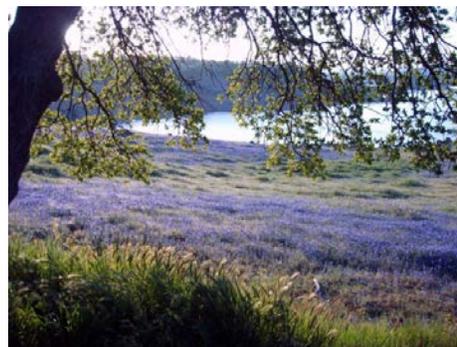
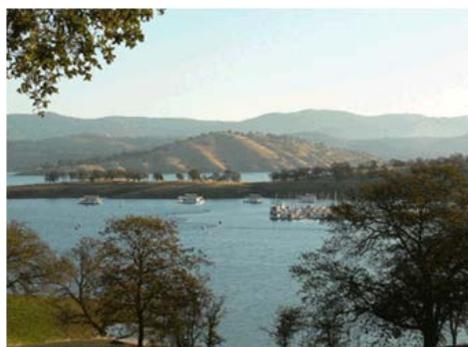


**LOWER TUOLUMNE RIVER  
LOWEST BOATABLE FLOW  
STUDY REPORT  
DON PEDRO PROJECT  
FERC NO. 2299**



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

**Prepared by:  
HDR Engineering, Inc.**

**December 2013**

# Lower Tuolumne River Lowest Boatable Flow Study Study Report

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Attachment B	Monthly Flow Duration Curves for the USGS Gages at La Grange (11289650) and Modesto (11290000) for the Period 2003-2012 (Average Daily Flow)
Attachment C	Volunteer Boater Background Information

## List of Acronyms

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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

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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

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mg/L	milligrams per liter
mgd	million gallons per day
mi	miles
mi <sup>2</sup>	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

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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

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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

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### 1.1 Background

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 has a 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 (mi<sup>2</sup>). The Project is designated by the Federal Energy Regulatory Commission (FERC) as project no. 2299.

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. The “water bank” within Don Pedro Reservoir provides significant benefits for CCSF’s 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 aquatic resources in the lower Tuolumne River, and hydropower generation.

The Project Boundary extends from RM 53.2, which is one mile below the Don Pedro powerhouse, upstream to RM 80.8 at an elevation corresponding to the 845 ft contour (31 FPC 510 [1964]). 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) 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.

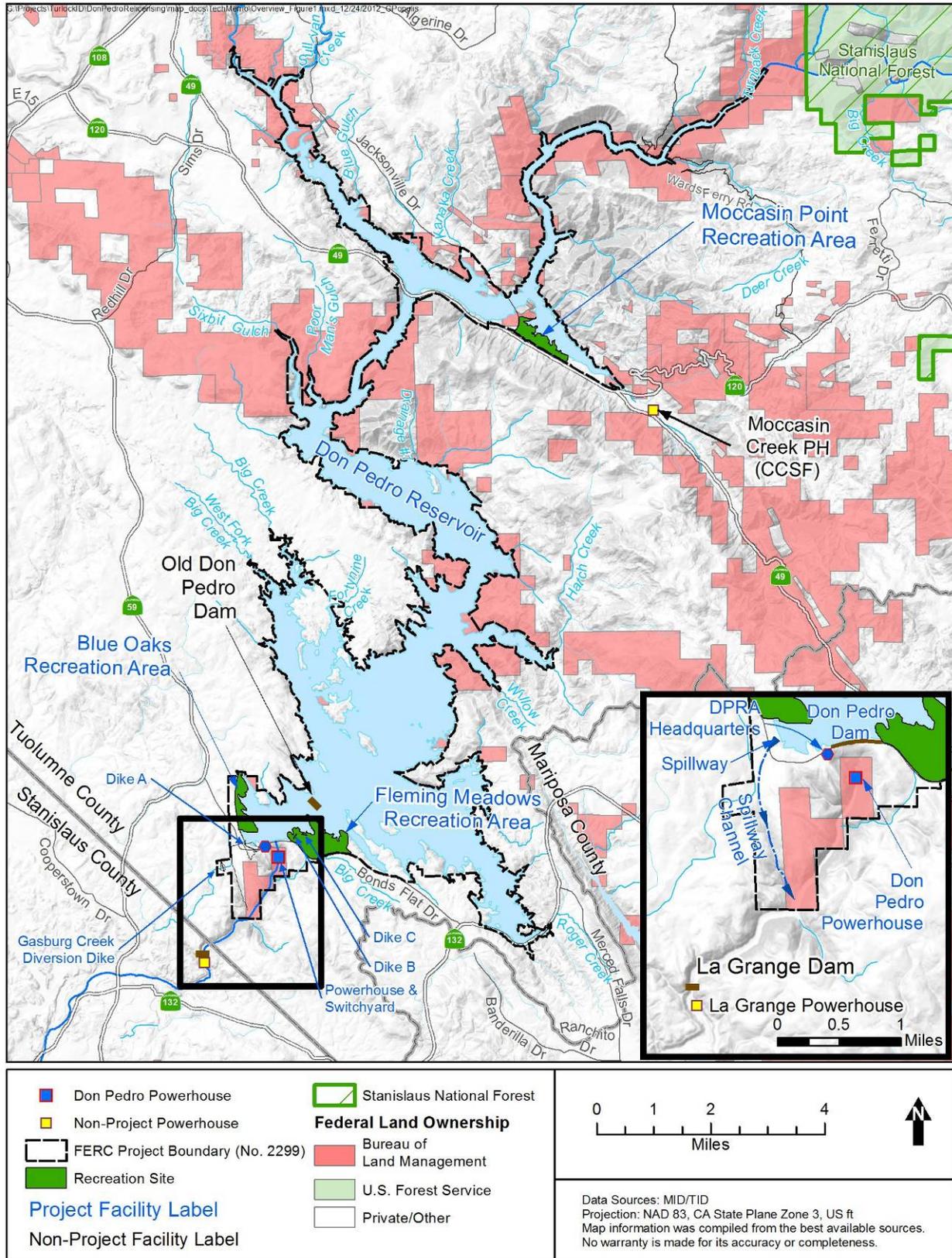


Figure 1.1-1. Don Pedro Project location.

## 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.

On January 17, 2013, the Districts filed the Initial Study Report for the Don Pedro Project, including the RR-03 Lower Tuolumne River Lowest Boatable Flow Study Report. In response to a request made by Bob Hackmack during the January 31, 2013 Initial Study Report Meeting, the Districts have confirmed the U.S. Department of the Interior, Geological Survey (USGS) gage data for all study days in 2012 and 2013. In response to a request made by the U.S. Department of the Interior, Bureau of Land Management (BLM) in a letter to the Federal Energy Regulatory Commission (FERC) dated March 11, 2013, the Districts expanded this study report to provide information about the Shiloh Bridge access site.

On May 21, 2013, FERC issued a determination on requests for study modifications and new studies, including this recommendation:

*[T]he 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). The study should achieve the required 5 to 8 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 3 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.*

In response to this recommendation, the Districts conducted a second year of study. This study report has been expanded to include the results of the second year of study.

Documents relating to the Project relicensing are publicly available on the Districts' relicensing website at [www.donpedro-relicensing.com](http://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 boats/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 first year study was carried out consistent with these directives. In its May 2013 determination on requests for modifications and new studies, FERC recommended the 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 recommended that the study should achieve the required 5 to 8 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 3 weeks and one week prior to the study. FERC also recommended that volunteer participant data from the first year of study (not including the Districts' consultants) should be included. Variances and modifications to the final approved and modified study plans are discussed in Section 7 of this report.

## 2.0 STUDY GOALS AND OBJECTIVES

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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).

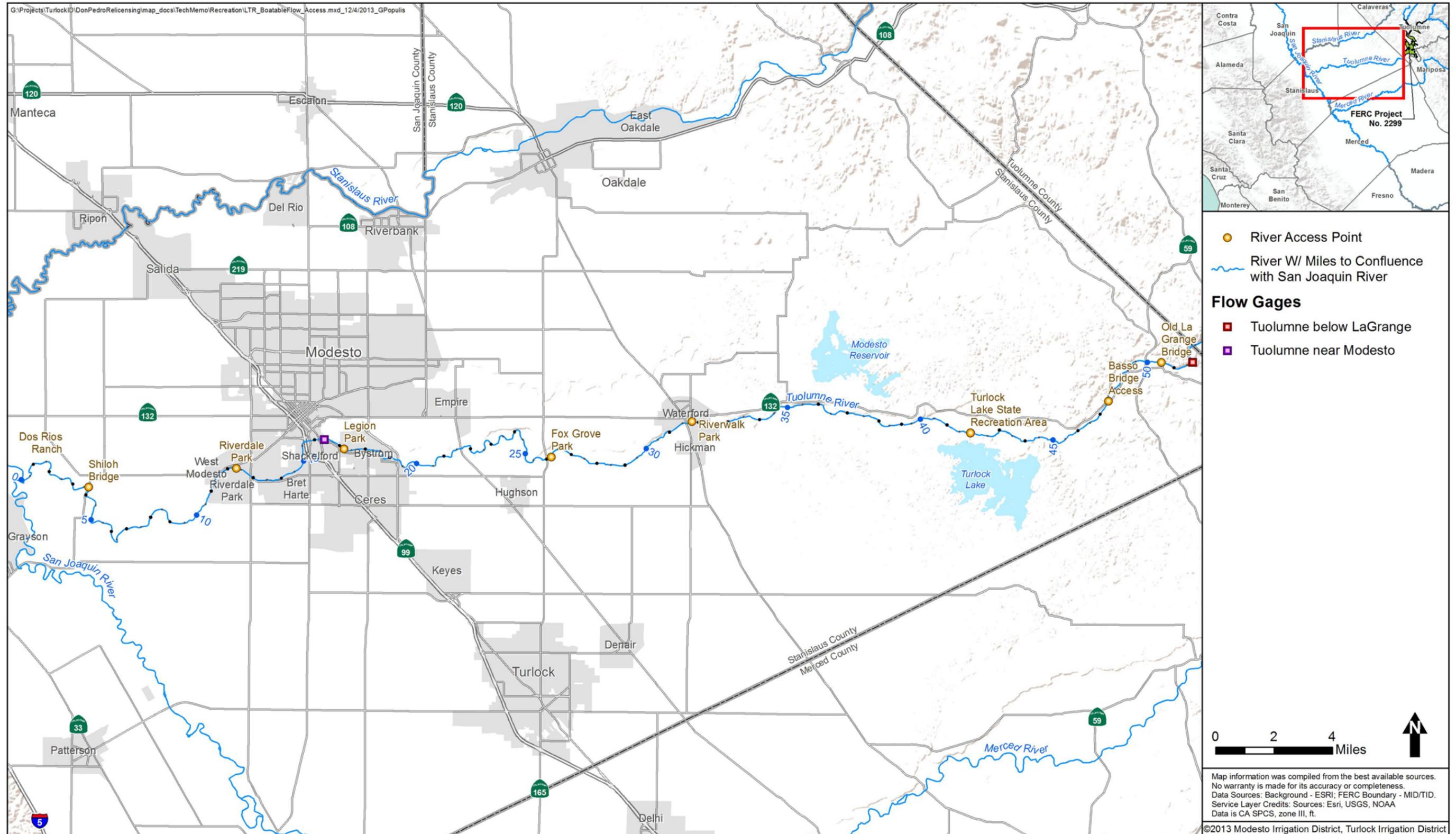


Figure 2.0-1. Lower Tuolumne River Lowest Boatable Flow study area.

### 3.0 STUDY AREA

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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 feet 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 eight publicly available access sites from the Old La Grange Bridge to Shiloh Bridge at RM 4.0. Downstream of RM 4.0 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 Shiloh Bridge, the study focuses on the lower Tuolumne River reach between Old La Grange Bridge and Shiloh Bridge (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 has 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**

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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 2012 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 on three segments of the river: Old La Grange Bridge to Turlock SRA, Turlock SRA to Riverwalk Park in Waterford, and Fox Grove Fishing Access to Riverdale Park. 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. As of December 3, 2013, the USGS website reports the data for this period as “Approved for publication -- Processing and review completed.”

Due to the gage recalibration, the Districts attempted to gather additional data on boatable flows in order to fully address the study plan requirements. The Districts scheduled an additional in-river boating event for September 29 to October 1, 2012, 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 between the hours of 8:00 AM and 4:00 PM. As of December 3, 2013, the USGS website reports the data for this period as “Approved for publication -- Processing and review completed.” The Districts presented the results of the original 2012 boating study in their January 16, 2013 ISR document.

Based on comments provided by relicensing participants in response to the Districts’ ISR, FERC issued its Determination on Requests for Study Modifications and New Studies on May 21, 2013. In the May 2013 Determination, FERC included the following recommendation:

*[T]he 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). The study should achieve the required 5 to 8 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 3 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.*

In response to this recommendation, the Districts conducted a second year of study. 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 La Grange gage. Due to low volunteer turn-out in 2012 and FERC’s recommendation to achieve 5-8 boaters in two watercraft categories for a 39-mile stretch of the river, the Districts undertook an extensive outreach and communication strategy to inform and solicit potential volunteers for the study. Table 4.1-1 lists the Districts’ outreach efforts. In addition to the Districts’ efforts, relicensing participants representing TRT, AW, and NPS also made substantial efforts to identify and persuade

volunteers to participate. For three of the study days in 2013, TRT offered their canoes and shuttle service for volunteers.

**Table 4.1-1. Lowest boatable flow study 2013 volunteer outreach and consultation.**

Date	Communication
July 8, 2013	E-mail from Districts' consultant to relicensing participants (RPs) announcing study and schedule, and soliciting input and volunteers
July 18, 2013	E-mail from Districts' consultant to RPs announcing study and schedule
July 18, 2013	E-mail to Districts' consultant to RPs who have expressed interest in a teleconference to discuss study methods, Email requested input to a Doodle Poll to select a date and time for consultation teleconference
July 23, 2013	E-mail invitation from Districts' consultant to RPs who expressed interest in participating in a coordination teleconference
July 26, 2013	Teleconference to discuss FERC recommendations, river segments to be studied, survey instruments, schedule, and need for volunteers
July 28, 2013	E-mail from Districts' consultant to RPs providing schedule and soliciting volunteers
July 29, 2013	E-mail from Districts' consultant to RPs providing schedule and soliciting input and volunteers
August 1, 2013	E-mail from Districts' consultant to interested RPs providing final survey instrument with revisions agreed-upon in consultation
August 6 and August 11, 2013	Newspaper ad/article published in Modesto Bee providing schedule and soliciting volunteers
August 15, 2013	Teleconference with interested RPs
August 15, 2013	E-mail from Districts' consultant to RPs reminding volunteers of upcoming study date
August 23, 2013	E-mail from Districts' consultant to RPs reminding volunteers of upcoming study date
September 5, 2013	E-mail from Districts' consultant to RPs reminding volunteers of upcoming study date
September 10, 2013	E-mail from Districts' consultant to RPs reminding volunteers of upcoming study date

Relicensing participants assisted in identifying segments of the river to be paddled and proposed revisions to the survey instrument (Attachment A). Due to concern over the number of volunteers that would be needed to cover the 39 miles of river recommended by FERC for study, and TRT's interest in including the segment from Riverdale Park (RM 12.3) to Shiloh Bridge (RM 4.0), a reach of river in proximity to urban and residential development in Modesto that was not included in FERC's recommendation, the Districts and relicensing participants agreed upon three segments of the lower Tuolumne River to be included in the study. Old La Grange Bridge (RM 50.5) to Turlock SRA (RM 42.0) and Turlock SRA to Riverwalk Park in Waterford (RM 12.3) were included because they offer the highest gradient and potential for fun chutes and rapids. The most downstream segment was included at the request of TRT.

While keeping the focus on the primary study objective of identifying the lowest boatable flows for at least one watercraft type, the survey instrument was modified to include two additional questions, Question 16 and Question 17, resulting in a total of three questions about boatability.

