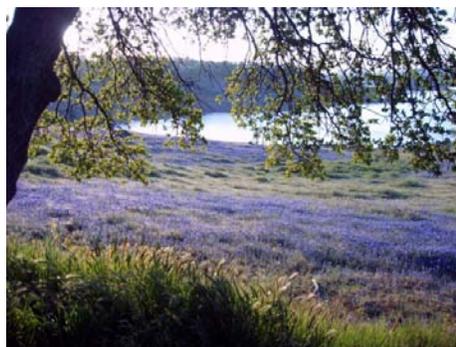
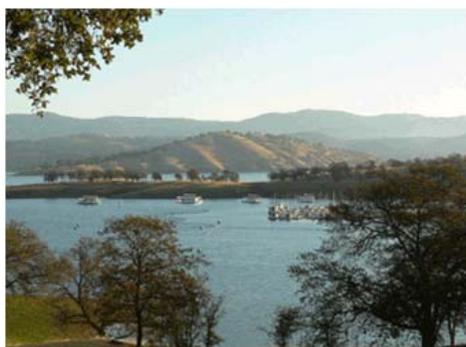


**LOWER TUOLUMNE RIVER
LOWEST BOATABLE FLOW
STUDY REPORT
DON PEDRO PROJECT
FERC NO. 2299**



**Prepared for:
Turlock Irrigation District – Turlock, California
Modesto Irrigation District – Modesto, California**

**Prepared by:
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January 2013

Lower Tuolumne River Lowest Boatable Flow Study Study Report

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List of Acronyms

ac	acres
ACEC	Area of Critical Environmental Concern
AF	acre-feet
ACOE	U.S. Army Corps of Engineers
ADA	Americans with Disabilities Act
ALJ	Administrative Law Judge
APE	Area of Potential Effect
ARMR	Archaeological Resource Management Report
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
CalEPPC	California Exotic Pest Plant Council
CalSPA	California Sports Fisherman Association
CAS	California Academy of Sciences
CCC	Criterion Continuous Concentrations
CCIC	Central California Information Center
CCSF	City and County of San Francisco
CCVHJV	California Central Valley Habitat Joint Venture
CD	Compact Disc
CDBW	California Department of Boating and Waterways
CDEC	California Data Exchange Center
CDFA	California Department of Food and Agriculture
CDFG	California Department of Fish and Game (as of January 2013, 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
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
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
CPUE	Catch Per Unit Effort
CRAM	California Rapid Assessment Method
CRLF	California Red-Legged Frog
CRRF	California Rivers Restoration Fund
CSAS	Central Sierra Audubon Society
CSBP	California Stream Bioassessment Procedure
CT	California Threatened Species
CTR	California Toxics Rule
CTS	California Tiger Salamander
CVRWQCB	Central Valley Regional Water Quality Control Board
CWA	Clean Water Act
CWHR	California Wildlife Habitat Relationship
Districts	Turlock Irrigation District and Modesto Irrigation District
DLA	Draft License Application
DPRA	Don Pedro Recreation Agency
DPS	Distinct Population Segment
EA	Environmental Assessment
EC	Electrical Conductivity

EFH.....	Essential Fish Habitat
EIR.....	Environmental Impact Report
EIS.....	Environmental Impact Statement
EPA.....	U.S. Environmental Protection Agency
ESA.....	Federal Endangered Species Act
ESRCD.....	East Stanislaus Resource Conservation District
ESU.....	Evolutionary Significant Unit
EWUA.....	Effective Weighted Useable Area
FERC.....	Federal Energy Regulatory Commission
FFS.....	Foothills Fault System
FL.....	Fork length
FMU.....	Fire Management Unit
FOT.....	Friends of the Tuolumne
FPC.....	Federal Power Commission
ft/mi.....	feet per mile
FWCA.....	Fish and Wildlife Coordination Act
FYLF.....	Foothill Yellow-Legged Frog
g.....	grams
GIS.....	Geographic Information System
GLO.....	General Land Office
GPS.....	Global Positioning System
HCP.....	Habitat Conservation Plan
HHWP.....	Hetch Hetchy Water and Power
HORB.....	Head of Old River Barrier
HPMP.....	Historic Properties Management Plan
ILP.....	Integrated Licensing Process
ISR.....	Initial Study Report
ITA.....	Indian Trust Assets
kV.....	kilovolt
m.....	meters
M&I.....	Municipal and Industrial
MCL.....	Maximum Contaminant Level
mg/kg.....	milligrams/kilogram

mg/L	milligrams per liter
mgd	million gallons per day
mi	miles
mi ²	square miles
MID	Modesto Irrigation District
MOU	Memorandum of Understanding
MSCS	Multi-Species Conservation Strategy
msl	mean sea level
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
NEPA	National Environmental Policy Act
ng/g	nanograms per gram
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
NGVD 29	National Geodetic Vertical Datum of 1929
O&M.....	operation and maintenance
OEHHA.....	Office of Environmental Health Hazard Assessment
ORV	Outstanding Remarkable Value
PAD.....	Pre-Application Document
PDO.....	Pacific Decadal Oscillation
PEIR.....	Program Environmental Impact Report
PGA.....	Peak Ground Acceleration
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
QA.....	Quality Assurance
QC	Quality Control
RA.....	Recreation Area
RBP	Rapid Bioassessment Protocol
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
RM	River Mile
RMP	Resource Management Plan
RP.....	Relicensing Participant
RSP	Revised Study Plan
RST	Rotary Screw Trap
RWF	Resource-Specific Work Groups
RWG	Resource Work Group
RWQCB.....	Regional Water Quality Control Board
SC.....	State candidate for listing under CESA
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
SFP	State Fully Protected Species under CESA
SFPUC	San Francisco Public Utilities Commission
SHPO	State Historic Preservation Office
SJRA	San Joaquin River Agreement
SJRG	San Joaquin River Group Authority
SJTA	San Joaquin River Tributaries Authority
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
SWRCB	State Water Resources Control Board
TAC	Technical Advisory Committee
TAF	thousand acre-feet
TCP	Traditional Cultural Properties
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
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
VRM	Visual Resource Management
WPT	Western Pond Turtle
WSA	Wilderness Study Area
WSIP	Water System Improvement Program
WWTP	Wastewater Treatment Plant
WY	water year
μS/cm	microSeimens per centimeter

1.0 INTRODUCTION

1.1 General Description of the Don Pedro Project

Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts) are the co-licensees of the 168-megawatt (MW) Don Pedro Project (Project) located on the Tuolumne River in western Tuolumne County in the Central Valley region of California. The Don Pedro Dam is located at river mile (RM) 54.8 and the Don Pedro Reservoir formed by the dam extends 24-miles upstream at the normal maximum water surface elevation of 830 ft above mean sea level (msl; NGVD 29). At elevation 830 ft, the reservoir stores over 2,000,000 acre-feet (AF) of water and has a surface area slightly less than 13,000 acres (ac). The watershed above Don Pedro Dam is approximately 1,533 square miles (mi²).

Both TID and MID are local public agencies authorized under the laws of the State of California to provide water supply for irrigation and municipal and industrial (M&I) uses and to provide retail electric service. The Project serves many purposes including providing water storage for the beneficial use of irrigation of over 200,000 ac of prime Central Valley farmland and for the use of M&I customers in the City of Modesto (population 210,000). Consistent with the requirements of the Raker Act passed by Congress in 1913 and agreements between the Districts and City and County of San Francisco (CCSF), the Project reservoir also includes a “water bank” of up to 570,000 AF of storage. CCSF may use the water bank to more efficiently manage the water supply from its Hetch Hetchy water system while meeting the senior water rights of the Districts. CCSF’s “water bank” within Don Pedro Reservoir provides significant benefits for its 2.6 million customers in the San Francisco Bay Area.

The Project also provides storage for flood management purposes in the Tuolumne and San Joaquin rivers in coordination with the U.S. Army Corps of Engineers (ACOE). Other important uses supported by the Project are recreation, protection of the anadromous fisheries in the lower Tuolumne River, and hydropower generation.

The Project Boundary extends from approximately one mile downstream of the dam to approximately RM 79 upstream of the dam. Upstream of the dam, the Project Boundary runs generally along the 855 ft contour interval which corresponds to the top of the Don Pedro Dam. The Project Boundary encompasses approximately 18,370 ac with 78 percent of the lands owned jointly by the Districts and the remaining 22 percent (approximately 4,000 ac) is owned by the United States and managed as a part of the U.S. Bureau of Land Management (BLM) Sierra Resource Management Area.

The primary Project facilities include the 580-foot-high Don Pedro Dam and Reservoir completed in 1971; a four-unit powerhouse situated at the base of the dam; related facilities including the Project spillway, outlet works, and switchyard; four dikes (Gasburg Creek Dike and Dikes A, B, and C); and three developed recreational facilities (Fleming Meadows, Blue Oaks, and Moccasin Point Recreation Areas). The location of the Project and its primary facilities is shown in Figure 1.1-1.

