February 1, 2017

Filed via Electronic Submittal (E-File)

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street NE
Washington, DC 20426

Subject: La Grange Hydroelectric Project, FERC Project No. 14581
Updated Study Report

Dear Secretary Bose:

Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts), co-owners of the La Grange Diversion Dam located on the Tuolumne River, herewith file their Updated Study Report (USR) in accordance with Federal Energy Regulatory Commission (FERC or Commission) regulations at 18 CFR § 5.15(f).

Pursuant to 18 CFR § 5.13(a), on January 5, 2015, the Districts filed a Revised Study Plan containing three study plans: (1) Cultural Resources Study Plan; (2) Recreation Access and Safety Assessment Study Plan; and (3) Fish Passage Assessment Study Plan. The Fish Passage Assessment Study Plan contained a number of individual, but related, study elements. On February 2, 2015, FERC issued its Study Plan Determination for the La Grange Project, approving or approving with modifications studies addressing cultural resources, recreation resources, and water and aquatic resources.

The Districts have implemented, or are in the process of implementing, a total of 20 individual studies as part of the La Grange Project licensing process (see table below). Of these, 11 studies were approved or approved with modifications by the Commission's February 2, 2015, Study Plan Determination. The remaining nine studies are being conducted by the Districts voluntarily.

Resource studies associated with the La Grange licensing process.

No.	Study
1	Fish Passage Facilities Alternatives Assessment[1,2]
2	Reservoir Transit Study[1,2]
3	La Grange Project Fish Barrier Assessment[1,2]
4	Topographic Survey[1,2]
5	Salmonid Habitat Mapping[1,2]
6	Fish Presence and Stranding Assessment[1,2]
7	Flow Records for Five Discharge Structures at the La Grange Project[1,2]
8	Investigation of Fish Attraction to La Grange Powerhouse Draft Tubes[1,2]
9	Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River Study[2]
10	Cultural Resources Study[2]
11	Recreation Access and Safety Assessment[2]
12	Upper Tuolumne River Basin Fish Migration Barriers Study[1,3]
13	Upper Tuolumne River Basin Water Temperature Monitoring and Modeling Study[1,3]
14	Upper Tuolumne River Chinook Salmon and Steelhead Spawning Gravel Mapping Study[3]
15	Upper Tuolumne River Habitat Mapping Assessment[3]
16	Upper Tuolumne River Macroinvertebrate Assessment[3]
17	Upper Tuolumne River Instream Flow Study[3]
18	Socioeconomic Scoping Study[3]
19	Regulatory Context for Potential Anadromous Salmonid Reintroduction into the Upper Tuolumne River Basin [3]
20	Hatchery and Stocking Practices Review[3]

[1] Component of the Fish Passage Assessment.
[2] Approved by FERC in the Commission's February 2, 2015, Study Plan Determination.
[3] Study is being conducted voluntarily by the Districts.

This USR summarizes the status of each of the 20 studies, as well as the status of the Genetic Evaluation of *O. mykiss* Populations in the Upper Tuolumne and Merced Watersheds and the Estimation of Steelhead and Spring-run Chinook Salmon Habitat Capacity in the Upper Tuolumne and Upper Merced Rivers, two studies which are being implemented by the National Marine Fisheries Service. In addition to these summaries, a technical memorandum, progress report, or study report is appended to this USR for each of the following studies:

1. La Grange Project Fish Barrier Assessment
2. Topographic Survey
3. Fish Presence and Stranding Assessment
4. Flow Records for Five Discharge Structures at the La Grange Project
5. Investigation of Fish Attraction to La Grange Powerhouse Draft Tubes

6. Cultural Resources Study (filed as Privileged with FERC)
7. Recreation Access and Safety Assessment
8. Upper Tuolumne River Basin Fish Migration Barriers Study
9. Hatchery and Stocking Practices Review

FERC regulations at 18 CFR § 5.15(f) require the Districts to hold a meeting with participants and FERC staff within 15 days following USR filing. The Districts' USR meeting will be held on Thursday, February 16, 2017, at Modesto Irrigation District's office located at 1231 11th Street in Modesto, California.

FERC regulations at 18 CFR § 5.16(c) require the Districts to file a notice of intent to file a Draft License Application (DLA) in this Updated Study Report. Per these regulations and the schedule approved by FERC on May 27, 2016, in its Determination on Requests for Study Modifications and New Study, the Districts plan to file the La Grange DLA no later than April 24, 2017.

If you have any questions about this filing, please contact the undersigned at the addresses or telephone numbers listed below.

Sincerely,

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Enclosure: La Grange Hydroelectric Project Updated Study Report

UPDATED STUDY REPORT

LA GRANGE HYDROELECTRIC PROJECT
FERC NO. 14581

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

Prepared by:
HDR, Inc.

February 2017

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List of Acronyms and Abbreviations

ac-ft .....acre-foot
BLM.....Bureau of Land Management
BOR .....Bureau of Reclamation
CCSF.....City and County of San Francisco
CDFG.....California Department of Fish and Game, now CDFW
CDFW.....California Department of Fish and Wildlife
cfs.....cubic feet per second
CG .....Conservation Groups
Districts.....Turlock Irrigation District and Modesto Irrigation District
FERC.....Federal Energy Regulatory Commission
FLA .....Final License Application
FPA .....Federal Power Act
GIS .....geographic information system
ILP.....Integrated Licensing Process
ISR .....Initial Study Report
LGDD .....La Grange Diversion Dam
LPs .....licensing participants
M&I.....municipal and industrial
MID.....Modesto Irrigation District
NMFS.....National Marine Fisheries Service
NPS .....National Park Service
O&M .....operation and maintenance
PAD.....Pre-Application Document
PSP.....Proposed Study Plan
QA/QC .....quality assurance/quality control
RM .....river mile
RSP .....Revised Study Plan
SD2 .....Scoping Document 2
SPD .....Study Plan Determination
TAF .....thousand acre-feet
TID.....Turlock Irrigation District
TM.....technical memorandum
USFWS .....United States Fish and Wildlife Service
USGS .....United States Geological Survey
USR.....Updated Study Report

1.0 INTRODUCTION

1.1 Background

The Turlock Irrigation District (TID) and Modesto Irrigation District (MID) (collectively, the Districts) own the La Grange Diversion Dam (LGDD) located on the Tuolumne River in Stanislaus County, California (Figures 1.1-1 and 1.1-2). LGDD is 131 feet high and is located at river mile (RM) 52.2 at the exit of a narrow canyon, the walls of which contain the pool formed by the diversion dam. Under normal river flows, the pool formed by the diversion dam extends for approximately one mile upstream. When not in spill mode, the water level upstream of the diversion dam is between elevation 294 feet and 296 feet approximately 90 percent of the time. Within this 2-foot range, the pool storage is estimated to be less than 100 acre-feet of water.

The drainage area of the Tuolumne River upstream of LGDD is approximately 1,550 square miles. Tuolumne River flows upstream of LGDD are regulated by four reservoirs: Hetch Hetchy, Lake Eleanor, Lake Lloyd (known as Cherry Lake), and Don Pedro. The Don Pedro Hydroelectric Project (Federal Energy Regulatory Commission [the Commission or FERC] No. 2299) is owned jointly by the Districts, and the other three dams are owned by the City and County of San Francisco (CCSF). Inflow to the La Grange pool is the sum of releases from the Don Pedro Project, located 2.3 miles upstream, and very minor contributions from two small intermittent streams downstream of Don Pedro Dam.

LGDD was constructed from 1891 to 1893 displacing Wheaton Dam, which was built by other parties in the early 1870s. LGDD raised the level of the Tuolumne River to permit the diversion and delivery of water by gravity to irrigation systems owned by TID and MID. The Districts' irrigation systems currently provide water to over 200,000 acres of prime Central Valley farmland and drinking water to the City of Modesto. Built in 1924, the La Grange hydroelectric plant is located approximately 0.2 miles downstream of LGDD on the east (left) bank of the Tuolumne River and is owned and operated by TID. The powerhouse has a capacity of slightly less than five megawatts. The La Grange Hydroelectric Project (La Grange Project or Project; FERC No. 14581) operates in a run-of-river mode. The LGDD provides no flood control benefits, and there are no recreation facilities associated with the Project or the La Grange pool.

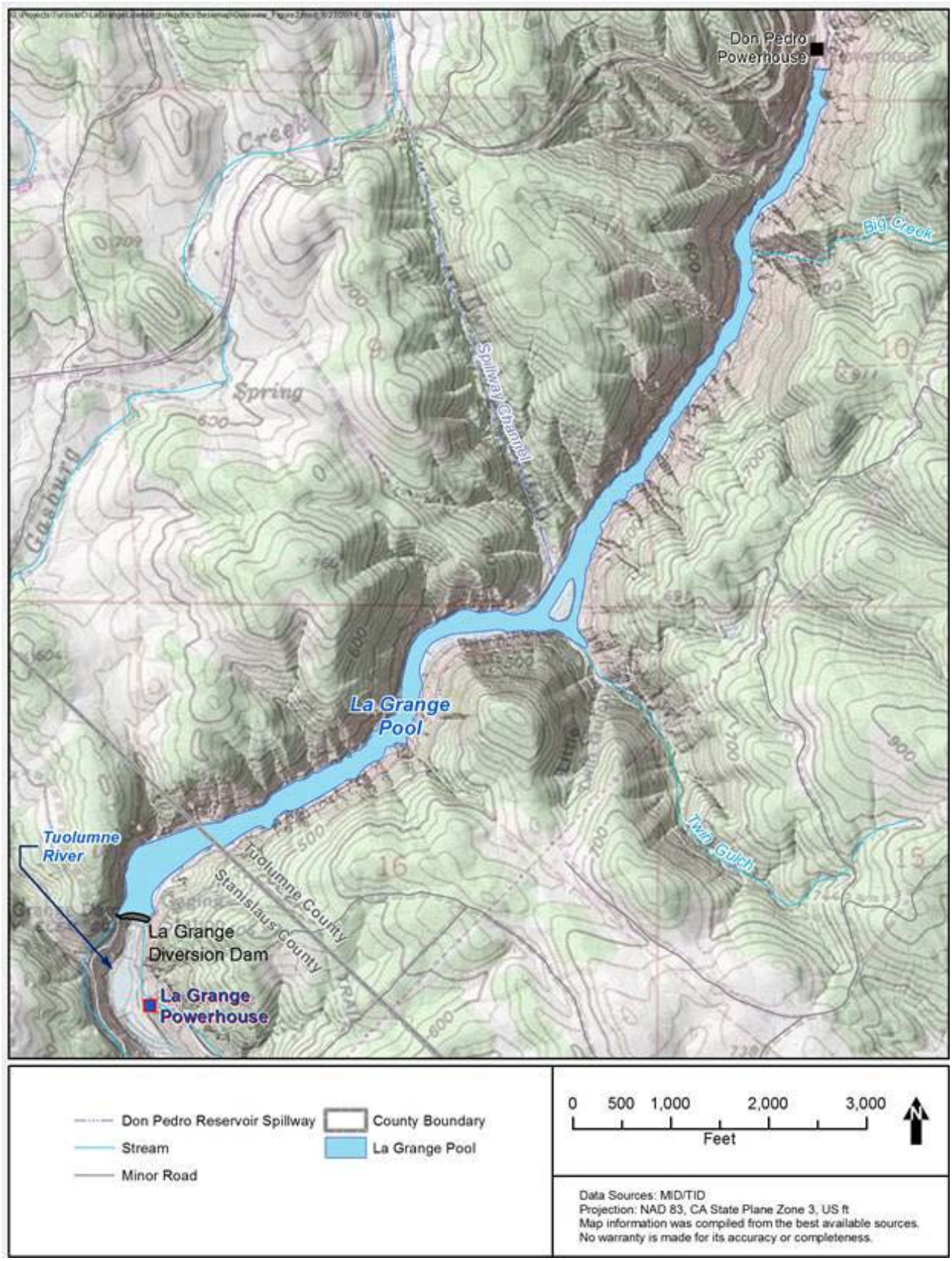

Figure 1.1-1. La Grange Hydroelectric Project location map.