- Question 15: For the watercraft-type you boated in for this run, was this flow boatable? (Yes or No)
- Question 16: For the watercraft-type you boated in for this run, was this flow enjoyable? (Yes or No)
- Question 17: Are you likely to return for future boating at today's flow? (Select one: Definitely Yes, Probably, Possibly, Definitely No)

Participation in 2013 was greater than in 2012. Thirty-nine volunteer boaters participated on September 7, and eight volunteer boaters participated on September 14, 37 participated on August 17 and 29 participated on August 24. Participants used hardshell kayaks, inflatable kayaks, canoes or drift boat/rafts. Study flows targeted 200 cfs (August 17), 150 cfs (August 24), 175 cfs (September 7), and 125 cfs (September 14). Flows as reported at the USGS La Grange gage ranged from 117 cfs to 206 cfs between the hours of 7:00 AM and 2:00 PM on the study days. As of December 4, 2013, USGS reports that the data for these periods is “Provisional data subject to revision” (USGS 2013).

Modifications to the study protocol for 2013, including additional volunteer boater outreach, river segments studied, watercraft-type studied, and sequence of the flows studied, were driven by and substantially adhere to the approved study plan and FERC’s May 2013 recommendations. Variances are discussed in Section 7.0.

#### **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 were 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 under a range of flow conditions. Between May 30, 2012 and September 14, 2013 the study team received a total of 132 useable boater surveys<sup>1</sup> on lower Tuolumne River segments from Old La Grange Bridge (RM 50.5) to Shiloh Bridge (RM 4.0). The flows at which boaters floated the river ranged from 101 cfs to 256 cfs, as recorded at the La Grange gage (Table 5.1-1). Boaters included volunteer participants in the study, California Department of Fish and Wildlife (CDFW) staff who coincidentally were working on the lower Tuolumne River during one of the river boating study days, and recreational boaters who were coincidentally intercepted at the study take-out location at Turlock SRA.

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

Date	Flow Level Range (cfs) <sup>1</sup>	No. of Completed Surveys	Hardshell kayaks, inflatable kayaks, and canoes	Drift Boat/Raft
<b>OLD LA GRANGE BRIDGE (RM 50.5) TO TURLOCK SRA (RM 42.0)</b>				
May 30, 2012	247-256 cfs	8	7	1
May 31, 2012	218-231 cfs	7	7	0
June 1, 2012	196-203 cfs	4	4	0
August 17, 2013	202-206 cfs	19	11	8
August 24, 2013	144-146 cfs	14	14	0
September 7, 2013	171-179 cfs	11	10	1
September 14, 2013	117-121 cfs	3	3	0
<b>BASSO BRIDGE (RM 47.5) TO TURLOCK SRA</b>				
September 29, 2012	101-109 cfs	1	1	0
September 7, 2013	171-179 cfs	6	6	0
September 14, 2013	117-121 cfs	1	1	0
<b>Total</b>		<b>74</b>	<b>64</b>	<b>10</b>
<b>TURLOCK SRA TO RIVERWALK PARK IN WATERFORD (RM 31.0)</b>				
May 31, 2012	218-231 cfs	1	1	0
August 17, 2013	202-206 cfs	12	8	4
August 24, 2013	144-146 cfs	10	9	1
September 7, 2013	171-179 cfs	11	11	0
September 14, 2013	117-121 cfs	4	4	0
<b>Total</b>		<b>38</b>	<b>33</b>	<b>5</b>
<b>FOX GROVE (RM 26.1) TO RIVERDALE PARK (RM 12.3)</b>				
May 30, 2012	247-256 cfs 584-675 cfs <sup>2</sup>	1	1	0

<sup>1</sup> Some surveys were partially completed or more than one answer was selected on multiple choice questions. Not all responses from such surveys could be used in tabulating summary results. Copies of all submitted surveys, whether completely useable or not, are available to relicensing participants.

Date	Flow Level Range (cfs) <sup>1</sup>	No. of Completed Surveys	Hardshell kayaks, inflatable kayaks, and canoes	Drift Boat/Raft
<b>FOX GROVE TO LEGION PARK (RM 17.6)</b>				
May 31, 2012	218-231 cfs 411-416 cfs <sup>2</sup>	1	1	0
<b>Total</b>		<b>2</b>	<b>2</b>	<b>0</b>
<b>RIVERDALE PARK TO SHILOH BRIDGE (RM 4.0)</b>				
August 17, 2013	202-206 cfs 229-243 cfs <sup>2</sup>	4	4	0
August 24, 2013	144-146 cfs 184-209 cfs <sup>2</sup>	4	4	0
September 7, 2013	171-179 cfs 228-239 cfs <sup>2</sup>	10	5	5
<b>Total</b>		<b>18</b>	<b>13</b>	<b>5</b>

<sup>1</sup> Flow level range at USGS La Grange gage (11289650) for the period 7:00 AM – 2:00 PM of each day reported, unless otherwise noted. Accessed December 3, 2013. 2013 data is provisional data subject to revision. 2012 data is approved for publication.

[http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb\\_00060=on&format=rdb&period=&begin\\_date=2012-05-30&end\\_date=2013-09-14&site\\_no=11289650](http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb_00060=on&format=rdb&period=&begin_date=2012-05-30&end_date=2013-09-14&site_no=11289650)

<sup>2</sup> Flow level range at USGS Modesto gage (112900) for the period 7:00 AM – 2:00 PM of each day reported. Accessed December 5, 2013. 2013 data is provisional data subject to revision. 2012 data is approved for publication.

[http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb\\_00060=on&format=rdb&period=&begin\\_date=2012-05-30&end\\_date=2013-09-14&site\\_no=11290000](http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb_00060=on&format=rdb&period=&begin_date=2012-05-30&end_date=2013-09-14&site_no=11290000)

In 2012, boaters experienced flows, as recorded at the USGS La Grange gage, ranging from 101 cfs to 256 cfs. Boaters considered these flows boatable, as reported in response to Question 15 on the 2012 survey instrument (Attachment A). The lowest flows boated during this study were 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 101 to 109 cfs, 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, the Old La Grange Bridge to Turlock SRA segment was reported as boatable, but without any attributes to entice toward boating at lower flows.

In 2013, with input from relicensing participants the survey instrument was modified to include additional questions about boatability at low flows (Attachment A). Question 15 remained the same from 2012 to 2013: “For the watercraft-type you boated in for this run, was this flow boatable? (Yes or No)” Questions 16 and 17 were added to the 2013 survey instrument:

- For the watercraft-type you boated in for this run, was this flow enjoyable? (Yes or No)
- Are you likely to return for future boating at today’s flow? (Select one: Definitely Yes, Probably, Possibly, Definitely No)

Tables 5.1-2 through 5.1.5 summarize responses to these questions about boatability at the four flows studied in 2013. Each table is sorted by river segments included in the 2013 study and by watercraft-type.

The evaluations of the flow of 200 cfs demonstrated strong consensus on boatability, enjoyment, and future boating interest (Table 5.1-2). For those taking out at Riverwalk Park and Shiloh

Bridge, all respondents reported that the flow was boatable. At Turlock SRA, nearly 80 percent of respondents reported that the flow was boatable.

**Table 5.1-2. Responses to boatability questions at flows of 202-206 cfs as measured at USGS La Grange gage, August 17, 2013**

Take-out	Watercraft Type	# of Boaters	Boatable at this flow		Enjoyable at this flow		Are you likely to return for future boating at this flow?			
			Yes	No	Yes	No	Definitely no	Possibly	Probably	Definitely yes
TLSRA	Canoe/Kayak	11	9	2	10	1	0	7	4	0
	Drift Boat/Raft	8	6	2	5	3	1	3	2	2
<b>Totals</b>		<b>19</b>	<b>15</b>	<b>4</b>	<b>15</b>	<b>4</b>	<b>1</b>	<b>10</b>	<b>6</b>	<b>2</b>
Riverwalk Park	Canoe/Kayak	8	8	0	6	2	0	5	1	2
	Drift Boat/Raft	4	4	0	3	1	0	1	0	3
<b>Totals</b>		<b>12</b>	<b>12</b>	<b>0</b>	<b>9</b>	<b>3</b>	<b>0</b>	<b>6</b>	<b>1</b>	<b>5</b>
Shiloh Bridge <sup>1</sup>	Canoe/Kayak	4	4	0	4	0	0	2	0	2
	Drift Boat/Raft	0	-	-	-	-	-	-	-	-
<b>Totals</b>		<b>4</b>	<b>4</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>

<sup>1</sup> Flow level range at USGS Modesto gage (112900) for the period 7:00 AM – 2:00 PM on August 17, 2013 was 229 cfs - 243 cfs. Accessed December 5, 2013. This data is provisional data subject to revision.  
[http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb\\_00060=on&format=rdb&period=&begin\\_date=2012-05-30&end\\_date=2013-09-14&site\\_no=11290000](http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb_00060=on&format=rdb&period=&begin_date=2012-05-30&end_date=2013-09-14&site_no=11290000)

The evaluations of the 175 cfs flow on boatability, enjoyment, and future boating interest are presented in Table 5.1-3. One hundred percent of respondents taking out at TLSRA found 175 cfs boatable. At Riverwalk Park, over 80 percent of respondents reported the flow boatable. At Shiloh Bridge, 20 percent of respondents reported that 175 cfs was boatable. The existence of mats of water hyacinth completely spanning the river in two locations as reported by eight of the 10 volunteer boaters on this day likely contributed to low boatability scores.

**Table 5.1-3. Responses to boatability questions at flows of 171-179 cfs as measured at USGS La Grange gage, September 7, 2013**

Take-out	Watercraft Type	# of Boaters	Boatable at this Flow		Enjoyable at this Flow		Are you likely to return for future boating at this flow?			
			Yes	No	Yes	No	Definitely no	Possibly	Probably	Definitely yes
TLSRA	Canoe/Kayak	17	16	0	15	2	0	8	6	3
	Drift Boat/Raft	1	1	0	1	0	0	0	1	0
<b>Totals</b>		<b>18</b>	<b>18</b>	<b>0</b>	<b>16</b>	<b>2</b>	<b>0</b>	<b>8</b>	<b>7</b>	<b>3</b>
Riverwalk Park	Canoe/Kayak	11	9	2	9	2	2	4	3	2
	Drift Boat/Raft	0	-	-	-	-	-	-	-	-
<b>Totals</b>		<b>11</b>	<b>9</b>	<b>2</b>	<b>9</b>	<b>2</b>	<b>2</b>	<b>4</b>	<b>3</b>	<b>2</b>
Shiloh Bridge <sup>1</sup>	Canoe/Kayak	5	1	4	3	2	1	2	1	1
	Drift Boat/Raft	5	1	4	2	3	2	2	1	0
<b>Totals</b>		<b>10</b>	<b>2</b>	<b>8</b>	<b>5</b>	<b>5</b>	<b>3</b>	<b>4</b>	<b>2</b>	<b>1</b>

<sup>1</sup> Flow level range at USGS Modesto gage (112900) for the period 7:00 AM – 2:00 PM on September 7, 2013 was 228 cfs – 239 cfs. Accessed December 5, 2013. This data is provisional data subject to revision.  
[http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb\\_00060=on&format=rdb&period=&begin\\_date=2012-05-30&end\\_date=2013-09-14&site\\_no=11290000](http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb_00060=on&format=rdb&period=&begin_date=2012-05-30&end_date=2013-09-14&site_no=11290000)

The evaluation of flows at 150 cfs are presented in Table 5.1-4. For the majority of those taking out at Turlock SRA, 150 cfs was boatable, enjoyable, and respondents were split on the

possibility of returning at this flow. For those taking out at Riverwalk Park, the majority did not find 150 cfs boatable, were split on level of enjoyment, and would possibly return at this flow. For those taking out at Shiloh Bridge, all four respondents reported that 150 cfs was boatable. This is in contrast to the reported non-boatability at flows of 175 cfs; as discussed above, this was likely due to the aquatic vegetation conditions encountered and reported by volunteer boaters during the 175 cfs study flow. In summary, boaters' evaluation of the 150 cfs flow varied depending on take-out and boater type, with a slight overall majority finding this flow boatable.

**Table 5.1-4. Responses to boatability questions at flows of 144-146 cfs as measured at USGS La Grange gage, August 24, 2013**

Take-out	Watercraft Type	# of Boaters	Boatable at this Flow		Enjoyable at this Flow		Are you likely to return for future boating at this flow?			
			Yes	No	Yes	No	Definitely no	Possibly	Probably	Definitely yes
TLSRA	Canoe/Kayak	14	8	6	8	6	7	2	5	0
	Drift Boat/Raft	0	-	-	-	-	-	-	-	-
<b>Totals</b>		<b>14</b>	<b>8</b>	<b>6</b>	<b>8</b>	<b>6</b>	<b>7</b>	<b>2</b>	<b>5</b>	<b>0</b>
Riverwalk Park	Canoe/Kayak	9	4	5	4	5	2	6	0	1
	Drift Boat/Raft	1	0	1	1	0	1	0	0	0
<b>Totals</b>		<b>10</b>	<b>4</b>	<b>6</b>	<b>5</b>	<b>5</b>	<b>3</b>	<b>6</b>	<b>0</b>	<b>1</b>
Shiloh Bridge <sup>1</sup>	Canoe/Kayak	4	4	0	3	1	1	1	2	0
	Drift Boat/Raft	0	-	-	-	-	-	-	-	-
<b>Totals</b>		<b>4</b>	<b>4</b>	<b>0</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>0</b>

<sup>1</sup> Flow level range at USGS Modesto gage (112900) for the period 7:00 AM – 2:00 PM on August 24, 2013 was 184 cfs – 209 cfs. Accessed December 5, 2013. This data is provisional data subject to revision.

[http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb\\_00060=on&format=rdb&period=&begin\\_date=2012-05-30&end\\_date=2013-09-14&site\\_no=11290000](http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb_00060=on&format=rdb&period=&begin_date=2012-05-30&end_date=2013-09-14&site_no=11290000)

A flow target of 125 cfs was scheduled for September 14, 2013. No one volunteered to boat the Riverdale Park to Shiloh Bridge segment of the river. For the two river segments paddled (Old La Grange Bridge to TLSRA and TLSRA to Riverwalk Park), three of the eight boaters who participated reported this flow as boatable, four reported it enjoyable, and four reported they would definitely not return at this flow (Table 5.1-5). In summary, three of the eight boaters who participated in the 125 cfs study flow found it to be boatable.

**Table 5.1-5. Responses to boatability questions at flows of 117-121 cfs as measured at USGS La Grange gage, September 14, 2013**

Take-out	Watercraft Type	# of Boaters	Boatable at this flow		Enjoyable at this flow		Are you likely to return for future boating at this flow?			
			Yes	No	Yes	No	Definitely no	Possibly	Probably	Definitely yes
TLSRA	Canoe/Kayak	4	1	3	1	3	3	0	0	0
	Drift Boat/Raft	0	-	-	-	-	-	-	-	-
<b>Totals</b>		<b>4</b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>3</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>
Riverwalk Park	Canoe/Kayak	4	2	2	2	1	1	2	0	1
	Drift Boat/Raft	0	-	-	-	-	-	-	-	-
<b>Totals</b>		<b>4</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>1</b>

To summarize by river segment for canoes/kayaks, the river segment from Old La Grange Bridge to Turlock SRA was reported as boatable by all respondents at 175 cfs; at 150 cfs, more than half of all canoe/kayak respondents reported this segment boatable; and at 125 cfs, only one of the four canoe/kayak respondents reported it boatable. On the river segment from Turlock Lake to Riverwalk Park in Waterford, all canoe/kayak respondents reported 200 cfs boatable and nine of 11 reported 175 cfs to be boatable; 50 percent or fewer reported 150 cfs and 125 cfs to be boatable. On the river segment from Riverdale Park to Shiloh Bridge, all four canoe/kayak respondents reported 200 cfs and 150 cfs to be boatable; four out of five respondents found 175 cfs not boatable, perhaps due to the aquatic vegetation conditions encountered on that study day.

Because so few volunteers used drift boats/rafts on any of the study segments (Table 5.1-5), results for that watercraft type are extremely limited and not summarized in this text.

Figure 5.1-1 presents the annual flow duration curve for the USGS gages at La Grange (11289650) and Modesto (11290000) for the period 1997-2012 (USGS 2012). 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. 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, 2012; and August 17, August 24, and September 7, 2013 (see Table 5.1-1 above).