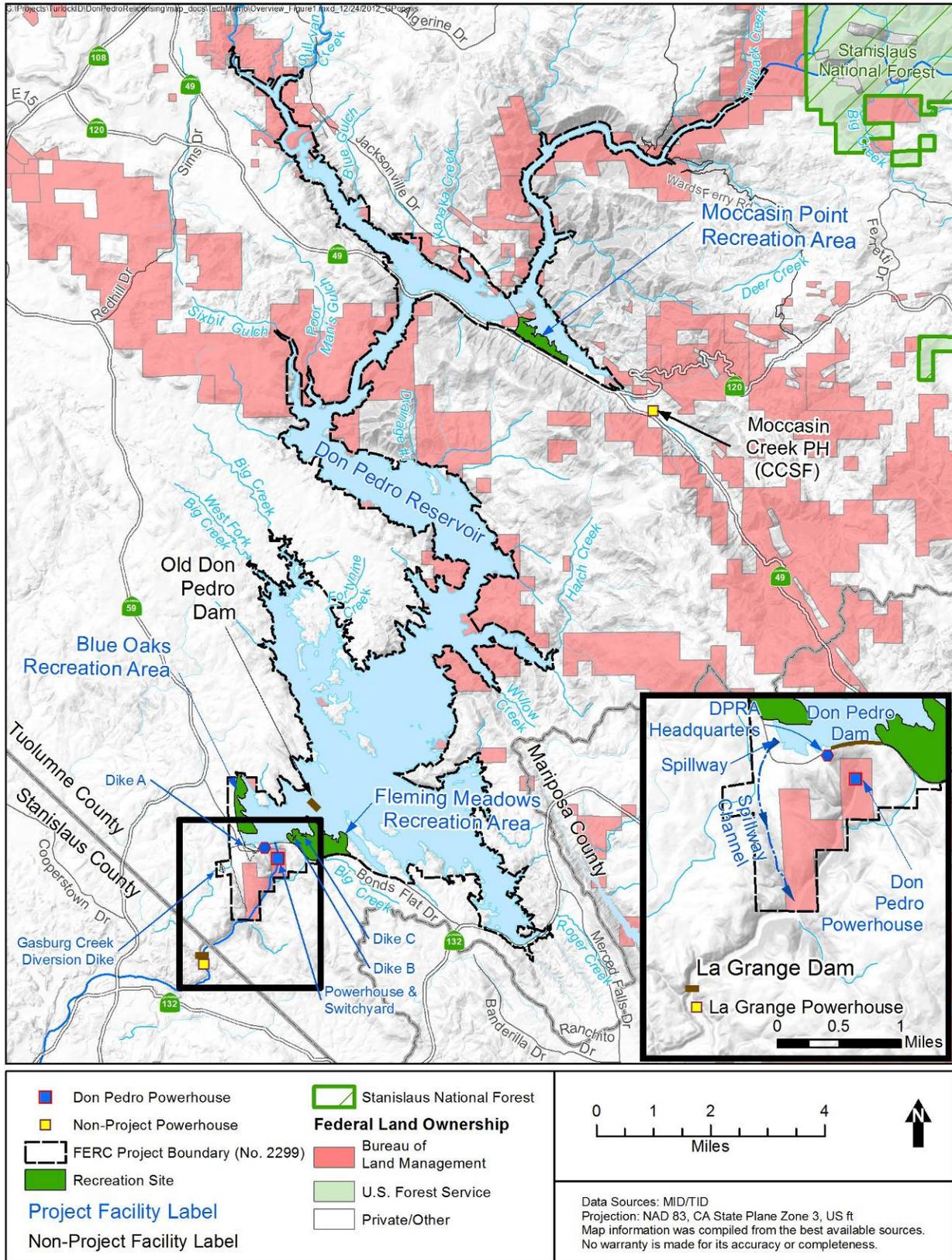


Figure 1.1-1. Don Pedro Project location.

1.2 Relicensing Process

The current FERC license for the Project expires on April 30, 2016, and the Districts will apply for a new license no later than April 30, 2014. The Districts began the relicensing process by filing a Notice of Intent and Pre-Application Document (PAD) with FERC on February 10, 2011, following the regulations governing the Integrated Licensing Process (ILP). The Districts' PAD included descriptions of the Project facilities, operations, license requirements, and Project lands as well as a summary of the extensive existing information available on Project area resources. The PAD also included ten draft study plans describing a subset of the Districts' proposed relicensing studies. The Districts then convened a series of Resource Work Group meetings, engaging agencies and other relicensing participants in a collaborative study plan development process culminating in the Districts' Proposed Study Plan (PSP) and Revised Study Plan (RSP) filings to FERC on July 25, 2011 and November 22, 2011, respectively.

On December 22, 2011, FERC issued its Study Plan Determination (SPD) for the Project, approving, or approving with modifications, 34 studies proposed in the RSP that addressed Cultural and Historical Resources, Recreational Resources, Terrestrial Resources, and Water and Aquatic Resources. In addition, as required by the SPD, the Districts filed three new study plans (W&AR-18, W&AR-19, and W&AR-20) on February 28, 2012 and one modified study plan (W&AR-12) on April 6, 2012. Prior to filing these plans with FERC, the Districts consulted with relicensing participants on drafts of the plans. FERC approved or approved with modifications these four studies on July 25, 2012.

Following 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. In accordance with the ILP, FERC convened a Dispute Resolution Panel on April 17, 2012 and the Panel issued its findings on May 4, 2012. On May 24, 2012, the Director of FERC issued his Formal Study Dispute Determination, with additional clarifications related to the Formal Study Dispute Determination issued on August 17, 2012.

This study report describes the objectives, methods, and results of the Lower Tuolumne River Lowest Boatable Flow Study (RR-03) as implemented by the Districts in accordance with FERC's SPD and subsequent study modifications and clarifications. Documents relating to the Project relicensing are publicly available on the Districts' relicensing website at www.donpedro-relicensing.com.

1.3 Study Plan

In its SPD, FERC approved the Districts' Lower Tuolumne River Lowest Boatable Flow Study with modification. FERC recommended the boating study effort include drift rafts and that the flow test start at 200 cubic feet per second (cfs), then increase or decrease the flow in 25 cfs increments based upon whether or not the 200 cfs flow is sufficient for boating. The study was carried out consistent with these directives. Variances and modifications to the final approved study plan are discussed in Section 7 of this report.

2.0 STUDY GOALS AND OBJECTIVES

The primary goal of the study was to determine if the Project's 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. Therefore, the study was conducted within the range of the minimum flow requirements of the current license.

The study was designed to achieve the following objectives:

- (1) determine whether the Project's minimum flows provide for river boating in portions of the lower Tuolumne River (see Figure 2.0-1 Lower Tuolumne River Lowest Boatable Flow Study Area);
- (2) use existing recreation information, where possible, to assess river boating including gradient of river segments;
- (3) determine the number of flow days by month at or above the minimum boatable flow for river boating opportunities (e.g. kayaking, canoeing) under current Project operations,
- (4) determine operational constraints, if any, of providing minimum flows for the river boating opportunities;
- (5) identify and describe put-in and take-out locations for river boating between La Grange Dam and the confluence with the San Joaquin River;
- (6) identify and describe the locations on the river where boaters encounter features of special interest, challenges, hazards, or difficulties; and
- (7) evaluate the adequacy of public flow information (i.e. availability, reliability, and real-time access).

