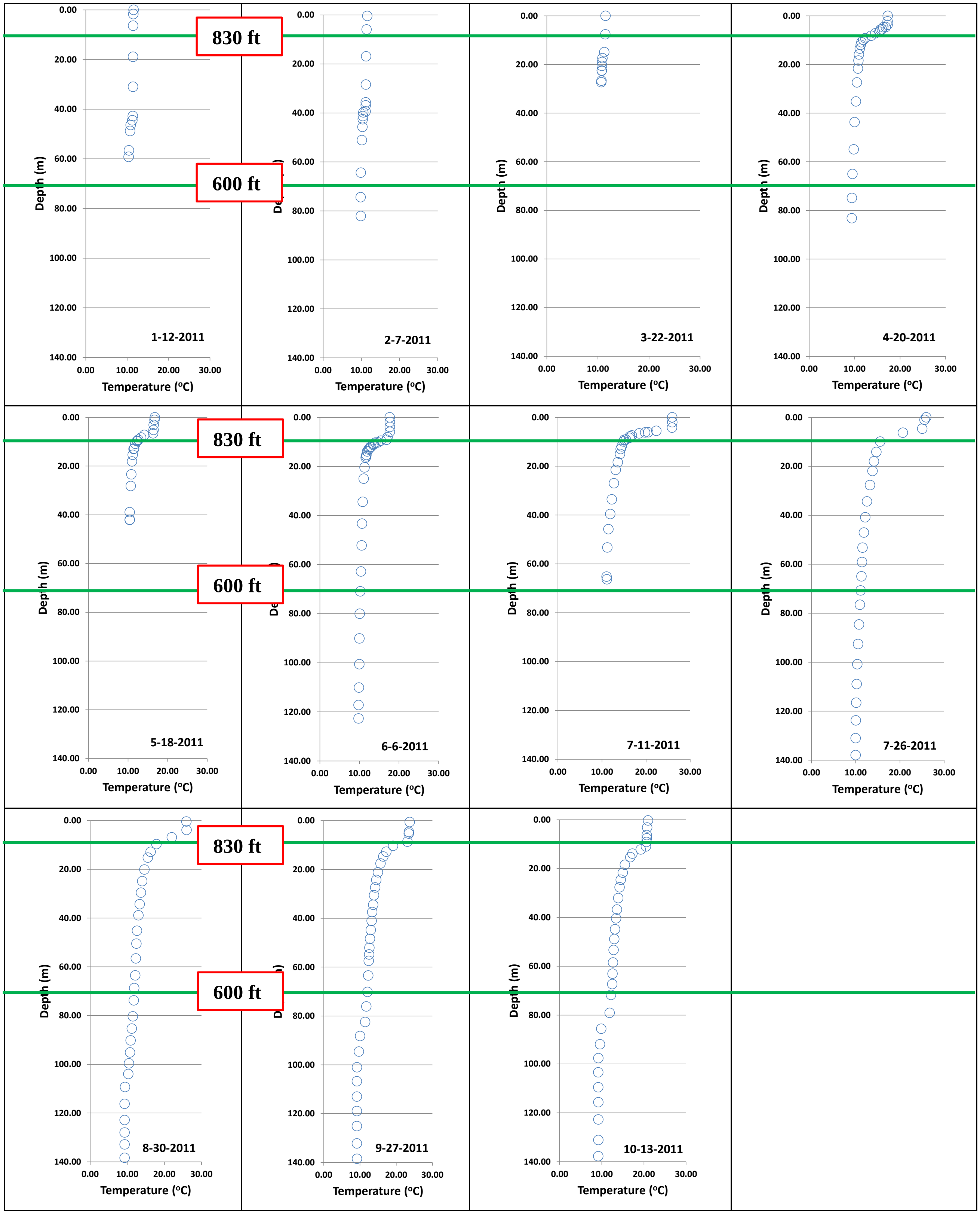


Figure 3.4-5. Water temperature profiles recorded in Don Pedro Reservoir in 2011; green lines indicate elevation.

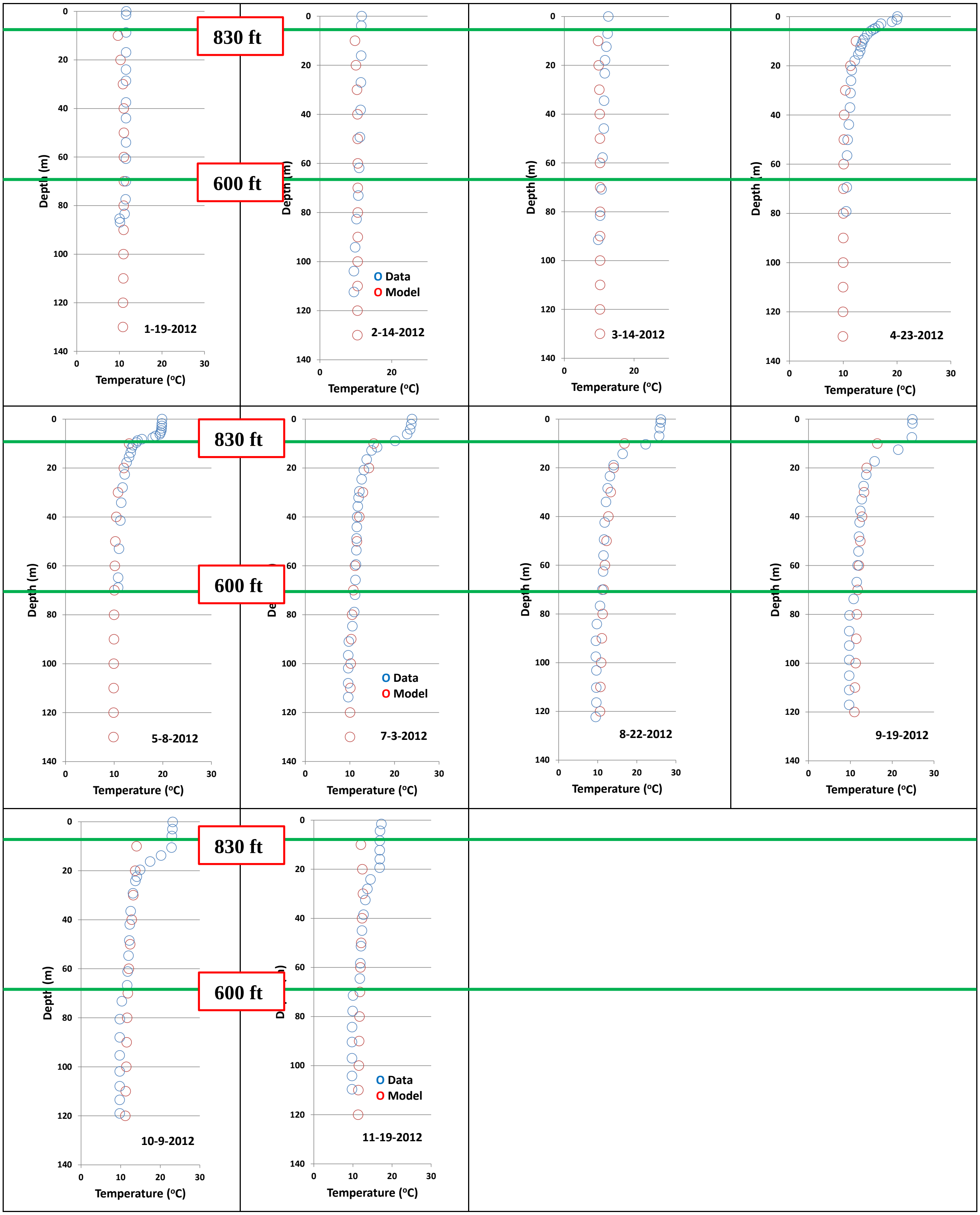


Figure 3.4-6. Water temperature profiles recorded in Don Pedro Reservoir in 2012; green lines indicate elevation.

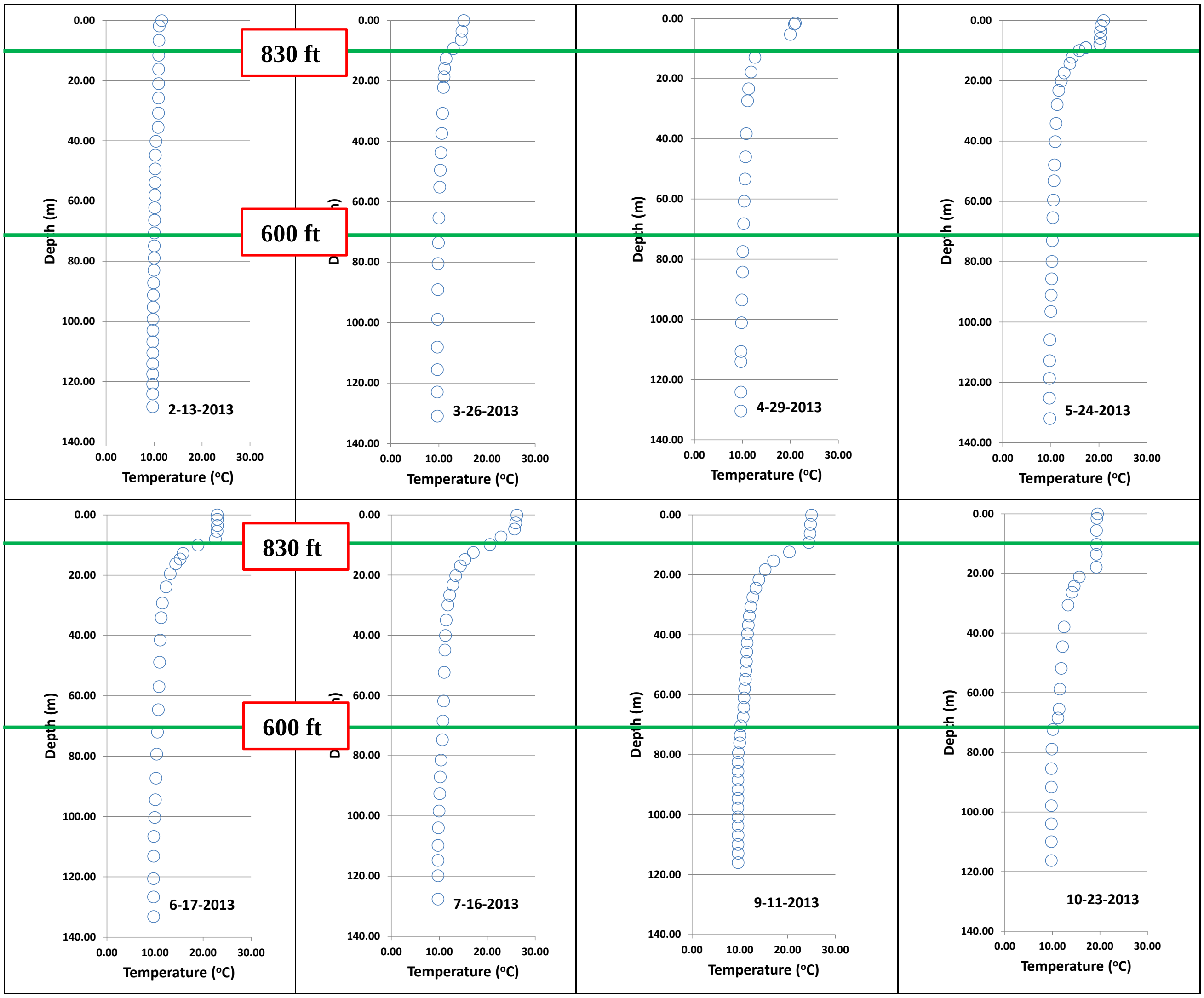


Figure 3.4-7. Water temperature profiles recorded in Don Pedro Reservoir in 2013; green lines indicate elevation.

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.