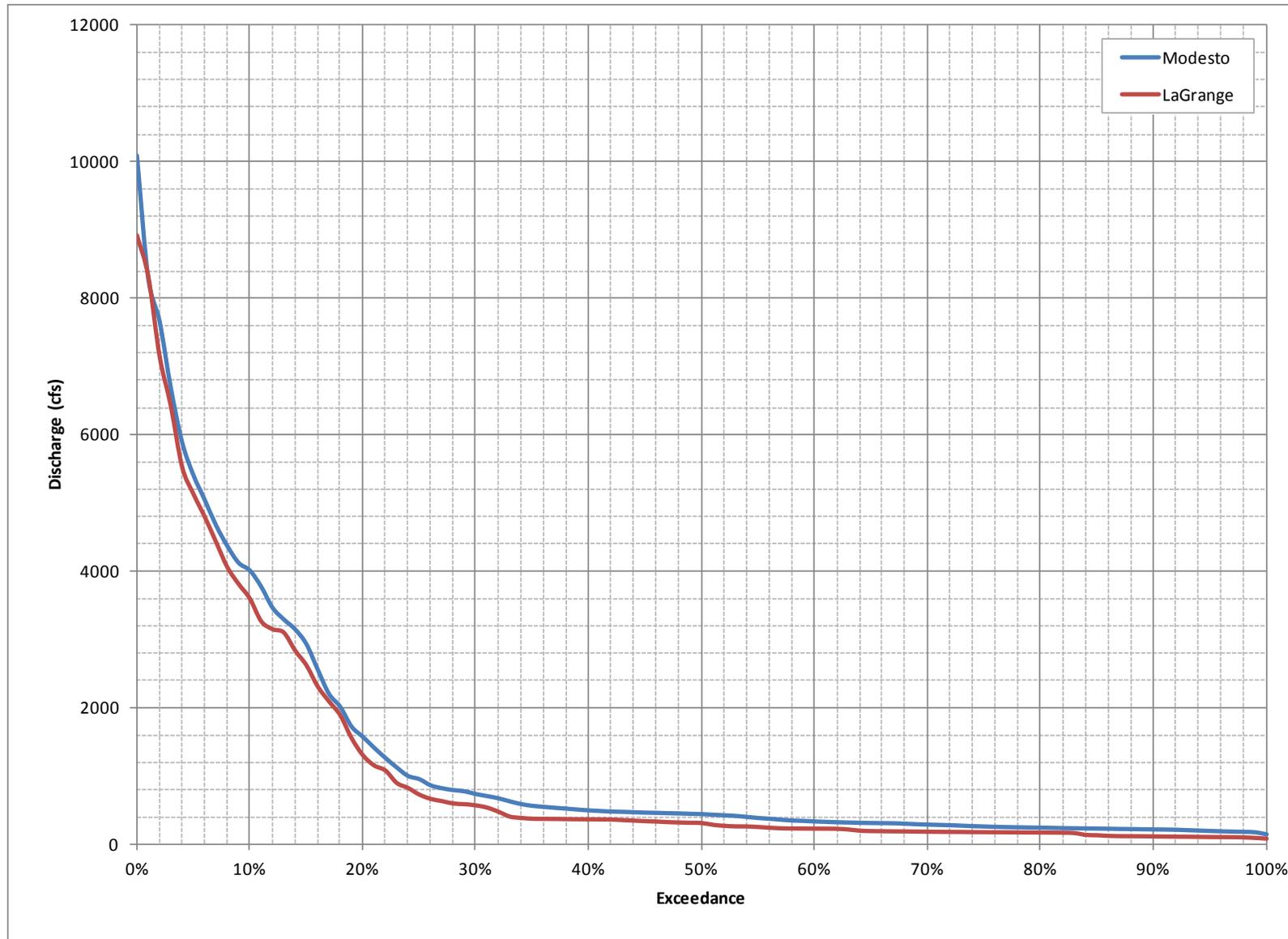


Figure 5.1-1. Annual flow duration curve for the USGS gages at La Grange (11289650) and Modesto (11290000).

## 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. Elevations are approximated based on USGS river miles and LiDAR data. 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: 5.9 feet per mile (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 70 ft.

Average Gradient: 5.0 ft/mi.

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

Length of Reach: 6 miles.

Elevation Range: 70 ft to 60 ft.

Average Gradient: 1.7 ft/mi.

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

Length of Reach: 14 miles.

Elevation Range: 60 ft to 40 ft.

Average Gradient: 1.4 ft/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.

### Riverdale Park (RM 12.3) to Shiloh Bridge (RM 4.0)

Length of Reach: 8 miles.

Elevation Range: 40 ft to 30 ft.

Average Gradient: 1.3 ft/mi.

In summary, there are eight publicly available put-in and take-out locations on the lower Tuolumne River on the 46-mile reach from La Grange to Shiloh Bridge Fishing Access providing numerous day or partial day non-motorized boating trip opportunities. Downstream of Shiloh Bridge (RM 4.0) 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, at least one boater reported that flows of 100 cfs and 125 cfs as recorded at the La Grange gage were boatable on the upper reaches of the lower Tuolumne River (Old La Grange Dam to Riverwalk Park in Waterford, RM 50.5 – RM 32). At flows of 150 cfs, approximately 50 percent of volunteer boaters reported the flow was boatable on this upper portion of the lower river. All four boaters on the Riverdale Park to Shiloh Bridge segment (RM 12 – RM 4) reported that 150 cfs was boatable. At 200 cfs, nearly 90 percent of the boaters surveyed reported that the flow was boatable. This section describes the historic frequency of these flow levels.

Based on a review of daily average flows as measured at the La Grange gage for the 16-year period from January 1, 1997 to September 30, 2012, flows were at or above 100 cfs 94 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 80 percent of the time in September for the period 1997-2012 (Table 5.3-1). During this 11 year period, flows were at or above 100 cfs every day of the year for 10 of the calendar years; flows occasionally dropped below 100 cfs during six years – 2001, 2002, 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 1997-2012.**

Month	Percent of Time Flow Greater than 100 cfs
May	100
June	84
July	81
August	86
September	80
October	98

Source: Tuolumne\_FlowDuration4.xlsx, Draft License Application Exhibit B

Similar analysis for flows of 125 cfs reveal that flows were at or above 125 cfs 86 percent of the time. During the months of the typical boating season of May through October, flows were at or above 125 cfs 100 percent of the time in May and 56 percent of the time in August and September for the period 1997-2012 (Table 5.3-2).

**Table 5.3-2. Percent of time USGS gage at La Grange reported flows of 125 cfs or greater for the period 1997-2012.**

Month	Percent of Time Flow Greater than 125 cfs
May	100
June	71
July	57
August	56
September	56
October	95

Source: Tuolumne\_FlowDuration4.xlsx, Draft License Application Exhibit B

Flows were at or above 150 cfs 84 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 150 cfs 98 percent of the time in May and 56 percent of the time in July, August, and September (Table 5.3-3).

**Table 5.3-3. Percent of time USGS gage at La Grange reported flows of 150 cfs or greater for the period 1997-2012.**

Month	Percent of Time Flow Greater than 150 cfs
May	98
June	60
July	56
August	56
September	56
October	94

Source: Tuolumne\_FlowDuration4.xlsx, Draft License Application Exhibit B

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 (Table 5.3-4).

**Table 5.3-4. Percent of time USGS gage at La Grange reported flows of 175 cfs or greater for the period 1997-2012.**

Month	Percent of Time Flow Greater than 175 cfs
May	97
June	58
July	56
August	56
September	56
October	83

Source: Tuolumne\_FlowDuration4.xlsx, Draft License Application Exhibit B

Flows were at or above 200 cfs 69 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 200 cfs 94 percent of the time in May and 56 percent of the time in July, August, and September (Table 5.3-5).

**Table 5.3-5. Percent of time USGS gage at La Grange reported flows of 200 cfs or greater for the period 1997-2012.**

Month	Percent of Time Flow Greater than 200 cfs
May	94
June	54
July	56
August	56
September	56
October	74

Source: Tuolumne\_FlowDuration4.xlsx, Draft License Application Exhibit B

## 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 provides 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 2.6 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 required minimum flows vary from 50 to 300 cfs depending on water year type and time of year. As the estimated lowest boatable flow is in the range of 100 cfs to 150 cfs, and this flow is somewhat greater than the current required minimum flows for the “critical dry” to “below normal” water year types, the Districts believe these flows can be delivered by the Don Pedro Project.

## 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, Fox Grove to Legion Park and Riverdale Park in Modesto, and Riverdale Park to Shiloh Bridge. 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 eight publicly available access locations for put-in and/or take-out of non-motorized watercraft, all located between La Grange (RM 52) and Shiloh Bridge (RM 4). Downstream of Shiloh Bridge, private property limits public access to the river. The access points are summarized below.

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

The put-in for this segment is Old La Grange Bridge for either the north or south bank. Direct access to the north bank put-in is via Highway 59, while direct access to the south bank is through the town of La Grange, off Highway 132. Street parking is available on both sides of the river and there are well-established user-defined access paths to the shoreline. There are no developed facilities at this put-in.

The take-out for this segment is the Turlock SRA, which is 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 to 20 minutes via Lake Road.

To shorten this segment, users may use the Basso Bridge put-in/take-out, which is located approximately three miles downriver from Old La Grange Bridge. Parking is available underneath the bridge and there is open access to the shoreline. Portable toilets are also available.

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

The put-in for this segment is the Turlock SRA. There is ample parking available at this location and a \$10 fee for parking/day-use. The take-out for this segment is Riverwalk Park, Waterford. Ample paved parking and vault toilets are available. Access to the shore is via a steep bank; although there are some constructed steps, they cover only a portion of the route to the shore. The drive between put-in and take-out is approximately 15 miles or 25 to 30 minutes via Lake Road to Highway 132 to Appling Road in Waterford.

#### **5.5.3 Riverwalk Park to Fox Grove Fishing Access (RM 26.1)**

The put-in for this segment is Riverwalk Park on Appling Road in Waterford and the take-out is Fox Grove Fishing Access, Geer Road. The take-out location has ample paved parking as well as a boat ramp. The location has no restrooms.

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

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

The put-in for this segment is Fox Grove Fishing Access, located off of Geer Road. Direct access to the put-in is via Geer Road. The take-out for this segment is Riverdale Park, South Carpenter Road. There is ample parking and restrooms at this location. Access to the shoreline is unimproved.

Legion Park in Modesto (RM 17.6), off of South Santa Cruz Avenue, is an alternate take-out for this segment. Legion Park provides ample parking and open access to the shore. The park has no restrooms.

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 Road.

#### **5.5.5 Riverdale Park (RM 12.3) to Shiloh Bridge Fishing Access (RM 4.0)**

The put-in for this segment is Riverdale Park, on South Carpenter Road. There is ample parking and restrooms at this location. Access to the shoreline is unimproved. The take-out for this segment is Shiloh Bridge Fishing Access. There is limited parking in the road right-of-way. Access to the shoreline is gated and boaters must walk approximately 200 yards from the parking area to the shoreline. Access to the shoreline is unimproved. There are no restrooms.

The drive between put-in and take-out is approximately 4 miles or 10 minutes via Paradise and Shiloh Roads.

### **5.6 Quality of Put-in Areas and Take-out Areas**

Boaters were asked to comment on the quality of put-in and take-out locations they used during the study. Eight locations were assessed by volunteers, and results are summarized below.

#### **5.6.1 Old La Grange Bridge**

Boaters described the put-in at Old La Grange Bridge as acceptable, with the river right location preferred of river left. Several respondents reported that the man-gate to restrict vehicle access presented a barrier to carrying boats to the put-in and that the walk from the parking area to the put-in was too long. Parking was described as not adequate by some respondents

#### **5.6.2 Basso Bridge**

Very few volunteer boaters used this put-in. Those who did use it reported that it was excellent or good.

### **5.6.3 Turlock Lake State Recreation Area**

Turlock SRA was used as a put-in or take-out by many volunteer boaters. The majority of users reported that it was an excellent or good non-motorized boating access site. There were negative comments from some respondents about the fees to use the site.

### **5.6.4 Riverwalk Park**

Most boaters described the take-out at Riverwalk Park as good or acceptable. Some respondents found the site difficult to use due to the steep riverbank. Other respondents noted that the site was busy and crowded.

### **5.6.5 Fox Grove Fishing Access**

The single volunteer who used the Fox Grove Fishing Access site reported that it was an adequate launch, but the site lacked restrooms.

### **5.6.6 Legion Park**

The single volunteer who used the Legion Park reported that there is no constructed launch and the site lacked restrooms, but that parking was available near the river.

### **5.6.7 Riverdale Park**

Most boaters described the put-in at Riverdale Park as acceptable or poor. Many respondents found the site difficult to use due to the steep riverbank and a long walk from parking to the put-in. Some respondents observed that the site was in a dangerous neighborhood with limited parking.

### **5.6.8 Shiloh Bridge**

Most boaters described the take-out at Shiloh Bridge as acceptable or poor. Many respondents found the site difficult to use due to the long walk from parking to the take-out and the remote character of the site.

## **5.7 Features of Special Interest, Challenge, Hazard, or Difficulty**

Volunteer participants in the river boating study effort were asked to report on flow dependent characteristics that contributed to the quality of the river trip experience (e.g., hazards, quality, functionality, time). This information is discussed below and presented in Tables 5.6-1 through 5.6-4.

### **5.7.1 Portages**

Most volunteer boaters who participated in the river boating study effort did not find it necessary to portage, i.e., leave the river to circumvent a hazard or challenge. However, several instances

of wading and pulling watercraft through areas of shallow water on all study reaches were reported as portages, including over a fishing weir located downstream of Fox Grove Fishing Access (Table 5.6-3). On September 7, 2013, nine out of 10 volunteer boaters on the Riverdale Park to Shiloh Bridge segment reported two portages (Table 5.6-4). As discussed in Section 5.1 and documented on the volunteer boaters' completed questionnaires, boaters on this segment encountered aquatic vegetation spanning the width of the river in two locations on that day.

### **5.7.2 Debris**

Boaters were asked how many times they experienced debris or overhanging vegetation that was difficult to avoid. This hazard was reported at all study flow levels on all river segments. Boaters experienced from zero to 98 places where debris was difficult to avoid, including a tree that fell across the river between two of the 2013 study days, creating an unexpected hazard for study participants paddling from Old La Grange Bridge to Turlock SRA. Debris and overhanging vegetation was reported most frequently on Old La Grange Bridge to Turlock SRA segment at flows of 150 cfs. In general, reported frequency of debris and overhanging vegetation declined with increasing flow.

### **5.7.3 Scraping Bottom**

Boaters were asked whether or not they scraped bottom and how many times. In 2013, survey questions about scraping were modified to determine if scraping bottom resulted in stopping and/or having to get out of the boat to drag or pull the boat. Boaters reported a wide range of scrapes at all study flow levels, from zero to 118 times. For the river segment from Old La Grange Bridge to Turlock SRA, the number of scrapes decreased with increasing flow for both canoes/kayaks and drift rafts/boats (Table 5.6-1). On other river segments studied in 2013, there was no strong correlation between responses about scraping and the flows or watercraft types. Anecdotal comments during the execution of the study indicated that more experienced boaters were better at avoiding scrapes than less experienced boaters, although the survey results comparing reported experience level and number of scrapes are mixed with no clear trends. The variety of craft with varying drafts used by volunteers and the number of occupants in each watercraft may help to explain the wide range of responses.

### **5.7.4 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 segments from Old La Grange Bridge to Turlock SRA and Turlock SRA to Riverwalk Park in Waterford.

### **5.7.5 Run Time**

The time it took boaters to complete the study reaches varied from 2 hours to 7 hours, with no strong pattern related to flows, watercraft types, or river segments.