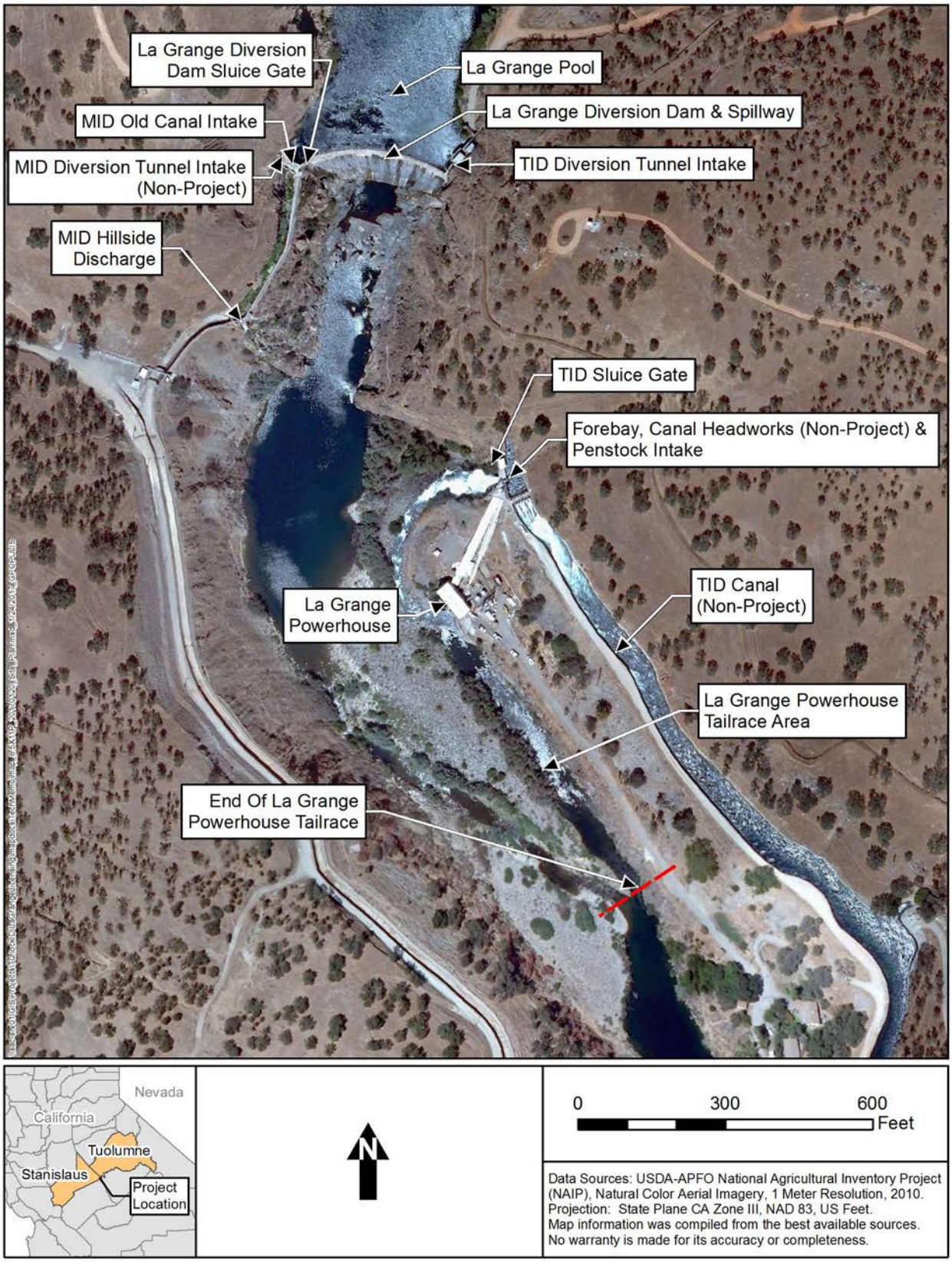

Figure 1.1-2. La Grange Hydroelectric Project site plan.

1.2 Licensing Studies

1.2.1 Revised Study Plan

Pursuant to 18 CFR § 5.11(a), on September 5, 2014, the Districts filed their Proposed Study Plan (PSP) to assess Project effects on fish and aquatic resources, recreation, and cultural resources in support of their intent to license the Project. On October 6, 2014, the Districts held a PSP meeting at MID's office in Modesto, California. Based on discussion at the PSP meeting, the Districts prepared an Updated Study Plan document that went to licensing participants (LP) for review and comment on November 21, 2014. On December 4, 2014, the National Marine Fisheries Service (NMFS), the Conservation Groups (CG), and the California Department of Fish and Wildlife (CDFW) filed comments on the PSP and/or Updated Study Plan.

On January 5, 2015, in response to comments from LPs, the Districts filed their Revised Study Plan (RSP) containing three study plans: (1) Cultural Resources Study Plan; (2) Recreation Access and Safety Assessment Study Plan; and (3) Fish Passage Assessment Study Plan[1]. The Fish Passage Assessment contains three related elements that together comprise the entire study plan: (1) Fish Passage Facilities Assessment; (2) Upper Tuolumne River Basin Habitat Assessment; and (3) Habitat Assessment and Fish Stranding Observations below La Grange Diversion Dam and Powerhouse. Each of these three elements contain several additional components (for a total of nine study components):

(1) Fish Passage Facilities Assessment
- Concept-level Fish Passage Alternatives
- La Grange Project Fish Barrier Assessment

(2) Upper Tuolumne River Basin Habitat Assessment
- Barriers to Upstream Anadromous Salmonid Migration
- Water Temperature Monitoring and Modeling
- Upstream Habitat Characterization[2]

(3) Habitat Assessment and Fish Stranding Observations below La Grange Diversion Dam and Powerhouse
- Topographic and Depth Survey
- Salmon Habitat Mapping Data
- Fish Presence and Potential for Stranding
- Hydrologic Data for Flow Conduits

[1] The Fish Passage Assessment Study Plan contained a number of individual, but related, study elements.
[2] This component refers to ongoing upstream habitat characterization work being completed by NMFS.

It is important to note that the Districts proposed the Fish Passage Assessment as a single study given the relevance of all elements and associated components to, as the SPD states, "help define the nature and degree to which the dam and powerhouse are barriers or impediments to the upstream migration of anadromous salmonids" and to assess the need for fish passage facilities at the La Grange Project.

Comments on the RSP were received from CDFW on January 16, 2015, and from NMFS, the CGs and the City of Modesto on January 20, 2015.

1.2.2 FERC Study Plan Determination

On February 2, 2015, FERC issued the Study Plan Determination (SPD), approving or approving with modifications six studies (Table 1.2-1). Of those six studies, five had been proposed by the Districts in the RSP. The Districts note that although FERC's SPD identified the Fish Passage Barrier Assessment, Fish Passage Facilities Alternatives Assessment, and Fish Habitat and Stranding Assessment below La Grange Diversion Dam as three separate studies, all three assessments are elements of the larger Fish Passage Assessment as described in the RSP. The sixth study approved by FERC, Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River, was requested by NMFS in its July 22, 2014 comment letter.

Table 1.2-1. Studies approved or approved with modifications in FERC's Study Plan Determination.

No.	Study	Approved by FERC in SPD without Modifications	Approved by FERC in SPD with Modifications
1	Recreation Access and Safety Assessment		X
2	Cultural Resources Study		X
3	Fish Passage Barrier Assessment		X[1]
4	Fish Passage Facilities Alternatives Assessment		X
5	Fish Habitat and Stranding Assessment below La Grange Dam		X
6	Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River	X[2]	

[1] Page A-1 of Appendix A of FERC's SPD states that FERC approved with modifications the Fish Passage Barrier Assessment. However, the Districts found no modifications to this study plan in the SPD and page B-7 of the SPD states that "no modifications to the study plan are recommended."

[2] FERC directed the Districts to conduct the study plan as proposed by NMFS.

In the SPD, FERC recommended that, as part of the Fish Passage Facilities Alternatives Assessment, the Districts evaluate the technical and biological feasibility of the movement of anadromous salmonids through La Grange and Don Pedro project reservoirs if the results from Phase 1 of that study indicate that the most feasible concept for fish passage would involve fish passage through Don Pedro Reservoir or La Grange pool. On September 16, 2016, the Districts filed the final study plan with FERC. On November 17, 2016, the Districts filed a letter with FERC after consulting with fish management agencies (i.e., NMFS and CDFW) regarding the availability of test fish and a determination that no fish would be available to support conducting the study in 2017. On January 12, 2017, the Districts filed a letter with FERC stating that with

FERC's approval, they intend to conduct the study in 2018 if the results from the Fish Passage Facilities Alternatives Assessment indicate that upstream or downstream fish passage at La Grange and Don Pedro projects would require anadromous fish transit through one or both reservoirs.

In addition to the six studies noted in Table 1.2-1, the SPD required the Districts to develop a plan to monitor anadromous fish movement in the vicinity of the Project's powerhouse draft tubes to determine the potential for injury or mortality from contact with the turbine runners. The Districts filed the Investigation of Fish Attraction to La Grange Powerhouse Draft Tubes study plan with FERC on June 11, 2015, and on August 12, 2015, FERC approved the study plan as filed.

1.2.3 Resolution of Disputed Studies

On February 23, 2015, NMFS filed a timely request with FERC for dispute resolution with regard to two of its study requests rejected by FERC staff in the SPD. The two disputed studies were:

- Request 3 – Quantifying Existing Upper Tuolumne River Habitats for Anadromous Fish as They Pertain to Fish Passage Blockage at La Grange Dam.
- Request 4 – Effects of the Project and Related Activities on the Genetic Makeup of Steelhead/Rainbow Trout *Oncorhynchus mykiss* in the Tuolumne River.

On February 27, 2015, FERC issued a letter to NMFS stating that FERC had determined that Request 3 would not be considered by the Study Dispute Panel because it had already been afforded the Commission's formal dispute resolution process in the Don Pedro Project dispute resolution proceeding. On May 1, 2015, FERC issued a Formal Study Dispute Determination, which stated that upon consideration of the findings and recommendations of the Study Dispute Panel, the Director was not requiring the La Grange Project study plan to be modified to incorporate a genetics study.

1.3 Initial Study Report

On February 2, 2016, the Districts filed the Initial Study Report (ISR) for the La Grange Project. The Districts held an ISR meeting on February 25, 2016, and on March 3, 2016, filed a meeting summary. Comments on the meeting summary and requests for new studies and study modifications were to be submitted to FERC by Monday, April 4. One new study request was submitted; NMFS requested a new study entitled Effects of La Grange Hydroelectric Project Under Changing Climate (Climate Change Study). On May 2, 2016, the Districts filed with FERC a response to comments received from licensing participants and proposed modifications to the Fish Passage Facilities Alternatives Assessment and the La Grange Project Fish Barrier Assessment. On May 27, 2016, FERC filed a determination on requests for study modifications and new study. The May 27, 2016 determination approved the Districts' proposed modifications and did not approve the NMFS Climate Change Study.

1.4 Updated Study Report

The Districts have implemented, or are in the process of implementing, a total of 20 individual studies as part of the La Grange Project licensing process (Table 1.4-1). This Updated Study Report (USR) summarizes the status of each study.

Table 1.4-1. Resource studies associated with the La Grange Project licensing process.

No.	Study
1	Fish Passage Facilities Alternatives Assessment[1,2]
2	Reservoir Transit Study[1,2]
3	La Grange Project Fish Barrier Assessment[1,2]
4	Topographic Survey[1,2]
5	Salmonid Habitat Mapping[1,2]
6	Fish Presence and Stranding Assessment[1,2]
7	Flow Records for Five Discharge Structures at the La Grange Project[1,2]
8	Investigation of Fish Attraction to La Grange Powerhouse Draft Tubes[1,2]
9	Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River Study[2]
10	Cultural Resources Study[2]
11	Recreation Access and Safety Assessment[2]
12	Upper Tuolumne River Basin Fish Migration Barriers Study[1,3]
13	Upper Tuolumne River Basin Water Temperature Monitoring and Modeling Study[1,3]
14	Upper Tuolumne River Chinook Salmon and Steelhead Spawning Gravel Mapping Study[3]
15	Upper Tuolumne River Habitat Mapping Assessment[3]
16	Upper Tuolumne River Macroinvertebrate Assessment[3]
17	Upper Tuolumne River Instream Flow Study[3]
18	Socioeconomic Scoping Study[3]
19	Regulatory Context for Potential Anadromous Salmonid Reintroduction into the Upper Tuolumne River Basin [3]
20	Hatchery and Stocking Practices Review[3]

[1] Component of the Fish Passage Assessment.
[2] Approved by FERC in the Commission's February 2, 2015, Study Plan Determination.
[3] Study is being conducted voluntarily by the Districts.

This USR includes the following sections:

- Section 1. Introduction. This section describes the background and content of this USR
- Section 2. Summary of Licensing Studies. This section summarizes the Districts' progress in implementing each of the licensing studies
- Section 3. Updated Study Report Meeting. This section describes the Districts' intent to hold a meeting to discuss this USR
- Section 4. Notice of Intent to File a Draft License Application
- Section 5. References
- Appendices
    - Appendix A: Fish Passage Facilities Alternatives Assessment and Upper Tuolumne River Reintroduction/Fish Passage Assessment Framework 2016 Engagement Record
    - Appendix B: January 12, 2017 Reservoir Transit Study Letter to FERC

- Appendix C: La Grange Project Fish Barrier Assessment Progress Report
- Appendix D: Topographic Survey Technical Memorandum
- Appendix E: Fish Presence and Stranding Assessment Technical Memorandum
- Appendix F: Flow Records for Five Discharge Structures at the La Grange Project Technical Memorandum
- Appendix G: Investigation of Fish Attraction to La Grange Powerhouse Draft Tubes Study Report
- Appendix H: Cultural Resources Study Report [filed as Privileged with FERC]
- Appendix I: Recreation Access and Safety Assessment Study Report
- Appendix J: Upper Tuolumne River Basin Fish Migration Barriers Study Report
- Appendix K: Hatchery and Stocking Practices Review Study Report
- Appendix L: Updates on NMFS Southwest Fisheries Science Center Projects Pertaining to the Upper Merced River and Upper Tuolumne River Watersheds

1.5 Other Studies and Data Collection Activities

Extensive information on potential cumulative effects to environmental resources in the vicinity of La Grange Diversion Dam and the lower Tuolumne River is available in the Don Pedro Hydroelectric Project Final License Application (TID/MID 2014a).