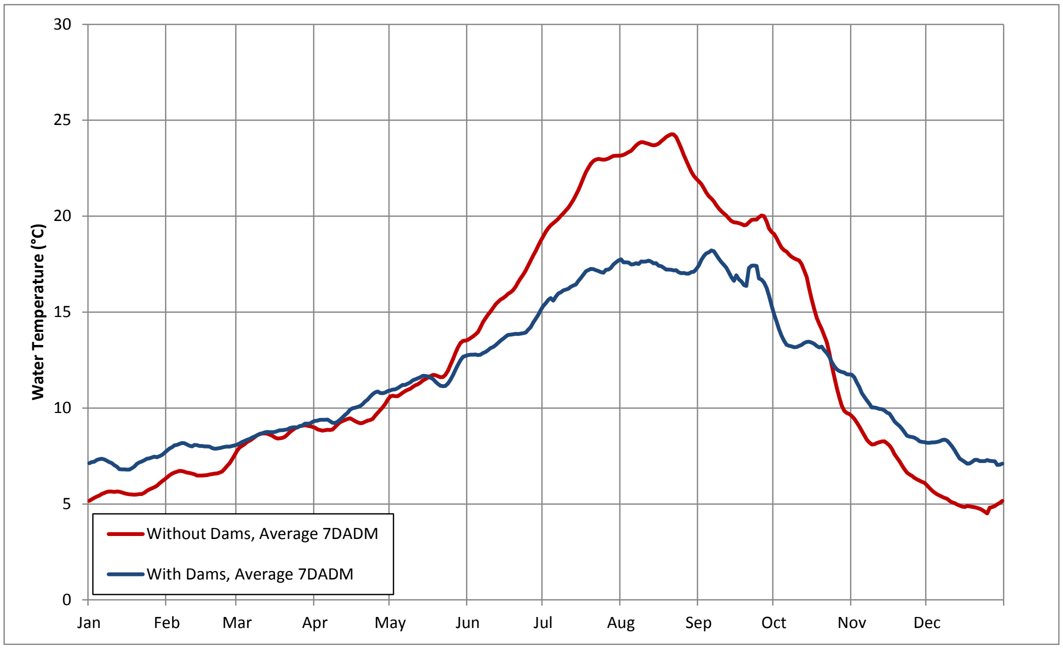


Figure 3.4-8. Comparison of 7DADM water temperatures under with- and without-dams conditions in the Tuolumne River below the South Fork Tuolumne River (≈RM 98). Without-dams temperatures are simulated based on the period 1970 - 2012 (Jayasundara et al. 2014), and with-dams temperatures are based on data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

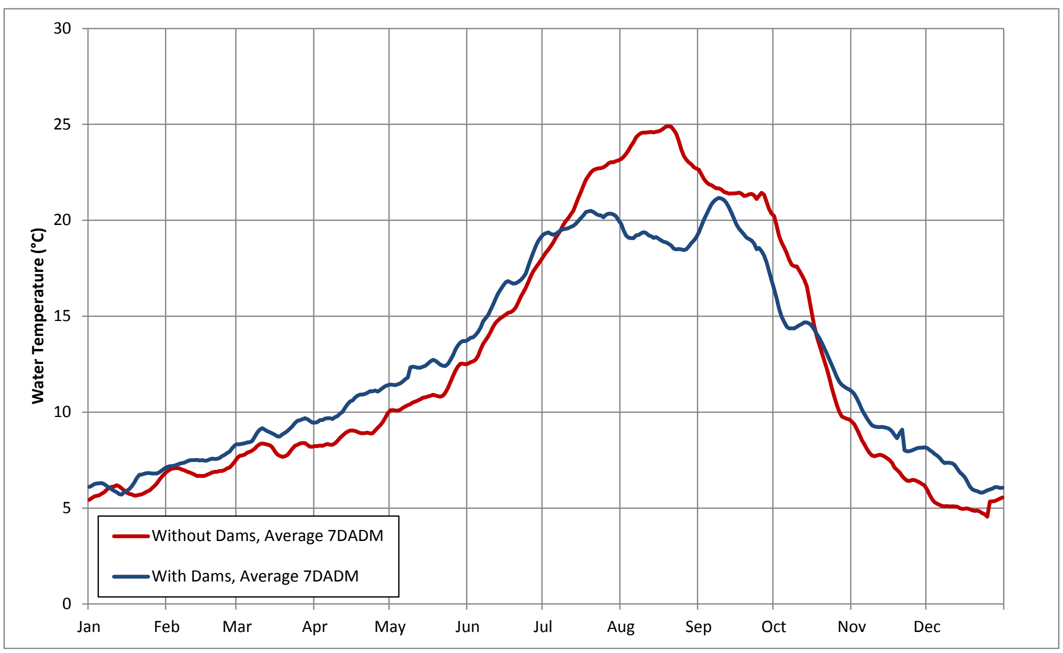


Figure 3.4-9. Comparison of 7DADM water temperatures under with- and without-dams conditions in the Tuolumne River below Indian Creek (≈RM 88). Without-dams temperatures are simulated based on the period 1970 - 2012 (Jayasundara et al. 2014), and with-dams temperatures are based on data collected by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

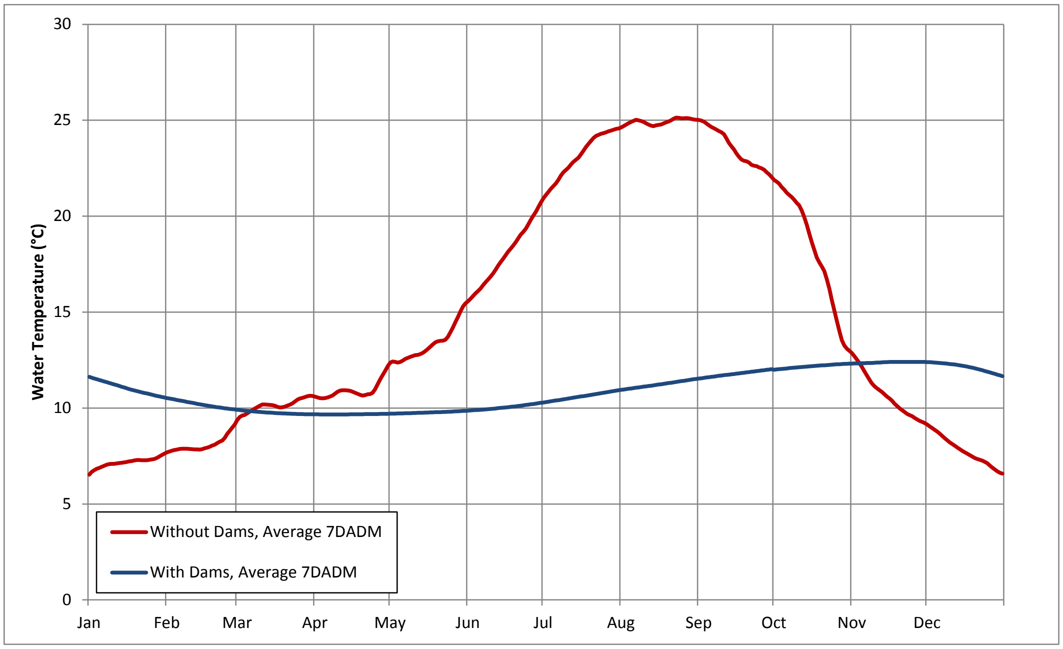


Figure 3.4-10. Comparison of 7DADM water temperatures under with- and without-dams conditions in the Tuolumne River below Don Pedro Dam (≈RM 54). Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 - 2012.

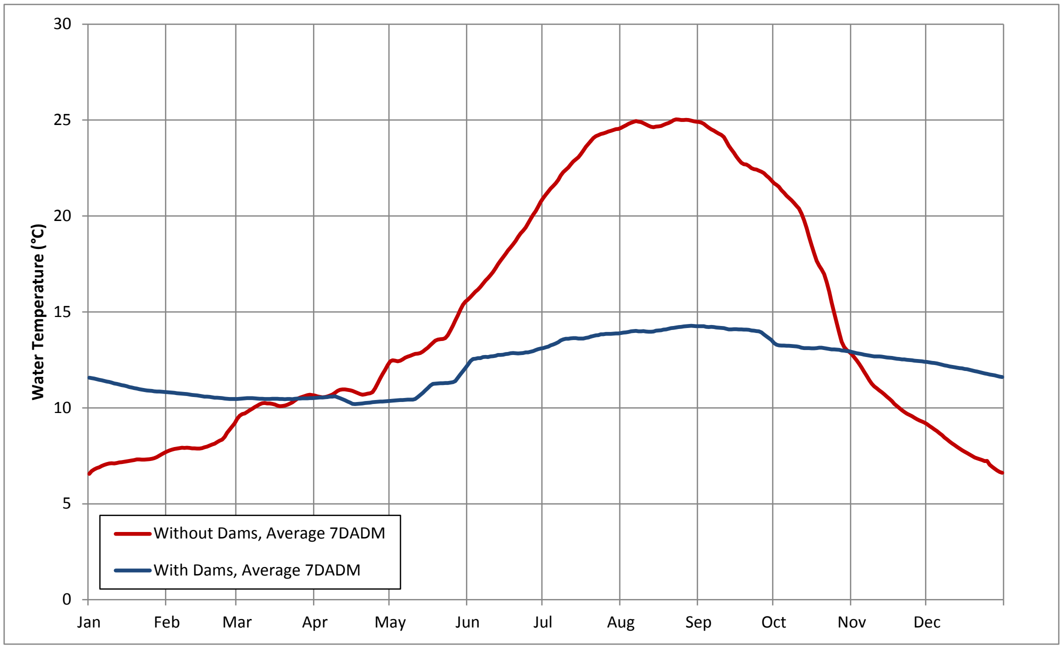


Figure 3.4-11. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 51.5. Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 – 2012.

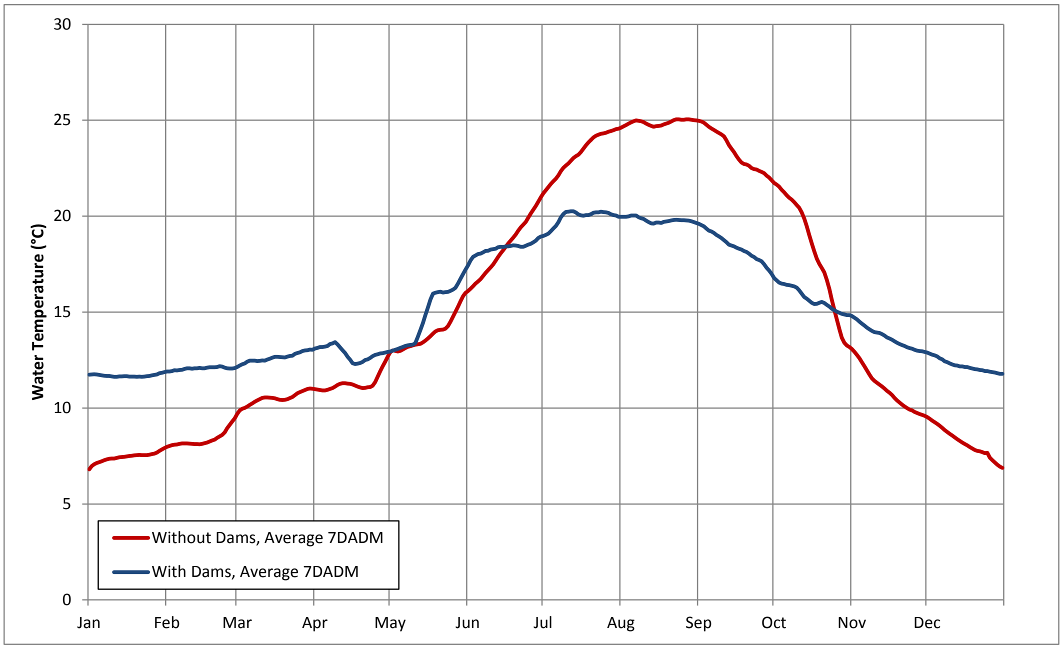


Figure 3.4-12. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 46. Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 - 2012.