**Table 5.6-1. Responses to survey questions regarding features of special interest, challenge, hazard, and difficulty – Old La Grange Bridge (RM 50.5) to Turlock Lake State Recreation Area (RM 42.0).**

Watercraft Type	Date	Range of Flow (cfs) <sup>1</sup>	# of Respondents	Range of responses				
				# Portages	Total Debris Location	# Scraped Bottom	Exciting, Fun Chutes	Time to Complete Run (hours)
Canoe/Kayak	5/30/12	247-256 cfs	8	0	0-5	0-20	0-6	2-5
	5/31/12	218-231 cfs	5	0	2-5	6-38	0-2	2-3
	6/1/12	196-203 cfs	4	0	3-6	13-30	0-4	2-4
	8/17/13	202-206 cfs	13	0-2	0-10	0-33	0-7	3-6
	9/7/13	171-179 cfs	16	0-1	0-15	4-43	0-12	3-5
	8/24/13	144-146 cfs	14	0-5	0-30	6-58	0-15	3-5
	9/14/13	117-121 cfs	4	0-7	0-7	21-67	0-8	4
	9/29/12	101-109 cfs	1	0	5	9	2	3
Drift Raft/Boat	5/30/12	247-256 cfs	1	0	1	4	5	5
	8/17/13	202-206 cfs	6	0-2	0-12	0-11	0-6	4-6
	9/7/13	171-179 cfs	1	0	7	34	3	4

<sup>1</sup> Flow level range at USGS La Grange gage (11289650) for the period 7:00 AM – 2:00 PM of each day reported. Accessed December 3, 2013. 2013 data is provisional data subject to revision. 2012 data is approved for publication. [http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb\\_00060=on&format=rdb&period=&begin\\_date=2012-05-30&end\\_date=2013-09-14&site\\_no=11289650](http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb_00060=on&format=rdb&period=&begin_date=2012-05-30&end_date=2013-09-14&site_no=11289650)

**Table 5.6-2. Responses to survey questions regarding features of special interest, challenge, hazard, and difficulty – Turlock Lake State Recreation Area (RM 42.0) to Riverwalk Park in Waterford (RM 31.0).**

Watercraft Type	Date	Range of Flow (cfs) <sup>1</sup>	# of Respondents	Range of responses				
				# Portages	Total Debris Location	# Scraped Bottom	Exciting, Fun Chutes	Time to Complete Run (hours)
Canoe/Kayak	5/31/12	218-231 cfs	1	1	2	21	0	4
	8/17/13	202-206 cfs	8	0	0-3	8-41	0-3	6-7
	9/7/13	171-179 cfs	12	0-3	0-6	10-74	0-4	3-6
	8/24/13	144-146 cfs	9	0-6	0-5	7-110	0-6	4-5
	9/14/13	117-121 cfs	4	0-7	3-10	4-40	3-10	5

Watercraft Type	Date	Range of Flow (cfs) <sup>1</sup>	# of Respondents	Range of responses				
				# Portages	Total Debris Location	# Scraped Bottom	Exciting, Fun Chutes	Time to Complete Run (hours)
Drift Raft/Boat	8/17/13	202-206 cfs	4	5	2-3	12-28	1-6	6-7
	8/24/13	144-146 cfs	1	0	4	8	0	4

<sup>1</sup> Flow level range at USGS La Grange gage (11289650) for the period 7:00 AM – 2:00 PM of each day reported. Accessed December 3, 2013. 2013 data is provisional data subject to revision. 2012 data is approved for publication. [http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb\\_00060=on&format=rdb&period=&begin\\_date=2012-05-30&end\\_date=2013-09-14&site\\_no=11289650](http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb_00060=on&format=rdb&period=&begin_date=2012-05-30&end_date=2013-09-14&site_no=11289650)

**Table 5.6-3. Responses to survey questions regarding features of special interest, challenge, hazard, and difficulty – Fox Grove (RM 26.1) to Riverdale Park (RM 12.3).**

Watercraft Type	Date	Range of Flow (cfs) <sup>1</sup>	# of Respondents	Range of responses				
				# Portages	Total Debris Location	# Scraped Bottom	Exciting, Fun Chutes	Time to Complete Run (hours)
Canoe/Kayak	5/30/12	247-256 cfs 584-672 cfs <sup>2</sup>	1	2	3	2	1	4
Canoe/Kayak	5/31/12 <sup>3</sup>	218-231 cfs 411-416 cfs <sup>2</sup>	1	1	3	4	1	4

<sup>1</sup> Flow level range at USGS La Grange gage (11289650) for the period 7:00 AM – 2:00 PM of each day reported, unless otherwise noted. Accessed December 3, 2013. 2013 data is provisional data subject to revision. 2012 data is approved for publication. [http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb\\_00060=on&format=rdb&period=&begin\\_date=2012-05-30&end\\_date=2013-09-14&site\\_no=11289650](http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb_00060=on&format=rdb&period=&begin_date=2012-05-30&end_date=2013-09-14&site_no=11289650)

<sup>2</sup> Flow level range at USGS Modesto gage (112900) for the period 7:00 AM – 2:00 PM of each day reported. Accessed December 5, 2013. 2013 data is provisional data subject to revision. 2012 data is approved for publication. [http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb\\_00060=on&format=rdb&period=&begin\\_date=2012-05-30&end\\_date=2013-09-14&site\\_no=11290000](http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb_00060=on&format=rdb&period=&begin_date=2012-05-30&end_date=2013-09-14&site_no=11290000)

<sup>3</sup> On May 31, 2012, the volunteer boater paddled Fox Grove to Legion Park (RM 17.6).

**Table 5.6-4. Responses to survey questions regarding features of special interest, challenge, hazard, and difficulty – Riverdale Park (RM 12.3) to Shiloh Bridge (RM 4.0).**

Watercraft Type	Date	Range of Flow (cfs) <sup>1</sup>	# of Respondents	Range of responses				
				# Portages	Total Debris Location	# Scraped Bottom	Exciting, Fun Chutes	Time to Complete Run (hours)
Canoe/Kayak	8/17/13	202-206 cfs 229-243 cfs <sup>2</sup>	4	0	0	4-41	0-1	4-6

Watercraft Type	Date	Range of Flow (cfs) <sup>1</sup>	# of Respondents	Range of responses				
				# Portages	Total Debris Location	# Scraped Bottom	Exciting, Fun Chutes	Time to Complete Run (hours)
	9/7/13	171-179 cfs 228-239 cfs <sup>2</sup>	5	2	0-2	1-14	0-1	4-5
	8/24/13	144-146 cfs 184-209 cfs <sup>2</sup>	4	0	0-6	18-66	0-6	3-5
Drift Raft/Boat	9/7/13	171-179 cfs 228-239 cfs <sup>2</sup>	5	0-2	0-3	2-118	0-2	6

<sup>1</sup> Flow level range at USGS La Grange gage (11289650) for the period 7:00 AM – 2:00 PM of each day reported, unless otherwise noted. Accessed December 3, 2013. 2013 data is provisional data subject to revision. 2012 data is approved for publication.

[http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb\\_00060=on&format=rdb&period=&begin\\_date=2012-05-30&end\\_date=2013-09-14&site\\_no=11289650](http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb_00060=on&format=rdb&period=&begin_date=2012-05-30&end_date=2013-09-14&site_no=11289650)

<sup>2</sup> Flow level range at USGS Modesto gage (112900) for the period 7:00 AM – 2:00 PM of each day reported. Accessed December 5, 2013. 2013 data is provisional data subject to revision. 2012 data is approved for publication.

[http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb\\_00060=on&format=rdb&period=&begin\\_date=2012-05-30&end\\_date=2013-09-14&site\\_no=11290000](http://nwis.waterdata.usgs.gov/ca/nwis/uv?cb_00060=on&format=rdb&period=&begin_date=2012-05-30&end_date=2013-09-14&site_no=11290000)

## 6.0 DISCUSSION AND FINDINGS

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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.** 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 (1 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 that flows of 175 cfs and 200 cfs are both boatable and enjoyable on the study reaches – Old LaGrange Bridge to Riverwalk Park in Waterford and Riverdale Park to Shiloh Bridge. At flows of 150 cfs and 125 cfs, volunteers who participated in the study were mixed in their assessments of boatability and enjoyability, with the affirmative assessment of boatability dropping below 50 percent among respondents.

Study results and the level of volunteer participation 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 those who did participate reported the river unboatable at study flows of 150 cfs and lower.

**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, 1997 – September 30, 2012 reports flows of 100 cfs and greater 94 percent 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 in May during the period 2003-2012. Even in the lowest flow month of September, 100 cfs was available 80 percent of the time.

La Grange data for the period January 1, 1997 – September 30, 2012 reports flows of 150 cfs and greater 84 percent of the time. For the period 2003-2012, 150 cfs was available as much as 98 percent of the time in May. During the lowest flow months of July, August, and September, 150 cfs was available 56 percent of the time.

During the same period of record, flows of 175 cfs and 200 cfs were available 56 percent of the time during the low flow months of July, August, and September.

**Objective 4: Determine operational constraints, if any, of providing minimum flows for the river boating opportunities.** At this time, no operational constraints have been identified by the Districts of providing minimum flows for the river boating opportunities. As the estimated lowest boatable flow is in the range of 100 cfs to 150 cfs, and this flow is somewhat greater than the current required minimum flows for the “critical dry” to “below normal” water year types, the Districts believe these flows can be delivered by the Don Pedro Project.

**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.** Eight public access points in 46 miles of river from La Grange Bridge to Shiloh Bridge are available for various day and partial day trips. The access areas have access for non-motorized boating purposes that ranges from excellent to poor, with poor access being reported mostly due to bank steepness and distance to parking at some access areas. Access points provide parking and some provide restrooms. Day use fees are charged at Turlock SRA.

**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. Between the August 24 and September 7 study events in 2013, a tree fell across the river upstream of Turlock SRA; several respondents found passage around this hazard challenging. And on the river reach between Riverdale Park and Shiloh Bridge, water hyacinth growth during the same period created vegetation mats that blocked the entire river in two locations. However, other than these vegetation challenges, 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

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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. This was a variance from the approved study schedule of September through October. This variance does not affect the 2012 river boating study effort as a second episode was ultimately conducted September 29 to October 1, 2012.

Second, the study plan identified that the volunteer boater group would ideally included five to eight people for each kind of watercraft with a range of skill levels to paddle portions of the lower Tuolumne. Volunteer turnout in 2012 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 and kayaks. No volunteers boated in drift boats/rafts.

Third, 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. On June 19, 2012, the USGS visited the gage site and took field measurements. Based on those field measurements, 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. These flow estimates have been approved for publication by USGS.

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 at a flow of 101 to 109 cfs.

Regarding variations in 2013, as discussed in Section 1.2, FERC staff recommended, among other things, that the study be modified to include study on each section of the lower Tuolumne River between Old La Grange Bridge (RM 51) and Riverdale Park (RM 12), and that 5 to 8 volunteers in both watercraft types participate on each section of the river. FERC's SPD also directed that study flows descend sequentially from 200 cfs by 25 cfs increments.

Relicensing participants assisted the Districts in identifying segments of the river to be studied. Due to concern over the number of volunteers that would be needed to cover the 39 miles of river recommended, an effort was made to reduce the number of river miles to be studied while still covering segments with the highest gradient and potential for fun and exciting chutes and rapids, and segments in close proximity to the urban and residential development in the Modesto area. In consultation, three segments on the lower Tuolumne River were selected: Old La Grange Bridge (RM 50.5) to Turlock SRA (RM 42.0), Turlock SRA to Riverwalk Park in Waterford (RM 12.3), and Riverdale Park (RM 12) to Shiloh Bridge (RM 4.0).

While volunteer participation in 2013 was greater than in 2012, participation by 5 to 8 boaters in each watercraft category was not achieved throughout the study. Participation by watercraft type

on each study segment is presented in Table 5.1-1. The desired minimum of 5 canoe/kayak volunteers and 5 drift boat/raft volunteers was achieved only twice – August 17, 2013 on the Old La Grange Bridge to Turlock SRA segment and September 7, 2013 on the Riverdale Park to Shiloh Bridge segment. Overall, the Old La Grange Bridge to Turlock SRA segment had the highest participation rates with 54 surveys completed in 2013. Volunteer participation on the Turlock SRA to Riverwalk Park segment resulted in 38 completed surveys in 2013. The Riverdale Park to Shiloh Bridge segment had the lowest participation with 18 surveys completed. When comparing watercraft types, canoe/kayak participation was much higher than drift boat/raft participation, with 93 surveys completed by canoe/kayak participants and 17 completed by drift boat/rafters. While FERC staff’s recommended participation levels were not achieved, this volunteer effort represents a significant commitment by dozens of volunteers, two of whom participated on all four study days. This updated study report presents the results from all surveys completed by volunteers in 2012 and 2013, and forms the basis for an informed decision on lowest boatable flows on the lower Tuolumne River.

A third variance in the 2013 study effort involved the sequence of study flows. FERC’s SPD directed that flows be studied in a descending sequence – 200 cfs, 175 cfs, 150 cfs, etc. Based on concern for the number of volunteers needed and the recognition that attrition might impact participation rates as the number of study days increased, the Districts agreed to study first 200 cfs (as ordered by FERC) and then skip to 150 cfs. It was agreed that if 150 cfs was judged boatable by a majority of participants, then 175 cfs could be skipped. As discussed in Section 5, 150 cfs was judged not boatable by many participants, so flows on the subsequent study day were set at 175 cfs. Ultimately, flows of 200 cfs, 175 cfs, 150 cfs, and 125 cfs were studied in 2013.

Despite these variances, all the study objectives were met.

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**STUDY REPORT RR-03  
LOWER TUOLUMNE RIVER LOWEST BOATABLE FLOW**

**ATTACHMENT A**

**LOWEST BOATABLE FLOW QUESTIONNAIRES FOR 2012 AND 2013**

## BOATING SURVEY for the LOWER TUOLUMNE RIVER

**Thank you for participating in the Lower Tuolumne River Boatable Flow Study. The following questionnaire will help MID and TID understand more about the lowest boatable flow on the Lower Tuolumne River.**

**1. Approximately how many times have you boated this reach?**

- a. Total number of times (including today) \_\_\_\_\_  
 b. Number of time in the last 12 months (including today) \_\_\_\_\_  
 c. What months of the year do you normally boat this reach? (Circle all that apply)  
 Jan Feb Mar Apr Ma Jun Jul Aug Sep Oct Nov Dec

**2. How many years have you been boating the reach? \_\_\_\_\_**

**3. In general, how many days per year do you spend flatwater boating? \_\_\_\_\_**

**4. What type of boats do you commonly use for flatwater boating?**

- Canoe       Sit-on-top kayak       Tube  
 Kayak       Drift raft       Other. Specify: \_\_\_\_\_

**5. How would you rate your flatwater boating skill level?**

- Expert       Intermediate  
 Highly skilled       Novice/Beginner

**6. What sources of information do you use for Lower Tuolumne River flow information? (Check all that apply.)**

- USGS website       Visual observation       I don't look for flow information  
 TID or MID websites       Other boaters

**7. How far in advance do you need flow information to use it for planning trips to the Lower Tuolumne River?**

- More than 48 hours       12-24 hours  
 24-48 hours       Fewer than 12 hours

**8. Approximately how many miles is it from your home to here? \_\_\_\_\_**

**9. Based on your experience, list comparable river reaches to this one.**

- a. \_\_\_\_\_  
 b. \_\_\_\_\_  
 c. \_\_\_\_\_  
 d. \_\_\_\_\_  
 e. \_\_\_\_\_

### Questions About the Run You Just Completed

**10. Please indicate the date, flow level, put-in & take-out locations for your run.**

- a. Date: \_\_\_\_\_  
 b. Flow (cfs): \_\_\_\_\_  
 c. Put-in location: \_\_\_\_\_  
 d. Take-out location: \_\_\_\_\_

**11. What type of watercraft did you use?**

- Canoe       Sit-on-top kayak       Tube  
 Kayak       Drift raft       Other. Specify: \_\_\_\_\_

**12. Did you encounter other boaters during this run (not part of this study group)?**

- No       Yes ► How many? \_\_\_\_\_. What type of watercraft? \_\_\_\_\_

**13. What type of hazards and challenges did you encounter on this run?**

- Portages. How many? \_\_\_\_\_  
 Debris or overhanging vegetation that was difficult to avoid. How many locations? \_\_\_\_\_  
 Scraped bottom. How many times? \_\_\_\_\_  
 Exciting or fun runs or chutes. How many locations? \_\_\_\_\_

**Using the map on the back, mark the locations of hazards & challenges you encountered. (P =Portage, D=Debris/overhanging vegetation, Sc =Scraped bottom, E=Exciting/fun run or chute)**