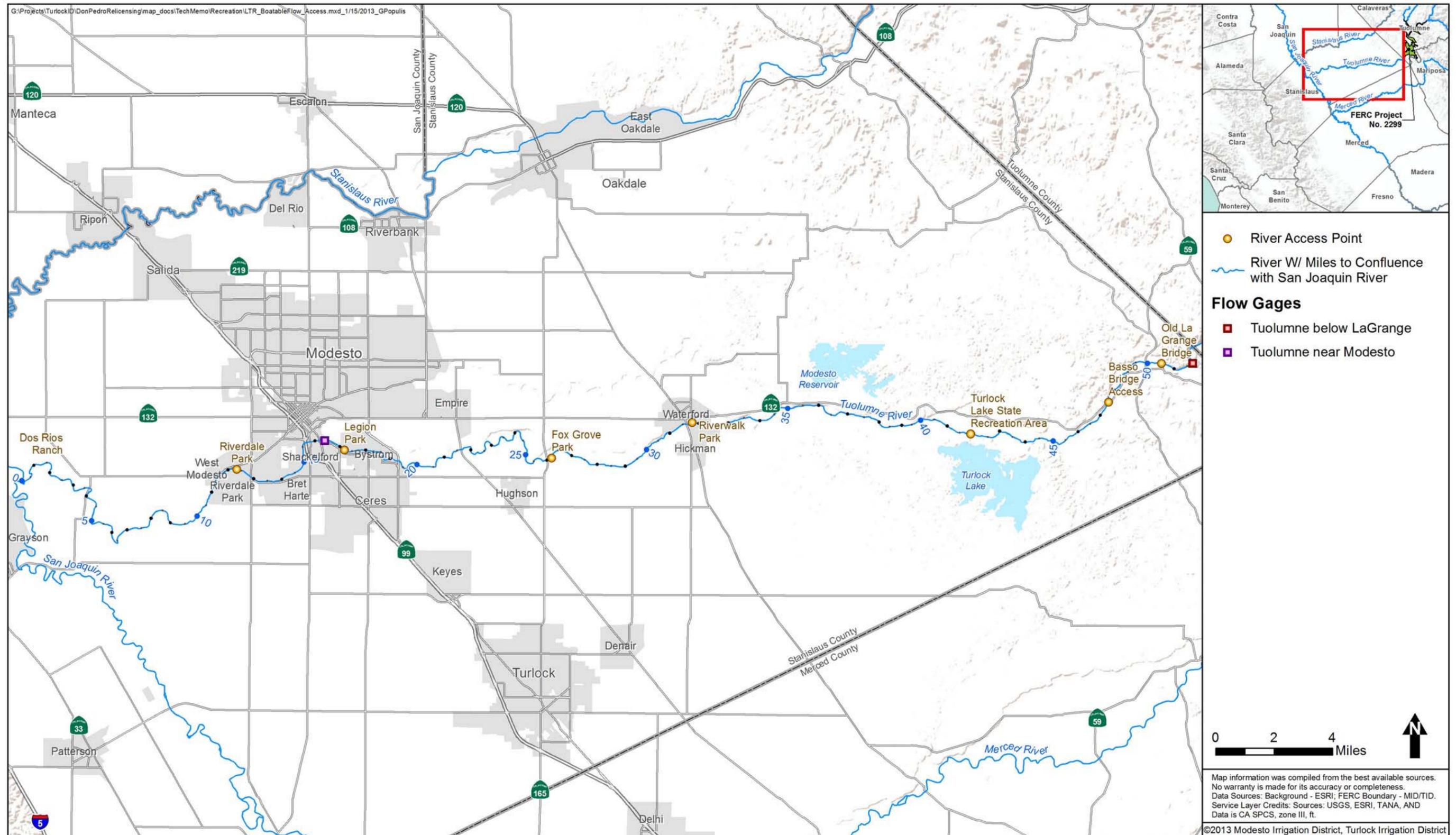


Figure 2.0-1. Lower Tuolumne River Lowest Boatable Flow study area.

3.0 STUDY AREA

The study area included the 52-mile river reach from La Grange Dam (River Mile 52) to the confluence with the San Joaquin River (River Mile 0) as shown in Figure 2.0-1. This river reach has a mild gradient, resulting in flatwater (Class I) boating opportunities, but no whitewater boating opportunities. The lower Tuolumne River drops about 130 ft in 52 miles for a mean gradient of 2.5 ft./mi. Whitewater boating occurs on the Tuolumne River upstream of Don Pedro Reservoir where the gradient often exceeds 50 ft/mi. Boating on the lower Tuolumne is generally a day use, or partial day, activity. The study was conducted within the limits of the current minimum flows and within the limits of currently accessible put-ins and take-outs.

The first publicly available access site for non-motorized boating on the lower Tuolumne River is at the Old La Grange Bridge in the town of La Grange at RM 50.5 (Figure 2.0-1). There are six publicly available access sites downstream of the Old La Grange Bridge to Riverdale Park in Modesto at RM 12.3. Downstream of RM 12.3 to the confluence of the San Joaquin River (RM 0), public access is currently limited by private land ownership. Based on the lack of access below Riverdale Park, the study focuses on the lower Tuolumne River reach between Old La Grange Bridge and Riverdale Park (Figure 2.0-1).

The lower Tuolumne River subbasin from RM 50.5 to RM 0 has a watershed of approximately 400 square miles and contains one major tributary, Dry Creek. In this reach, the Tuolumne River ranges from about elevation 170 feet at the Old La Grange Bridge to approximately elevation 35 feet at the confluence with the San Joaquin River.

The lower Tuolumne River watershed is long and narrow. Land is primarily privately owned and used for agriculture, grazing, and rural residential purposes, or for denser residential, municipal and industrial purposes in cities and communities such as Waterford, Ceres, and Modesto (Stanislaus County 2006). The lower Tuolumne River also provides spawning habitat for fall-run Chinook salmon, especially from RM 46 to 52.

Large-scale anthropogenic changes have occurred to the lower Tuolumne River corridor over time. Gold mining, grazing, and agriculture encroached on the lower Tuolumne River channel before the first aerial photographs were taken by the Soil Conservation Service in 1937. Excavation of bed material for gold and aggregate to depths below the river thalweg eliminated active floodplains and terraces and created large in-channel and off channel pits. Agricultural and urban encroachment have contributed to the lower Tuolumne River being a relatively static channel within a narrow floodway confined by dikes and agricultural fields. Gravel and aggregate mining continue to occur alongside the river for a number of miles, particularly upstream of the town of Waterford (RM 32).

Native riparian vegetation occupies 2,625 acres along a nearly continuous but variably wide band along the lower Tuolumne River corridor as reported in the Districts Riparian Study conducted as part of relicensing (TID/MID 2013a). Since 1996, there has been a 461 acre increase in net extent of native vegetation brought about primarily through active restoration projects. Areas with the least riparian vegetation and narrowest riparian corridor are along RM 10.5 to 19.3, which runs through the urban areas of Modesto and Ceres. Upstream of Modesto, the river is also

confined by gravel mining and other land uses, and includes large areas that are sparsely vegetated due to historical mining and dredger tailing deposits.

4.0 METHODOLOGY

The study consisted of addressing seven different topics related to recreational boating on the lower Tuolumne River. Each of these is discussed below.

4.1 Investigate Whether the Project's Minimum Flows Provide for Boating

The primary source of data to address this objective was obtained by testing the boatability of known flows along the lower Tuolumne River. For the purposes of conducting this study plan, establishing the flow rate in the lower river was accomplished by the Districts adjusting the amount of flow released from Don Pedro, diverting a portion into the irrigation system and passing the flow to be tested downstream. Flows in the river were recorded at the USGS' La Grange gage. The study team solicited volunteers to evaluate river flows in the lower Tuolumne River. Based on FERC's SPD, the intent was to perform the study in September or October using a sequence of flows starting at 200 cfs. If 200 cfs was determined to be boatable along portions of the river, study flows would be decreased in 25 cfs increments until the lowest boatable flow was determined. If a flow of 200 cfs was not boatable, study flows would be increased in 25 cfs increments until a boatable flow for at least one watercraft type is reached. In all cases, study flows were to be consistent with the current license and the Districts' minimum flow schedule in the lower Tuolumne River.

Water year (WY) 2012 was a dry year. Based on the California Department of Water Resources May 8, 2012 forecast update, flows in the proposed study period of September – October were scheduled to be below the 200 cfs starting flow identified in FERC's SPD (Figure 4.1-1). Therefore, the river boating portion of this study was modified to accommodate the flow schedule that the Districts submitted to resource agencies by letter dated May 17, 2012 (Figure 4.1-1). It was recognized that the flows scheduled to occur in the lower Tuolumne River from May 30 to June 3 provided an opportunity to conduct the in-river boating study component consistent with the modifications FERC required in the SPD without conflicting with or constraining other water uses and flow requirements on the river. Volunteers were solicited on May 21, 2012 to participate in the boating study effort.

The study team sought the participation of volunteer boaters (ideally five to eight people for each kind of watercraft) with a range of skill levels to paddle portions of the lower Tuolumne River with the preference of two times in succession. The participants paddled each pre-selected flow in a pre-selected reach, and then completed questionnaires at the conclusion of each boating run. The questionnaire included a section to gather data for a comparative flow evaluation for each run. The questionnaire is presented in Attachment A to this report.

Volunteers were identified through information provided by relicensing participants knowledgeable about river boating in central California. The study team also contacted boating clubs and organizations active in the central California area to identify potential participants. The Tuolumne River Trust (TRT) was helpful in identifying several participants.