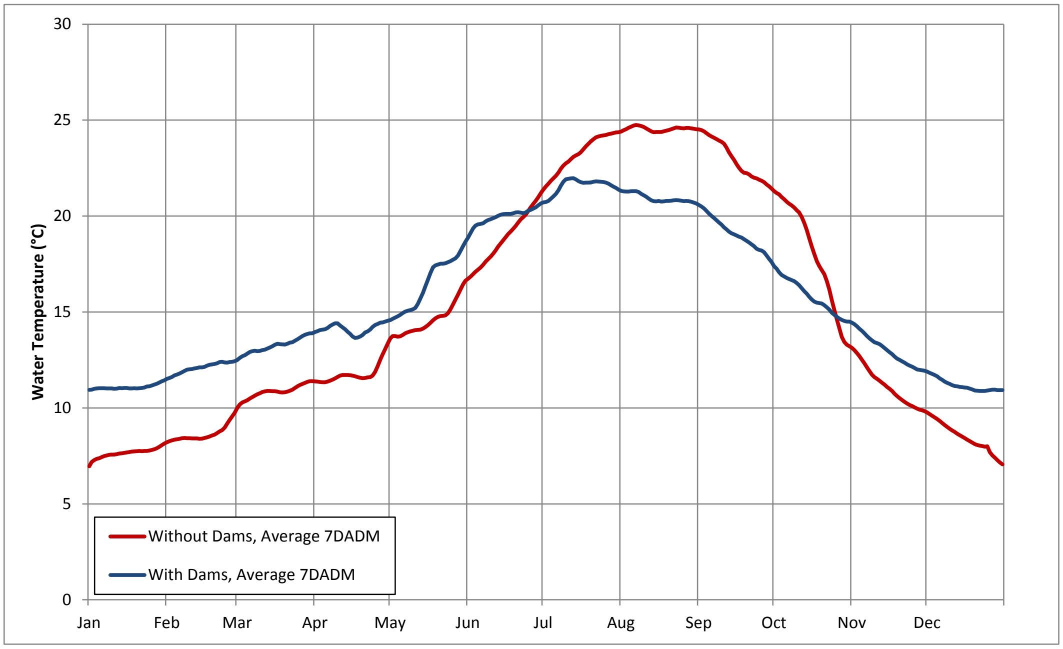


Figure 3.4-13. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 40. Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 - 2012.

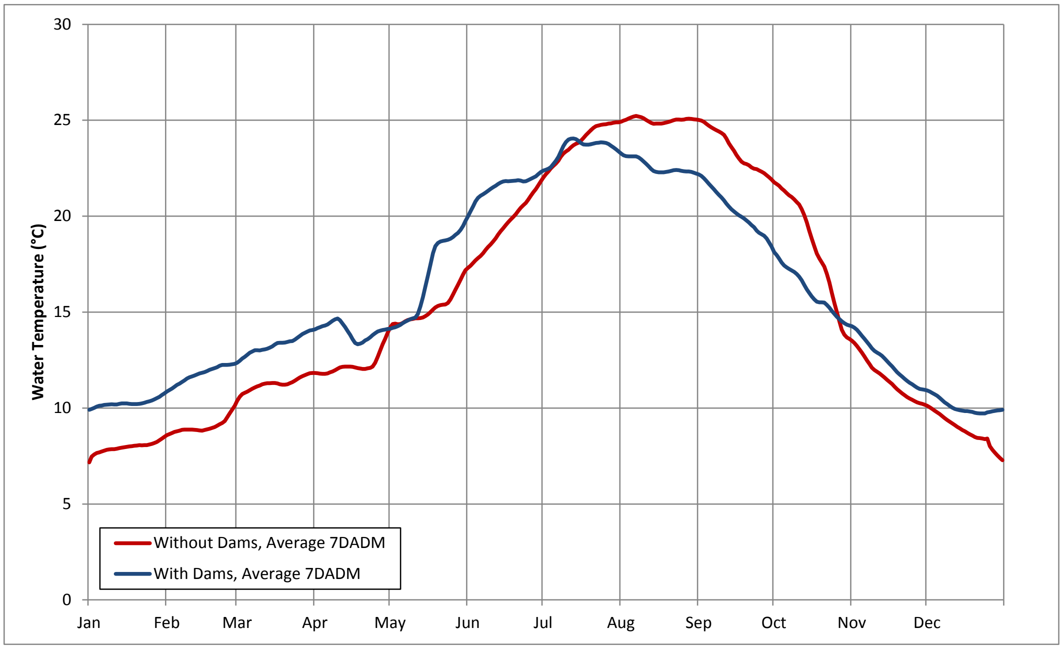


Figure 3.4-14. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 34. Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 - 2012.

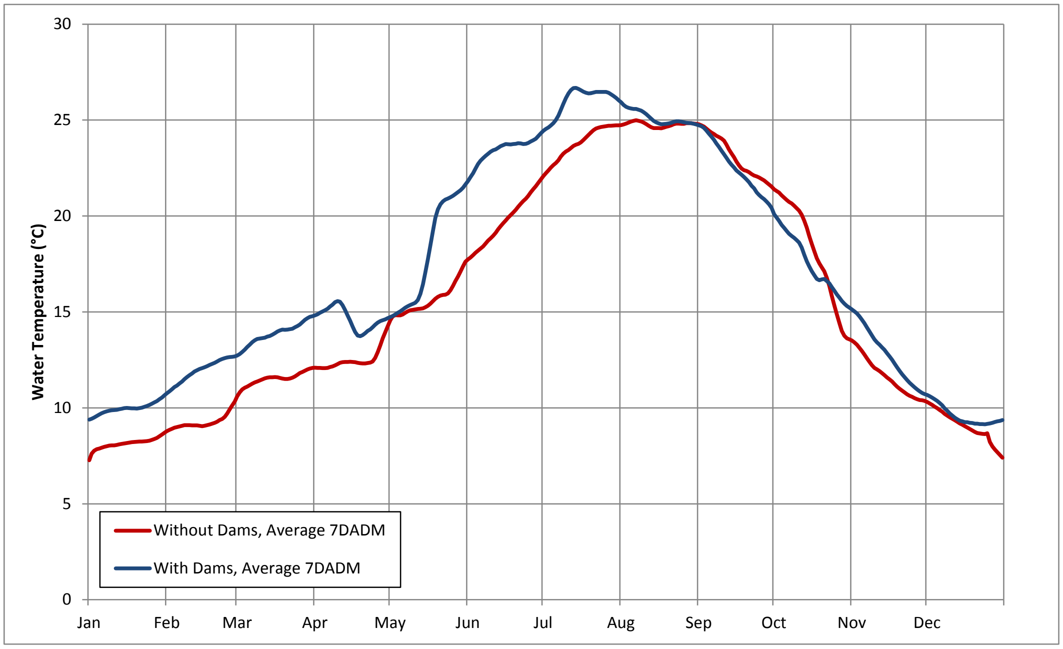


Figure 3.4-15. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 24. Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 - 2012.

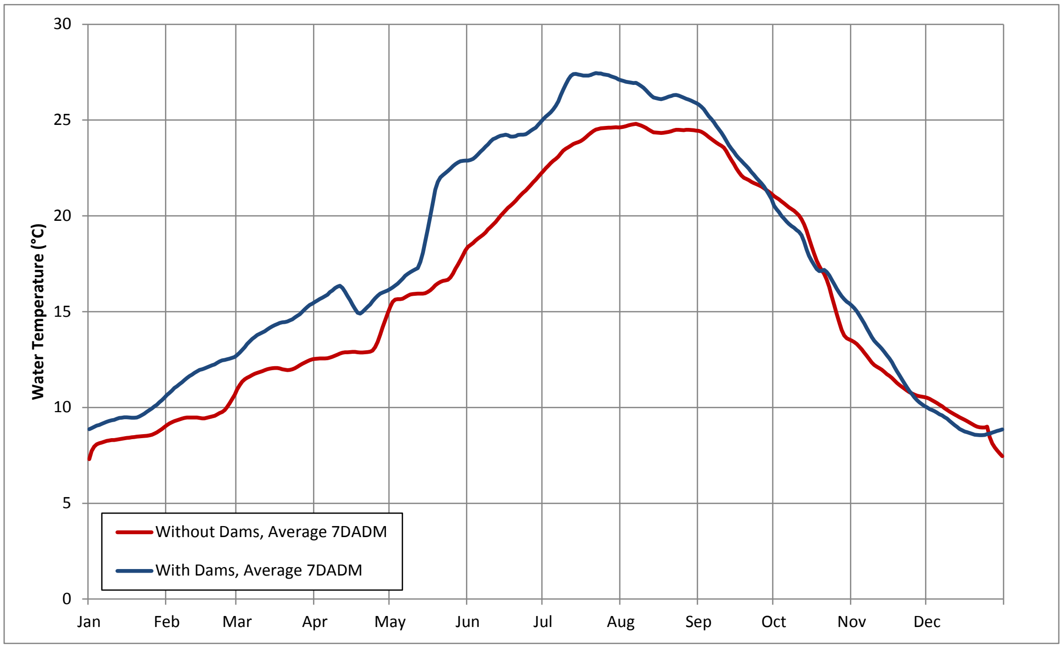


Figure 3.4-16. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 10. Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 - 2012.

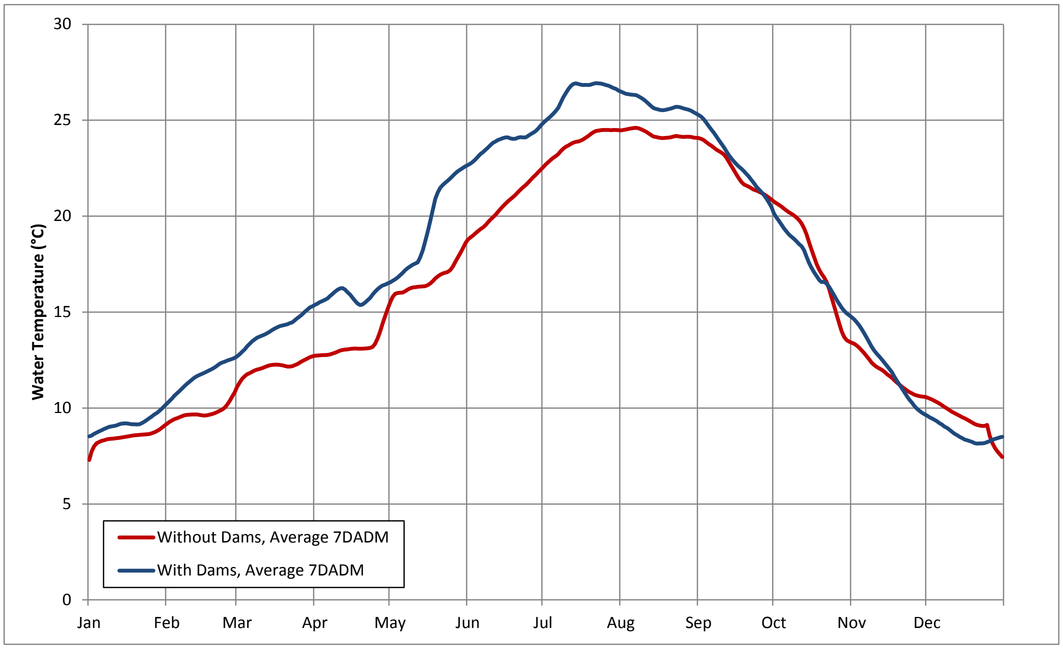


Figure 3.4-17. Comparison of 7DADM water temperatures under with- and without-dams conditions in the lower Tuolumne River at RM 1. Without-dams temperatures (Jayasundara et al. 2014) and with-dams (base case) temperatures (TID/MID 2013d) are simulated based on the period 1970 - 2012.

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).