**14. How long did it take you to complete the run? \_\_\_\_\_hours \_\_\_\_\_minutes**

**15. For the watercraft-type you boated in for this run, was this flow boatable?**

- No       Yes

**16. Do you think this flow is boatable for other watercraft-types?**

- No       Yes If YES, which types? \_\_\_\_\_

**17. Describe the quality & functionality of the put-in & take-out locations you used.**

- a. Put-In: \_\_\_\_\_  
 \_\_\_\_\_  
 b. Take-Out: \_\_\_\_\_  
 \_\_\_\_\_

### Recreation Activities Other Than Boating

**18. Did you observe any recreation activity besides boating during this run?**

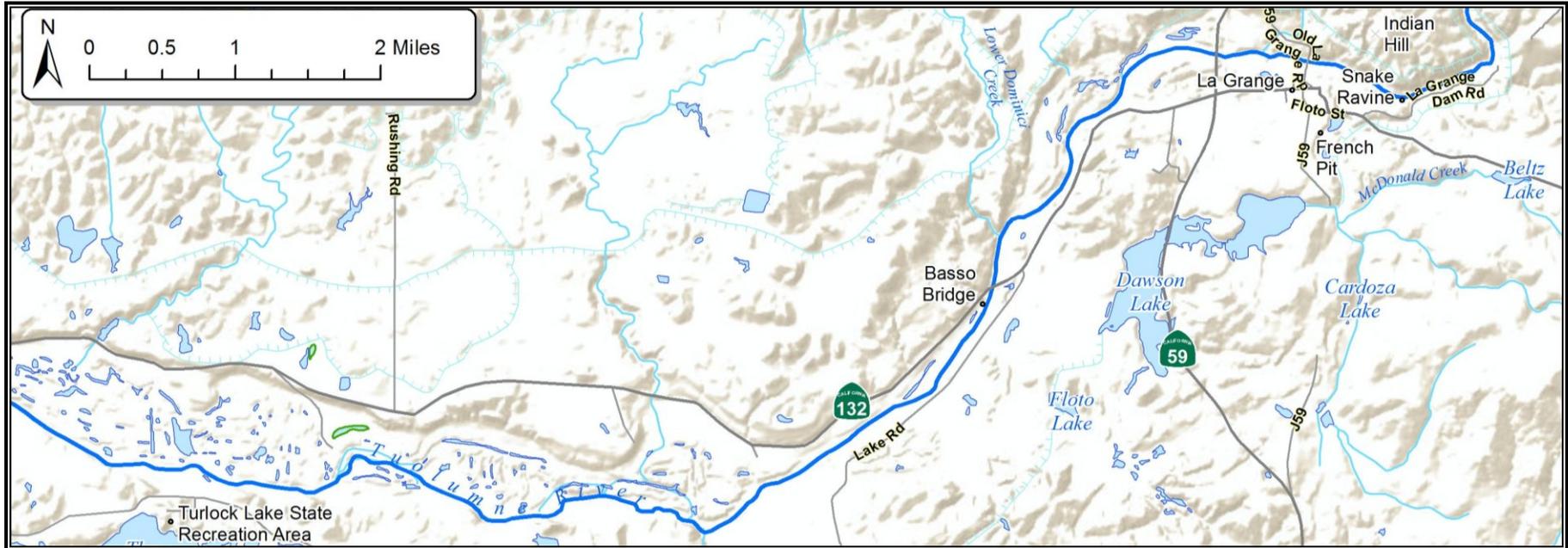
- Swimming       Bicycling       Relaxing or playing on the shore  
 Fishing       Hiking or walking

**Using the map on the back, mark the locations of recreation activities you observed. (Sw=Swimming, R=Relaxing/playing on the shore, F=Fishing, H=Hiking/walking, B=Bicycling)**

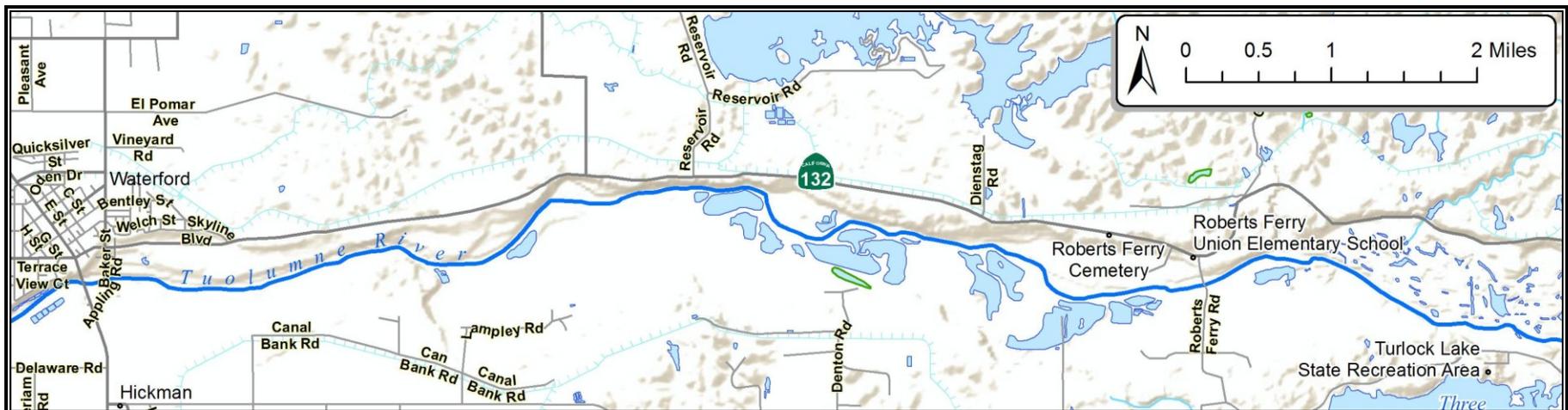
# BOATING SURVEY for the LOWER TUOLUMNE RIVER

Please use the map below to mark locations related to Question 13 and 18 using the following key.

Types of Hazards/Challenges Encountered on this Run?		Other Recreation Activities Observed on the Run?		
◦ P = Portage	◦ Sc = Scraped bottom	◦ Sw = Swimming	◦ H = Hiking/walking	◦ R = Relaxing/playing on the shore
◦ D = Debris/overhanging vegetation	◦ E = Exciting or fun run/chute	◦ F = Fishing	◦ B = Bicycling	



**Upper Run: La Grange Dam to Turlock Lake State Recreation Area.**



**Lower Run: Turlock Lake State Recreation Area to Waterford.**

# BOATING SURVEY for the LOWER TUOLUMNE RIVER

Thank you for participating in the Lower Tuolumne River Boatable Flow Study. The following questionnaire will help MID and TID understand more about boatable flow on the Lower Tuolumne River.

Your name: \_\_\_\_\_

1. Approximately how many times have you boated this reach?

- a. Total number of times (including today) \_\_\_\_\_
- b. Number of time in the last 12 months (including today) \_\_\_\_\_
- c. What months of the year do you normally boat this reach? *(Circle all that apply)*

Jan Feb Mar Apr Ma Jun Jul Aug Sep Oct Nov Dec

2. How many years have you been boating the reach? \_\_\_\_\_

3. In general, how many days per year do you spend flatwater boating? \_\_\_\_\_

4. What type of boats do you commonly use for flatwater boating?

- Canoe
- Sit-on-top kayak
- Tube
- Kayak
- Drift raft
- Other. Specify: \_\_\_\_\_

5. How would you rate your flatwater boating skill level?

- Expert
- Highly skilled
- Intermediate
- Novice/Beginner

6. What sources of information do you use for Lower Tuolumne River flow information? (Check all that apply.)

- USGS website
- Visual observation
- TID or MID websites
- Other boaters
- I don't look for flow information

7. How far in advance do you need flow information to use it for planning trips to the Lower Tuolumne River?

- More than 48 hours
- 24-48 hours
- 12-24 hours
- Fewer than 12 hours

8. Approximately how many miles is it from your home to here? \_\_\_\_\_

9. Based on your experience, list comparable river reaches to this one.

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_
- e. \_\_\_\_\_

10. Please identify your put-in & take-out locations.

Put-in: \_\_\_\_\_

Take-out: \_\_\_\_\_

11. What type of watercraft did you use?

- Canoe
- Sit-on-top kayak
- Drift boat
- Other. Specify \_\_\_\_\_
- Kayak
- Drift raft
- Inflatable kayak

12. Did you encounter other boaters during this run (not part of this study group)?

- No
- Yes ► How many? \_\_\_\_\_. What type of watercraft? \_\_\_\_\_

13. What type of hazards and challenges did you encounter on this run?

- Portages. How many? \_\_\_\_\_
- Debris or overhanging vegetation that was difficult to avoid. How many locations? \_\_\_\_\_
- I scraped bottom or hit rocks or other obstacles, but did not stop. How many times? \_\_\_\_\_
- I was stopped after scraping bottom or hitting obstacles, but did not have to get out of my boat. How many times? \_\_\_\_\_
- I had to drag or pull my boat off of the bottom, rocks, or other obstacles. How many times? \_\_\_\_\_
- Exciting or fun runs or chutes. How many locations? \_\_\_\_\_

*Using the map provided, mark the location of the hazards & challenges you encountered.*

*(P =Portage, D=Debris/overhanging vegetation, Sc =Scraped bottom, St=Stopped, P-Drag or pull, E=Exciting/fun run or chute)*

14. How long did it take you to complete the run? \_\_\_\_\_ hours \_\_\_\_\_ minutes

15. For the watercraft-type you boated in for this run, was this flow boatable?

- No
- Yes

16. For the watercraft-type you boated in for this run, was this flow enjoyable?

- No
- Yes

17. Are you likely to return for future boating at today's flow? (Select one)

- Definitely No     
  Possibly     
  Probably     
  Definitely Yes

18. If you feel qualified to offer an opinion of the boatability of this run at today's flow using different types of crafts, please respond to the following statements. Leave blank if you do not have experience with a particular type of craft. (Circle one number for each type of craft)

.This run at this flow would work well for:	Strongly Disagree	Disagree	No Opinion	Agree	Strongly agree
Kayaks	1	2	3	4	5
Rafts	1	2	3	4	5
Cataracts	1	2	3	4	5
Drift boats	1	2	3	4	5
Open Canoes	1	2	3	4	5
Inflatable Kayaks	1	2	3	4	5

19. Describe the quality & functionality of the put-in & take-out locations you used.

Put-In: \_\_\_\_\_  
 \_\_\_\_\_

Take-Out: \_\_\_\_\_  
 \_\_\_\_\_

20. Did you observe any recreation activity besides boating during this run?

- Swimming     
  Bicycling     
  Relaxing or playing on the shore  
 Fishing     
  Hiking or walking

Using the map provided, mark the location of the recreation you observed.

(Sw=Swimming, R=Relaxing/playing on the shore, F=Fishing, H=Hiking/walking, B=Bicycling)