2.0 SUMMARY OF LICENSING STUDIES

The Districts have implemented, or are in the process of implementing, 20 studies in support of the La Grange Project licensing process (Table 1.4-1). The status of each of those studies is described below. Section 2.1 provides summaries of studies approved by FERC in the SPD. Section 2.2 provides summaries of studies being implemented voluntarily by the Districts. Section 2.3 provides a summary of the Genetic Evaluation of *O. mykiss* Populations in the Upper Tuolumne River and Merced Watersheds and the Estimation of Steelhead and Spring-run Chinook Salmon Habitat Capacity in the Upper Tuolumne and Upper Merced Rivers, two studies being implemented by NMFS.

2.1 Studies Approved by FERC

2.1.1 Fish Passage Facilities Alternatives Assessment

2.1.1.1 Study Goals and Objectives

The goal of the Fish Passage Facilities Alternatives Assessment is to identify and develop concept-level alternatives for upstream and downstream passage of Chinook salmon (*Oncorhynchus tshawytscha*) and steelhead (*O. mykiss*) at the La Grange and Don Pedro projects. Specific objectives of the study are to:

- obtain available information to establish existing baseline conditions relevant to impoundment operations and siting passage facilities;
- obtain available hydrologic data and basic biological design criteria to identify potential types, configurations, and locations of fish passage facilities consistent with estimated run size, fish periodicity, life-stage requirements, and anticipated passage efficiencies for the selected species of interest;
- formulate and develop preliminary facility sizing and functional design for select, alternative potential upstream and downstream fish passage facilities consistent with the resource agencies' anadromous fish reintroduction goals and objectives; and
- develop reliable opinions of probable construction cost and annual operations and maintenance costs for select fish passage concept(s).

2.1.1.2 Study Methods and Approach

The Fish Passage Facilities Alternatives Assessment is occurring in two phases, as described below.

Phase 1, which began in 2015, involves information gathering and evaluation of facility siting and sizing, general biological and engineering design parameters, and operational considerations in a collaborative process with LPs. In 2015, the Districts held a number of public workshops and produced Technical Memorandum No. 1, the goals of which were to collaboratively establish biological and engineering design parameters. Identification of data gaps and

addressing these data gaps within a collaborative process is a critical step to completing Phase 1 of the study, which is a prerequisite to the development of a suite of fish passage conceptual alternatives that are capable of meeting the anadromous fish reintroduction goals and objectives.

Phase 2 was to be conducted in 2016 but now will be conducted in 2017 (see Study Variances and Study Status, below). Phase 2 will be based on the input that has been obtained during the Phase 1 workshop process and assumptions on parameters still unaddressed through the collaborative process. Based on the biological and engineering design parameters, the Districts will proceed to develop functional site layouts, facility sizing, general fish population and run size parameters, assumed fish capture and survival efficiencies, and associated reliable opinions of probable construction and operation and maintenance costs for select fish passage alternatives developed in the workshop process.

2.1.1.3 Study Findings

Work performed in 2015 resulted in the identification of numerous data gaps relevant to informing the biological basis of the design for concept alternatives. The Fish Passage Facilities Alternatives Assessment Progress Report (TID/MID 2016a) provides a summary of consultation with LPs and site-specific considerations and potential biological and engineering criteria intended to inform Phase 2. Given that anadromous salmonids are not currently present in the target reintroduction area, much of the biological information presented in TID/MID (2016a) is based upon assumptions. Therefore, this information may not be representative of conditions in the Tuolumne River. In addition, there remain a number of data gaps relevant to informing the biological and related engineering basis of design for concept alternatives that are necessary to be able to produce reliable estimates of fish passage facility performance and cost.[3]

Through a series of workshops conducted in 2015 and 2016, the Districts, in collaboration with LPs, broadened the scope of the Fish Passage Facilities Alternatives Assessment to implement an Upper Tuolumne River Reintroduction/Fish Passage Assessment Framework process (Framework). Information describing the structure and function of the Framework is provided in TID/MID (2016a) and in Appendix A to this USR. Elements of the Framework are interconnected and fish-passage engineering is just one of several key elements. Other Framework elements include ecological feasibility, biological constraints, and economic, regulatory, and other key considerations. Providing fish passage in the Tuolumne River is fundamentally linked to a decision to pursue anadromous fish reintroduction[4], and as such, fish passage should be evaluated in this broader context. Additionally, numerous data gaps and design parameters critical to advancing the fish passage assessment process were identified in the

[3] The Districts provided TM No. 1 on September 4, 2015 and reviewed data gaps identified in the TM at a Workshop on September 17, 2015. Comments were requested to be provided by October 23, 2015. An additional comment period was provided through October 30, 2015. The Districts received no input or comments on TM No. 1 from any participant in the collaborative process. At subsequent Workshops in 2016, the Districts continued to highlight the need for comment and input from LPs in order to proceed with the next steps in the Fish Passage Facilities Alternatives Assessment. Despite numerous requests, the necessary input on the identified data gaps has not been provided as of the date of this USR report.

[4] Since the available information regarding historical spring-run Chinook and steelhead distribution and use in the upper Tuolumne River (above the Don Pedro Project) is anecdotal at best, the Districts do not agree that these species have been shown to have consistently populated the river upstream of the Don Pedro Project, and as such, do not necessarily consider this potential action under consideration to be a "reintroduction".

Districts' Technical Memorandum (TM) No. 1, and the proposed Framework process was intended to provide an opportunity for collecting this information and confirming biological assumptions. The siting, design, construction, and operation of fish passage facilities at high head dams is complex and costly. As such, a thorough investigation of the engineering, biological, regulatory, social and economic issues surrounding such a proposal is necessary to ensure that reintroduction is appropriate and that rigorously collected and scientifically defensible information is available to inform cost-effective and efficient fish passage facility design. The Framework process is consistent with guidance provided in Anderson et al. (2014), *Planning Pacific Salmon and Steelhead Reintroductions Aimed at Long-Term Viability and Recovery*. This peer-reviewed journal article authored by the NMFS Northwest Fisheries Science Center in collaboration with state fish and wildlife agencies, stresses the need for implementing a broad evaluation process that describes benefits, risks, and constraints prior to implementing a fish introduction or reintroduction program.

The Framework process continued throughout 2016. Workshops were conducted on January 27 and May 19 for all Framework participants. At these meetings, a process and schedule, a summary of potential information gaps, a list of potential voluntary studies to be conducted to address information gaps, and the formation of technical subcommittees were approved to help guide 2016 activities. Eight additional engagements (meetings or conference calls) took place,[5] involving technical subcommittees composed of interested LPs. In general, technical subcommittee meetings were focused on specialized technical topics related to the Framework, including: (1) collaborative development of study plans for 2016 voluntary upper Tuolumne River studies that the Districts considered undertaking (see next paragraph); (2) discussions to define reintroduction goals and objectives to evaluate reintroduction feasibility; and (3) discussions to identify appropriate water temperature criteria to evaluate thermal suitability in the potential reintroduction reach. Detailed information for all 2016 engagements is included in Appendix A.

In 2015, the Districts began implementing the first of nine voluntary studies to support the collaborative Framework process. The studies are intended to evaluate a suite of reintroduction related topics, including migration barriers, temperature modeling, habitat suitability, productivity, regulatory and socioeconomic considerations of reintroduction, and the potential implications of historical and current hatchery practices. The status of these studies is summarized in Section 2.2 of this USR.

2.1.1.4 Study Variances

There has been one modification to, but no variances associated with, the Fish Passage Facilities Alternatives Assessment. The FERC-approved study plan states that Phase 1 would occur in 2015, and Phase 2 would occur in 2016. In the ISR, the Districts indicated that Phase 1 would continue into 2016 to allow time for coordination with LPs, the Districts' continuing efforts to obtain input and comments on TM No. 1, and on the overall Framework process. Phase 2 would be conducted in 2017. In its May 27, 2016 Determination on Requests for Study Modifications and New Study for the La Grange Hydroelectric Project, FERC approved modification of the

[5] Dates of engagements in 2016: February 16, March 18, April 13, April 18, September 15, October 14, October 20, December 1.

study and granted an additional year to complete Phase 1 (in 2016) and Phase 2 (in 2017), noting that "the results are necessary for our review of the license application because they would form the basis to evaluate the technical feasibility of providing fish passage if NMFS decides to reintroduce anadromous salmonids to the upper Tuolumne River."

2.1.1.5 Study Status

The study is currently in progress. There remain numerous data gaps relevant to informing the biological basis of the design of concept alternatives that must be addressed for the process to move into Phase 2 and complete the study in 2017. Despite the TM No. 1 having been issued 17 months ago in September 2015, and repeated requests for input and comment, to date no input has been provided on the information needs except a request by NMFS to add fall-run Chinook salmon to the list of species to be considered and general acknowledgement of, but not formal agreement on, life stage periodicities.

Ongoing phases of work in 2017 will be focused on attempting to address data gaps by continuing implementation of the Framework process. Specific activities include coordination with LPs, completing the analysis of the voluntary studies, and meeting with LPs to develop relevant reintroduction feasibility evaluation criteria. Absent input from LPs, assumptions about biological and engineering design parameters will be made by the Districts, and consistent with the licensing schedule, the study will be completed and filed with the La Grange Hydroelectric Project Final License Application in September 2017.

2.1.2 Reservoir Transit Study

2.1.2.1 Study Goals and Objectives

The goal of the Reservoir Transit Study is to evaluate the downstream movement of juvenile anadromous fish through Don Pedro Reservoir. There is no empirical information regarding migration of juvenile salmonids through Don Pedro Reservoir, as there are no anadromous populations occurring upstream of the reservoir. The purpose of the Reservoir Transit Study is to evaluate juvenile salmonid reservoir passage efficiency through the Don Pedro Project Reservoir by determining estimates of reach-specific migration success. Evaluating reservoir passage efficiency is one component of assessing overall fish passage feasibility and performance, and results of this study will be used to inform the cost estimating, concept design, and siting of alternative downstream passage facilities.

2.1.2.2 Study Methods and Approach

A total of 960 hatchery-reared juvenile Chinook salmon are to be surgically implanted with acoustic transmitters. Eight groups of 60 tagged fish would be released at each of two release sites during the study period: Lumsden (RM 96) and Wards Ferry (RM 78.5), i.e., the only accessible sites near or above the upstream end of the reservoir. Following their release, a combination of fixed and mobile receivers will be used to document movement of juvenile Chinook salmon through Don Pedro Reservoir. Data will be used to determine the proportion of fish that migrate successfully through each study reach.

A request for the requisite number of juvenile Chinook salmon will be submitted to CDFW in 2017 so that if necessary the study can be conducted during 2018. This request will be for fall-run Chinook salmon in a size range representing large young-of-the-year smolts and/or yearlings (95-120 mm).

2.1.2.3 Study Findings

If necessary, this study will be conducted in 2018, after which a report will be prepared.

2.1.2.4 Study Variances

The study has not yet been conducted.

2.1.2.5 Study Status

On July 11, 2016, the Districts distributed the draft Reservoir Transit Study Plan to licensing participants for a 30-day review and comment period. On August 1, 2016, the Districts distributed an amendment to the study plan, which requested comments on the use of fall-run Chinook salmon smolts if the permits needed to acquire ESA-listed spring-run Chinook salmon test fish were denied or not issued in time to complete the Reservoir Transit Study planned for spring 2017. Comments on the study plan and study plan amendment were received from the Central Sierra Environmental Resource Center, the NMFS, and Mr. Lonnie Moore, a private citizen. No parties objected to the use of fall-run Chinook smolts if spring-run Chinook smolts were not available. No changes to the study plan or study plan amendment were necessary to address the comments and on September 16, 2016, the Districts filed the final study plan and their response to comments with FERC. On September 22, the Districts filed with FERC additional copies of the study plan and study plan amendment comment letters.

On September 7, 2016, the Districts received a determination from NMFS that ESA-listed spring-run Chinook salmon would not be available for the study; therefore, fall-run Chinook would be the only potential source of test fish. On September 29, 2016, the CDFW approved the Districts' request for fall-run Chinook test fish. However, in its approval, CDFW required that the Districts use only triploid fall-run Chinook in the study. CDFW noted that at this time, the Iron Gate Hatchery, located on the Klamath River, is the only potential source for triploid fall-run Chinook. On October 20, 2016, the Districts received notice from CDFW that due to low adult fall-run Chinook returns to the Iron Gate Hatchery, there would be no triploid fall-run Chinook test fish available for the Reservoir Transit Study in 2017.

On November 17, 2016, the Districts filed a letter with FERC regarding the availability of test fish and a determination that no fish would be available to support conducting this study in 2017. On January 12, 2017, the Districts filed a letter with FERC stating that with FERC's approval, they intend to conduct the study in 2018 if the results from the Fish Passage Facilities Alternatives Assessment indicate that at La Grange and Don Pedro projects appears feasible and would require anadromous fish transit through one or both reservoirs. Please see Appendix B for further details about this study.