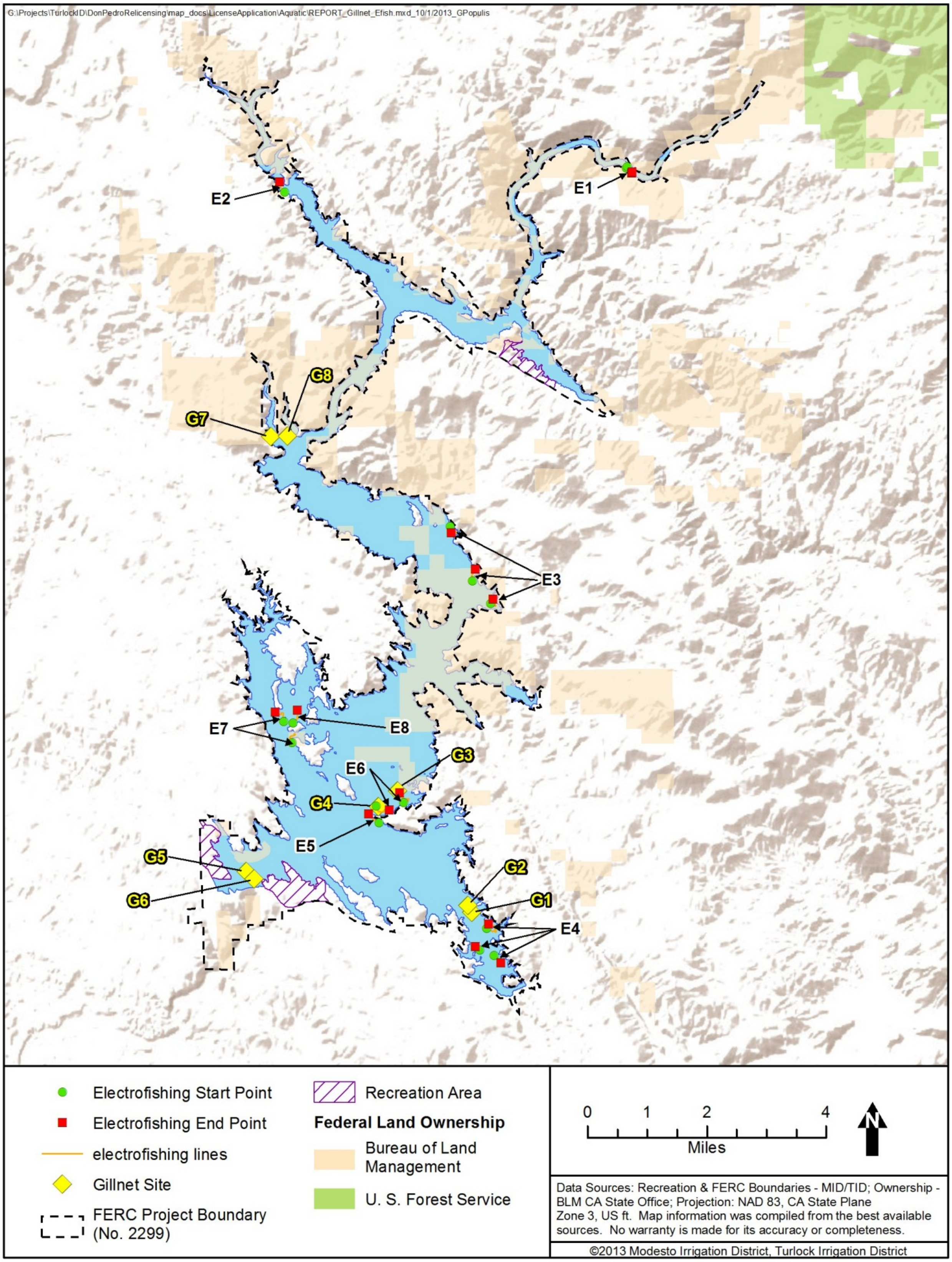


Figure 3.5-1. Location of fish population survey sites sampled using boat electrofishing and gill nets during the Don Pedro Reservoir fish population survey, October 2012.

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.

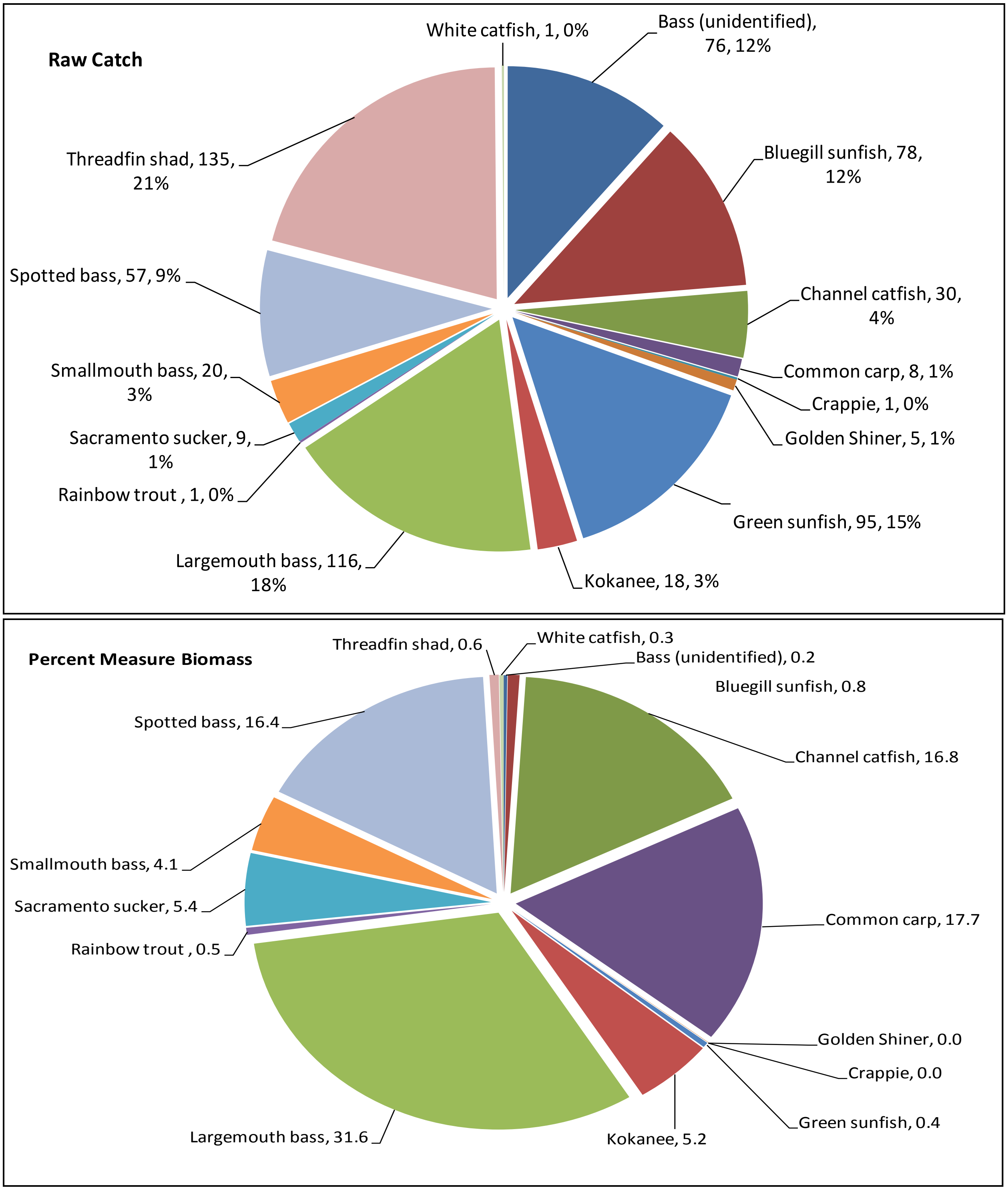


Figure 3.5-2. **Relative numbers of fish (top) and percent measured biomass (bottom) by species, combined from gillnet and boat electrofishing activities during the Don Pedro Reservoir fish population survey conducted in October 2012.**

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.

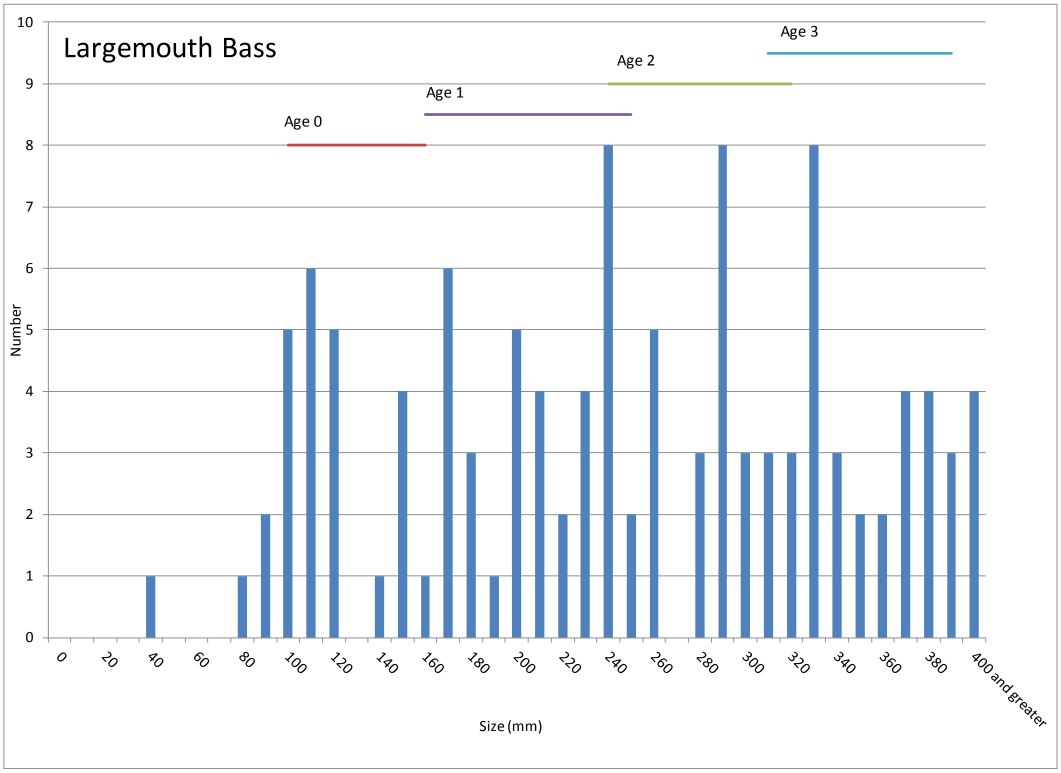


Figure 3.5-3. Length-frequency distribution of largemouth bass sampled during the Don Pedro Reservoir fish population survey, October 2012.