Tuolumne River Flow Schedule
 Dry Conditions Based on DWR April 24, 2012 Forecast
 SCHEDULE FOR 2012 - 2013 Fish Flow Year

DATE		Number of DAYS	TOTAL FERC FLOW	
From	To		CFS	ACCUM. A.F.
15-Apr-2012	15-Apr-2012	1	150	298
16-Apr-2012	16-Apr-2012	1	150	595
17-Apr-2012	17-Apr-2012	1	150	893
18-Apr-2012	18-Apr-2012	1	150	1,190
19-Apr-2012	19-Apr-2012	1	150	1,488
20-Apr-2012	20-Apr-2012	1	150	1,785
21-Apr-2012	21-Apr-2012	1	150	2,083
22-Apr-2012	22-Apr-2012	1	150	2,380
23-Apr-2012	23-Apr-2012	1	150	2,678
24-Apr-2012	24-Apr-2012	1	150	2,975
25-Apr-2012	25-Apr-2012	1	Pulse Flow 195	3,363
26-Apr-2012	26-Apr-2012	1	Pulse Flow 200	3,759
27-Apr-2012	27-Apr-2012	1	Pulse Flow 300	4,355
28-Apr-2012	28-Apr-2012	1	Pulse Flow 350	5,049
29-Apr-2012	29-Apr-2012	1	Pulse Flow 350	5,743
30-Apr-2012	30-Apr-2012	1	Pulse Flow 350	6,437
01-May-2012	01-May-2012	1	Pulse Flow 650	7,726
02-May-2012	02-May-2012	1	Pulse Flow 650	9,016
03-May-2012	03-May-2012	1	Pulse Flow 650	10,305
04-May-2012	04-May-2012	1	Pulse Flow 650	11,594
05-May-2012	05-May-2012	1	Pulse Flow 650	12,883
06-May-2012	06-May-2012	1	Pulse Flow 650	14,173
07-May-2012	07-May-2012	1	Pulse Flow 650	15,462
08-May-2012	08-May-2012	1	Pulse Flow 650	16,751
09-May-2012	09-May-2012	1	Pulse Flow 2,050	20,817
10-May-2012	10-May-2012	1	Pulse Flow 2,050	24,883
11-May-2012	11-May-2012	1	Pulse Flow 2,050	28,950
12-May-2012	12-May-2012	1	Pulse Flow 2,050	33,016
13-May-2012	13-May-2012	1	Pulse Flow 1,300	35,594
14-May-2012	14-May-2012	1	Pulse Flow 1,000	37,578
15-May-2012	15-May-2012	1	Pulse Flow 750	39,065
16-May-2012	16-May-2012	1	Pulse Flow 250	39,561
17-May-2012	17-May-2012	1	Pulse Flow 250	40,057
18-May-2012	18-May-2012	1	Pulse Flow 250	40,553
19-May-2012	19-May-2012	1	Pulse Flow 250	41,049
20-May-2012	20-May-2012	1	Pulse Flow 250	41,545
21-May-2012	21-May-2012	1	Pulse Flow 400	42,338
22-May-2012	22-May-2012	1	Pulse Flow 400	43,131
23-May-2012	23-May-2012	1	Pulse Flow 400	43,925
24-May-2012	24-May-2012	1	Pulse Flow 400	44,718
25-May-2012	25-May-2012	1	Pulse Flow 761	46,228
26-May-2012	26-May-2012	1	Pulse Flow 761	47,738
27-May-2012	27-May-2012	1	Pulse Flow 761	49,248
28-May-2012	28-May-2012	1	Pulse Flow 761	50,757
29-May-2012	29-May-2012	1	350	51,452
30-May-2012	30-May-2012	1	200	51,848
31-May-2012	31-May-2012	1	175	52,195
01-Jun-2012	01-Jun-2012	1	150	52,493
02-Jun-2012	02-Jun-2012	1	125	52,741
03-Jun-2012	03-Jun-2012	1	100	52,939
04-Jun-2012	04-Jun-2012	1	75	53,088
05-Jun-2012	05-Jun-2012	1	50	53,187
06-Jun-2012	06-Jun-2012	1	50	53,286
07-Jun-2012	30-Jun-2012	24	50	55,666
01-Jul-2012	31-Jul-2012	31	50	58,741
01-Aug-2012	31-Aug-2012	31	50	61,815
01-Sep-2012	30-Sep-2012	30	50	64,790
01-Oct-2012	01-Oct-2012	1	150	65,088
02-Oct-2012	07-Oct-2012	6	150	66,873
08-Oct-2012	10-Oct-2012	3	150	67,766
11-Oct-2012	12-Oct-2012	2	150	68,361
13-Oct-2012	14-Oct-2012	2	411	69,990
15-Oct-2012	31-Oct-2012	17	150	75,048
01-Nov-2012	30-Nov-2012	30	150	83,973
01-Dec-2012	31-Dec-2012	31	150	93,196
01-Jan-2013	31-Jan-2013	31	150	102,419
01-Feb-2013	28-Feb-2013	28	150	110,750
01-Mar-2013	31-Mar-2013	31	150	119,973
01-Apr-2013	14-Apr-2013	14	150	124,138
No. of days		365		

1 cfs day = 1.983471 acre-feet (af)

Figure 4.1-1. Tuolumne River flow schedule dated May 14, 2012.

The river boating study effort was conducted from May 30 to June 2, 2012, with flows ranging from 200 cfs down to 110 cfs as recorded at the USGS Gauge 11289650: Tuolumne River near La Grange CA (La Grange gage). Thirteen volunteer boaters participated from May 30 to June 1 using canoes, hardshell kayaks, inflatable kayaks, and a drift raft. It is important to note that on June 19, 2012, USGS personnel visited the La Grange gage site and based on field measurements taken that day, the gage was recalibrated and previously reported provisional data was revised on June 28, 2012 and December 17, 2012. The recalibrations resulted in revised estimates for flows occurring during the May 30 to June 2 boating study. The revised flows ranged from 256 cfs down to 171 cfs. The data provided on the USGS website on December 27, 2012 is used in this report. Data for the period October 1, 2011 through December 27, 2012 continues to be rated as provisional at the time of this report.

In addition to the flows boated by the volunteer boaters from May 30 to June 2, the study team assessed flows opportunistically throughout the study period by boating at flows in the range of 98 cfs to 132 cfs and participating in portions of the TRT's Paddle-to-the-Sea event from June 13 to 15, 2012, at flows ranging from 128 cfs to 132 cfs (all flows as recorded at the La Grange gage).

Due to the gage recalibration, the Districts felt they needed to gather additional data on boatable flows in order to more fully address the study plan requirements. The Districts scheduled a repeat of the in-river boating study for September 29 to October 1, and began soliciting volunteers in late August. One volunteer -- Steve Bowes of the National Park Service (NPS) -- participated in the September 29 to October 1 event, kayaking the Basso Bridge to Turlock Lake State Recreation Area (Turlock SRA) reach on September 29, 2012 at a flow recorded at the USGS gage of 101 to 109 cfs.

4.2 Assessment of Availability of Existing Information on River Boating

This component of the study included a review of available information on river boating (i.e., canoe, kayak, raft, and other non-motorized watercraft types) on the lower Tuolumne River and public access in the study area. This research included a review of internet guide books (California Creeks 2012, AW 2012), input from and discussions with boaters who have floated this particular reach, including Bob Hackamack (2012), and field reconnaissance of the lower Tuolumne River. The objective of this information gathering was to identify, document, and describe the available non-motorized boating opportunities on the lower Tuolumne River.

4.3 Determine the Number of Days in Each Month that Boatable Flows Occur

The study team estimated the annual and monthly number of usable days that occur based on flow information in the historical hydrology record. For the purpose of this study, a usable day is defined as a day when the mean daily flow at the La Grange gage is at or above the lowest boatable flow.

4.4 Determine Operational Constraints to Providing Flows

The study team reviewed Don Pedro operations that might prohibit or impact the ability to provide flows to the lower Tuolumne River. Operations of the La Grange facilities was also reviewed.

4.5 Identify and Describe Put-In and Take-Out Locations

The study team documented put-in and take-out locations based on review of guide books, websites, and maps; discussions with boaters who have floated the river; and field reconnaissance.

4.6 Identify Features of Special Interest, Challenge, Hazard, or Difficulty

The study team documented in-river and shoreline constraints, challenges, play spots, the types of craft suitable for boating in the study area based on review of guide books and websites, in-river boating survey results, discussions with boaters who have floated the river; and field reconnaissance, including participation in three segments of the 2012 Paddle-to-the-Sea event.

4.7 Evaluate the Adequacy of Public Information

The study team researched the availability, reliability, and real-time access to websites that provided information on flows in the lower Tuolumne River.

5.0 STUDY FINDINGS

The findings of the Lower Tuolumne River Lowest Boatable Flow study are discussed below for each of the seven study components.