2.1.3 La Grange Project Fish Barrier Assessment

2.1.3.1 Study Goals and Objectives

The purpose of the La Grange Project Fish Barrier Assessment is to evaluate the potential impact of LGDD and the La Grange powerhouse as potential barriers to the upstream migration of adult fall-run Chinook salmon and, if they occur in the lower Tuolumne River, steelhead. This includes documenting the proportion of the fall-run Chinook salmon population that may migrate upstream to these facilities and evaluating potential impacts to fall-run Chinook spawning and production. Specific objectives of the study are to:

- determine the number of fall-run Chinook salmon and steelhead migrating upstream to LGDD and the La Grange powerhouse during the 2015-2016 and 2016-2017 migration seasons;
- compare the number of fall-run Chinook salmon and steelhead migrating upstream to the LGDD and the La Grange powerhouse to total escapement during the 2015-2016 and 2016-2017 migration seasons;
- document carcass condition (egg retention) to evaluate pre-spawn mortality rates of fall-run Chinook salmon and steelhead migrating upstream to LGDD and the La Grange powerhouse, which do not move back downstream to spawn; and
- implement formal documentation of incidental fish observations in the vicinity of LGDD, La Grange powerhouse tailrace, and the TID sluice gate channel. Note that this objective is being addressed as part of the Fish Presence and Stranding Assessment.

2.1.3.2 Study Methods and Approach

Two fish-counting weirs were installed in the Tuolumne River on September 11, 2015. After a brief testing period, weir operation and monitoring began on September 23, 2015 and continued through April 14, 2016. For the 2016-2017 monitoring season, both weirs were installed on September 15, 2016 and monitoring will continue through April 2017. However, due to current flood control releases from Don Pedro Reservoir, weirs have been removed and sampling has been temporarily suspended since January 2, 2017.

One weir segment was placed downstream of the large pool below LGDD in the Tuolumne River main channel, and the second segment was placed just below the La Grange powerhouse in the tailrace channel. Each weir consisted of rigid panels that directed fish through a passing chute that was continuously monitored by a video system. Each weir panel was constructed of steel angle and horizontal pipe with 1⅛-inch spacing and secured in the channel diagonal to the river flow.

The passing chute of the main channel weir consisted of a 3-foot-wide by 4-foot-long white, high-density polyethylene floor secured to the substrate. An overhead camera and an underwater side-view camera were positioned to view the entire passing chute. The tailrace weir consisted of a 6-foot by 6-foot, high-density polyethylene passing chute equipped with an overhead camera

and two underwater side-view cameras. Each passing chute was equipped with an infrared lighting system for 24-hour monitoring.

The overhead cameras at each weir provided full coverage of the passing chute areas and were used to detect passing fish. Individual underwater cameras were used to assist with species identification. The camera systems for each weir were fed into a multi-camera video surveillance application (SecuritySpy) and stored on independent computers. Hourly video files from each camera were saved to external hard drives and downloaded daily for data backup. Motion detection settings were used to create five-second clips of all potential passage events.

Digital video footage was reviewed to identify passage events. Passage date, time, direction of passage, fish species, and estimated fish size were recorded for each event. The certainty of each fish observation was recorded as high, medium, or low. A high certainty rating signified complete confidence in determining species and the presence or absence of an adipose fin; medium certainty signified confidence in determining species, but sex and/or presence of an adipose fin were unknown; and low certainty signified uncertainty in determining species. Raw data were summarized to evaluate daily upstream and downstream weir counts and the total number of fish exhibiting persistent upstream migration behavior (upstream counts minus downstream counts). The total number of fish exhibiting persistent upstream migration behavior was divided by total escapement determined at the downstream weir (at RM 24.5) to estimate the extent to which the La Grange facilities are a barrier to upstream migration and spawning.

2.1.3.3 Study Findings

Both weirs operated almost continuously between September 23, 2015 and April 15, 2016, except during two high-debris flow events on October 17 and October 28 that washed out a portion of the weir in the tailrace channel. Sections of the rigid weir were temporarily removed and reinstalled to make the weir fish-tight, and this resulted in the system being inoperable for a total of 40.8 hours and 27.0 hours, respectively.

Chinook Salmon

Based on data collected between September 23, 2015 and April 14, 2016, 3,264 Chinook salmon passage events (1,617 upstream, 1,647 downstream) were detected at the tailrace and main channel weirs. The first Chinook salmon upstream passage was observed on September 23, 2015 and the last on February 15, 2016. The majority of passage events (89.7 percent) occurred during November and December.

Individual fish were identified based on estimated fish length, sex, and general morphological characteristics. Based on this approach, 105 individual Chinook salmon accounted for the 2,329 passages at the tailrace channel weir, and 12 Chinook salmon accounted for the 935 passages at the main channel weir. Of these, 82 were males and 35 females, and 33 (28 percent) had a clipped adipose fin (i.e., were hatchery-origin fish). Based on morphological characteristics, it is likely that some individuals were detected at both weirs.

Individual Chinook salmon often made multiple, consecutive upstream and downstream passages. At the tailrace weir, elapsed time from initial passage through final passage averaged 119.0 hours (ranging from 0.4 to 823.9 hours). At the main channel weir, elapsed time from initial passage through final passage averaged 183.9 hours (ranging from 4.8 to 491.3 hours).

Total escapement into the Tuolumne River was determined to be 421 adult fall-run Chinook salmon based on weir counts at RM 24.5 between September 28, 2015 and December 31, 2015 (Becker et al. 2016).

Oncorhynchus mykiss

Based on data collected between September 23, 2015, and April 14, 2016, 272 *O. mykiss* passage events (141 upstream, 131 downstream) were detected at the tailrace weir and no *O. mykiss* were detected at the main channel weir. Estimated lengths of *O. mykiss* ranged from 10 cm to 60 cm. Adult-sized *O. mykiss* (>30 cm) accounted for 103 of these passages (45 upstream, 58 downstream). Unlike Chinook salmon, it was not possible to identify individual *O. mykiss*, because there was much less variability in fish length, sex, and general morphological characteristics.

Adult *O. mykiss* were first observed on October 6, 2015, and last observed on March 29, 2016. The majority (83.5 percent) of adult *O. mykiss* detections occurred from November through January. Two adipose-clipped *O. mykiss* (i.e., hatchery-origin fish) observations occurred on February 19 and February 24. Based on estimated length (approximately 50 cm) and general morphological characteristics, these two observations were likely of a single fish.

Three *O. mykiss* (>30 cm) passages were recorded during the winter/spring period (January 1, 2016 to May 13, 2016).

Pre-Spawn Mortality

Based on daily observations during the 2015-2016 monitoring season, there was no Chinook salmon or *O. mykiss* spawning activity upstream of the tailrace channel weir or the main channel weir. CDFW escapement surveys conducted in the Tuolumne River did not document any pre-spawn or partial-spawn Chinook mortalities during the 2015 fall-run monitoring period (Gretchen Murphey, CDFW pers. comm., January 2017).

Other Fish Species

Other fish species observed passing the weirs include bluegill (*Lepomis macrochirus*), carp (*Cyprinus carpio*), goldfish (*Carassius auratus*), largemouth bass (*Micropterus salmoides*), Sacramento pikeminnow (*Ptychocheilus grandis*), Sacramento sucker (*Catostomus occidentalis*), and striped bass (*Morone saxatilis*).

2.1.3.4 Study Variances

No study variances have occurred to date.

2.1.3.5 Study Status

The study is currently in progress. Current reporting summarizes all data collected during the 2015-2016 migration season. Results of the 2016-2017 season will be provided in a final report after monitoring is completed, and all data have been processed. Please refer to the La Grange Project Fish Barrier Assessment Progress Report (Appendix C) for more information about this study.

2.1.4 Topographic Survey

2.1.4.1 Study Goals and Objectives

The goal of the Topographic Survey is to collect information to evaluate the effects of Project operation on stream flow and anadromous fish habitat in the Tuolumne River between LGDD and the La Grange USGS gage. Specific objectives of the survey are to:

- survey a longitudinal profile and transects along the channel thalweg in the La Grange powerhouse tailrace, TID sluice gate channel, and the Tuolumne River mainstem channel upstream of where it joins the tailrace channel and taking survey measurements that characterize the large cobble and bedrock island that separates the La Grange powerhouse tailrace and the mainstem Tuolumne River below LGDD;
- take survey measurements at geomorphic hydraulic control features in the channels below the LGDD and La Grange powerhouse; and
- measure water depths at a flow of approximately 25 cfs in the mainstem river channel upstream of where it joins the tailrace channel and at approximately 75 to 100 cfs in the La Grange powerhouse tailrace channel and the TID sluice gate channel.

2.1.4.2 Study Methods and Approach

The longitudinal and hydraulic control feature surveys were completed using a Real Time Kinematic (RTK) Global Positioning System (GPS). The survey crew collected RTK positions along the thalweg of the channel at approximately every 10 feet. Additional positions were recorded at locations of hydraulic control. A Remote Control Vessel was used along with the RTK GPS and a single beam echo-sounder to record positions in regions of deeper water, such as the large pool at the upstream end of the mainstem channel.

Flows were measured on the same day as the RTK survey. Depths were recorded at each survey location along the longitudinal profiles. The large cobble and bedrock island that separates the La Grange powerhouse tailrace and the mainstem Tuolumne River below LGDD was characterized by existing LiDAR data. The TID sluice gate channel longitudinal profile was developed using the same LiDAR data.

2.1.4.3 Study Findings

The topographic surveys were completed in June and July 2015 and in October 2016 . During the 2015 surveys, two points of hydraulic control were identified in each of the mainstem channel and the La Grange powerhouse tailrace channel. Both channels had a larger pool at the upstream end with a smaller pool about halfway down the reach above the confluence of the channels.

Flows on the days of the 2015 surveys were approximately 25 cfs in the mainstem river channel and approximately 75 cfs in the La Grange powerhouse tailrace channel. Depths in the mainstem river channel ranged from 0.3 to 23.1 feet, with an average of 6.2 feet and a median of 2.9 feet. Depths in the La Grange powerhouse channel ranged from 0.7 to 9.1 feet, with an average of 3.4 feet and a median of 2.2 feet. No water depths were recorded in the TID sluice gate channel during the time of the 2015 survey because the sluice gate channel was dry during both survey days. Operators reopened the 18-inch pipe in the fall of 2015 to allow for a minimum channel maintenance flow of approximately 5 to 10 cfs in the sluice gate channel at all times.

In October 2016 a hydraulic study of the TID sluice gate channel was completed.

2.1.4.4 Study Variances

There was one variance and no modifications to the study plan. At the time of the 2015 survey, there were no flows in the TID sluice gate channel and thus no depth measurements could be collected, as called for in the study plan. The Districts instead collected this information in 2016.

2.1.4.5 Study Status

The study is complete. Please refer to the Topographic Survey Technical Memorandum (Appendix D) for more information about this study.

2.1.5 Salmonid Habitat Mapping

2.1.5.1 Study Goals and Objectives

The Salmonid Habitat Mapping study provides information to examine potential effects of Project operations on anadromous fish habitat in the Tuolumne River in the vicinity of the LGDD and La Grange Hydroelectric Project facilities. Specific objectives of the study are to:

- map substrate and habitat in the main channel and tailrace, delineating the presence of pools, runs, high- and low-gradient riffles, step-pools, and chutes;
- map patches of spawning-sized gravels in the tailrace and main channel that are greater than 2 m^2 (21.5 square feet); and
- conduct pebble counts in riffles, runs, and pool tailouts to document substrate particle size distribution in these habitats.

2.1.5.2 Study Methods and Approach

Habitat mapping was conducted by wading the main channel, tailrace, and sluice gate channel using high resolution aerial imagery as a base map to record mesohabitat unit boundaries. Mesohabitat typing followed USFWS recommendations for channel form and habitat type.

Gravel mapping was conducted by traversing the study area channels and gravel bars on foot using the same aerial imagery as a base map to record distinct units of surface sediment mixtures with a minimum recordable unit of approximately 100 square feet. The facies mapping method used was based on the methodology devised by Buffington and Montgomery (1999). The alluvial surface was classified according to the proportional occurrence of the five most prevalent substrate types: sand, gravel, cobble, boulder, and bedrock.

Four pebble counts were conducted in selected areas using methods developed by Bunte and Abt (2001) to calibrate visual estimates of sediment facies and to document the actual grain size distributions of individual facies.

2.1.5.3 Study Findings

The main channel downstream of LGDD is dominated by pool habitat, including a plunge pool immediately downstream of LGDD, a large mid-channel pool adjacent to the MID hillside discharge, and two smaller pools in the lower portion of the channel. There are three small, low-gradient riffles in the lower portion of the main channel, along with one glide associated with the tailout of the large pool, and a bedrock outcrop separating the large pool from the plunge pool. The total length of the main channel was calculated at 1,773 feet.

Upstream of the La Grange powerhouse, the TID sluice gate channel is a high-gradient step-pool that originates at the TID canal (a non-Project feature) and empties into the pool at the upstream portion of the tailrace channel. The tailrace channel includes two riffles along with one run, one pool, and one glide associated with the tailout of the pool. The length of the sluice gate and tailrace channels were calculated at 383 feet and 699 feet, respectively.

Gravel mapping showed the main channel to be predominately composed of cobble-sized sediments, with varying proportions of gravel and boulder substrates, along with some bedrock outcrops. The four pebble-count samples exhibited a well-graded (poorly sorted) texture, with measurable sizes varying between sand (≈2 mm) and bedrock (>4,096 mm), but with no patches meeting the size ranges suitable for spawning of Chinook salmon (16–78 mm) or *O. mykiss* (10–46 mm).

The tailrace and sluice gate channels were shown to be predominately cobble-bedded with varying proportions of gravel- and boulder-size substrates, along with some bedrock outcrops in the sluice gate channel. Of the two spawning gravel patches mapped in the tailrace channel, only one was suitable for Chinook salmon spawning based on a pebble count D50 of 70 mm. The D50 of 112 mm, based on a pebble count within the other spawning gravel patch, exceeded the suitable range for Chinook (16-78 mm).