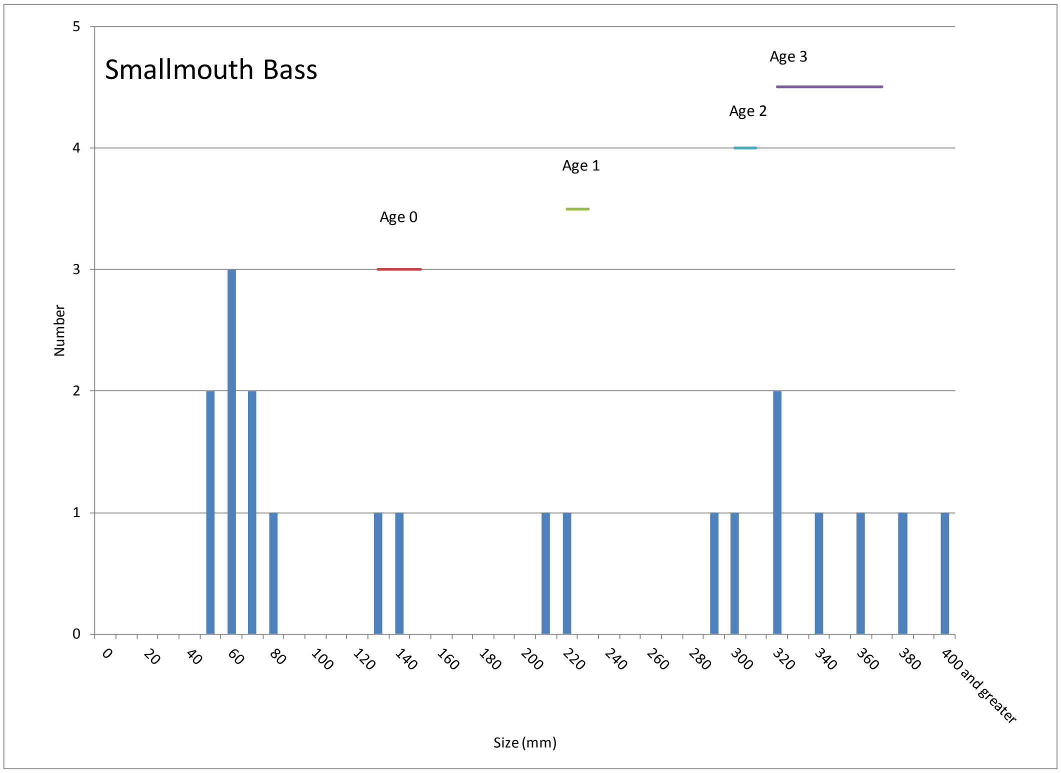


Figure 3.5-4. **Length-frequency distribution of smallmouth bass sampled during the Don Pedro Reservoir fish population survey, October 2012.**

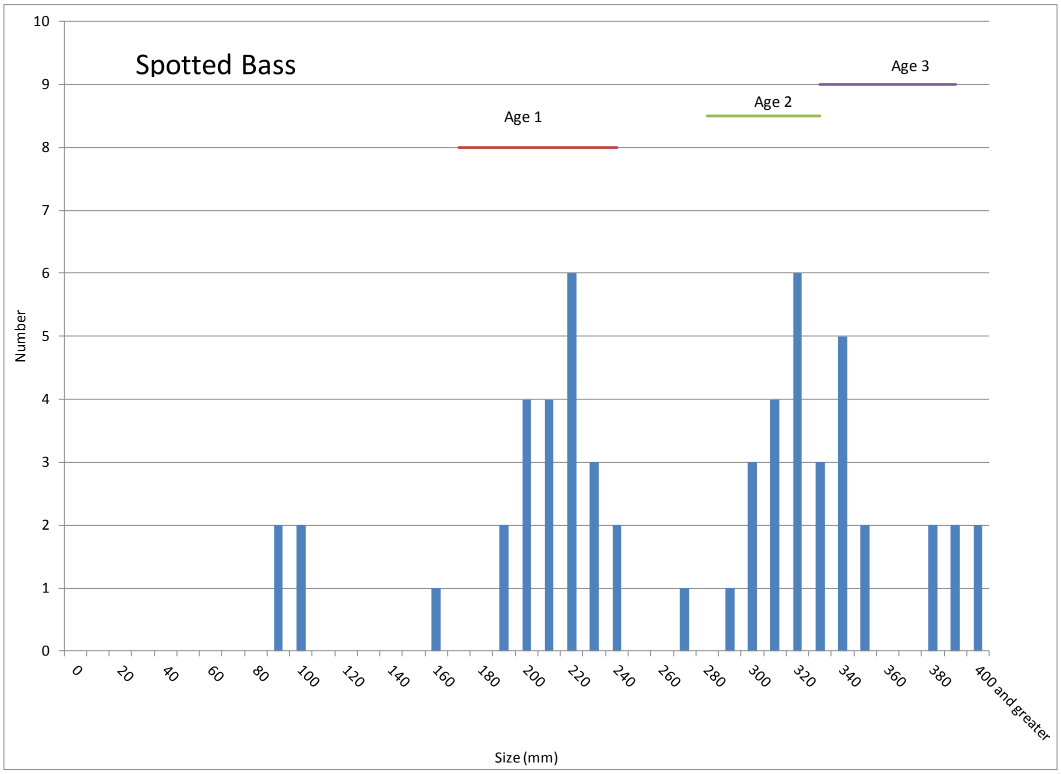


Figure 3.5-5. **Length-frequency distribution of spotted bass sampled during the Don Pedro Reservoir fish population survey, October 2012.**

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).

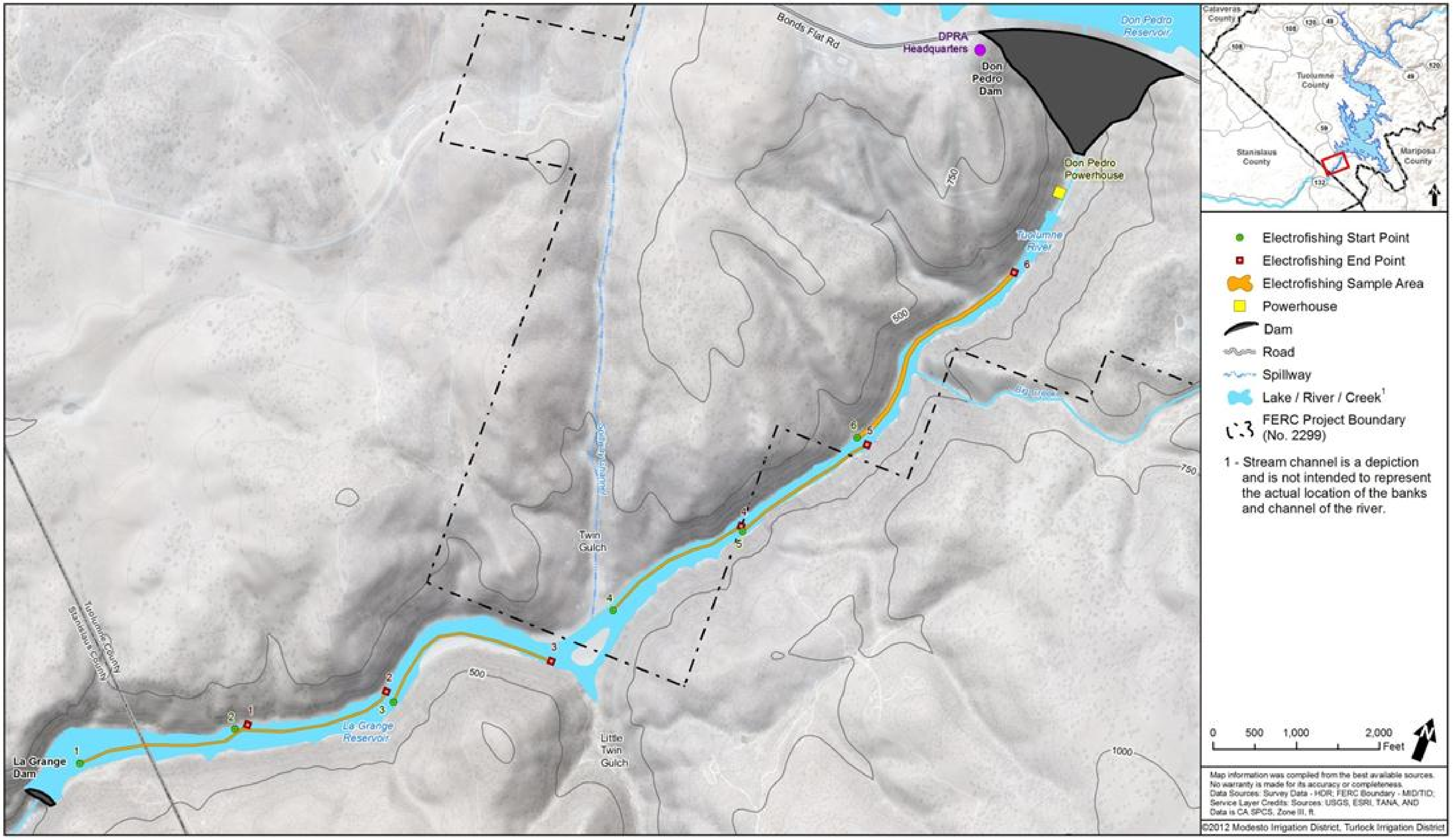


Figure 3.5-6. Study reaches and fish sampling areas in the reach between Don Pedro Dam and La Grange Diversion Dam in 2012.

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 <u>Physical Habitat Conditions in the Lower Tuolumne River</u>

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).

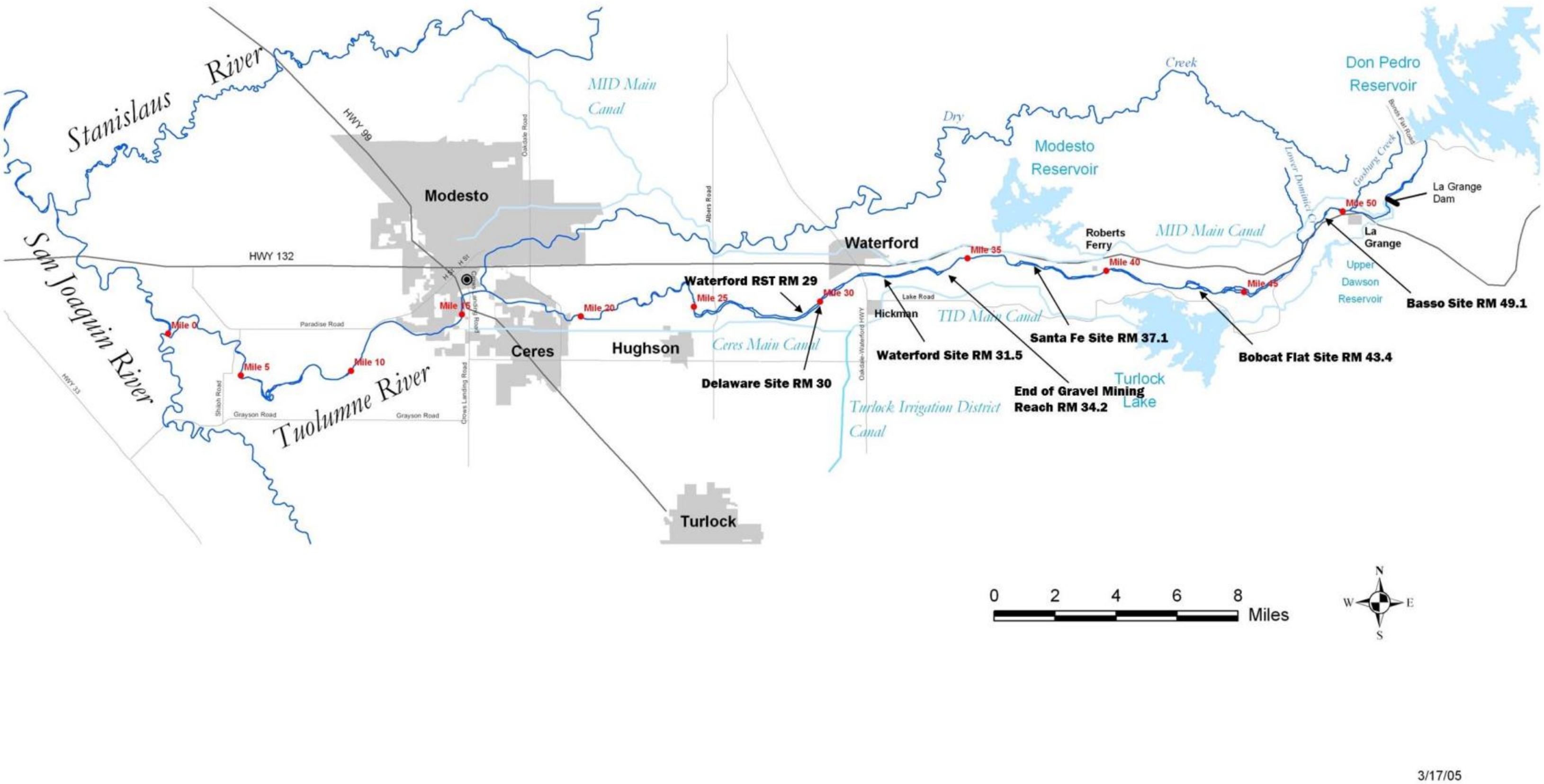


Figure 3.5-7. Vicinity map and study site locations for the Lower Tuolumne River Instream Flow Study.

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).