5.1 Lowest Boatable Flows

The lowest boatable flow was assessed primarily through in-river boating by volunteers and Districts' consultants under a range of flow conditions. Between May 30, 2012 and September 30, 2012 the study team received a total of 33 completed boater surveys on lower Tuolumne River segments from Old La Grange Bridge to Venn Farms at Big Bend (RM 6.3). The flows at which boaters floated the river ranged from 98 cfs to 256 cfs, as recorded at the La Grange gage (Table 5.1-1). Boaters included volunteer participants in the study, the Districts' consultants, and California Department of Fish and Game (CDFG) staff who coincidentally were working on the lower Tuolumne River during one of the river boating study days.

Table 5.1-1. Summary of boated reaches by flow level and craft type.

Date	Participant	Flow Level Range (cfs) ¹	No. of Completed Surveys	Hardshell Kayakers	Inflatable Kayakers	Drift Boat	Canoeists
OLD LA GRANGE BRIDGE (RM 50.5) TO TURLOCK SRA (RM 42.0)							
May 30, 2012	Boaters	247-256 cfs	8	4	1	1	2
	HDR Staff		1	0	1	0	0
May 31, 2012	Boaters	218-231 cfs	7	2	2	0	3
June 1, 2012	Boaters	196-203 cfs	4	2	1	0	1
	HDR Staff		1	0	1	0	0
June 2, 2012	HDR Staff	171-175 cfs	2	0	2	0	0
July 21, 2012	HDR Staff	98-120 cfs	2	0	2	0	0
September 29, 2012	HDR Staff	101-109 cfs	1	0	1	0	0
September 30, 2012	HDR Staff	124-132 cfs	1	0	1	0	0
BASSO BRIDGE (RM 47.5) TO TURLOCK SRA							
September 29, 2012	Boater	101-109 cfs	1	0	1	0	0
Total			27	8	12	1	6
TURLOCK SRA TO RIVERWALK PARK IN WATERFORD (RM 31.0)							
May 31, 2012	Boaters	218-231 cfs	1	0	0	0	1
Total			1	0	0	0	1
RIVERWALK PARK TO FOX GROVE FISHING ACCESS (RM 26.1)							
June 13, 2012	HDR Staff	128-132 cfs	1	0	0	0	1
Total			1	0	0	0	1
FOX GROVE TO RIVERDALE PARK (RM 12.3)							
May 30, 2012	Boater	247-256 cfs 584-672 cfs ²	1	1	0	0	0

Date	Participant	Flow Level Range (cfs) ¹	No. of Completed Surveys	Hardshell Kayakers	Inflatable Kayakers	Drift Boat	Canoeists
FOX GROVE TO LEGION PARK (RM 17.6)							
May 31, 2012	Boaters	218-231 cfs	1	1	0	0	0
June 14, 2012	HDR Staff	126-130 cfs	1	0	0	0	1
Total			3	2	0	0	1
RIVERDALE PARK TO VENN FARMS (PRIVATE LAND) (RM 6.3)							
June 15, 2012	HDR Staff	128-130 cfs 228-243 cfs ²	1	0	0	0	1
Total			1	0	0	0	1

¹ Flow level range at USGS La Grange gage (11289650) for the period 7:00 AM – 2:00 PM of each day reported. Accessed December 27, 2012, unless otherwise noted.

http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb_00060=on&cb_00065=on&format=html&period=&begin_date=2012-05-30&end_date=2012-06-02&site_no=11289650

² Flow level range at USGS Modesto gage (11290000) for the period 7:00 AM – 2:00 PM of each day reported. Accessed January 3, 2013. http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb_00065=on&cb_00095=on&format=rdb&period=&begin_date=2012-06-16&end_date=2012-06-16&site_no=11290000

In all cases, the flows boaters experienced were considered boatable for the type of craft used, as reported in response to Question 15 on the evaluation form (Attachment A). The lowest flows boated during this study were 98 to 120 cfs on July 21, 2012 and 101 to 109 cfs on September 29, 2012 (as recorded at the La Grange gage) in the reach from Old La Grange Bridge (RM 50.5) to Turlock SRA (RM 42.0) (Table 5.1-1). At these flows of 98 to 109 cfs, the Districts' consultants and the single volunteer who participated in the September 29 - October 1 volunteer flow study effort reported the flow to be boatable, but declined to boat any lower flows in search of a lower boatable flow. At flows in the 100 cfs range, these experienced boaters found the Old La Grange Bridge to Turlock SRA segment to be boatable, but without any attributes to entice toward boating at lower flows.

Figure 5.1-1 presents the annual flow duration curve for the USGS gages at La Grange (11289650) and Modesto (11290000) for the period 2003-2012 (USGS 2012). Attachment B presents the monthly flow duration curves for the same period. Records from these gages were compared to demonstrate that Tuolumne River is a gaining stream between the two gages. This conclusion is generally supported by the accretion data presented in relicensing study W&AR-02 (TID/MID 2013b) as reported in section 2.4.2 of the Initial Study Report. However, for several miles of the upper segment of the river the river may be a losing stream reach based on the accretion flow measurements. During this lowest boatable flow study, the available flow for boating increased in a downstream direction as evidenced by the flows recorded on May 30 and June 15, 2012 when study boaters paddled the segment between the Modesto gage (RM 16.2) and Riverdale Park (RM 12.3) (see Table 5.1-1 above).

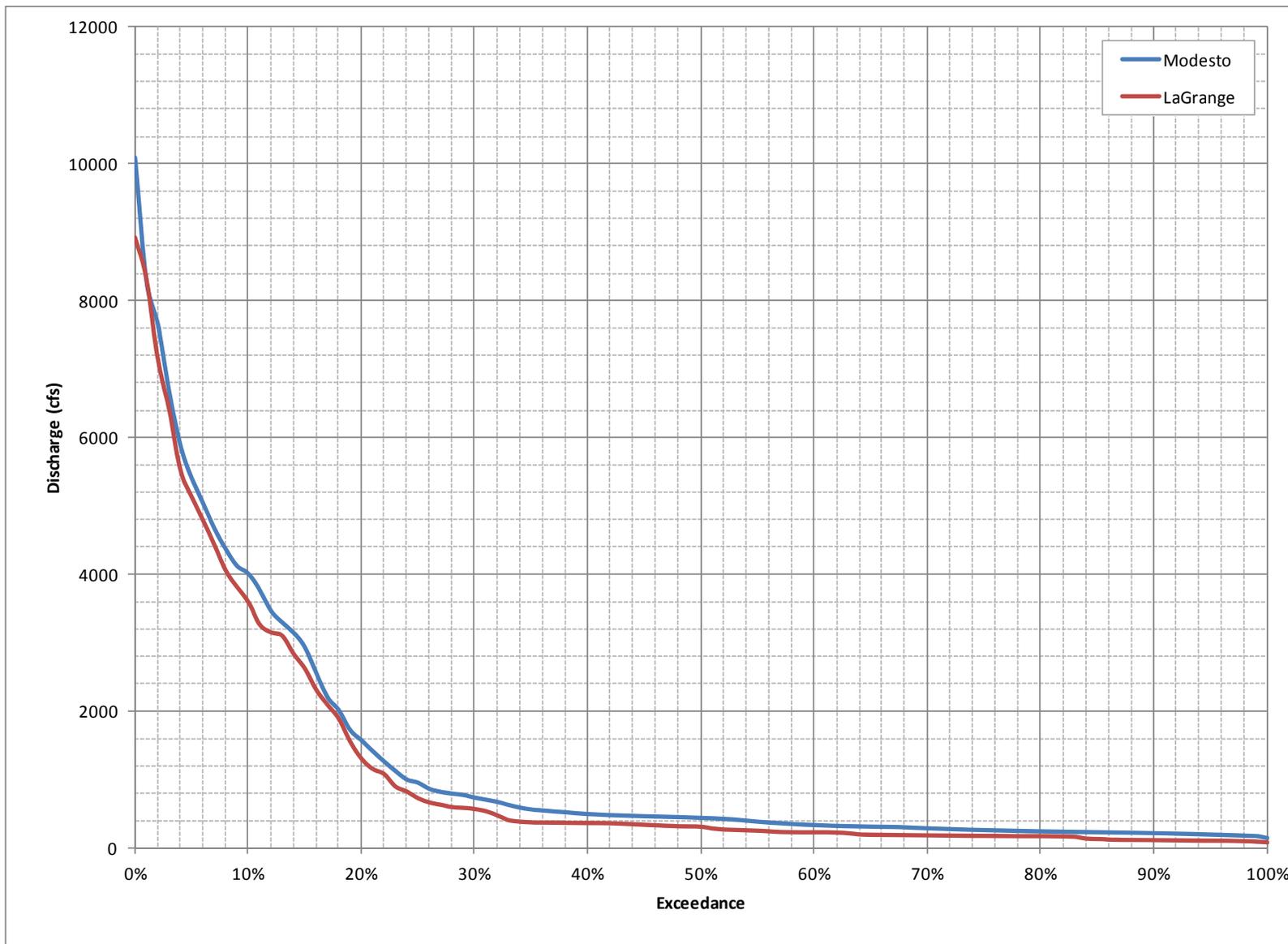


Figure 5.1-1. Annual flow duration curve for the USGS gages at La Grange (11289650) and Modesto (11290000).