There was no suitable spawning gravel for Chinook salmon in the Tuolumne River main channel or sluice gate channel, and no suitable spawning substrate found for *O. mykiss* at any location in the study area. For Chinook salmon, the area of suitable spawning gravel in the tailrace channel was estimated to be 13,610 ft^2. Of that area, 9,014 ft^2 were estimated to meet the spawning depth and velocity criteria projected at approximately 175 cfs.

2.1.5.4 Study Variances

At the request of NMFS representatives during a May 5, 2015 telephone discussion of study implementation, the study was expanded to provide: (1) complete gravel facies mapping of channel and bar features found within the study area; and (2) an expanded assessment of spawning gravel areas with an estimate of maximum potential spawning population sizes of Chinook salmon and *O. mykiss*. Aside from these two additional objectives, there were no variances or modifications to the study.

2.1.5.5 Study Status

The study is complete. On February 2, 2016, the Districts filed the Salmonid Habitat Mapping Technical Memorandum with FERC as part of the ISR (TID/MID 2016b). On April 4, 2016, the Districts received comments on the memo from NMFS. On May 2, 2016, the Districts filed with FERC a response to NMFS' comments. No edits to the Salmonid Habitat Technical Memorandum were necessary to address NMFS' comments; therefore, the memo as filed in the ISR is final.

2.1.6 Fish Presence and Stranding Assessment

2.1.6.1 Study Goals and Objectives

The goal of the Fish Presence and Stranding Assessment is to formally document fish observations in the vicinity of the LGDD, La Grange powerhouse tailrace, and the TID sluice gate channel. Specific objectives of the study are to:

- record daily observations of fish in the immediate vicinities of the LGDD, La Grange powerhouse, and within the sluice gate channel;
- if the La Grange powerhouse trips offline (i.e., unexpectedly stops operating), conduct sluice gate channel surveys to record fish presence and, if necessary, conduct relocation activities; and
- document redds that become dewatered, and the duration of any dewatering, due to changes in La Grange powerhouse operations.

2.1.6.2 Study Methods and Approach

Daily fish observation surveys in the immediate vicinities of LGDD and La Grange powerhouse, and within the TID sluice gate channel, were conducted during fall-run Chinook salmon and steelhead migration periods in the 2015-2016 and 2016-2017 seasons. Surveys were conducted

twice daily: morning surveys were conducted by FISHBIO fisheries biologists/technicians during daily operations and maintenance of the weir associated with the Fish Barrier Assessment. Afternoon surveys were conducted by TID Project operators under the supervision of the TID fisheries biologist.

FISHBIO surveys included observation of the tailrace channel area above the weir, sluice gate channel, and the mainstem Tuolumne River channel from LGDD downstream to where it meets the tailrace channel. Surveys conducted by TID project operators included the tailrace channel area above the weir and the sluice gate channel.

Observations recorded on standardized datasheets included the following:

- observer;
- date and time of survey;
- approximate discharge and sluice gate conduit status at time of survey (flow observations were also post-processed using data from the Project);
- powerhouse output at time of survey;
- number of fish observed and their approximate sizes;
- identification of species, if possible; at a minimum each fish was identified as either a salmonid or non-salmonid;
- locations of fish (indicated on a previously-generated base map);
- description of general fish behaviors, such as moving upstream or downstream, spawning, holding in one specific location, or leaping/jumping;
- notation of any observations of fish swimming into the La Grange powerhouse tailrace; and
- notation of any observations of fish swimming into the TID sluice gate channel.

If La Grange powerhouse trips offline, the TID sluice gate opens immediately to bypass the powerhouse and maintain river flow. Direct observations in the TID sluice gate channel downstream to the end of the La Grange powerhouse tailrace channel (i.e., to the confluence of the tailrace channel and the mainstem Tuolumne River) for the presence and potential stranding of salmonids were conducted during any flow transition from the time of maximum flow in the sluice gate channel through the subsequent closing of the sluice gate and until complete cessation of the sluice gate flow release. Once powerhouse operations were restored and the sluice gate had been closed, an additional survey was conducted to ensure that fish were not stranded in the sluice gate channel.

Powerhouse operators conducted sluice gate channel stranding surveys. A qualified biologist was present during the first five surveys to ensure that surveys were conducted effectively.

Data collected during sluice gate channel stranding surveys included:

- presence of fish;

- species;
- fish location;
- estimated fish length;
- presence of adipose fin clip;
- general condition of fish;
- photo documentation; and, if appropriate,
- relocation time.

2.1.6.3 Study Findings

During the 2015-2016 monitoring period, fish observations occurred twice daily from September 23, 2015 through April 14, 2016. Fish species observed in the tailrace during this period included Chinook salmon, *O. mykiss*, Sacramento pikeminnow, Sacramento sucker, and striped bass. Fish observed in the main channel surveys included bluegill, Chinook salmon, hardhead (*Mylophardon conocephalus*), sculpin (*Cottidae spp.),* Sacramento pikeminnow, Sacramento sucker, and threespine stickleback (*Gasterosteus aculeatus*). No incidences of fish attempting to enter into La Grange powerhouse or the TID sluice gate channel were observed.

During the study, a minimum channel maintenance flow of approximately 5 to 10 cfs was provided in the sluice gate channel (by an 18-inch pipe) at all times to significantly reduce the risk of stranding or dewatering any fish that entered the channel during high flows, i.e., by providing sufficient water to allow fish to exit the channel volitionally at all times. During the 2015-2016 season, if Chinook were observed stranded in the sluice gate channel, a qualified biologist was contacted to conduct salvage activities and relocate them to the tailrace channel (see following paragraph).

La Grange powerhouse tripped offline and the TID sluice gate opened 18 times during the 2015-2016 monitoring period. The duration of flows in the sluice gate channel (above the minimum flow maintained at all times) ranged from 0.25 hours to 505.5 hours. TID operators and a qualified biologist were on-site each time the sluice gate channel was closed and flow was gradually reduced to the minimum flow of approximately 5 to10 cfs. On three occasions fish were documented in the sluice gate channel during stranding surveys, with five adult Chinook salmon observed. Three of these adult Chinook were relocated to the tailrace channel, one swam into the tailrace channel volitionally, and a single un-spawned female carcass was recovered on December 25, 2015.

Biweekly salmonid redd mapping surveys for the 2015-2016 monitoring period began on October 14, 2015 and continued through April 6, 2016. A single Chinook salmon redd was identified in the tailrace channel on November 30, 2015. Based on Levelogger® data, this redd was not dewatered during the monitoring period.

2.1.6.4 Study Variances

No study variances have occurred to date.

2.1.6.5 Study Status

The study is currently in progress. Fieldwork will continue through April 2017. Results of the 2016-2017 monitoring season will be provided in a final report after monitoring is complete and the data have been processed. Please refer to the Fish Presence and Stranding Assessment Technical Memorandum (Appendix E) for more information about this study.

2.1.7 Flow Records for Five Discharge Structures at the La Grange Project

2.1.7.1 Study Goals and Objectives

FERC's SPD recommended that the Districts develop historical flow records for all five "release structures" at the La Grange Project "if existing information allows for some sort of back-calculation method to provide historical estimates." The Districts note that as part of the Don Pedro Hydroelectric Project (FERC No. 2299) relicensing, a list of available flow information for the La Grange Project was provided in the ISR (TID/MID 2013) and an assessment of rates of change of flow as measured at the USGS La Grange gage located just below LGDD was provided in the Don Pedro Project USR (TID/MID 2014b).

2.1.7.2 Study Methods and Approach

The Districts developed spreadsheets that provide hourly flow data for La Grange powerhouse Units 1 and 2, TID sluice gates 1 and 2, the sum of flows at the MID hillside discharge and Portal 1, and the LGDD spillway for the period of January 2005 through October 2015. The Districts continued flow monitoring through the end of water year (WY) 2016.

2.1.7.3 Study Findings

Spreadsheets that provide hourly flow data for La Grange powerhouse Units 1 and 2, TID sluice gates 1 and 2, the sum of flows at the MID hillside discharge and Portal 1, and the LGDD spillway are now available for the period of January 2015 through November 2016.

2.1.7.4 Study Variances

There were no variances or modifications in the implementation of this study.

2.1.7.5 Study Status

The study is currently in progress. Flow data for the remainder of 2016 will be provided in the Final License Application. Please refer to the Flow Records for Five Discharge Structures at the La Grange Project Technical Memorandum (Appendix F) for more information about this study.

2.1.8 Investigation of Fish Attraction to La Grange Powerhouse Draft Tubes

2.1.8.1 Study Goals and Objectives

The goal of the Investigation of Fish Attraction to La Grange Powerhouse Draft Tubes is to evaluate the potential impact of certain La Grange powerhouse facilities on adult fall-run Chinook salmon and *O. mykiss*. Specific objectives of the study are to:

- document adult resident *O. mykiss* and adult anadromous salmonid behavior in the vicinity of the La Grange powerhouse discharge during fall 2015 (fall-run Chinook) to spring 2016 (*O. mykiss*) migration season;
- identify anadromous fish reaching the La Grange powerhouse;
- describe behavioral activities of fish in relation to La Grange powerhouse operations; and
- determine if fish are moving into the draft tubes of operating units.

2.1.8.2 Study Methods and Approach

An imaging sonar unit was installed at the outlet of the La Grange powerhouse on September 1, 2015 to determine if fish attempted to access the La Grange powerhouse or enter the powerhouse draft tubes, and to assess fish behavior in relation to powerhouse operations. The Unit 1 draft tube was the focus of the evaluation because water availability and projected generation indicated that only this unit was likely to operate during the 2015-2016 study period.

Continuous data collection began on September 4, 2015. Data were ported directly to external hard drives and backed up and archived daily. Because analyzing imagery data is time-intensive, monitoring footage was analyzed for five consecutive weeks during the fall-run Chinook salmon migration/spawning period (October-December) and five additional three-day sampling periods after the fall-run Chinook salmon season and *O. mykiss* migration season (January-April/May). This level of effort was considered appropriate given that the Districts had installed a counting weir downstream of the La Grange powerhouse. Weir count data were reviewed retrospectively to optimize the timing of the sonar imaging analysis (i.e., to determine when peak numbers of fish were in the vicinity of the powerhouse). In addition, sonar data were recorded during any unit shutdown periods greater than 24 hours at times when salmonids were expected to be in the vicinity of the tailrace.

For all detected adult-sized (>300 mm) fish, the following data were documented: date, time, estimated total fish length, direction of travel, and whether the fish entered or exited the Unit 1 draft tube. Flow through the powerhouse is also reported. Fish observations are reported by hour, day, month, and total observations. Segmented data clips and images from the footage were extracted to provide general examples of fish observations and behaviors.

2.1.8.3 Study Findings

Results indicate that adult fish frequently occupied the vicinity of the draft tube pit, although they were detected most frequently in the foreground of the field of view and not close to or

under the draft tube. This was true whether Unit 1 was operating or not. Adult fish observations often exceeded 30 per day. Results from the Fish Barrier Assessment indicate that most fish at the tailrace weir were adult salmonids, although striped bass, Sacramento pikeminnow, common carp, and goldfish were observed. Based on this, it is likely that sonar imaging observations included individuals of each of these species. Results of this study indicate that there is little risk of fish entering the draft tube. Because both powerhouse units are similarly configured, it is likely that study results apply to both units. Daily visual observations made during the study period corroborate the study results. No injured or dead adult fish were seen, supporting the conclusion that turbine strike is not occurring at the powerhouse.

2.1.8.4 Study Variances

There was one study variance. The study plan identified January through April as the period for conducting five additional three-day sampling events to assess *O. mykiss* after the fall-run Chinook migration/spawning season. Review of weir data in the tailrace immediately downstream of the monitoring location revealed an increase in *O. mykiss* passages starting in mid-December. To better evaluate potential interactions of *O. mykiss* near the draft tubes, the monitoring period was shifted to mid-December through February, to ensure three-day sampling events corresponded with peaks in *O. mykiss* passage.

2.1.8.5 Study Status

The study is complete. Please refer to the Investigation of Fish Attraction to La Grange Powerhouse Draft Tubes Study Report (Appendix G) for more information about this study.

2.1.9 Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River

2.1.9.1 Study Goals and Objectives

The goal of the Losses of Marine-Derived Nutrients study, as cited by NMFS, is to evaluate the potential effects of the Project and Project-related activities on the degree of reduction in or loss of nutrient replenishment in the upper and lower Tuolumne River. Specific objectives of this study, as requested by NMFS, are described below:

- NMFS Request Element #1: Estimate a range of the historical mass of marine-derived nitrogen transported annually by Chinook salmon (all runs) to the Tuolumne River.
- NMFS Request Element #2: Estimate the historical mass of marine-derived nitrogen that was transported annually by spring-run Chinook salmon to the upper Tuolumne River.
- NMFS Request Element #3: Estimate the current annual mass of marine-derived nitrogen transported by fall-run Chinook salmon to the Tuolumne River.
- NMFS Request Element #4: Estimate annual losses, from historical to current levels, of marine-derived nitrogen transported by fall-run Chinook salmon to the Tuolumne River.

- Estimate the annual loss, from historical to current levels, of marine-derived nitrogen to the upper Tuolumne River.