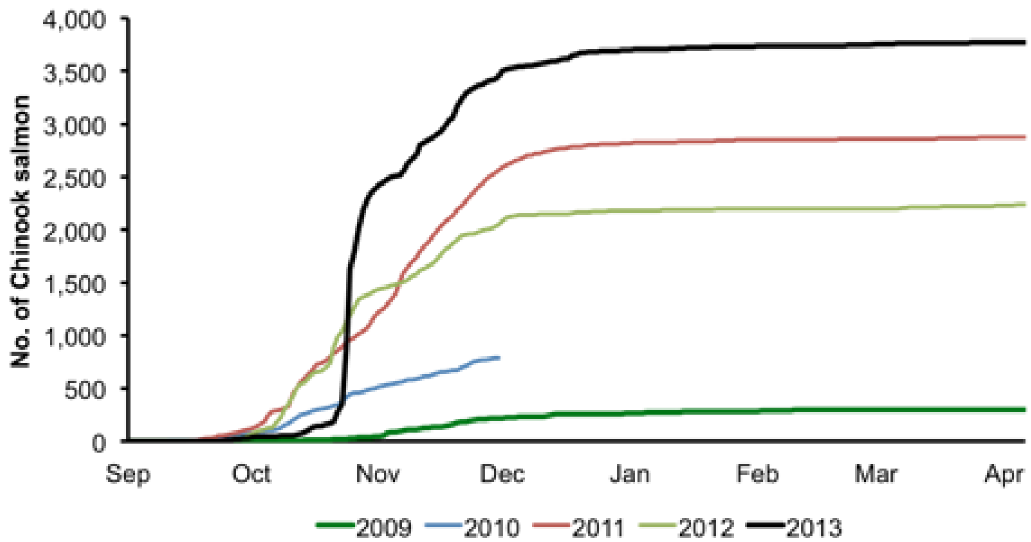


Figure 3.5-8. Cumulative adult fall-run Chinook salmon counts at the Tuolumne River weir (RM 24.5) 2009–2013.

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.

<u>Tuolumne River *O. mykiss* Population Model</u>

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.

- <u>Upmigration and Spawning</u>: Moderate sensitivity to parameters related to spawning timing and fecundity.
- <u>Egg incubation and fry emergence:</u> 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.
- <u>Fry rearing:</u> 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.

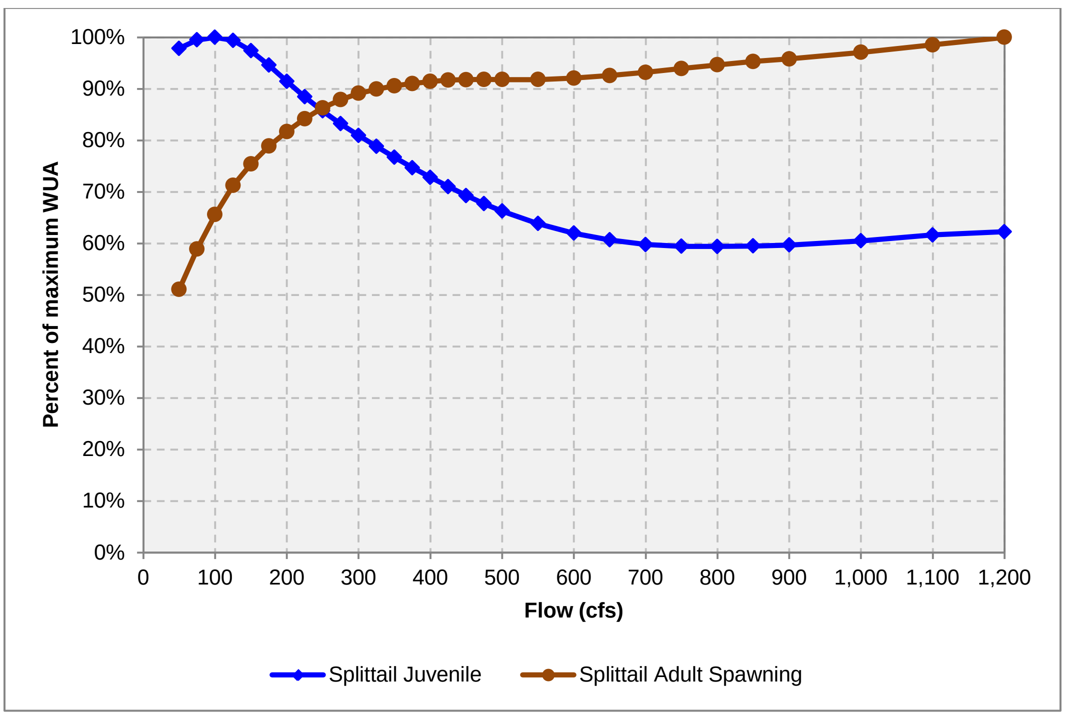


Figure 3.5-9. Sacramento splittail WUA results (percent of maximum) for the lower Tuolumne River.

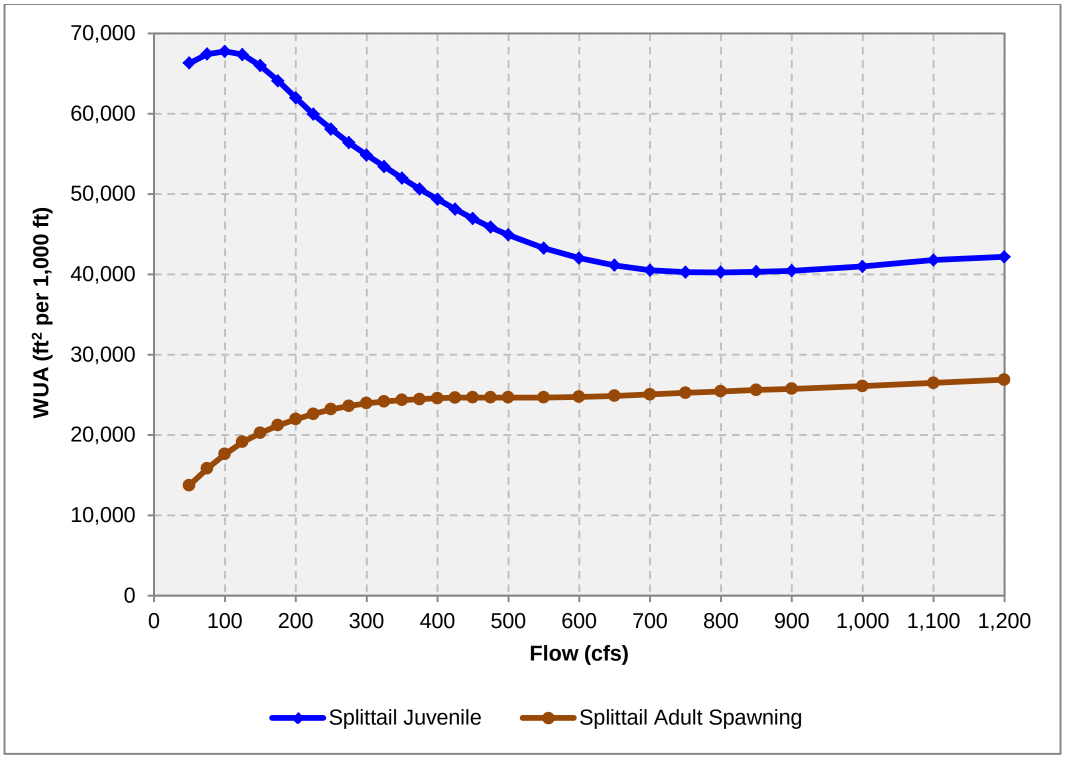


Figure 3.5-10. Sacramento splittail WUA results for the lower Tuolumne River.

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.

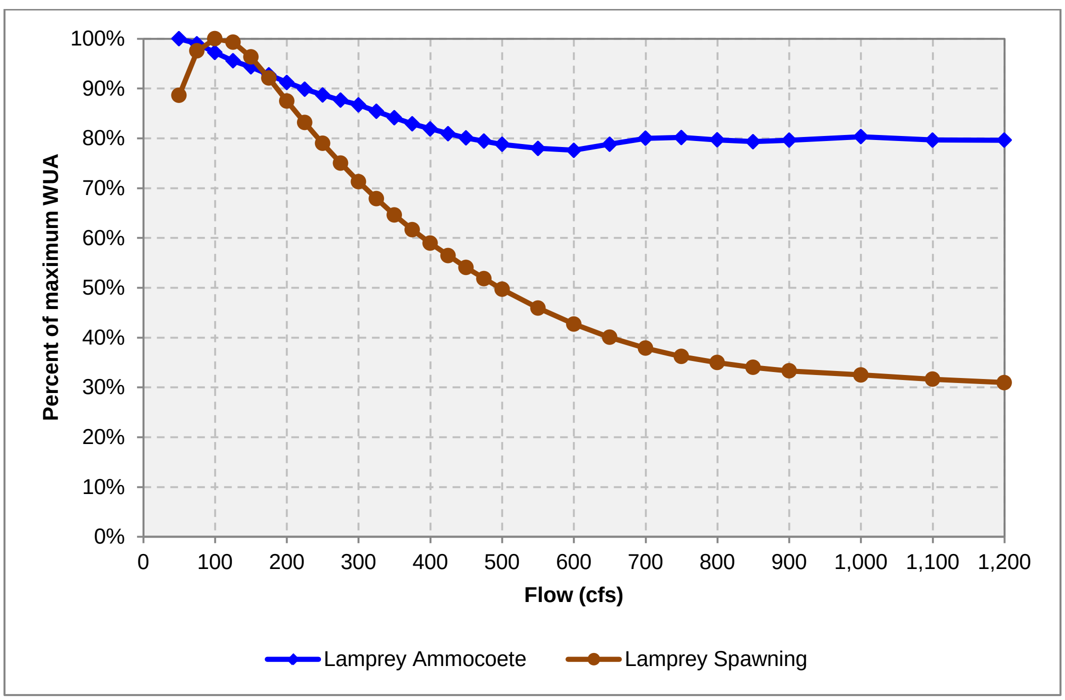


Figure 3.5-11. Pacific lamprey WUA results (percent of maximum) for the lower Tuolumne River.

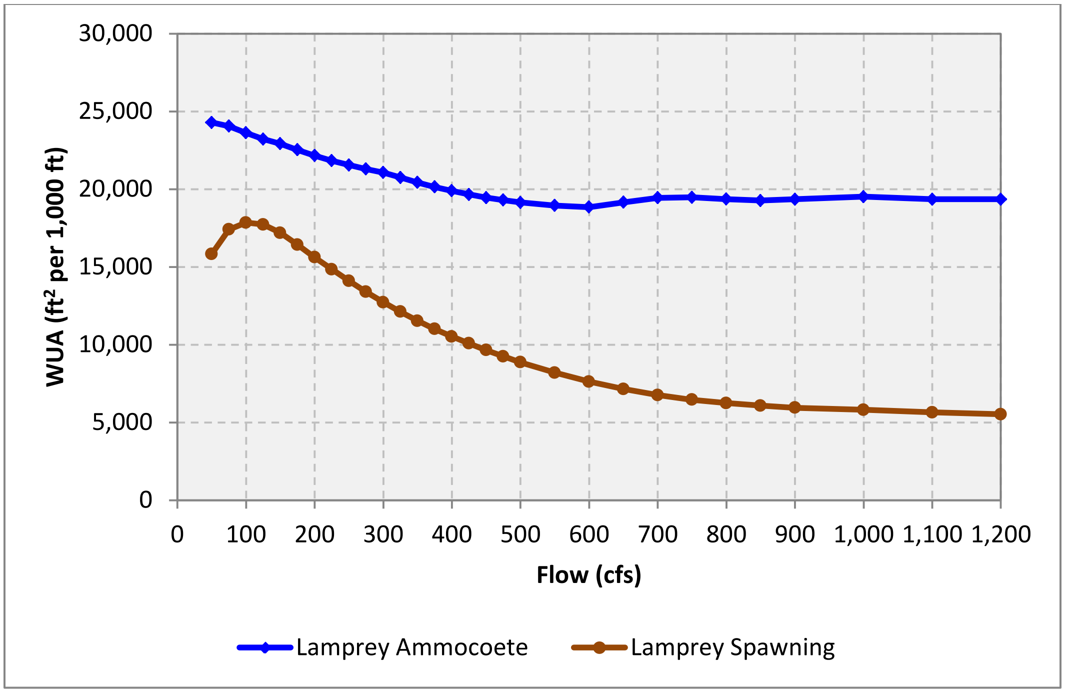


Figure 3.5-12. Pacific lamprey WUA results for the lower Tuolumne River.