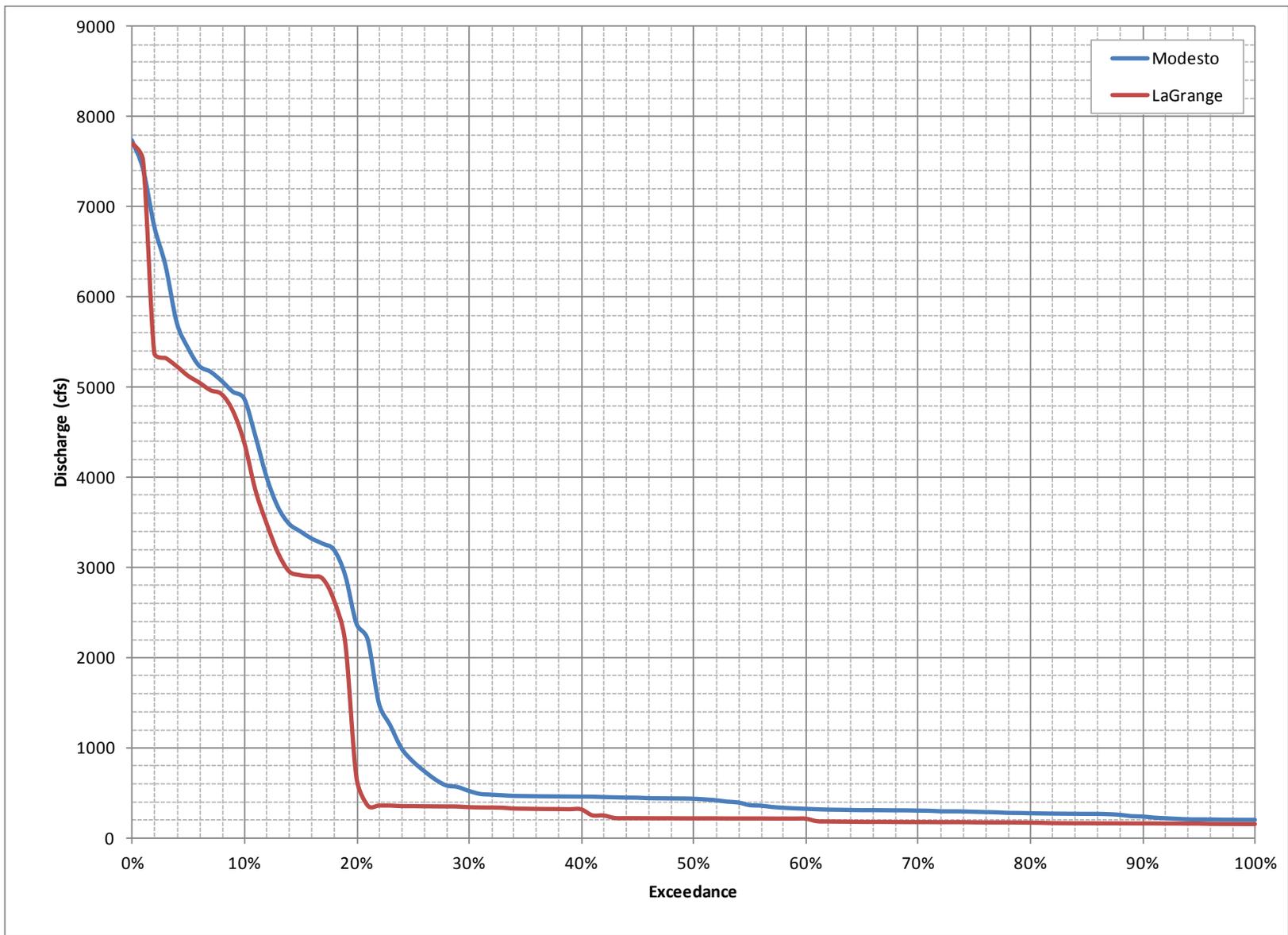
**STUDY REPORT RR-03  
LOWER TUOLUMNE RIVER LOWEST BOATABLE FLOW**

**ATTACHMENT B**

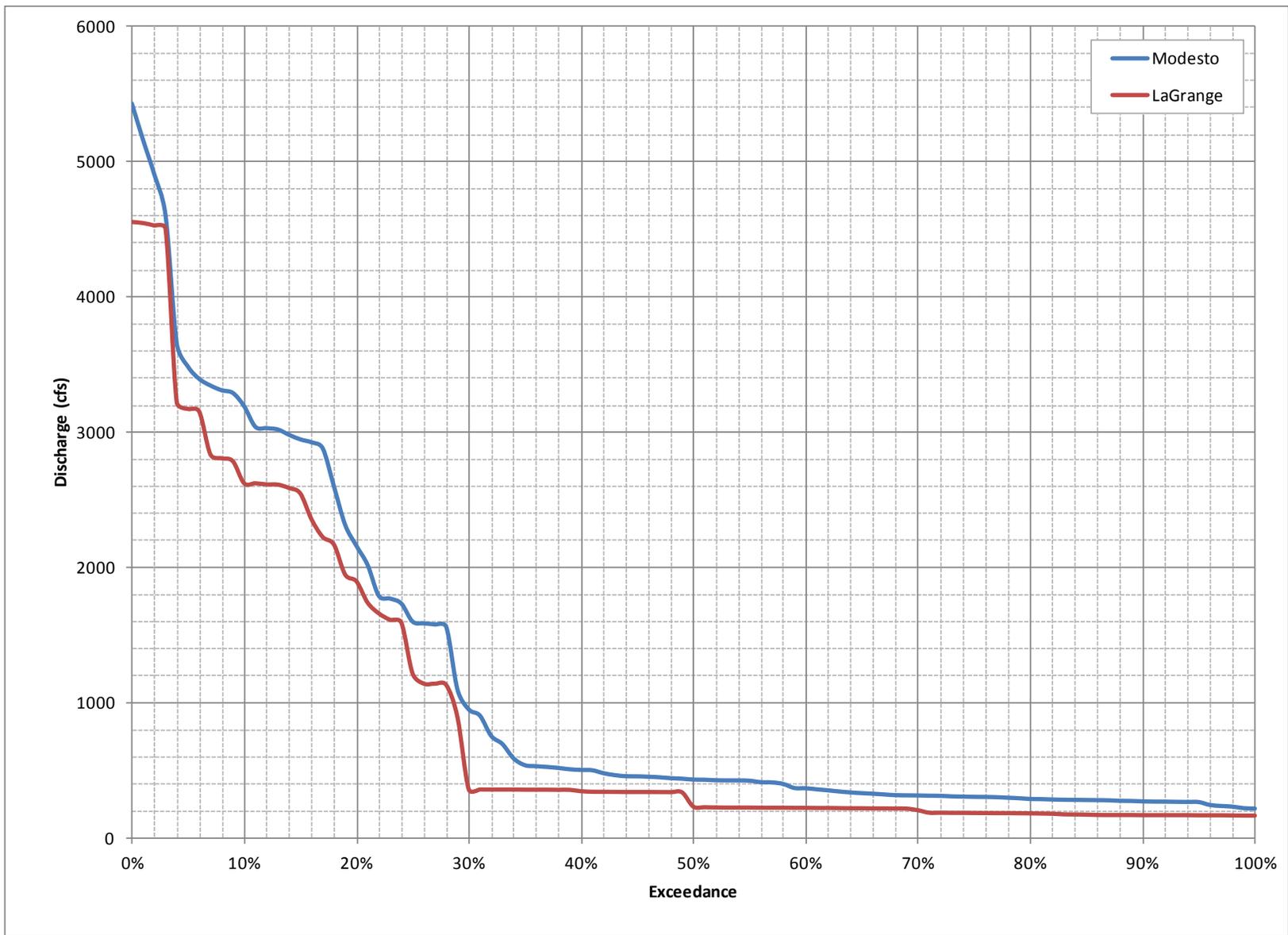
**MONTHLY FLOW DURATION CURVES FOR THE USGS GAGES  
AT LA GRANGE (11289650) AND MODESTO (11290000)  
FOR THE PERIOD 2003-2012 (AVERAGE DAILY FLOW)**