2.1.9.2 Study Methods and Approach

NMFS Request Element #1 of the study required derivation of three primary variables: (1) estimated historical total annual escapement of all runs of Chinook salmon (i.e., fall-run and spring-run) to the Tuolumne River; (2) estimated average mass of individual adult Chinook salmon; and (3) estimated average nitrogen content of individual fish. Three different approaches were used to develop rough approximations of historical spring-run and fall-run Chinook salmon escapement to the Tuolumne River.

NMFS Request Element #2 required estimation of the historical mass of marine-derived nitrogen transported annually by spring-run Chinook salmon to the upper Tuolumne River. A range in the maximum annual run sizes associated with the three different escapement estimation approaches was used in the calculations.

NMFS Request Element #3 required estimation of the current annual escapement of fall-run Chinook salmon to the Tuolumne River. Current annual escapement was characterized by the recent peak and 10-year average for two time periods (2001-2010 and 2005-2014) in the calculation of transport of marine-derived nitrogen.

NMFS Request Element #4 involved the subtraction of estimates of marine-derived nitrogen transported to the Tuolumne River by fall-run Chinook salmon under current conditions from estimates of historically transported marine-derived nitrogen.

In addition, although not presented as a request element, in its study request NMFS stated that the information to be obtained included an estimate of the annual loss, from historical to current levels, of marine-derived nitrogen to the upper Tuolumne River. This equates to the results of NMFS Request Element #2, that is, a comparison of historical conditions to existing conditions in the upper river (i.e., extirpated spring-run Chinook population).

2.1.9.3 Study Findings

In its study request, NMFS acknowledges that empirical data are not available to estimate historical annual Chinook salmon escapement in the Tuolumne River. Consequently, historical annual escapement estimates, and resultant estimates of marine-derived nitrogen, are highly speculative. The speculative nature of the estimates and necessary assumptions in the estimation methodology are reflected in the extremely broad range of results.

The estimated historical mass of marine-derived nitrogen transported annually by Chinook salmon (all runs) to the Tuolumne River ranged from 34,000 to 315,000 pounds (lbs).

The estimated historical mass of marine-derived nitrogen transported annually by spring-run Chinook salmon to the upper Tuolumne River ranged from 4,400 to 147,000 lbs. Because no Chinook salmon presently return to the upper Tuolumne River, the estimated loss of marine-

derived nitrogen from historical to current conditions in the upper Tuolumne River ranges from 4,400 to 147,000 lbs.

The current estimated annual mass of marine-derived nitrogen transported by fall-run Chinook salmon to the Tuolumne River ranges from 200 to 11,400 lbs. The difference from historical to current escapement levels in the annual mass of marine-derived nitrogen transported by fall-run Chinook salmon to the Tuolumne River is estimated to range from 18,400 to 167,800 lbs. This represents the potential loss of marine-derived nitrogen from historical to current conditions in the lower Tuolumne River. Please refer to the Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River Study Report (TID/MID 2016c) for more information about this study.

2.1.9.4 Study Variances

There were no variances or modifications in the implementation of this study.

2.1.9.5 Study Status

The study is complete. On February 2, 2016, as part of the ISR, the Districts filed with FERC the Effects of the Project and Related Activities on the Losses of Marine-Derived Nutrients in the Tuolumne River Study Report (TID/MID 2016c). On April 4, 2016, the Districts received comments on the study report from NMFS. On May 2, 2016, the Districts filed with FERC a response to NMFS' comments. No edits to the study report were necessary to address NMFS' comments; therefore, the study report as filed in the ISR is final.

2.1.10 Cultural Resources Study

2.1.10.1 Study Goals and Objectives

The goal of the Cultural Resources Study is to assist FERC in meeting its compliance requirements under Section 106 of the National Historic Preservation Act (NHPA), as amended, by determining if the Proposed Action of licensing the Project will have an adverse effect on historic properties. Specific objectives of the study are to:

- in consultation with potentially affected Tribes, BLM, the State Historic Preservation Officer (SHPO), and other interested parties, identify cultural resources within the area of potential effects (APE);
- formulate a plan to evaluate their eligibility to the National Register of Historic Places (NRHP), if needed; and
- identify any Project-related effects on those resources.

2.1.10.2 Study Methods and Approach

The study consisted of seven steps: (1) obtain SHPO approval of the APE; (2) conduct archival research; (3) complete a field survey of the APE; (4) conduct a Tribal field visit to assist in the

identification of traditional cultural properties (TCPs); (5) complete NRHP evaluations of resources that can be evaluated at the inventory level; (6) identify and assess potential effects on NRHP-eligible properties; and (7) provide an inventory report to the Tribes and BLM for review and to SHPO for review and concurrence. The Tribal field visit included an ethnographic review, which included: (1) assessment of potential TCPs in the APE; (2) conducting interviews with knowledgeable Tribal members; (3) organizing Tribal field visits; and (4) incorporating results into the inventory report.

Results of archival research were used to prepare a historic context, which was used in conjunction with data collected during the field survey and tribal outreach to evaluate the NRHP eligibility of resources identified within the APE, where possible, and to produce California Department of Parks and Recreation (DPR) inventory forms for all documented resources. The comprehensive and intensive field survey of the APE was completed in August 2016 in accordance with the Secretary of Interior's Standards and Guidelines for Identification (USDOI 1983) and the BLM Class III/intensive standards, per the BLM's 8100 manual series. Areas of the APE that were inaccessible and/or unsafe to access were not surveyed. Tribal monitors from the Tuolumne Band of Me-Wuk Indians and the Southern Sierra Miwuk Nation accompanied the field crew during the survey.

2.1.10.3 Study Findings

Twenty archaeological and built environment resources were identified within the APE, of which two are eligible for inclusion on the NRHP. These resources include: (1) two isolated finds that are not eligible for inclusion on the NRHP; (2) five newly identified archaeological sites that are not eligible for inclusion on the NRHP; and (3) 13 built environment resources (11 newly recorded), of which two are recommended as eligible for inclusion on the NRHP. The two built resources recommended to be eligible for inclusion are the LGDD and the La Grange Ditch. The La Grange Ditch was previously determined eligible, and SHPO concurred with this determination in a letter dated December 12, 2014. The La Grange Project was also evaluated as a potential historic district, but the Project as a whole was found to have insufficient physical integrity to be eligible for listing on the NRHP as a historic district. No Project-related effects on cultural resources were documented during the study. Based on interviews and background research, there is no evidence of TCPs within the APE.

2.1.10.4 Study Variances

There were no variances or modifications in the implementation of this study.

2.1.10.5 Study Status

The study is complete. Please refer to the Cultural Resources Study Report (Appendix H) for more information about this study.

2.1.11 Recreation Access and Safety Assessment

2.1.11.1 Study Goals and Objectives

Specific objectives of the study are to:

- identify and characterize public use and potential recreation opportunities in the study area; and
- assess the public safety risk of identified recreation opportunities in the study area.

2.1.11.2 Study Methods and Approach

The study area includes the Tuolumne River from approximately RM 51.2 (which is approximately 0.25 mile downstream of USGS gage 11289650) upstream to Don Pedro Dam, located at RM 54.8. The study area includes any potential public access ways that may be reasonably safe and feasible to use along the east and west banks of the Tuolumne River along this reach.

Existing public access routes and site characteristics in the study area were first identified and assessed via desktop study, which included reviewing existing aerial photographs, property ownership data, and topography data and soliciting input from TID and MID staff. Site characteristics that were assessed included proximity to public roads and public trails as well as considerations of slopes adjacent to the La Grange pool and the river.

On June 30, 2016, a site visit with LPs was conducted to gather site-specific information. Observations during the site visit were used to help produce descriptions of each potential public access route, including route length, terrain, and a qualitative description of the route. Site conditions along access ways and along the La Grange pool and river were described and photographed to aid in assessing recreation potential.

A seven-step public safety assessment was completed, which entailed identifying public activities within the study area, identifying hazards and existing risk treatment measures, and assigning incident likelihood ratings and incident consequence ratings to determine the level of risk.

2.1.11.3 Study Findings

Significant portions of the west bank upstream of LGDD, and both banks of the river immediately downstream of it, are owned by TID or MID or are administered by the BLM. This combination of Districts' ownership and public land may present opportunities for public access, subject to considerations of risk, safety, project security and environmental impact.

Upstream of LGDD, an assessment of bank slope within 1 mile of Bonds Flat Road (the nearest public road) and within 75 feet of the high water line indicated that although slopes immediately adjacent to the La Grange pool are generally less than seven percent in grade, but the slopes steepen sharply as you move away from the river bank. A similar assessment completed

downstream of LGDD indicates that grades along this stretch of the river bank are generally less steep.

The public safety assessment determined that upstream of LGDD, current activities are limited to occasional use by the adjacent private property owners. Normal operation of the Don Pedro Project during the irrigation season can cause high and rapid changes in water velocities through the entire reach of the La Grange pool or rapid changes from lower to higher velocities. While shoreline activities could be considered reasonably safe, in-water activities would be high risk. Trail access to the west bank (river right) of the river, while steep, may be feasible, subject to satisfactory resolution of concerns related to public safety and security of the Don Pedro Project facilities located immediately upstream.

Downstream of LGDD, access for fishing and other activities is available to individuals by walking along La Grange Dam Road, which is gated near where the main canal crosses Highway 132. Individuals also walk and wade upstream from a public access point in the town of La Grange near the Old La Grange Bridge. Safety signs are installed throughout the dam and powerhouse area to warn users of potential hazards. The most significant potential risk downstream of LGDD appears to be to individuals fishing in close proximity to LGDD or the powerhouse at the time of a spill event or an increase in flows. In addition, plant and project security issues associated with allowing public access directly to the powerhouse or dam infrastructure must be recognized.

2.1.11.4 Study Variances

A single variance occurred during the Recreation Access and Safety Assessment: based on conditions identified during the site visit, the study area was expanded to encompass potential public access points in reasonably close proximity to the La Grange Project.

2.1.11.5 Study Status

The study is complete. Please refer to the Recreation Access and Safety Assessment Study Report (Appendix I) for more information about this study.

2.2 The Districts' Voluntary Studies

The Districts are currently conducting a number of voluntary studies as part of the Fish Passage Facilities Alternatives Assessment (see Sections 2.2.1-2.2.9 of this USR). In 2015, the Districts voluntarily implemented the Upper Tuolumne River Basin Fish Migration Barriers Study and the Upper Tuolumne River Basin Water Temperature Monitoring and Modeling Study. In addition, based on discussions of identified data gaps held in the Framework Workshops the Districts developed a preliminary list of potential data gap studies, and after licensing participant input, the Districts subsequently drafted and circulated study plans for seven additional voluntary studies: (1) Upper Tuolumne River Chinook Salmon and Steelhead Spawning Gravel Mapping Study; (2) Upper Tuolumne River Habitat Mapping Assessment; (3) Upper Tuolumne River Macroinvertebrate Assessment; (4) Upper Tuolumne River Instream Flow Study; (5) Hatchery

and Stocking Practices Review; (6) Socioeconomic Scoping Study; and (7) Regulatory Context for Potential Anadromous Salmonid Reintroduction into the Upper Tuolumne River Basin.

The study plans were refined through a collaborative process as part of the Framework workshops and final study plans were posted to the La Grange Project licensing website in July 2016. In the summer of 2016, the Districts began implementing these seven additional studies and continued the second year of implementation on the two voluntary studies that began in 2015 (i.e., the Upper Tuolumne River Basin Fish Migration Barriers Study and the Upper Tuolumne River Basin Water Temperature Monitoring and Modeling Study).

2.2.1 Upper Tuolumne River Basin Fish Migration Barriers Study

2.2.1.1 Study Goals and Objectives

The goal of the Upper Tuolumne River Basin Fish Migration Barriers Study is to assess barriers to the upstream migration of adult spring-run Chinook salmon and steelhead in the upper Tuolumne River basin from the upstream extent of the Don Pedro Project Boundary (RM 80.8 at elevation 845 feet) to the CCSF Early Intake (RM 105). Specific objectives of the study are to:

- review and compile results from any relevant prior studies and conduct field surveys to identify barriers (both complete and partial) to upstream anadromous salmonid migration in the mainstem Tuolumne River upstream of the Don Pedro Project Boundary and tributaries; including the North, Middle, and South forks of the Tuolumne River, Cherry Creek, and the Clavey River; and
- characterize and document the physical structure of each barrier under base flow and high flow (i.e., spring runoff) conditions.

2.2.1.2 Study Methods and Approach

Activities performed in 2015 included both desktop exercises and measurements in the field. Desktop exercises focused on the review of existing barrier documentation and were conducted with topographic mapping software, aerial photographs, available hydrologic data, and other information to identify initial accounts of physical features that may potentially be barriers to the upstream migration of spring-run Chinook salmon and steelhead. Once priority locations were identified, field investigations included visual observation and the collection of physical data to confirm site characteristics and draw conclusions regarding the ability of migrating anadromous spring-run Chinook salmon and steelhead to pass physical features that may potentially be barriers.

Features identified within the study area through desktop or field exercises which may or may not be impediments to fish passage are classified in the report as follows:

- Potential Barrier – A feature identified by the study team that may exhibit conditions which create an impediment to upstream fish passage of adult spring-run Chinook or steelhead on a partial or temporal basis but where conclusions have not yet been developed to establish the duration, range of flows, or conditions when or if the feature is passable.