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.

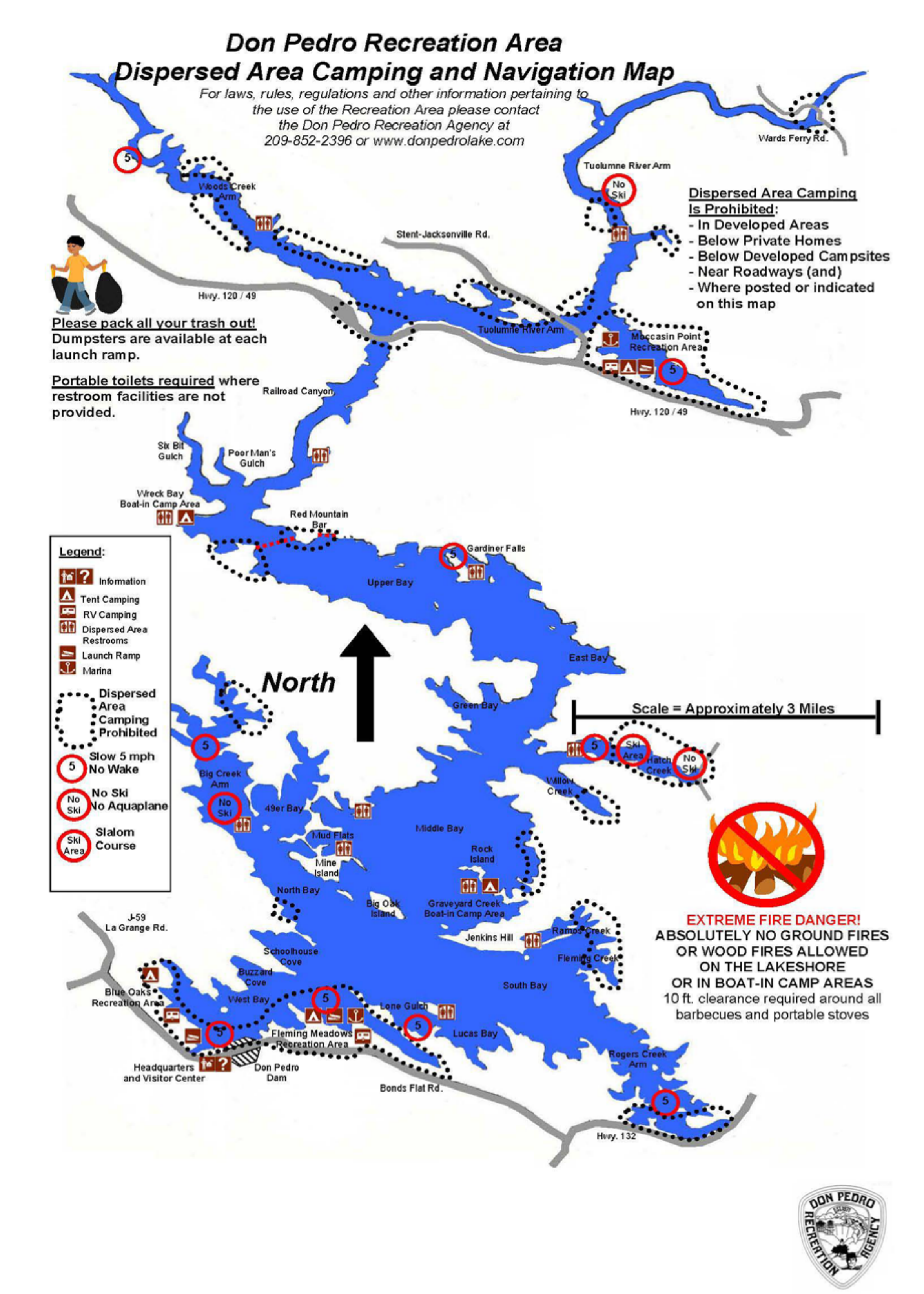


Figure 3.9-1. **Existing recreation facilities on Don Pedro Reservoir.**

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.

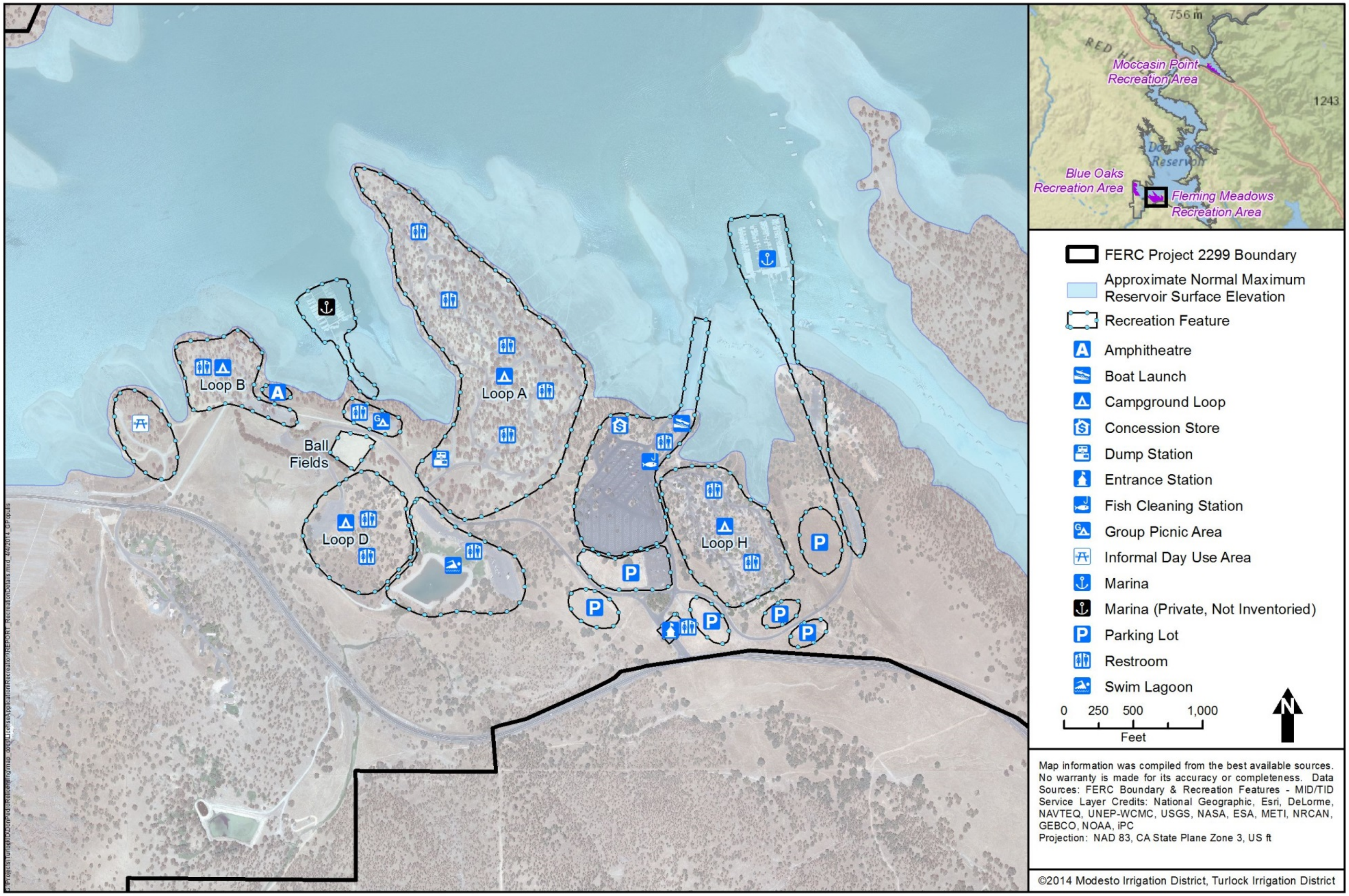


Figure 3.9-2. **Fleming Meadows Recreation Area amenities.**

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.

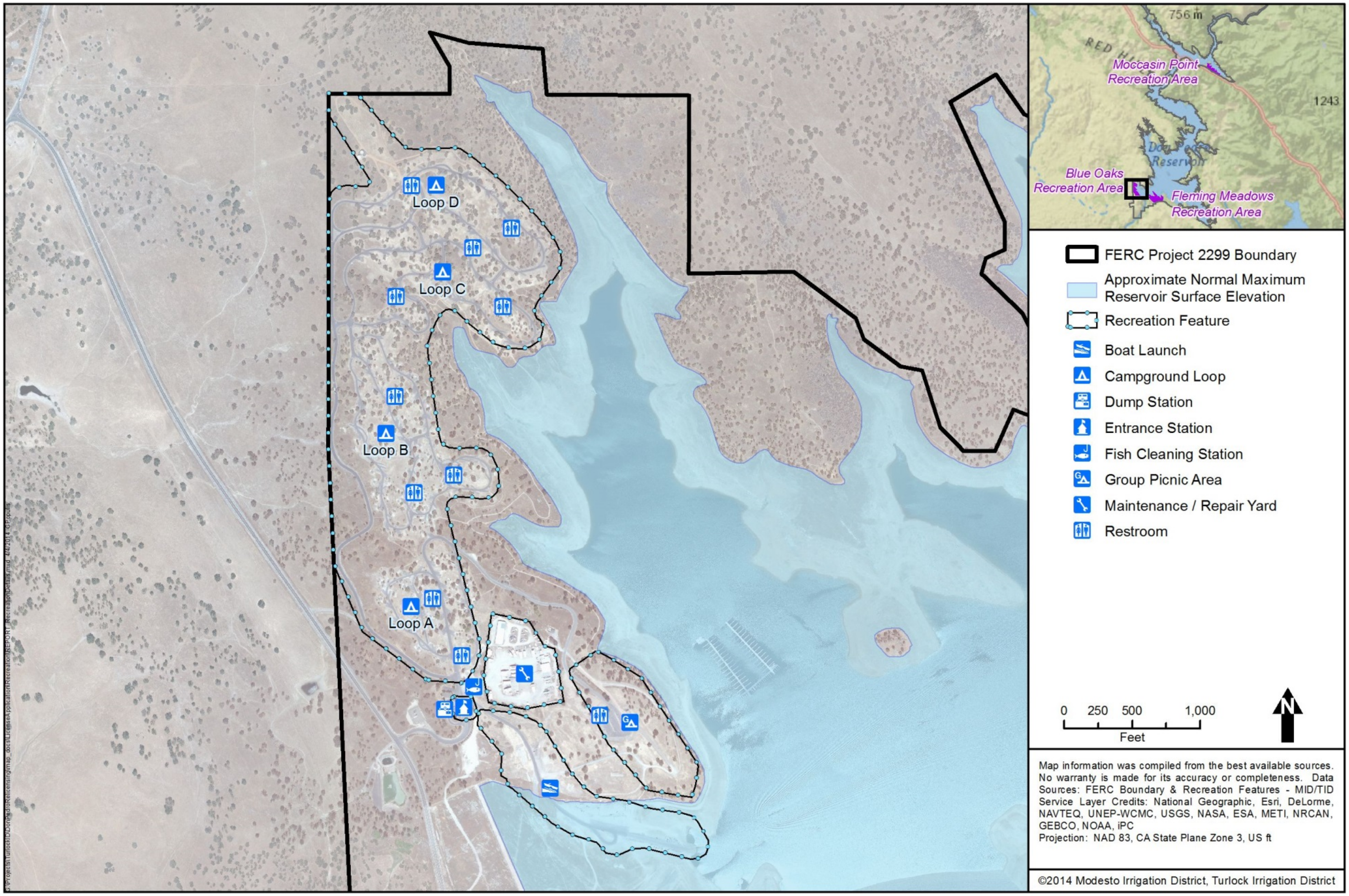


Figure 3.9-3. Blue Oaks Recreation Area amenities.