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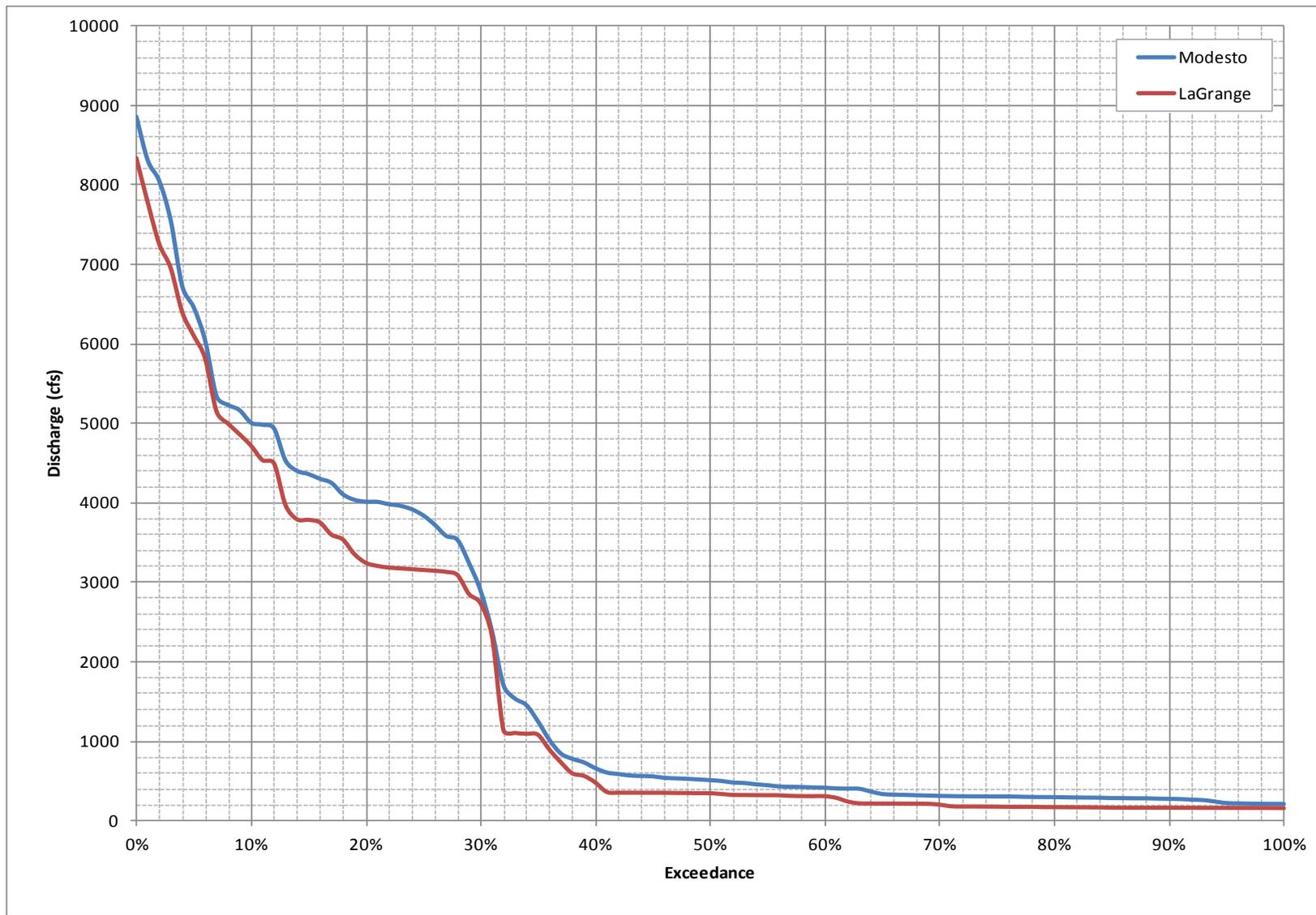
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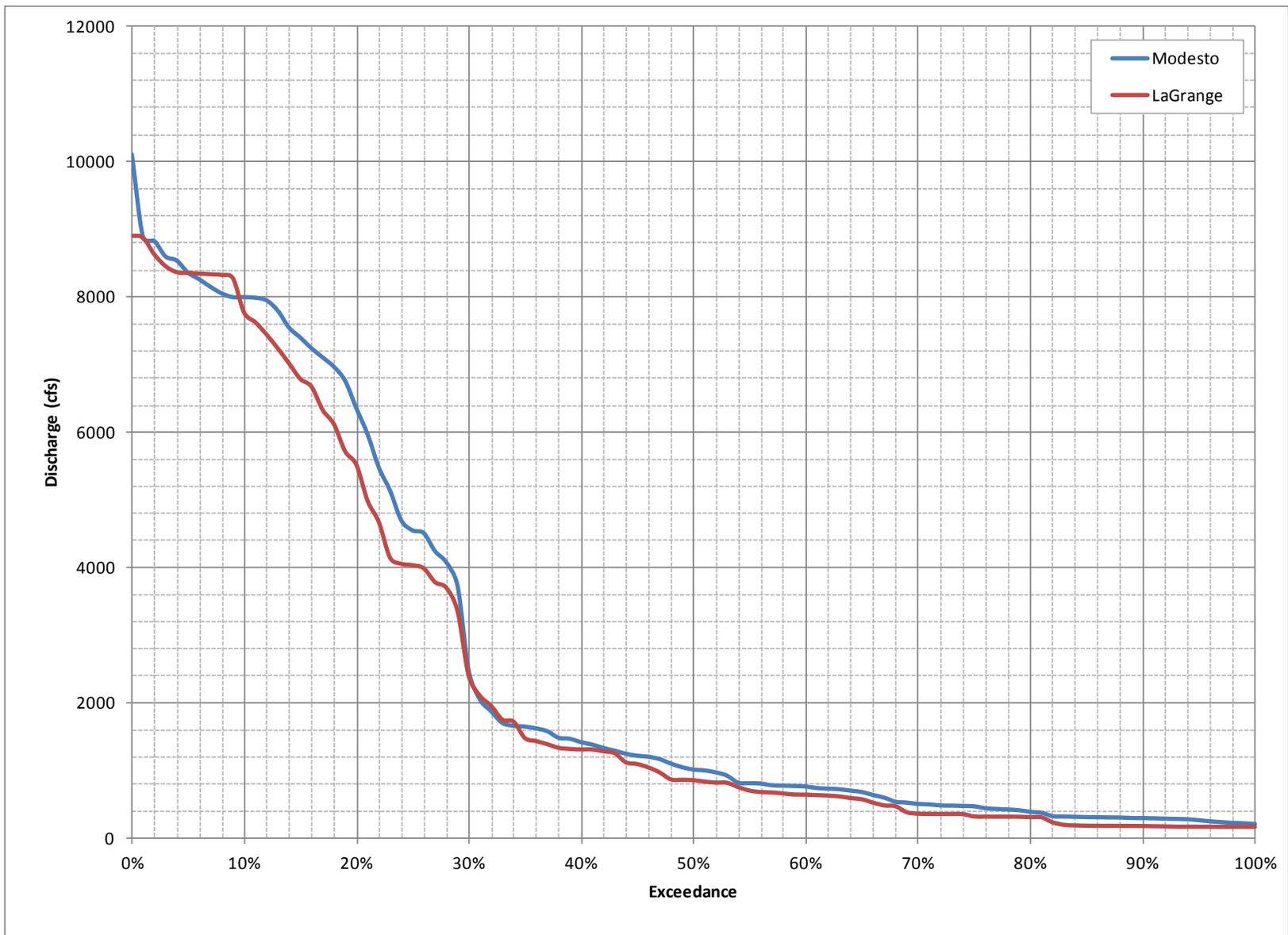
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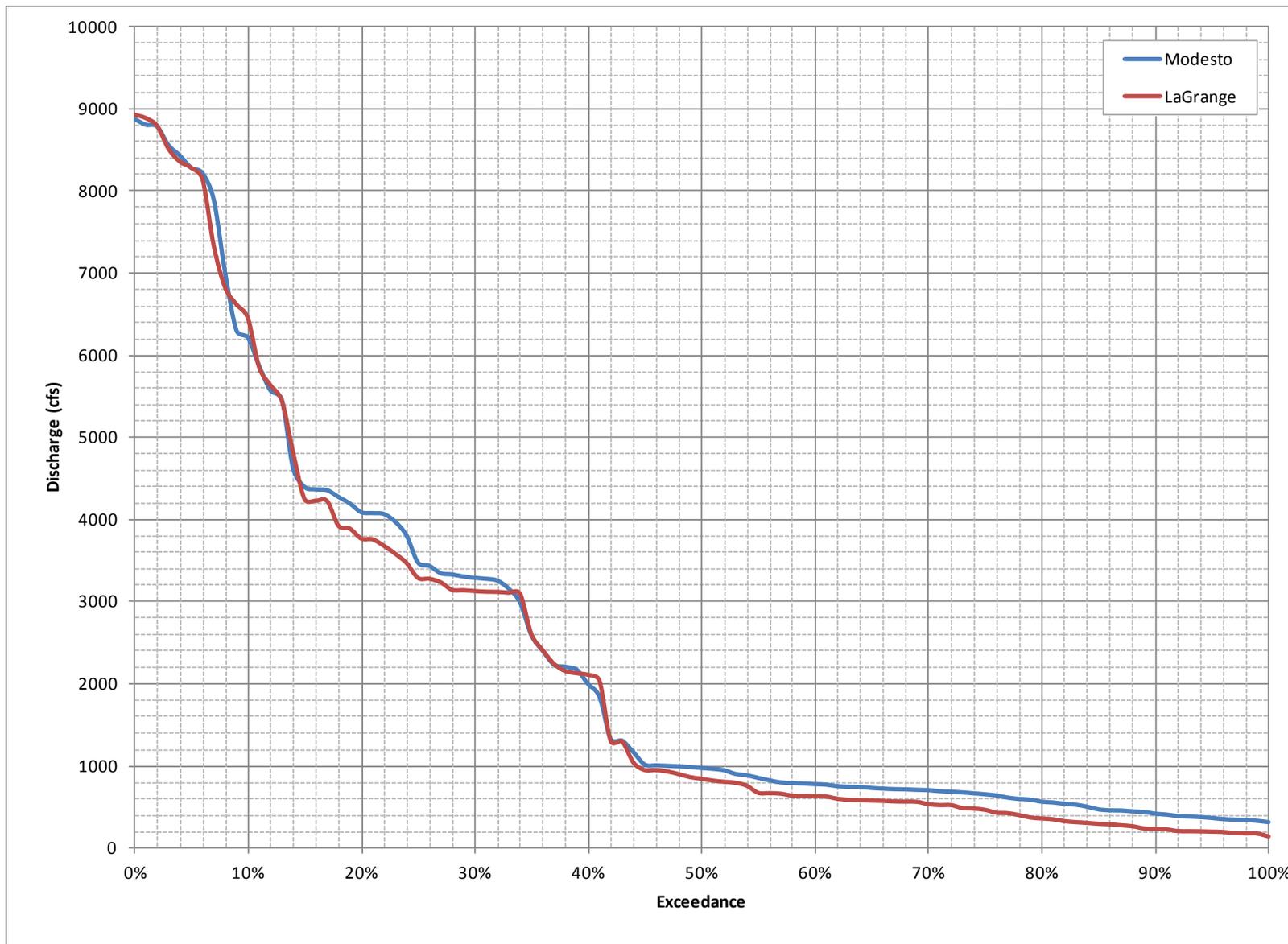
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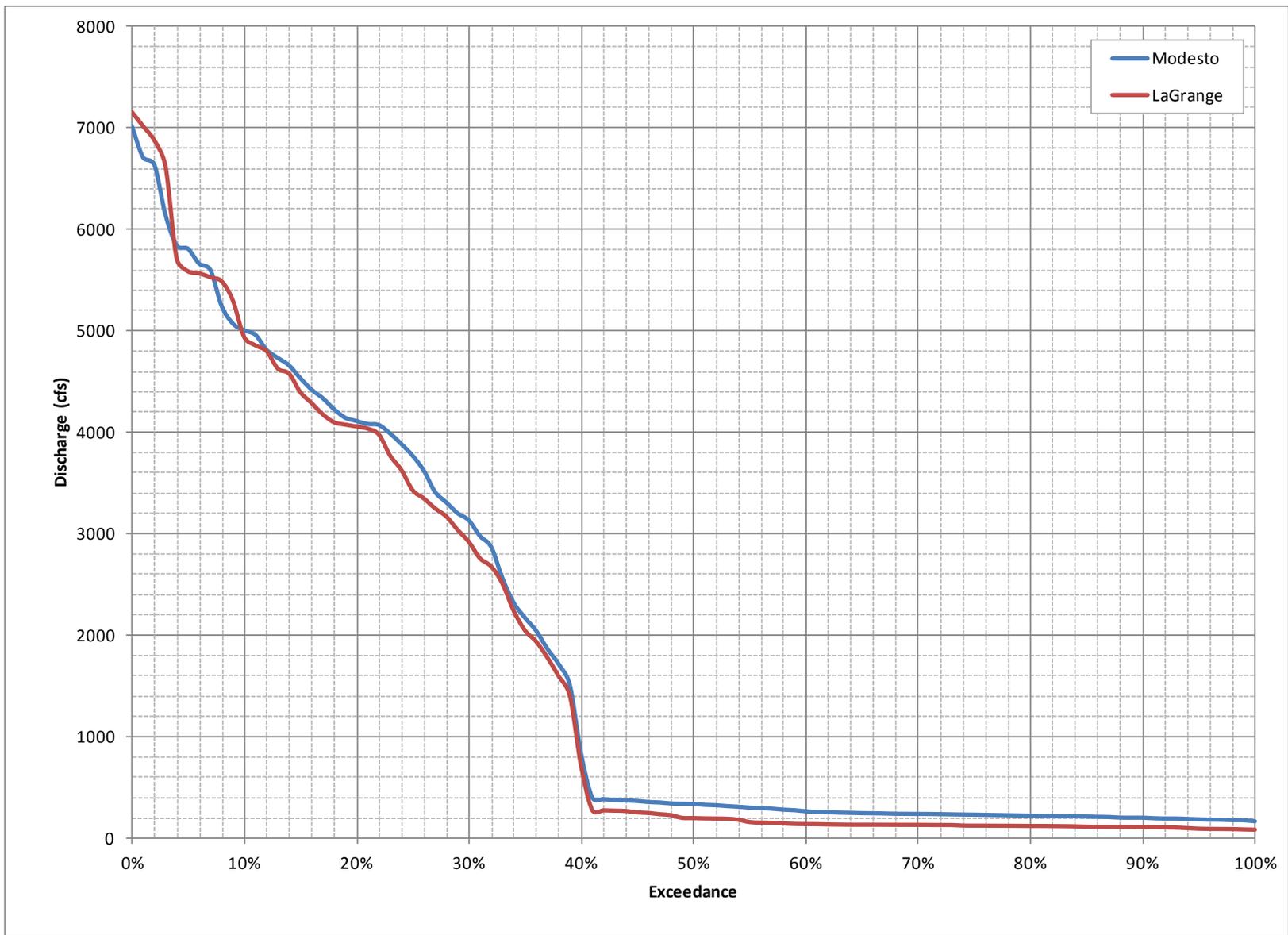
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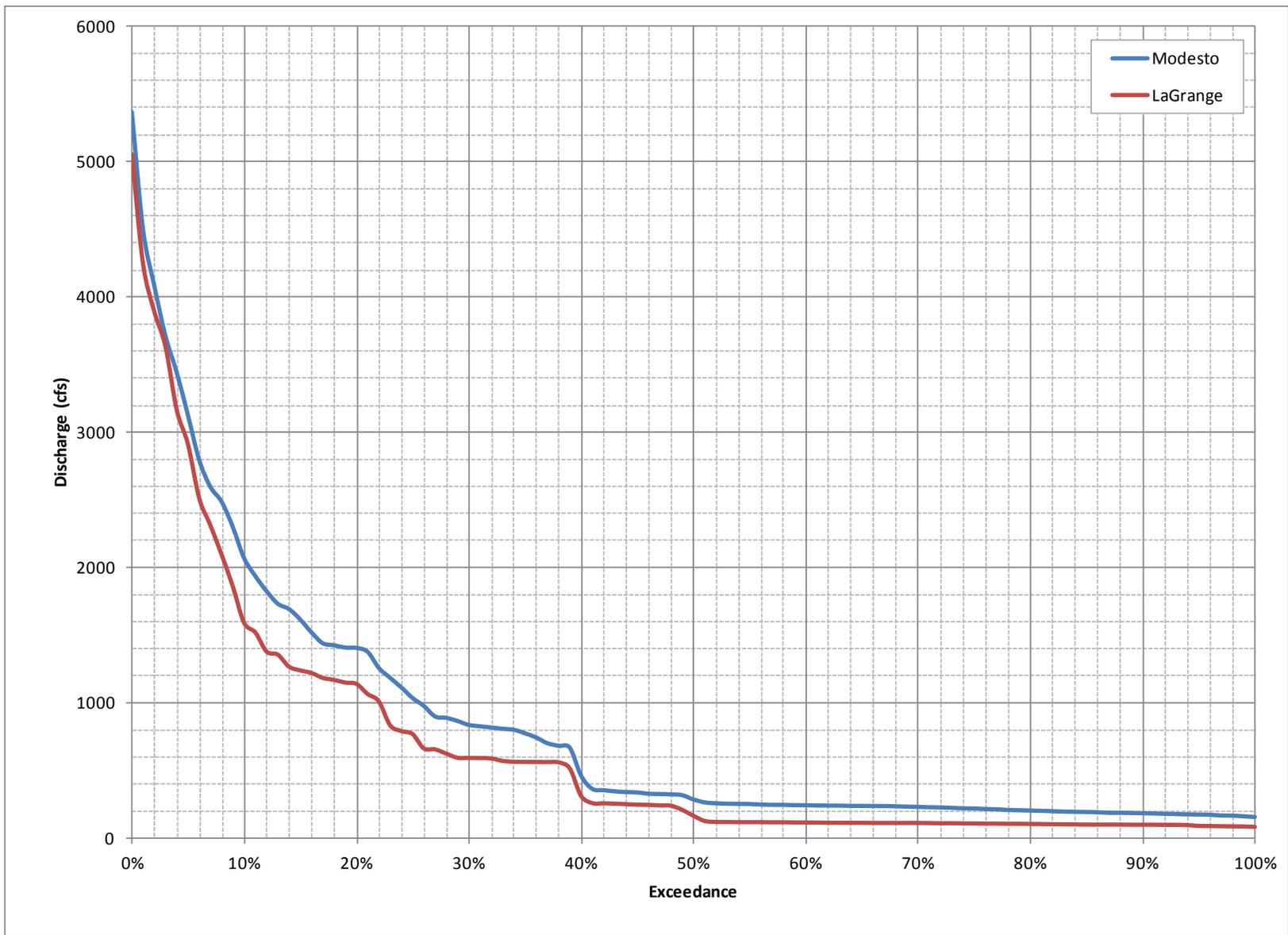
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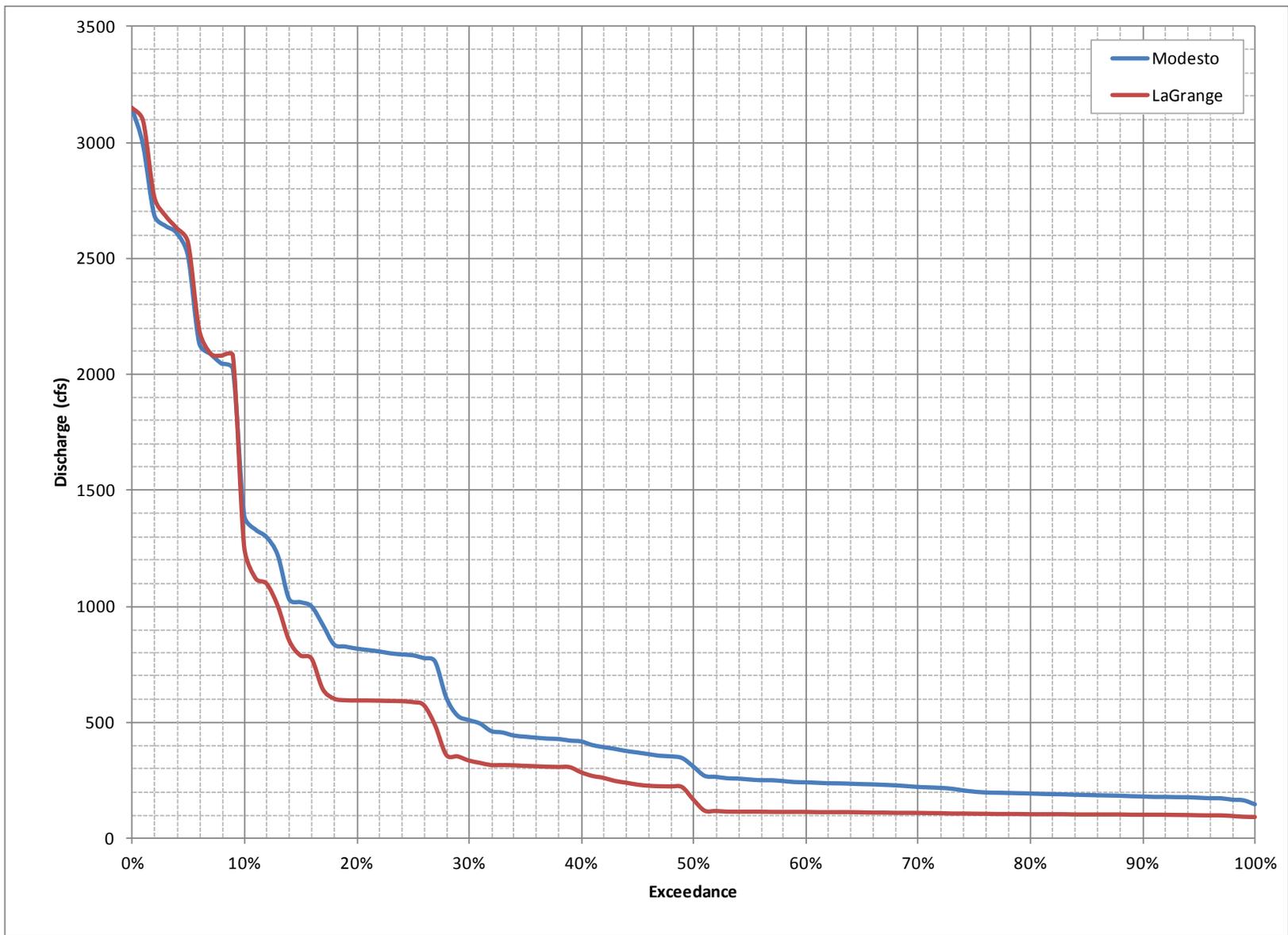
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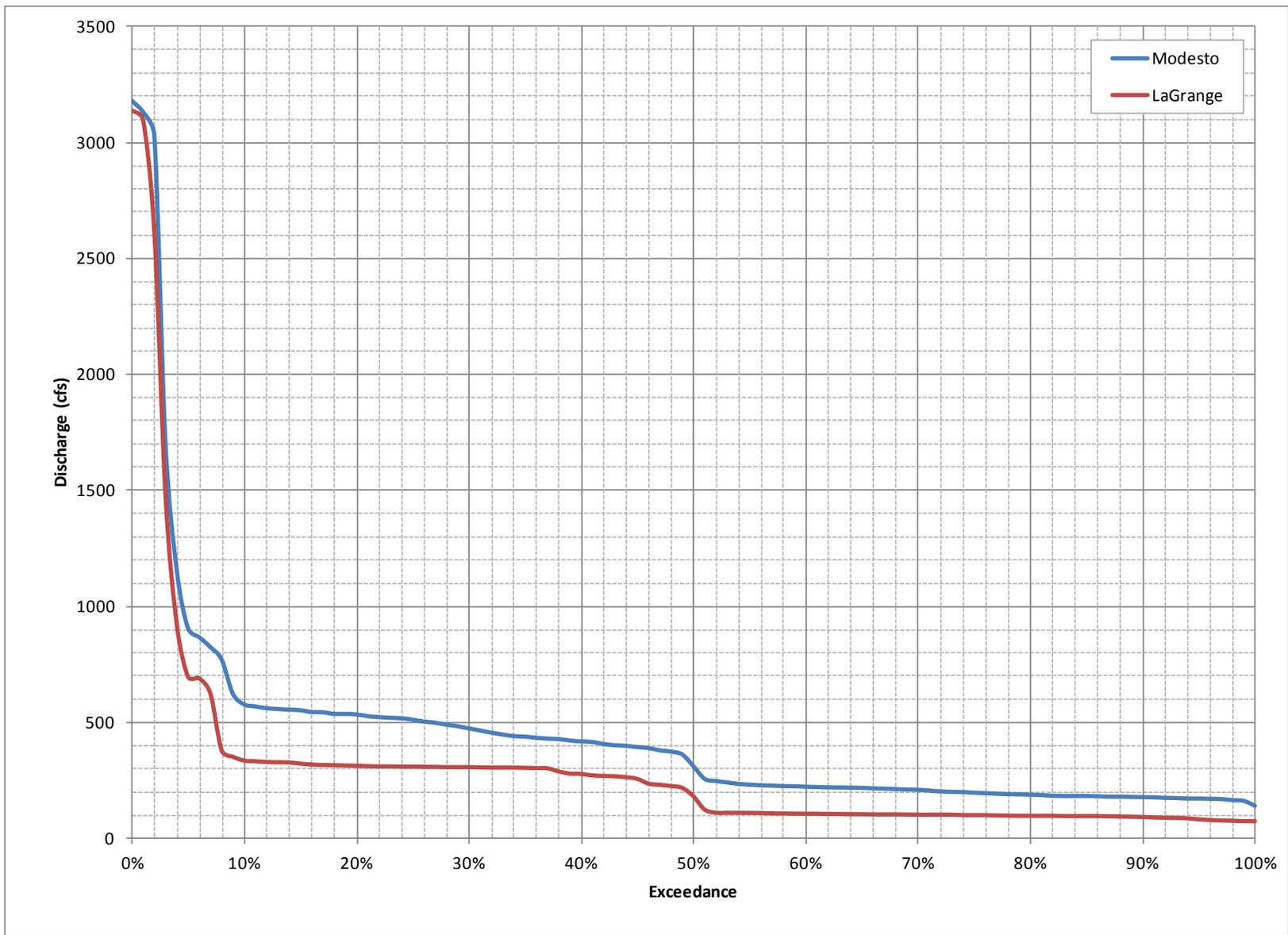
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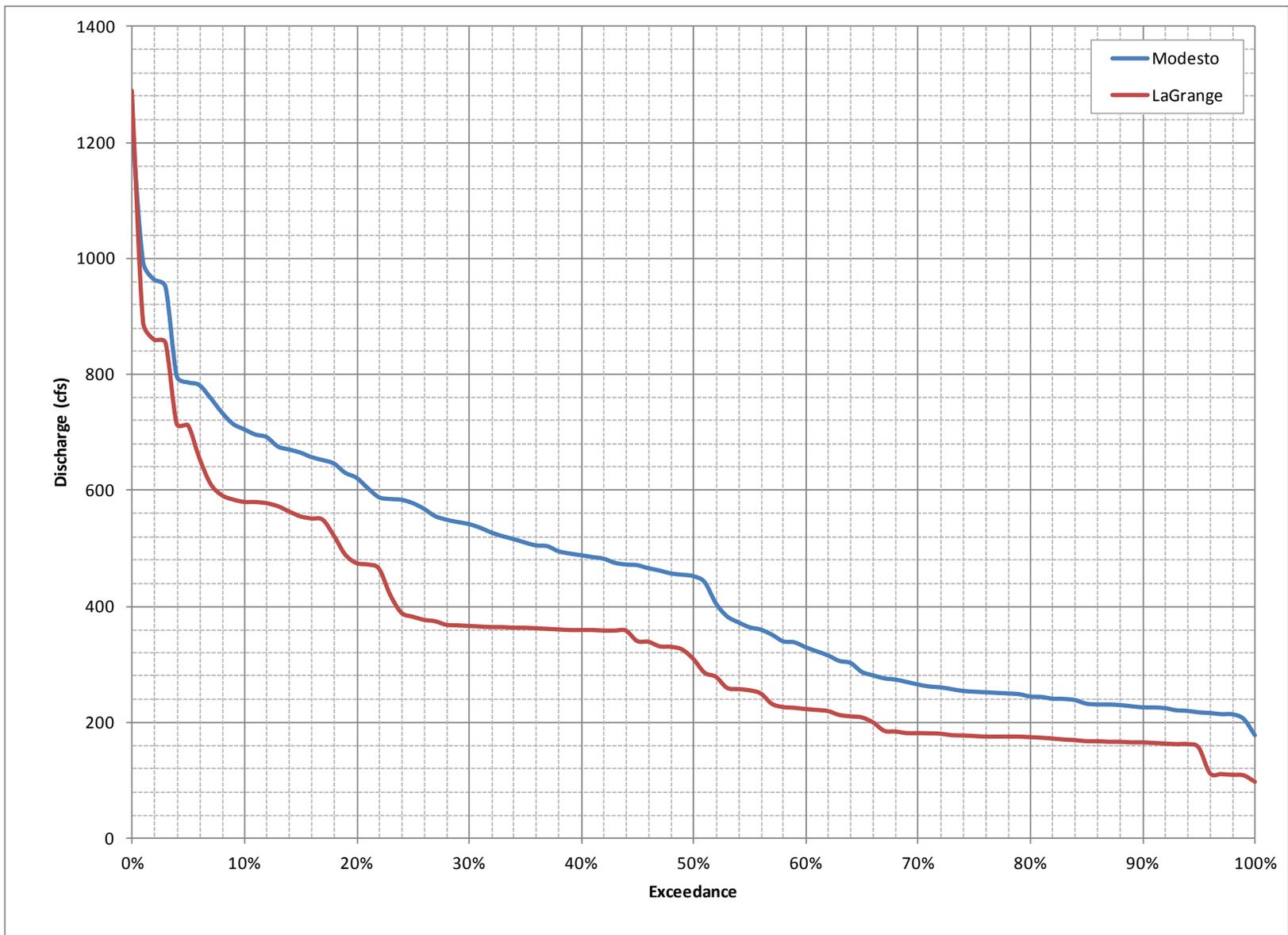
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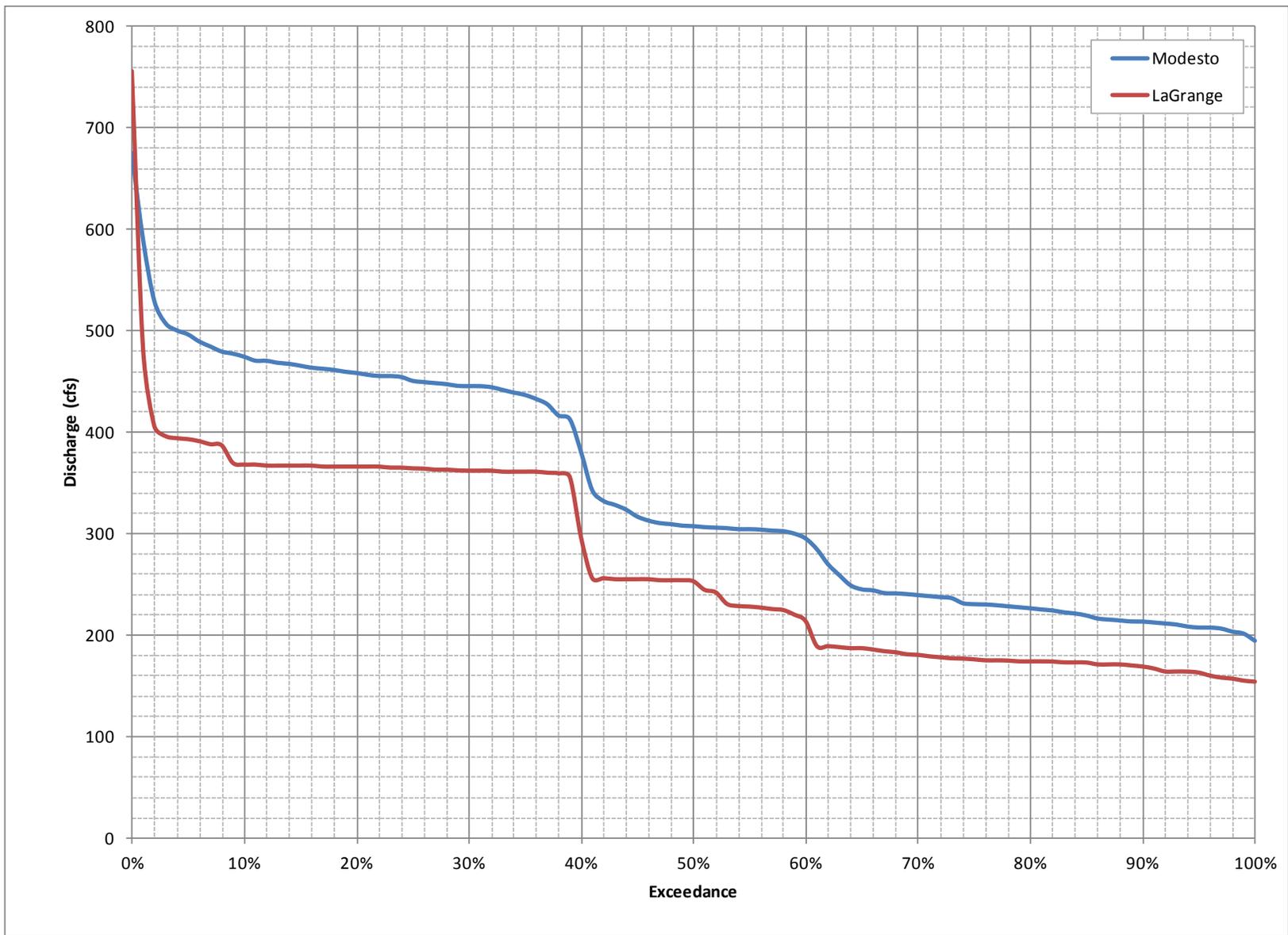
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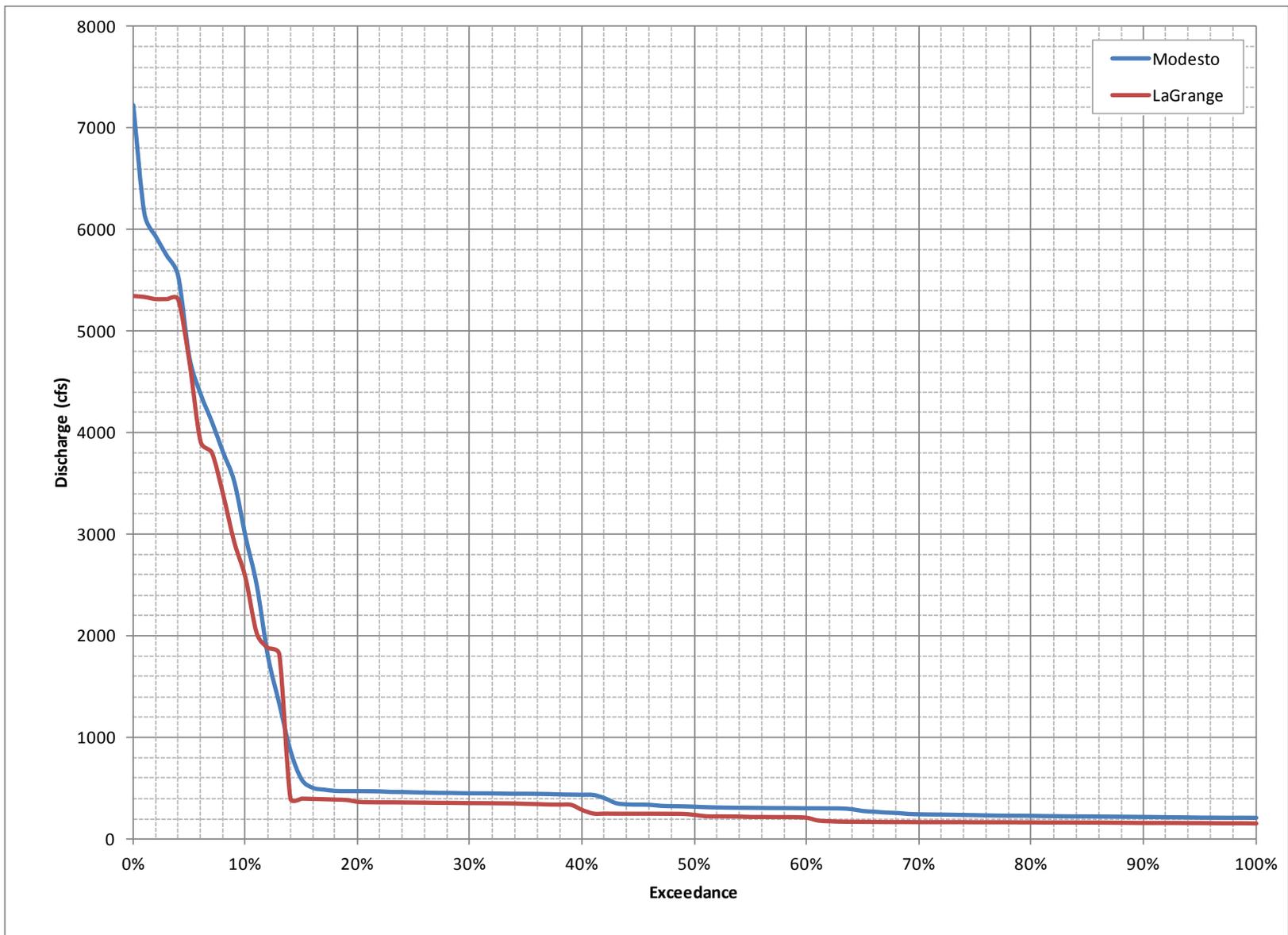
**Figure 9. September flow duration curve for the USGS Gages at La Grange and Modesto for the period 2003-2012.**