5.2 Assessment of Availability of Existing Information on River Boating

The study team gathered information on put-ins and take-outs that define boatable segments of the lower Tuolumne River from existing internet guidebooks, other websites, and maps; recreational boaters familiar with the lower Tuolumne River; and volunteers who participated in this study. After established reaches with publicly available put-ins and take-outs were identified, the following geographic and topographic information was compiled. These locations are labeled in Figure 2.0-1.

Old La Grange Bridge (RM 50.5) to Turlock Lake State Recreation Area (RM 42.0)

Length of Reach: 8.5 miles.

Approximate Elevation Range: 170 ft to 120 ft.

Average Gradient: 5.7 feet per mile (ft/mi) (ranges from 5.9 to 5.5 ft/mi)

Alternative Put-in/Take-out Locations:

Old La Grange Bridge to Basso Bridge (RM 47.5)

Length of Reach: 3 miles.

Basso Bridge to Turlock SRA

Length of Reach: 5.5 miles.

Turlock Lake State Recreation Area (RM 42.0) to Riverwalk Park in Waterford (RM 31.0)

Length of Reach: 10 miles.

Elevation Range: 120 ft to 68 ft.

Average Gradient: 3.7 ft/mi (ranges from 5.4 to 2.0 ft/mi).

Riverwalk Park in Waterford (RM 31.0) to Fox Grove Fishing Access (RM 26.1)

Length of Reach: 6 miles.

Elevation Range: 68 ft to 57 ft.

Average Gradient: 1.8 ft/mi (ranges from 2.0 to 1.6 ft/mi).

Fox Grove (RM 26.1) to Riverdale Park (RM 12.3)

Length of Reach: 14 miles.

Elevation Range: 57 ft to 42 ft.

Average Gradient: 1.5 ft/mi (ranges from 1.6 to 1.32 t/mi).

Alternative Put-in/Take-out Locations:

Fox Grove to Legion Park (RM 17.6)

Length of Reach: 8.5 miles.

Legion Park to Riverdale Park

Length of Reach: 5.3 miles.

In summary, there are seven publicly available put-in and take-out locations on the lower Tuolumne River on the 38-mile reach from La Grange to Riverdale Park downstream of Modesto providing numerous day or partial day non-motorized boating trip opportunities. Downstream of Riverdale Park (RM 12.3) to the confluence with the San Joaquin River (RM 0), public access was limited due to private land ownership. However, the Tuolumne River Trust purchased the

Dos Rios Ranch in 2012, which consists of 1,600 acres of Tuolumne River floodplain (Koepele 2012). The Dos Rios Ranch occupies three miles of river frontage along the confluence of the Tuolumne and San Joaquin Rivers and the site may provide future recreation potential (TRT 2012).

5.3 Number of Boatable Flow Days Available

Based on the results of this study as reported in Section 5.1, the lowest boatable flow was found to be approximately 100 cfs (98 cfs to 109 cfs), as recorded at the La Grange gage. Flows lower than 96 cfs did not occur in 2012, as recorded at the La Grange gage, and therefore, flows than this level could not be tested.

Based on a review of daily average flows as measured at the La Grange gage for the 10-year period from January 1, 2003 to December 28, 2012, flows were at or above 100 cfs 95.4 percent of the time. During the months of the typical boating season of May through October, flows were at or above 100 cfs 100 percent of the time in May and 78 percent of the time in September for the period 2003-2012 (Table 5.3-1 and Attachment B). During this 10 year period, flows were at or above 100 cfs every day of the year for six of the calendar years; flows occasionally dropped below 100 cfs during only four years – 2007, 2008, 2009, and 2012.

Table 5.3-1. Percent of time USGS gage at La Grange reported flows of 100 cfs or greater for the period 2003-2012.

Month	Percent of Time Flow Greater than 100 cfs
May	100%
June	93.4%
July	84.2%
August	88.8%
September	78.4%
October	98.8%

Source: http://nwis.waterdata.usgs.gov/ca/nwis/dv?cb_00060=on&format=rdb&period=&begin_date=2003-01-01&end_date=2012-12-28&site_no=11289650&referred_module=sw

5.4 Operational Constraints to Providing Flows

The Don Pedro Project is operated and managed as a multi-purpose water resource project providing water storage for irrigation, municipal and industrial (M&I) use, flood control, recreation, power generation, and fisheries protection and enhancement purposes. The Project's primary purpose is to provide water storage for irrigation for 210,000 acres of prime Central Valley farmland located east of the San Joaquin River primarily in Stanislaus County. In general, Project operations follow a relatively consistent annual cycle of water management for flood control; capturing runoff from snowmelt and seasonal rainfall; storage and delivery of water to meet irrigation, municipal, and industrial needs; providing recreation opportunity; and providing scheduled releases to benefit anadromous fish in the lower Tuolumne River. The Don Pedro Project also provides water storage (in the form of "water bank" credit) for the City and County of San Francisco (CCSF) which enables it to meet the water needs of its over two million customers in the San Francisco Bay Area. Operations are conducted in accordance with all FERC license terms.

Releases from the Don Pedro Project, therefore, vary depending on irrigation, municipal, and industrial water needs. Releases from Don Pedro Dam are also made to meet flow requirements in the lower Tuolumne River as measured at the USGS La Grange gage. These releases are made in accordance with the schedule adopted as part of the Districts' 1995 settlement agreement.

FERC issued an order on July 31, 1996 amending the Don Pedro license to incorporate the lower Tuolumne River minimum flow provisions contained in the settlement agreement. The revised minimum flows were to vary from 50 to 300 cfs depending on WY type and time of year.

At this time, no specific problems have been identified by the Districts in regard to releasing the minimum flow requirements of the Don Pedro Project related to the lowest boatable flow of 100 cfs measured at the La Grange gage. It is noted that flows lower than 100 cfs as measured at the La Grange gage were not attempted to be floated in any portion of the lower Tuolumne River.

5.5 Put-In and Take-Out Locations

Information on put-ins and take-outs was gathered from existing sources, recreational boaters familiar with the lower Tuolumne River, volunteers who participated in the study, and direct observation. Volunteer boaters provided information on the following segments: Old La Grange Bridge to Turlock SRA, Basso Bridge to Turlock SRA, Turlock SRA to Waterford, and Fox Grove to Legion Park and Riverdale Park in Modesto. The study team participated in three segments of the Paddle to the Sea Event (segments 5-7 from Riverwalk Park in Waterford to Venn Farms). Figure 2.0-1 presents the location of identified put-ins and take-outs.

The 52-mile lower Tuolumne River from La Grange to the confluence of the San Joaquin River has seven publicly available access locations for put-in and/or take-out of non-motorized watercraft, all located between La Grange (RM 52) and Modesto (RM 16). Downstream of Modesto, private property limits public access to the river. The access points are summarized below.

Old La Grange Bridge (RM 50.5) to Turlock Lake State Recreation Area (RM 42.0)

Put-In: Old La Grange Bridge (north or south access). Direct access to the put-in is via Highway 59 for north bank access; or through the town of La Grange off Highway 132 for access on the south side of the river. Street parking is available on both sides of the river with well-established user-defined access paths to the shoreline. There are no developed facilities at this put-in.

Takeout: Turlock Lake State Recreation Area (approximately 8.7 miles from Old La Grange Bridge). Ample parking and full service restrooms are available. There is a fee of \$10 for parking/day-use.

The drive between put-in and take-out is approximately 8 miles or 15-20 minutes via Lake Road.

An alternative to make this reach shorter is the put-in/take-out Basso Bridge approximately three miles downriver from Old La Grange Bridge. Parking is available underneath the bridge with open access to the shoreline. Portable toilets are provided at this site.

Turlock Lake State Recreation Area to Riverwalk Park in Waterford (RM 31.0)

Put-In: Turlock Lake State Recreation Area: Ample parking is available at this possible put-in location. \$10 fee for parking/day-use.

Takeout: Riverwalk Park, Waterford. Ample paved parking and vault toilets are available.

Access to the shore is via a steep bank with constructed steps over only a portion of the distance. The drive between put-in and take-out is approximately 15 miles or 25-30 minutes via Lake Road to Highway 132 to Appling Road in Waterford.

Riverwalk Park to Fox Grove Fishing Access (RM 26.1)

Put-In: Riverwalk Park on Appling Road in Waterford.