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.

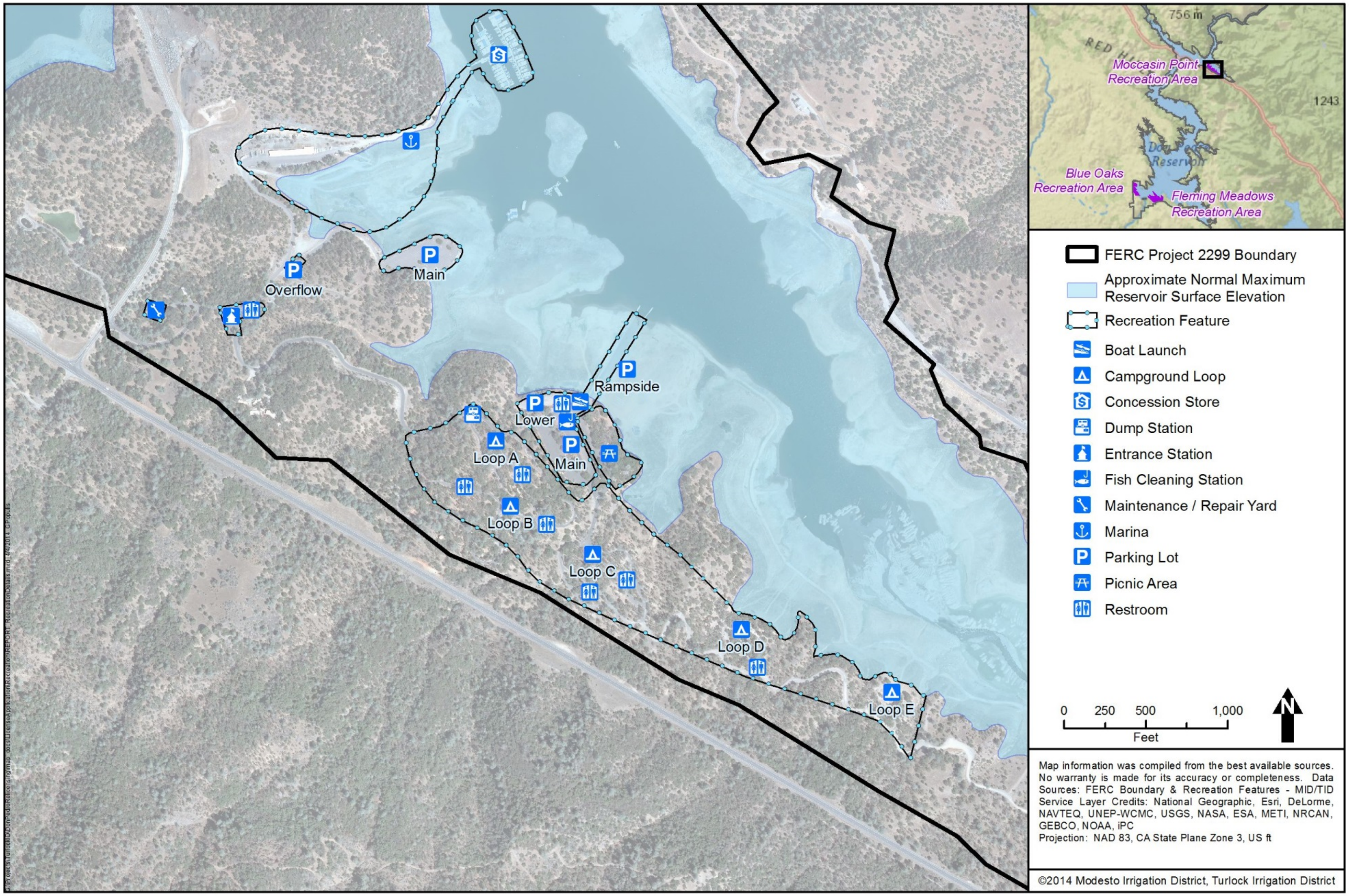


Figure 3.9-4. Moccasin Point Recreation Area amenities.

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.

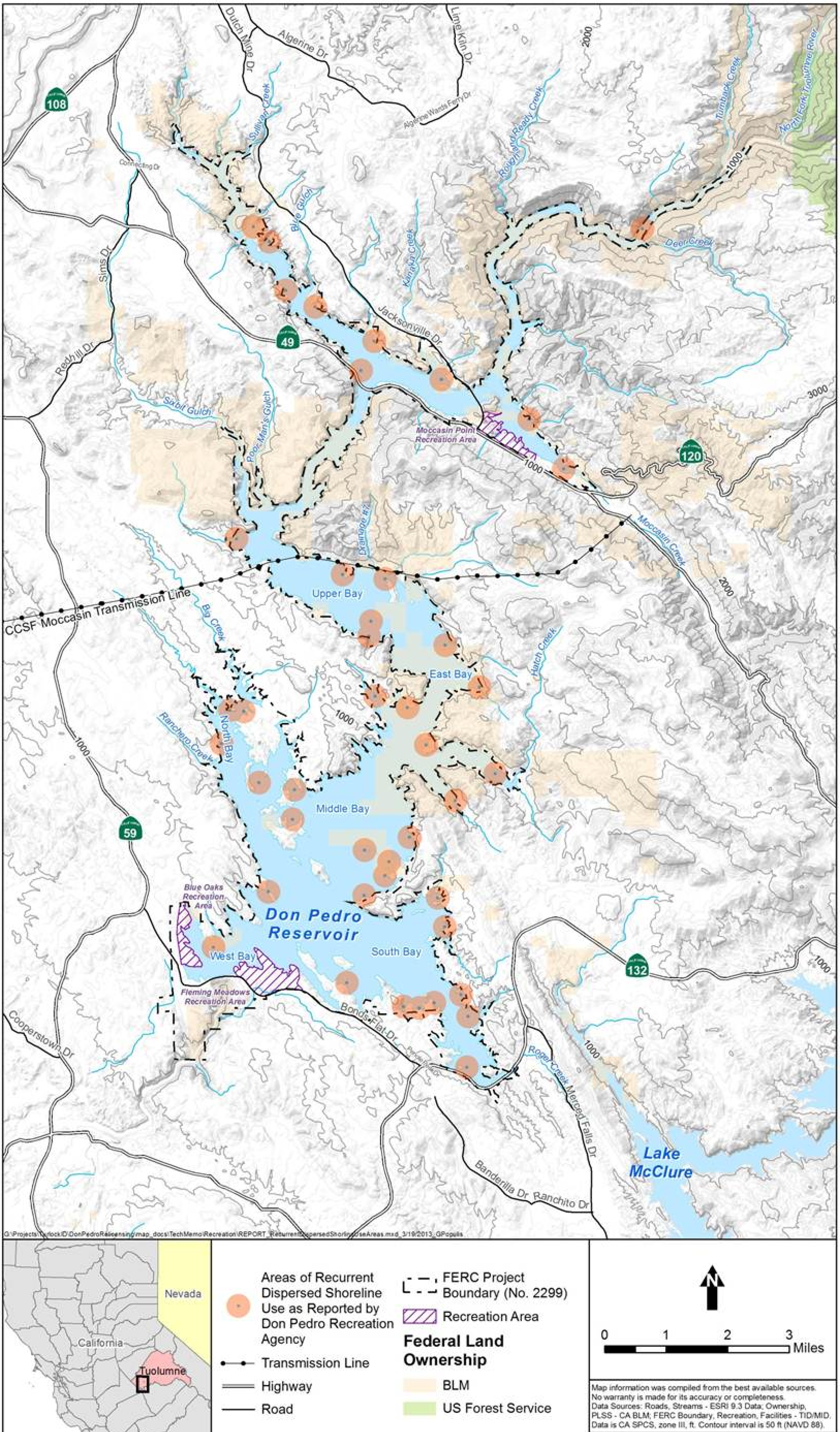


Figure 3.9-5. Dispersed recreation areas at the Don Pedro Project.

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 <u>Recreation Facility Condition and Public Accessibility Assessment, and Recreation Use Assessment</u>

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.

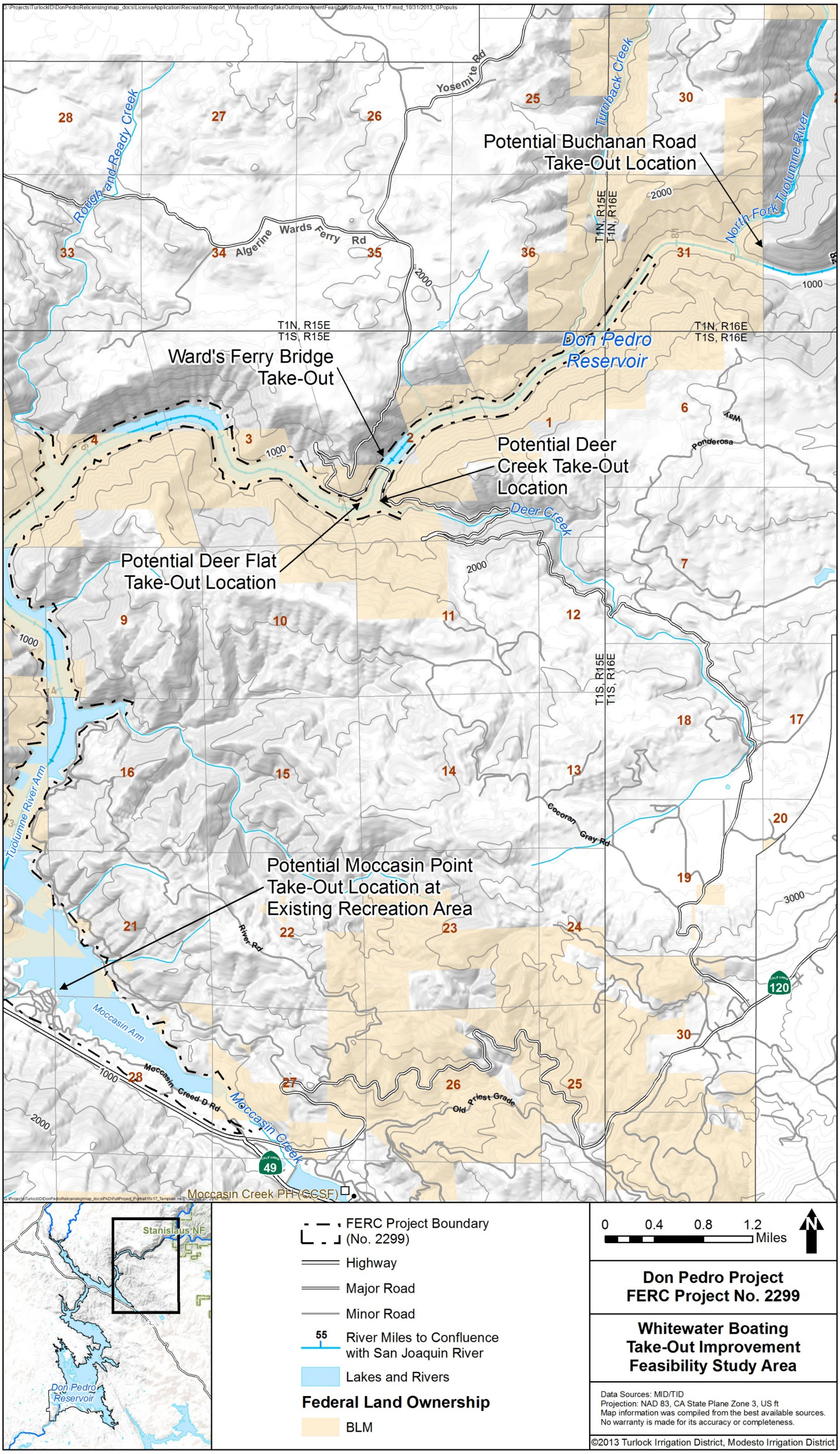


Figure 3.9-6. **Potential upper Tuolumne River whitewater boating take-out locations.**

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.

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