- Partial Barrier – A feature which has been evaluated by the study team and conclusions have been developed which establish a feature as passible on a partial or temporal basis. The term "partial" generally extends to barriers that are impassible by one or more species or life stages of fish species being evaluated. The term "temporal" generally refers to barriers that are impassable intermittently on a seasonal basis or when a certain range of flow, debris, or sediment conditions exist. For the purposes of this study, the term "partial" combines both interpretations.
- Total Barrier – A feature which has been evaluated by the study team and found to be not passable by adult spring-run Chinook or steelhead throughout the range of flows when migration is anticipated.
- Passable Feature – A feature which has been evaluated by the study team and found to be passable by adult spring-run Chinook or steelhead throughout the range of flows when migration is anticipated.

The presence and/or absence of barriers to upstream passage and findings regarding the ability of fish to pass identified features employed a phased approach as described below.

- A list of potential barriers to upstream passage was initially developed based upon the information gathered by desktop methods.
- Field surveys were performed to gather physical data at each feature and to characterize major elements which influence fish passage.
- A screening level barrier assessment was performed using data from desktop review and the field surveys.
- Each feature identified was classified as one of the following: (1) a "total barrier" to fish passage; (2) a "passable feature"; or (3) a "potential barrier" to fish passage. The initial classification was based upon screening criteria.
- Potential barriers requiring additional field surveys, further evaluation, and final classification were identified and recommendations for activities to be performed in the 2016 field season were made.

2.2.1.3 Study Findings

The work conducted in 2015 and 2016 included a review of existing data, collection of field data, and analysis of all the resulting available data. Study findings included the identification of the following features:

- One partial barrier and one total barrier on the mainstem of the Tuolumne River;
- Seven potential barriers and one total barrier on North Fork Tuolumne River;
- Two partial barriers and one total barrier on the Clavey River;
- Seventeen partial barriers and one total barrier on the South Fork Tuolumne River; and
- Four partial barriers and one total barrier on Cherry Creek.

Conclusions from this study suggest that the mainstem Tuolumne River is accessible by anadromous fish to Lumsden Falls at RM 97.3 and may potentially be accessible from Lumsden Falls to Early Intake at RM 104.3. The mainstem Tuolumne River is not accessible upstream of Early Intake. The lower 1.69 miles of the North Fork Tuolumne River are also potentially accessible during adequate flow conditions, while the reach upstream of RM 1.69 is not accessible. The lower 2.05 miles of the Clavey River are potentially accessible during adequate flow conditions, while the Clavey River upstream of RM 2.05 is not accessible by anadromous fish. The lower 1.9 miles of the South Fork Tuolumne River are also potentially accessible during adequate flow conditions, while the reach upstream of RM 1.9 is not accessible. The Middle Fork Tuolumne River originates upstream of RM 1.9 of the South Fork and therefore is also not accessible by anadromous fish. The lower 1.62 miles of Cherry Creek are also potentially accessible during adequate flow conditions, while the reach upstream of RM 1.62 is not accessible.

2.2.1.4 Study Status

The study is complete. Please refer to the Upper Tuolumne River Basin Fish Migration Barriers Study Report (Appendix J) for more information about this study.

2.2.2 Upper Tuolumne River Basin Water Temperature Monitoring and Modeling Study

2.2.2.1 Study Goals and Objectives

Specific goals and objectives of the study are to:

- use existing data to characterize the thermal regimes of the upper Tuolumne River and tributaries from Early Intake (RM 105) to the upstream limit of the Don Pedro Project Boundary (RM 80.8 at elevation 845 feet) and portions of the North and South forks of the Tuolumne River, Cherry Creek, and Clavey River. This will form the basis of future work that will identify potential locations where temperatures may be suitable for the potential reintroduction of anadromous salmonids;
- depending on the availability of information, logistical feasibility, and safety, install water temperature and/or stage data loggers to obtain additional information at locations for which existing data are inadequate; and
- develop and test a computer model to simulate existing thermal conditions in the Tuolumne River from below Early Intake to the upstream extent of the Don Pedro Project Boundary. The focus of the Upper Tuolumne River Flow and Water Temperature Model Update is to update and apply the existing Tuolumne River model by calibrating it with measured data collected by multiple sources between 2008 and 2016. Sub-daily flow and water temperature are simulated to provide detailed spatial and temporal information that allow development of sub-daily temperature metrics.

2.2.2.2 Study Methods and Approach

The monitoring study involved identifying, synthesizing, and interpreting existing data (temperature, flow, meteorological, etc.), and the installation of additional water temperature and stage data loggers as needed. Data collected were reviewed using a quality assurance/quality control process (QA/QC) and used for model data development.

The modeling study included four major components: development of a conceptual framework, model selection, model development, and model application. The development of the conceptual framework provided focus and direction. A review of appropriate computer models resulted in the selection of RMA-2 and RMA-11 to accommodate this high gradient reach, wide range of flows, and dynamic hydropower peaking regime. Model development was further divided into data development, implementation, and calibration phases. As part of the data development process, the geometry, flow, temperature, and meteorological data were compiled, reviewed, and formatted as required by the models. Model implementation included developing the initial model conditions and specifying the model parameters and coefficients. Once data were prepared and the model developed, the calibration phase began. Model performance at the calibration locations was assessed both graphically and statistically.

2.2.2.3 Study Findings

Preliminary findings indicate that water temperature data collected throughout the study area during 2015 and 2016 are consistent with historical data collected through 2014. The 2015-2016 data at all sites exhibit seasonal trends similar to historical patterns, and maximum and minimum temperatures are comparable to those of previous years. Data collected at additional tributary locations have been useful for characterizing longitudinal thermal regimes in these systems.

Temperature model development, calibration and validation activities are in progress.

2.2.2.4 Study Status

The study is currently in progress.

2.2.3 Upper Tuolumne River Chinook Salmon and Steelhead Spawning Gravel Mapping Study

2.2.3.1 Study Goals and Objectives

The goal of the Upper Tuolumne River Chinook Salmon and Steelhead Spawning Gravel Mapping Study is to characterize spawning gravel in the upper Tuolumne River. Specific objectives of the study are to:

- map the distribution of potentially suitable spawning gravel available for Chinook salmon and steelhead in the approximately 23.8-mile reach of the upper Tuolumne River (hereafter study area) from the upstream limit of the Don Pedro Project Boundary (RM 80.8 at elevation 845 feet) to Early Intake (approximately RM 105);

- quantify the amount of suitable spawning gravel for each species; and
- assess the quality of potentially suitable spawning gravel based on particle characteristics (i.e., size, sorting, angularity, and embeddedness), gravel depth, and permeability.

2.2.3.2 Study Methods and Approach

The first step in characterizing spawning gravel was to conduct desktop mapping of spawning gravel deposits. The area inundated at approximately 130 cfs, the flow at which the best available aerial photography was taken in 2007 (Towill Inc. 2007), was defined by digitizing the water's edge observed in the imagery in GIS. Gravel patches visible in the 2007 aerial photographs were also initially delineated by digitizing in GIS.

Field reconnaissance was conducted in June 2016 to calibrate and validate the preliminary desktop mapping. The boundaries of all potentially suitable spawning gravel patches were field-delineated from the Cherry Creek confluence to the upstream limit of the Don Pedro Project Boundary. Field tiles used for mapping included the desktop gravel mapping, 2007 aerial photographs, river stationing, and the initial inundation area. Mapping was conducted by a two-person crew using the support of two whitewater rafts.

Each spawning gravel patch was described in terms of bed surface texture (i.e., facies), grain size parameters (D_{50}, D_{84} and D_{16}), geomorphic feature type (i.e., bar form), and spawning gravel quality (substrate depth, particle sorting, angularity, and embeddedness).

After spawning gravel deposits were mapped in the field, gravel permeability (Barnard and McBain 1994) was evaluated in select spawning gravel patches from pool tail, point bar, medial bar, and lateral bar geomorphic units with gravel-dominant facies, cobble or finer subdominant facies, and an estimated D84 ≤128 mm (i.e., small cobble or finer).

2.2.3.3 Study Findings

The processing and analysis of data for this report are in progress.

2.2.3.4 Study Status

The study is currently in progress.

2.2.4 Upper Tuolumne River Habitat Mapping Assessment

2.2.4.1 Study Goals and Objectives

The goal of this study is to provide information on aquatic habitat distribution, quantity, and quality in the upper Tuolumne River. This information will inform evaluations in the context of the Framework and will be critical for assessing the feasibility of anadromous salmonid reintroduction, estimating potential carrying capacity, and developing passage engineering alternatives for the upper Tuolumne River. Specific objectives are to:

- document the number, size, and distribution of mesohabitat units in the upper Tuolumne River;
- collect detailed data on habitat attributes in representative reaches of the upper Tuolumne River; and
- document potential pool holding habitat that could be used for over-summering by adult Chinook salmon.

2.2.4.2 Study Methods and Approach

Mapping was used to quantify the type, amount, and location of habitats that would be available to riverine life stages (adult holding/spawning, incubation, and rearing) of anadromous salmonids if they were to be reintroduced into the upper Tuolumne River basin. Habitat mapping was conducted both in the field and remotely using standardized methodologies. Raft-based surveys were conducted from July 17, 2016 to July 31, 2016, which consisted of mesohabitat mapping and habitat inventory mapping.

Reconnaissance-level mesohabitat mapping that began in summer 2015 was completed from July 17 to July 23 from Merals Pool (RM 96) to approximately RM 80.8 (upper extent of the Don Pedro Project Boundary). Flow during this period ranged from 300 cfs to 1200 cfs. Mapping was conducted from a raft, and mesohabitat boundaries were recorded with GPS, and GIS analysis was used to quantify the length of each habitat unit.

Mapping was conducted from Early Intake (RM 105) to Merals Pool (RM 96) from July 28 to July 31. Flow during this period ranged from 300 cfs to 1200 cfs. Due to the high gradient and large number of rapids upstream of Merals Pool, it was not feasible to conduct mesohabitat typing with a GPS and map book (as was done downstream of Merals Pool). Instead, mesohabitat typing was conducted via post-processing of geo-referenced GoPro® video that was recorded during the raft survey, and GIS analysis was used to quantify the length of each habitat unit.

Mapping was contiguous, with each habitat unit abutting the next unit. Each distinct habitat unit was numbered consecutively in an upstream direction. Individual habitat units were delineated where the unit length was at least equal to the active channel width or if the unit was otherwise distinctive.

Additional detailed habitat measurements were made following the CDFW Level III habitat typing methodology (CDFG 2010) during the same periods the mesohabitat work referenced above was conducted. Habitat inventory mapping was conducted during the daily low flow during this period of approximately 300 cfs. Two surveyors collected the habitat data, which included unit type, unit length, large woody debris counts, and substrate characteristics. Other data were collected as appropriate to the habitat unit (e.g., pool depths and pool tail embeddedness). Detailed habitat mapping was conducted at seven sites totaling a length of 28,701 feet (5.4 miles), which represents 21.7 percent of the study reach.

2.2.4.3 Study Findings

Data processing and analysis is ongoing.

2.2.4.4 Study Status

The study is currently in progress.

2.2.5 Upper Tuolumne River Macroinvertebrate Assessment

2.2.5.1 Study Goals and Objectives

The Upper Tuolumne River Macroinvertebrate Assessment is being conducted to characterize prey resources generally available to support an existing or reintroduced salmonid population and evaluate aquatic habitat condition (i.e., biological integrity) of the upper Tuolumne River study area. Specific objectives of the study are to:

- collect and analyze macroinvertebrate drift samples to determine whether the taxonomic composition and density of drift is consistent with other regional systems currently supporting healthy salmonid populations; and
- collect and analyze benthic macroinvertebrate samples from the substrate to develop metrics for bioassessment of aquatic ecosystem health and compare results with similar streams and datasets.

2.2.5.2 Study Methods and Approach

Sampling was conducted once in summer 2016 and once in fall 2016. The methods and approach for the fall sampling are the same as those described for the summer sampling.

Field Sampling

Macroinvertebrate sampling was conducted in the upper Tuolumne River from July 17 to July 21, 2016 and from July 27 to July 30, 2016 in conjunction with the Upper Tuolumne River Habitat Mapping Assessment. Samples of drifting and benthic macroinvertebrates were collected at seven sites distributed along the length of the study area. Physical habitat characteristics, water velocity, and basic water quality parameters were measured at each site. Drift samples were collected in riffle or run habitats at two locations per site, with two replicates (net placements) per site. The net width, submerged depth, water velocity, and duration were recorded for each drift sample to compute the volume of water sampled per unit time. Samples were preserved for processing in the laboratory.

Benthic macroinvertebrate sampling was conducted with a modified version of the targeted riffle composite (TRC) method described in the SWRCB Surface Water Ambient Monitoring Program (SWAMP) Bioassessment Standard Operating Procedure (Ode 2007, Ode et al. 2016). A composite sample was collected from a fast-water habitat at seven sampling sites. Subsamples

were collected within a 0.09 m^2 (1 square foot) area with a kicknet fitted with a 500-µm (0.02-inch) mesh net.

Laboratory Analysis

Aquatic invertebrates are to be identified according to the Southwestern Association of Freshwater Invertebrate Taxonomists (SAFIT) (Richards and Rogers 2011) Level 1 standard taxonomic effort, and terrestrial invertebrates were identified to order. For drift samples, density (number of individuals per unit volume of water) and biomass (dry mass per unit volume of water) of organisms were calculated.