Take-out: Fox Grove Fishing Access, Geer Road. There is ample paved parking and a boat ramp for access to the shore; but no restrooms are available.

The drive between put-in and take-out is approximately seven miles or 20 minutes via Highway 132 and Geer Road.

Fox Grove Fishing Access (RM 26.1) to Riverdale Park (RM 12.3)

Put-In: Fox Grove Fishing Access, Geer Road. Direct access to the put-in is via Geer Road.

Take-out: Riverdale Park, South Carpenter Road. There is ample parking and restrooms at this location. Access to the shoreline is unimproved.

Alternate Take-out: Legion Park in Modesto (RM 17.6), South Santa Cruz Avenue. Ample parking is available at this developed park with lawns and open access to the shore. There are no restrooms at Legion Park.

The drive between put-in and take-out is approximately 11 miles or 20 minutes via Hatch Road. The drive from Fox Grove to Legion Park in Modesto is approximately 9.5 miles, or 20 minutes via E. Hatch Rd.

Quality of Put-in Areas

Boaters were asked to comment on the quality of put-in locations they used during the river boating study effort. Table 5.5-1 summarizes all the comments received from boaters.

Table 5.5-1. Comments on quality of put-in areas.

	Number of Responses
La Grange Put-in	
Excellent	1
Fair	1
Good access on the south side of the river off 132.	1
Good.	1
Lack of good parking and river access.	2
OK.	9
Turlock State Park Put-in	
Easy access and put-in.	1
Basso Bridge Put-in	

	Number of Responses
Great ramp!	1
Great.	1
Waterford Put-in	
Nice parking area. A bit steep to carry boats down or up to the river.	1
Fox Grove Launch Put-in	
Fox Grove launch is adequate, but no restrooms are available.	1
Nice parking area and launch ramp. Similar to Turlock State Recreation Area.	1

Quality of Take-out Areas

Boaters were also asked to evaluate the various take-out locations they used during the river boating study effort. Table 5.5-2 summarizes all of the comments received by boaters regarding take-out areas. Boaters identified the take-out at Turlock SRA as generally excellent, although the fees for take-out/parking were perceived as high overall.

Table 5.5-2. Comments on quality of take-out areas.

Turlock Lake State Recreation Area	Number of Responses
Excellent.	1
First class.	1
Good.	5
Great but expensive.	1
Great ramp.	1
OK-very good, except for normal parking fee.	2
Turlock State Park-love it!	1
Very easy.	1
OK.	2
OK, the park should not charge to park vehicles for boat shuttles.	1
Riverwalk Park	
Easy access. Slightly difficult exit, steep hill with loose dirt.	1
Fox Grove Fishing Access	
Great boat ramp and easy put-in.	1
Legion Park, Modesto	
There is no launch at Legion Park, but there is a parking lot near the river. No restrooms.	1
Functional beach area used to take-out 20 yards away from parking lot.	1
Riverdale Park	
Very functional new park. Easy walk down to the river.	1
Riverdale Park has no launch at all and access is poor. Bathrooms are open but it is a very dangerous neighborhood.	1
Venn Farms (Private property Paddle to the Sea take-out location)	
Private property. Take out was only 30 yards from the parking area.	1

5.6 Features of Special Interest, Challenge, Hazard, or Difficulty

Volunteer participants in the river boating study effort and the Districts' consultants were asked to evaluate the flows boated. In evaluating flows, respondents were asked to consider flow dependent characteristics that contributed to the quality of the river trip experience (e.g., hazards, quality, functionality, time). This information is summarized below. Additional tabular information is presented in Attachment C.

Portages

Most volunteer boaters who participated in the river boating study effort did not find it necessary to portage. Canoeists and hardshell kayakers experienced one to three portages (Table 5.6-1). Of those who did experience portages, one occurred from the Old La Grange Bridge to Turlock SRA reach at a flow of 196 to 203 cfs; one portage occurred from Turlock SRA to Riverwalk Park at 213 to 215 cfs; the boater who put-in at Riverwalk Park portaged around metal debris and over a gravel island approximately two miles downstream of Waterford and pulled the boat through shallow areas twice; and the boaters who put-in at Fox Grove Fishing Access and paddled to Riverdale Park (May 30) and Legion Park (May 31 and June 14) portaged around a fishing weir. During the Paddle-to-the-Sea event on June 15, participants put-in at Riverdale Park (RM 12.3) rather than Legion Park (RM 17.6) to avoid the need to portage around a remnant dam.

Debris

Boaters were asked how many times they experienced debris or overhanging vegetation that was difficult to avoid. Boaters experienced from zero to six places where debris was difficult to avoid at all flow levels (Table 5.6-1).

Scraping Bottom

Boaters were asked whether or not they scraped bottom and how many times. Boaters reported a wide range of scrapes, from zero to 38 times, with no identifiable pattern to the frequency or number of boaters reporting this occurrence (Table 5.6-1).

Exciting and Fun Chutes

Boaters noted the occurrence of exciting and fun chutes at all flow levels. These chutes were most commonly reported in the segment from Old La Grange Bridge to Turlock SRA and were less frequent with decreasing flows (Table 5.6-1).

Run Time

The time it took boaters to complete the various reaches was between mostly between two and four hours (Table 5.6-1).

Table 5.6-1. Evaluation of river segments from Old La Grange Bridge to Venn Farms.

Watercraft Type ¹	Reach	Flow Level (cfs)	# of Boaters	Response by Watercraft Type and Flow Level						
				# Portages	Total Debris Location	# Scraped Bottom	Exciting, Fun Chutes	Time to Complete Run (hours)	Boatable at this Flow	
									Yes	No
	La Grange to Turlock SRA	247-256 cfs	4	0	0, 2, 5, multiple	0, 11, 20, 20	0, 0, 5, 5	2-3	4	0
	La Grange to Turlock SRA	218-231 cfs	3	0	3, 3, 5	6, 31, 38	0, 2, 2	2-3	3	0

Watercraft Type ¹	Reach	Flow Level (cfs)	# of Boaters	Response by Watercraft Type and Flow Level						
				# Portages	Total Debris Location	# Scraped Bottom	Exciting, Fun Chutes	Time to Complete Run (hours)	Boatable at this Flow	
									Yes	No
Hardshell Kayak	La Grange to Turlock SRA	196-203 cfs	1	0	6	13	1	4	1	0
	Fox Grove to Riverdale Park	247-256 cfs	1	2	3	2	1	4	1	0
	Fox Grove to Legion Park	218-231 cfs	1	1	3	38	2	3	1	0
Inflatable-Kayak/Sit on Top	La Grange to Turlock SRA	247-256 cfs	2	0	5	3, 10	6	3-4	2	0
	La Grange to Turlock SRA	196-203 cfs	2	0	0	25	4	4	2	0
	La Grange to Turlock SRA	171-175 cfs	2	0	0	14, 16	4, 6	4	2	0
	La Grange to Turlock SRA	124-132 cfs	1	0	0	11-12	1	3	1	0
	La Grange to Turlock SRA	101-109 cfs	1	0	5	9	2	3	1	0
	La Grange to Turlock SRA	98-102 cfs	2	0	2	21, 26	0, 1	4.5	2	0
	Basso Bridge to SRA	101-109 cfs	1	0	5	9	2	3	1	0
	Turlock SRA to Riverwalk	196-203 cfs	1	0	0	6	0	4	1	0
Canoe	La Grange to Turlock SRA	247-256 cfs	2	0	4	8	2	2	2	0
	La Grange to Turlock SRA	218-231 cfs	3	0	2	18-21	3	2-3	3	0

Watercraft Type ¹	Reach	Flow Level (cfs)	# of Boaters	Response by Watercraft Type and Flow Level						
				# Portages	Total Debris Location	# Scraped Bottom	Exciting, Fun Chutes	Time to Complete Run (hours)	Boatable at this Flow	
									Yes	No
	La Grange to Turlock SRA	196-203 cfs	2	1	3	30	2	2	2	0
	Turlock SRA to Riverwalk	218-231 cfs	1	1	2	21	0	3.5	1	0
	Riverwalk to Fox Grove	128-132 cfs	1	3	2	4	0	4	1	0
	Fox Grove to Legion Park	126-130 cfs	1	2	0	13	0	5	1	0
	Riverdale Park to Venn Farms	228-243 ¹ cfs	1	0	0	3	0	2	1	0
Drift Boat	Basso Bridge to Turlock SRA	247-256 cfs	1	0	1	4	5	5	1	0

¹ Flow level range at USGS Modesto gage (112900) for the period 7:00 AM – 2:00 PM of each day reported. Accessed January 3, 2013. http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb_00065=on&cb_00095=on&format=rdb&period=&begin_date=2012-06-16&end_date=2012-06-16&site_no=11290000

Open-ended Responses by Boaters

Fox Grove to Legion Park/ Riverdale Park, Note by Respondent May 30: “Overall in this reach I tried to stay in the deepest channels and with my experience and knowing where to stay away from shallow areas. An inexperienced boater would have easily hit bottom several more times than I did. This is the minimum flow level I would boat and it took me a long time paddling very hard. It was hot and there are not very many public access points to shorten the trip.”