**Figure 10. October flow duration curve for the USGS Gages at La Grange and Modesto for the period 2003-2012.**



**Figure 11. November flow duration curve for the USGS Gages at La Grange and Modesto for the period 2003-2012.**



**Figure 12. December flow duration curve for the USGS Gages at La Grange and Modesto for the period 2003-2012.**

**STUDY REPORT RR-03**  
**LOWER TUOLUMNE RIVER LOWEST BOATABLE FLOW**  
**ATTACHMENT C**  
**VOLUNTEER BOATER BACKGROUND INFORMATION**

Between May 30, 2012 and September 30, 2012 the study team received a total of 21 completed boater surveys at flows coordinated with the Districts on reaches that spanned the Lower Tuolumne River from Old LaGrange Bridge to Modesto, CA. The flows at which the boaters ran the river ranged from 98 cfs to 256 cfs.

*Watercraft Type*

For the study, the Districts received surveys from 4 respondents who paddled hardshell kayaks, followed 5 who paddled inflatable kayaks, 1 drift boat, and 5 canoeists. The HDR staff also paddled a 14 foot raft by R2 watercraft (i.e., inflatable raft less than 12 ft long paddled by two people) (Table C-1).

**Table C-1. Type of watercraft.**

Watercraft	# of Volunteer Boaters	Number of Boater Surveys	Percentage of Boater Survey
Hardshell Kayak/Sit on Top	5	10	45.4%
Inflatable Kayak	5	5	22.7%
Drift Boat	1	1	4.5%
Canoe	4	6	27.2%
<b>Total</b>	<b>15</b>	<b>22</b>	<b>99.80%</b>

With respect to skill level among the volunteer and study team boaters, one person identified as an expert flatwater boater, 13 identified themselves as highly skilled, six identified as intermediate, and one identified as a novice/beginner boater. The expert-level respondent had been boating for two years on the Lower Tuolumne River, with 10 times on the Lower Tuolumne River; the highly skilled respondents spent an average of 15 years on the Lower Tuolumne River, with an average of 24.5 times down the river; the intermediate level boaters spent an average of seven years on the Lower Tuolumne, with average of 21.2 times down the river; and the novice had not spent any number of years on boating the Lower Tuolumne River, however has flatwater boated 40 days in general flatwater boating (Table C-2).

**Table C-2. Number of years boating the Lower Tuolumne River by skill level.**

Watercraft Type <sup>1</sup>	Reach	Date	# of Boaters	Response by Watercraft Type and Flow Level			
				Flatwater Boating Skill Level	# of years on LTR	Days Spent Flatwater Boating	
Hardshell Kayak	La Grange to Turlock SRA	5/30/12	4	Expert	1	2	10
				Highly skilled	2	0, 25	2, 15
				Intermediate	1	n/a	20
				Novice/Beginner	0	n/a	n/a
		5/31/12	2	Expert	0	n/a	n/a
				Highly skilled	0	n/a	n/a
				Intermediate	2	n/a	15, 20
				Novice/Beginner	0	n/a	n/a
		6/1/12	1	Expert	0	n/a	n/a
				Highly skilled	0	n/a	n/a
				Intermediate	1	25	20
				Novice/Beginner	0	n/a	n/a

Watercraft Type <sup>1</sup>	Reach	Date	# of Boaters	Response by Watercraft Type and Flow Level			
				Flatwater Boating Skill Level		# of years on LTR	Days Spent Flatwater Boating
Inflatable-Kayak/Sit on Top	Basso Bridge to Waterford	9/29/12	1	Expert	0	n/a	n/a
				Highly skilled	1	0	4
				Intermediate	0	n/a	n/a
				Novice/Beginner	0	n/a	n/a
	Fox Grove to Turlock SRA	5/31/12	1	Expert	0	n/a	n/a
				Highly skilled	1	3	30
				Intermediate	0	n/a	n/a
				Novice/Beginner	0	n/a	n/a
	La Grange to Turlock SRA	5/30/12	1	Expert	0	n/a	n/a
				Highly skilled	0	n/a	n/a
				Intermediate	1	2	40
				Novice/Beginner	0	n/a	n/a
		5/31/12	1	Expert	0	n/a	n/a
				Highly skilled	1	6	15
				Intermediate	0	n/a	n/a
				Novice/Beginner	0	n/a	n/a
Fox Grove to Riverdale SRA	5/30/12	1	Expert	0	n/a	n/a	
			Highly skilled	1	3	30	
			Intermediate	0	n/a	n/a	
			Novice/Beginner	0	n/a	n/a	
Canoe	La Grange to Turlock SRA	5/30/12	2	Expert	0	n/a	n/a
				Highly skilled	2	22, 35	4, 30
				Intermediate	0	n/a	n/a
				Novice/Beginner	0	n/a	n/a
		5/31/12	2	Expert	0	n/a	n/a
				Highly skilled	2	20, 30	4, 30
				Intermediate	0	n/a	n/a
				Novice/Beginner	0	n/a	n/a
	6/01/12	2	Expert	0	n/a	n/a	
			Highly skilled	2	20, 30	4, 30	
			Intermediate	0	n/a	n/a	
			Novice/Beginner	0	n/a	n/a	
Turlock SRA to Waterford	5/31/12	1	Expert	0	n/a	n/a	
			Highly skilled	0	n/a	n/a	
			Intermediate	0	n/a	n/a	
			Novice/Beginner	1	0	40	
Drift Boat	Basso Bridge to La Grange	5/30/12	1	Expert	0	n/a	n/a
				Highly skilled	1	1	120
				Intermediate	0	n/a	n/a
				Novice/Beginner	0	n/a	n/a
Other	La Grange to Turlock SRA	6/01/12	1	Expert	0	n/a	n/a
				Highly skilled	0	n/a	n/a
				Intermediate	1	5	12
				Novice/Beginner	0	n/a	n/a

Travel from respondent's residence to the put-in ranged from 10 miles or less (4 persons) to over 30 miles (8 persons), with 21 to 30 minutes most frequently identified (8 persons) (Table C-3).

**Table C-3. Approximate number of miles from home to put-in.**

Travel Time	Number of Boaters	Percentage of All Boaters
0-10 miles	3	27
11-20 miles	0	na
21-30 miles	4	36
31-40 miles	2	18
41-50 miles	1	9
51 and greater	1	9
<b>Total</b>	<b>11</b>	<b>100</b>

With respect to boating comparable reaches to the Lower Tuolumne River, boaters identified in California and elsewhere (Table C-4).

**Table C-4.**

Watercraft Type <sup>1</sup>	Reach	# of Boaters	Response by Watercraft Type and Flow Level
			Reaches
Hardshell Kayak	La Grange to Turlock SRA	4	Lower Chattahoochee Lower Merced (Snelling) Lower Stanislaus below Knights Ferry Stanislaus Knights Ferry Lower Kings below Kings Canyon Lower Stanislaus Lower Stanislaus Orange Blossom
Inflatable-Kayak/Sit on Top	Basso Bridge to Waterford	1	Upper Delaware Rio Chama
	Fox Grove to Turlock SRA	1	Waterford to Fox Grove Riverdale Park to Old Fishermans Club Turlock State Park to Waterford
	La Grange to Turlock SRA	1	n/a
	Fox Grove to Riverdale SRA	1	Waterford to Fox Grove, Riverdale Park to Old Fishermans Club, Turlock State Park to Waterford
Canoe	La Grange to Turlock SRA	2	Lower Stanislaus, Orange Blossom down Stanislaus (lower) Lower Merced
Drift Boat	Basso Bridge to Turlock SRA	1	n/a