Standard metrics will be computed to characterize benthic macroinvertebrate assemblages and used as indicators of disturbance. A subset of these metrics will be used to calculate indices of biotic integrity. Metrics for benthic samples will be compared to data collected on the lower Tuolumne River in summer 2009 and the upper Merced River in 2007.

2.2.5.3 Study Findings

Lab analysis of samples collected in summer 2016 is complete; samples collected in fall 2016 are currently being processed.

2.2.5.4 Study Status

The study is currently in progress.

2.2.6 Upper Tuolumne River Instream Flow Study

2.2.6.1 Study Goals and Objectives

Results of this study will be used to evaluate habitat suitability for spring-run and fall-run Chinook salmon and steelhead in the upper Tuolumne River. Specific objectives of the study are to:

- model existing aquatic habitat over a representative range of site-specific hydrologic conditions, and
- provide quantifiable metrics of habitat suitability to be used as part of the overall evaluation of the feasibility of potential Chinook salmon and steelhead reintroduction.

2.2.6.2 Study Methods and Approach

Reach and Site Selection

The study area is the Tuolumne River from the upstream extent of the Don Pedro Project Boundary (RM 80.8) to Early Intake (RM 105). Five subreaches within the study area were delineated based on: (1) geomorphology; (2) hydrology; (3) habitat mapping; (4) spawning gravel mapping; and (5) existing aerial imagery (Towill Inc. 2007). Two reaches were removed

from consideration based either on safety and logistical considerations or the potential for reservoir inundation. After further refinement and field reconnaissance, the following study sites were identified:

- Upper Subreach - Tin Can Cabin (RM 93.5)
- Middle Subreach - Wheelbarrow (RM 87.3)
- Lower Subreach - Mohican (RM 81.9)

Field Data Collection

Field data collection included a topographical survey to develop the model surface and the collection of hydraulic data to calibrate the 2-dimensional models. Data collection was completed by teams of six over a continuous seven-day period.

Initial topography was based on LiDAR data collected by the USFS from November 6 - 24, 2013. LiDAR data were collected when river flow was approximately 130 cfs. Upland areas not adequately represented by the LiDAR were surveyed in the field. Bathymetric surveys were conducted in areas that were submerged during the LiDAR data collection.

Model calibration was based on discharge (i.e., calibration flow), water surface elevation, water velocity, and water depth. Two high-flow and two low-flow events were measured at each study site. Data were collected using an acoustic Doppler current profiler (ADCP). To ensure flow stability during each calibration data collection period, at least three measurements were made or until a difference of 10 percent or less from the average was observed. Water surface elevation, depth, and velocity measurements were made through the full length of each site and in association with a specific measured discharge. Depth and velocity calibration data were collected either manually with a Swoffer or Marsh-McBirney flow meter or with an ADCP. All data were spatially referenced. Changes in water surface elevation and depth were monitored throughout each study site to develop site-specific stage-discharge relationships. Substrate and cover were mapped at each study site. Substrate and cover information were recorded by drawing polygons on a series of high resolution aerial images. Polygons were later geo-referenced in a GIS program.

Field Data Processing and Surface Development

To generate a complete channel surface, processed field data were integrated with LiDAR data collected by NMFS in 2014 for out-of-water and upland topography. Further quality control was performed by evaluating the surface for irregularities that may have arisen from survey errors not noted in the field. Final surface files were generated and imported into the River2D model platform.

The River 2D model will be used to simulate approximately a range of discharges at each study site, resulting in an expected flow range of 50 to 1,200 cfs. Habitat suitability and weighted useable area will be computed for each Chinook salmon and steelhead life-stage for each simulation flow. Habitat suitability will be based on a fish preference file (i.e., habitat suitability

criteria), a channel index, depth, and velocity. Channel index files are a River2D equivalent of a substrate and/or cover map for a study site.

2.2.6.3 Study Findings

Field data collection is complete. All topographic and bathymetric data have been processed, compiled, and reviewed, and surfaces for each study site have been developed. Activities in progress include calibration data processing and the development of preliminary stage and flow hydrographs, preliminary stage-discharge relationships and two-dimensional model development.

2.2.6.4 Study Status

The study is currently in progress.

2.2.7 Socioeconomic Scoping Study

2.2.7.1 Study Goals and Objectives

A component of the Framework is the exploration of economic considerations associated with the implementation of a potential anadromous fish reintroduction program in the upper Tuolumne River basin. The Socioeconomic Scoping Study Plan identified the need to gather information on existing uses in the Tuolumne River basin to inform the assessment of passage and reintroduction alternatives and assess potential positive and negative impacts on existing socioeconomic conditions in the watershed.

Initially proposed as a review with a study area similar to the biological studies being conducted upstream of Don Pedro Reservoir, LPs recognized that anadromous fish passage or reintroduction in the Tuolumne River could be influenced by and influence socioeconomic conditions at a broader regional scale. Therefore, the study area was expanded to encompass the Tuolumne River basin, including the upper Tuolumne River, as well as Don Pedro Reservoir and the mainstem Tuolumne River to its confluence with the San Joaquin River.

The goal of this study is to describe the human environment, activities, and current uses of resources and facilities in the study area that may be impacted by constructing and/or operating fish passage facilities and the introduction of anadromous fish.

2.2.7.2 Study Methods and Approach

A literature review of resources associated with the Tuolumne River basin and other economic activities in the study area is underway. As the ecological, biological, and technical feasibility components of the Framework are completed, interviews with key resource users and agency personnel may be conducted to further develop necessary information to complete an analysis of socioeconomic conditions that may be impacted by any proposed fish passage or reintroduction alternatives. The Socioeconomics Study completed for the Don Pedro Project relicensing provides extensive information on the human environment and socioeconomic resources and

activities in the lower Tuolumne River, and will be useful as part of any assessment of socioeconomic impacts of future proposals (TID/MID 2014b).

2.2.7.3 Study Findings

Data has been collected and compiled, report preparation is ongoing.

2.2.7.4 Study Status

The study is currently in progress.

2.2.8 Regulatory Context for Potential Anadromous Salmonid Reintroduction into the Upper Tuolumne River Basin Study

2.2.8.1 Study Goals and Objectives

One component of the Framework is the exploration of regulatory considerations associated with the implementation of a potential anadromous fish reintroduction program in the upper Tuolumne River basin. There is a complex, overlapping, and sometimes conflicting set of federal, state, and local laws relevant to natural resources management decisions being considered for the upper Tuolumne River basin. These laws, in conjunction with regulations, comprehensive plans, and policy directives, provide management direction for specific geographic areas or species at varying scales.

The goal of the Regulatory Context for Potential Anadromous Salmonid Reintroduction into the Upper Tuolumne River Basin Study is to review resource management plans and federal, state, and local regulations that may have relevance to the potential reintroduction of fall-run Chinook salmon and steelhead into the upper Tuolumne River (i.e., upstream of Don Pedro Reservoir) and spring-run Chinook into the Tuolumne River basin, where the run currently does not occur. With the potential reintroduction of anadromous salmonids, regulatory requirements related to such laws as the Endangered Species Act (spring-run Chinook and steelhead are ESA-listed threatened species), Magnuson-Stevens Fishery Conservation and Management Act, Clean Water Act, National Environmental Policy Act, Federal Land Policy and Management Act, National Forest Management Act, and California Environmental Quality Act may become relevant to activities occurring in the study area. Specific objectives of the study are to:

- identify applicable existing legal precedent, regulatory guidance, and resource management plans in the study area;
- identify additional regulatory guidance and rules that may apply to or affect the reintroduction of fall-run and spring-run Chinook and/or steelhead; and
- identify federal, state, and local regulatory issues associated with a potential fish passage/reintroduction program.

2.2.8.2 Study Methods and Approach

Step 1 of the study was to identify and assemble relevant documents for the study area. State and federal resource management agencies and other entities participating in the development of the Framework were asked to identify relevant plans. Step 2 was to review the resource management documents and create a summary. A comprehensive matrix of planning goals and regulations was developed to summarize salient details, including species, relevant resource area(s), geographic scope, management goals, proposed actions, and applicable laws and regulations that could pertain to the potential reintroduction of Chinook and/or steelhead or fish passage activities in the basin.

2.2.8.3 Study Findings

Data has been collected and compiled, report preparation is ongoing.

2.2.8.4 Study Status

The study is currently in progress.

2.2.9 Hatchery and Stocking Practices Review

2.2.9.1 Study Goals and Objectives

The goal of the Hatchery and Stocking Practices Review study is to assess historical and current hatchery stocking practices in the Tuolumne River basin and adjacent watersheds, and identify potential interactions between stocking activities and the possible reintroduction of anadromous salmonids to the reach of the Tuolumne River between Don Pedro Reservoir and Early Intake. Specific objectives of this study are to:

- identify species, source hatcheries, and their stocking practices in the area, and time periods of fish introduction associated with historical stocking in the Tuolumne River, tributaries to the Tuolumne River, and in Don Pedro Reservoir;
- identify release locations and seasonal release timing for species currently stocked (and that may be stocked in the future) in the Tuolumne River, tributaries to the Tuolumne River, and in Don Pedro Reservoir;
- identify stocking activities in the San Joaquin River and its other tributaries;
- identify and describe self-sustaining potamodromous populations (species of fish that migrate, upstream or downstream, exclusively in freshwater) originating from previously stocked species, their life-history characteristics, and population characteristics, as available;
- identify available information on documented incidents of disease in hatchery stocks and in the Tuolumne River basin;
- describe life histories of stocked species, as well as their spatial and temporal migrations and distributions, to identify the potential for them to interact with reintroduced anadromous salmonids;

- describe potential spatial and temporal overlap of stocked species and life-stages with potentially reintroduced species (i.e., steelhead and spring-run Chinook salmon) and life stages in the Tuolumne River; and
- identify potential effects of historical and existing/future hatchery and stocking practices on efforts to reintroduce anadromous salmonids to the upper Tuolumne River.

2.2.9.2 Study Methods and Approach

A desktop literature review was conducted, which includes a review of agency technical memoranda, fish stocking data, fish health information, journal articles, and websites used to identify and describe historical, current, and potential future hatchery and stocking practices in the Tuolumne River watershed and greater San Joaquin River Basin. Agencies and organizations involved with hatchery and stocking activities, including the Don Pedro Recreation Agency (DPRA) and CDFW, were also contacted to gather additional information on historical and existing fish stocking activities in the study area.

Based on the information collected regarding stocking practices, existing hatchery operations, life histories of stocked fish species, and literature on interactions between stocked fish species and anadromous salmonids, potential effects of hatchery and stocking practices on an anadromous salmonid reintroduction effort were described and evaluated. Potential risks to an anadromous salmonid reintroduction program associated with hatchery and stocking practices were also identified and described.

2.2.9.3 Study Findings

The species of fish that are currently or were historically stocked within the Tuolumne River basin spawn and rear in habitats that are very similar to those preferred by the salmonid species/runs being considered for reintroduction and could result in deleterious interactions among stocked species and reintroduced salmonids.

It is well documented that stocking nonnative fishes can impact native fish communities via direct predation, competition for food and habitat, interbreeding/hybridization, and the spread of disease (Pacific Rivers Council 2006; Kostow 2009; Araki et al. 2008). Specifically, potential interactions between stocked fish species and reintroduced anadromous salmonids include competition for spawning habitat, hybridization and genetic impacts, competition for rearing resources, juvenile predation, and increased incidence of disease. The extent and intensity of potential impacts would depend on many factors and cannot be predicted at this time, but it is not uncommon for nonnative species to outcompete native species in western Sierra Nevada watersheds, sometimes resulting in extirpation of native species.

2.2.9.4 Study Status

The study is complete. Please refer to the Hatchery and Stocking Practices Review Study Report (Appendix K) for more information about this study.

2.3 NMFS Studies

On January 25, 2017, NMFS provided to the Districts a status update regarding two ongoing NMFS studies: (1) Genetic Evaluation of *O. mykiss* Populations in the Upper Tuolumne and Merced Watersheds and (2) Estimation of Steelhead and Spring-Run Chinook Salmon Habitat Capacity in the Upper Tuolumne and Upper Merced Rivers. NMFS' update is appended to this USR as Appendix L.

3.0 UPDATED STUDY REPORT MEETING

FERC regulations at 18 CFR 5.15(f) require the Districts to hold a meeting with participants and FERC staff within 15 days following USR filing. The Districts' USR meeting will be held on Thursday, February 16, 2017, at Modesto Irrigation District's office located at 1231 11th Street in Modesto, California. Following the meeting, the La Grange Project licensing schedule is as follows:

- March 3, 2017 – Districts file USR meeting summary
- April 2, 2017 – LPs file disagreements with meeting summary and recommendations for modified or new studies
- April 24, 2017 – Districts file Draft License Application
- May 2, 2017 – Districts file response to April 2 comments
- June 1, 2017 – FERC issues determination on meeting summary disagreements and recommendations for modified or new studies

4.0 NOTICE OF INTENT TO FILE DRAFT LICENSE APPLICATION

FERC regulations at 18 CFR 5.16(c) require the Districts to file notice of intent to file a Draft License Application (DLA) in this Updated Study Report. Per these regulations and the schedule approved by FERC on May 27, 2016 in its Determination on Requests for Study Modifications and New Study, the Districts plan to file the La Grange Project DLA no later than April 24, 2017.

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