Fox Grove to Legion Park/ Riverdale Park, Note by Respondent May 31: “Many more close calls with hitting bottom and an increase in water hazards both above and below the water. In most places the only consistently safe channel was on river right. Very “lakey” in many parts and at this flow and wind/sun/experience/length between put-in and take-out issues would cause some problems with boatability.”

Fox Grove to Legion Park, Note by District contractor participating in Paddle to the Sea June 14: “The half mile before take-out was the lowest water we saw. Very wide section of river that left no current.

Riverdale Park to Venn Farms, Note by District contractor participating in Paddle to the Sea June 15: “This leg had the best currents and water movement [compared to Riverwalk to Legion

Park]. TRT said they shortened the trip [put-in at Riverdale Park instead of Legion Park] due to forecasted high air temps and high westerly winds. They also stated that they didn't want the participants to have to portage around the remnants of an old dam that would have been in the first stretch of the leg.”

5.7 Adequacy of Public Information on Flow

Boaters were asked to identify all of the sources of information used to understand flows in the lower Tuolumne River. The majority of boaters identified the USGS website as their source of flow information (Table 5.7-1).

Table 5.7-1. Sources of information used for lower Tuolumne River information¹.

Source	Number of Boaters
USGS Website	15
TID or MID Websites	5
Visual observation	3
Other boaters	3
I don't look for flow information	4

¹ Boaters could select more than one answer.

When seeking flow information, boaters were asked how far in advance they need information to use for planning trips to the lower Tuolumne River. The responses varied, with some respondents reporting more than one answer (Table 5.7-2).

Table 5.7-2. Need for advance flow information for planning trips to the lower Tuolumne River.

Source	Number of Boaters
More than 48 hours	4
24-48 hours	6
12-24 hours	5
Fewer than 12 hours	7
Total	22

¹ Boaters could select more than one response.

6.0 DISCUSSION AND FINDINGS

Findings from the Lower Tuolumne River Lowest Boatable Flow study are discussed below within the context of the seven study objectives.

Objective 1: Determine whether the Project’s minimum flows provide for river boating in portions of the lower Tuolumne River

A review of USGS gage records indicates that the lower Tuolumne River is generally a gaining reach from the La Grange gage to the Modesto gage.

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 Lake State Recreation Area (Turlock SRA). At flows in the 100 cfs range, three experienced boaters found the Old La Grange Bridge to Turlock SRA segment to be boatable, but without any attributes to entice toward boating at lower flows. While these data points are limited (three boaters), the results lead to the conclusion that 100 cfs is boatable and lower flows would not provide enjoyable boating in inflatable kayaks or any other craft.

Regarding segments downstream of Turlock SRA, the gradient of the lower Tuolumne River is greatest from Old La Grange Bridge to Turlock SRA, providing the most interesting paddling of the entire reach. Downstream of Turlock SRA and especially downstream of Waterford, the river is very flat, resulting in shallow water and low velocities and thus increasing required paddling effort and incidence of scraping.

The river is a gaining stream between the USGS gages at La Grange and Modesto, as discussed in Section 5.1. Study results indicate that when La Grange gage flows are in the range of 126 to 231cfs, segments downstream of Turlock SRA are boatable. These segments were not boated at flows in the 100 cfs range as measured at the La Grange gage. As with many flatwater boating rivers, higher flows increase velocity and depth, making paddling easier.

Objective 2: Evaluate existing recreation information, where possible, to assess river boating including gradient of river segments

Boating opportunities on the lower Tuolumne River below Old La Grange Bridge were assessed. The lower Tuolumne River is a flatwater boating opportunity. American Whitewater (AW) calls the valley section of the Tuolumne River “a scenic and excellent beginner run.” Further, AW identified the river as primarily flat, but there are many riffles, narrow channels, and sharp turns—providing some challenging areas, and generally not recommended for the inexperienced boater (American Whitewater, 2012).

The lower Tuolumne River offers flat water boating opportunities with higher gradients in the upstream portion from Old La Grange Bridge to Turlock SRA where gradient averages approximately 6 ft/mi. Below Waterford, the river gradient averages less than 2 ft/mi.

Boaters identified similar opportunities to boat flatwater river reaches in Central California including the lower Merced River near Snelling, and the lower Stanislaus River below Knights Ferry and below Orange Blossom.

Objective 3: Determine the number of flow days by month at or above the minimum acceptable flow for river boating opportunities (e.g. kayaking, canoeing) under current Project operations.

There are a substantial number of days available to boaters at and well above the lowest boatable flow range. La Grange data for the period January 1, 2003 – December 28, 2012 reports flows of 100 cfs and greater 95.4% of the time. Considering the months of the typical boating season (May – October), 100 cfs was available as much as 100 percent of the time (May) for the period 2003-2012; even in the lowest flow month of September, 100 cfs was available 78 percent of the time.

Objective 4: Determine operational constraints, if any, of providing minimum flows for the river boating opportunities.

At this time, no specific problems have been identified by the Districts in regard to releasing the minimum flow requirements of the Don Pedro Project related to the lowest boatable flow of 100 cfs measured at the La Grange gage. It is noted that flows lower than 100 cfs as measured at the La Grange gage were not attempted to be floated in any portion of the lower Tuolumne River.

Objective 5: Identify and describe put-in and take-out locations for river boating between La Grange Dam and the confluence with the San Joaquin River.

Seven public access points in 38 miles of river from La Grange Bridge to Modesto are available for various day and partial day trips. The access areas have easy access for boating purposes. Access points provide parking and some provide restrooms. Day use fees are charged at Turlock SRA, and the quality of put-in and take-out areas was viewed as acceptable overall.

Objective 6: Identify and describe the locations on the river where boaters encounter features of special interest, challenges, hazards, or difficulties.

The uppermost reach (Old La Grange Bridge to Turlock SRA) provides the highest gradient on the lower Tuolumne River, with average fall of almost 6 ft/mi. Below Waterford, the river gradient averages less than 2 ft/mi.

Boaters encountered a range of features and some challenges on the river. The challenges identified were two areas where boaters portaged their watercraft, and a few places where debris or in-river constructed elements blocked a portion of the river. However, the reaches reported on were boatable overall. Further, primarily kayakers noted a few fun chutes to run on the reaches from Old La Grange Bridge to Turlock SRA.

Objective 7: Evaluate the adequacy of public flow information (i.e. availability, reliability, and real-time access).

Volunteer boaters were familiar with several sources of flow information. The primary source was the USGS website, followed by the TID or MID websites. Boaters also used visual observation and information from other boaters. Most boaters identified the need for flow information 12 hours or more before making a decision to boat, with some boaters identifying fewer than 12 hours as adequate.

7.0 STUDY VARIANCES AND MODIFICATIONS

Variations occurred during the study related to the volunteer boating effort conducted during river boating events. First, water year 2012 was a very dry year. When the water year type was determined to be a critical flow year, the Districts decided to conduct the volunteer boating portion of the study from May 30 through June 3, 2012 (earlier than stated in the approved study plan). This was a variance from the approved study schedule of September-October. This variance does not affect the river boating study effort as a second episode was ultimately conducted September 29 to October 1, 2012.

Secondly, the study plan identified that the volunteer boater group would ideally include five to eight people for each kind of water craft with a range of skill levels to paddle portions of the lower Tuolumne. Volunteer turnout was low at a total of 14 volunteers (13 for the May 30 to June 3 flow and one for the September 29 to October 1 flow). Volunteers boated in canoes, hardshell kayaks, and inflatable kayaks.

Thirdly, the river boating study effort was conducted May 30 to June 2, 2012 with flows ranging from 110 cfs to 200 cfs as measured at USGS La Grange gage. However, on June 19, 2012, the USGS visited the gage site and based on field measurements taken that day, the gage was adjusted and previously reported provisional data was revised on June 28, 2012 and December 17, 2012. The recalibrations resulted in revised estimates of flow for the river boating study days ranging from 171 cfs to 256 cfs.

Due to the gage recalibration in late June, the Districts scheduled a repeat of the river boating study for September 29 to October 1, and began soliciting volunteers in late August. Only Steve Bowes of the National Park Service participated in the September 29 event, kayaking the Basso Bridge to Turlock SRA segment on September 29, 2012 at a flow of 101 to 109 cfs.

La Grange gage data for the period October 1, 2011 through December 27, 2012 continues to be rated as provisional at the time of this report.

Despite variations in the schedule for flows, all the study objectives were met.

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