

**Conservation Groups’  
Upper Tuolumne River Anadromous Fish Habitat Assessment  
Study Request**

**1.0. Background**

The requested study will inform the Commission and licensing participants about the current quantity and quality of suitable habitat for salmonids in the upper Tuolumne River watershed.

The Tuolumne River is known to have been historically inhabited by Central Valley steelhead (“DPS”), Central Valley fall-run Chinook salmon, and Central Valley spring-run Chinook salmon (“ESU”).<sup>1</sup> Clavey Falls, at the confluence of the Clavey River, may have obstructed salmon migration at certain flows, but spring-run salmon and steelhead undoubtedly ascended the mainstem past Clavey Falls for a considerable distance. Spring-run salmon and steelhead were most likely blocked from further upstream migration by Preston Falls, four miles upstream of the present Early Intake Dam, about 50 miles upstream of the present Don Pedro Dam. Today, the City and County of San Francisco’s Early Intake Dam is the upstream limit of native fish distribution, including Sacramento suckers, riffle sculpins, and California roach, on the mainstem Tuolumne River.<sup>2</sup>

Steelhead once occupied the upper reaches of the mainstem Tuolumne (324.8 km mainstem).<sup>3</sup> Steelhead likely ascended Cherry Creek and the Clavey River but not the South and Middle Forks of the Tuolumne, where there are formidable waterfalls within a short distance of the South Fork’s confluence with the mainstem.<sup>4</sup>

Central Valley spring-run Chinook and Central Valley Steelhead are now listed as threatened under the federal Endangered Species Act. Central Valley fall-run Chinook are designated as species of special concern.

One of the major causes of the decline in anadromous fish populations in the Tuolumne River is blocked access to historically occupied upper Tuolumne River habitat by the La Grange

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<sup>1</sup> Lindley, S. T., R. S. Schick, A. Agrawal, M. Goslin, T. E. Pearson, E. Mora, J. Anderson, B. May, S. Greene, C. Hanson, A. Low, D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams, “Historical Population Structure of Central Valley Steelhead and its Alteration by Dams.” *San Francisco Estuary and Watershed Science* 4(1)(3):1-19 (Feb. 2006); available at: <http://repositories.cdlib.org/jmie/sfews/vol4/iss1/art3>. See also Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle, “Historical and present distribution of Chinook salmon in the Central Valley drainage of California” (2006), pp. 71-176 in California Department of Fish and Game, “Contributions to the Biology of Central Valley Salmonids,” *Fish Bulletin* 179, p. 100.

<sup>2</sup> *Id.*

<sup>3</sup> *Id.*

<sup>4</sup> Pers. Comm. Michael Martin, PhD., fisheries biologist and local landowner (July 2014).

Dam.<sup>5</sup> La Grange Dam, constructed in 1893, completely blocked upstream migration of anadromous fish.<sup>6</sup> La Grange Dam remains the terminal barrier to upstream migration of anadromous fish in the Tuolumne River today.

Turlock Irrigation District operates the La Grange Project powerhouse. Modesto and Turlock Irrigation Districts (collectively, “Districts”) operate La Grange Dam for water supply and power purposes and to make fish flow releases required under the Don Pedro License. Whether the Districts use La Grange facilities to reregulate releases from Don Pedro Powerhouse is a disputed issue currently pending before the D.C. Circuit Court of Appeals.<sup>7</sup> Don Pedro Dam is approximately 2.3 miles upstream of La Grange Dam. There is no dispute that the Districts coordinate operation of the La Grange and Don Pedro Projects for water supply and power purposes.

There is little riverine habitat between La Grange Dam and Don Pedro Dam. La Grange Diversion Pool is not significantly fluctuated in its stage height, and its backwater extends effectively to Don Pedro Dam.<sup>8</sup> There would likely be little benefit to providing fish passage at La Grange Dam alone, since fish that passed La Grange Dam would be blocked almost immediately by Don Pedro Dam, resulting in no significant increase in spawning or rearing habitat for anadromous salmonids. This study request therefore focuses on the nearest substantial riverine habitat upstream of La Grange Reservoir: the Tuolumne River upstream of Don Pedro Reservoir.

In addition to the Districts’ projects, the upper Tuolumne River has been extensively developed by the City and County of San Francisco’s Hetch Hetchy Water and Power Project. Dams and diversions modify flows of the Tuolumne River, Cherry Creek, Eleanor Creek, and Moccasin Creek. San Francisco Public Utilities Commission (“SFPUC”) has initiated study of the upper Tuolumne River flows and habitat relationships and summarized finds in a report titled “Upper Tuolumne River Ecosystem Project O’Shaughnessy Dam Instream Flow Evaluation Study Plan.”<sup>9</sup> However, this report does not analyze the habitat as it would be applicable to reintroduced anadromous fish.

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<sup>5</sup> National Marine Fisheries Service, “Public Draft Recovery Plan for the Evolutionary Significant Units of Sacramento River Winter Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead” (Draft Recovery Plan) (2009), p. 3. Available at <http://swr.nmfs.noaa.gov/recovery/centralvalleyplan.htm>. The Final Recovery Plan is scheduled for release on July 22, 2014.

<sup>6</sup> Yoshiyama, p. 101.

<sup>7</sup> Turlock Irrigation Dist., et al. v. FERC, Nos. 13-1250 and 13-1253 (D.C. Cir. filed Sept. 13, 2014).

<sup>8</sup> See Order on Rehearing, eLibrary no. 20130719-3031, ¶73, p. 29.

<sup>9</sup> McBain & Trush, “Upper Tuolumne Ecosystem Project O’Shaughnessy Dam Instream Flow Evaluation Study Plan” (July 7, 2009), p. 27.

The National Marine Fisheries Service’s (“NMFS”) Draft Recovery Plan<sup>10</sup> identifies the Upper Tuolumne River above Don Pedro Reservoir as a candidate area for reintroduction of steelhead and spring-run Chinook salmon to further recovery of these threatened species. The plan includes recommendations for evaluating and implementing a recovery plan on the Tuolumne River watershed for these protected species and their habitats.<sup>11</sup> Information produced during this study may also be used to inform NMFS’ exercise of authority under Federal Power Act (“FPA”) sections 10(j), 18, and consultation under Endangered Species Act (“ESA”) section 7 for the licensing/relicensing of the La Grange and Don Pedro projects.<sup>12</sup>

## **2.0. Evaluation of upper Tuolumne River Mainstem and Tributary Habitat for Spring-run Chinook Salmon and Steelhead: Study Elements**

### **2.1. Establish a Tuolumne River Fish Passage Technical Working Group**

Applicants shall invite interested relicensing stakeholders to participate in a Fish Passage Technical Working Group (“TWG”) to develop specifications for study elements required by this study and a parallel study to evaluate engineering options for fish passage. The TWG will also review study implementation and results. We believe that the TWG will need to function for about two years. We believe the study overall will take two years to complete.

### **2.2. Determine the Study Area**

Applicants, in consultation with the TWG, shall determine the study area. At this time, Conservation Groups believe the appropriate study area to be Tuolumne River between the high water mark of Don Pedro Reservoir and Early Intake Dam and the tributaries to this river reach.

### **2.3. Conduct a Fish Barrier Assessment**

This assessment is to verify fish passage barriers in the study area for both spring-run Chinook salmon and steelhead.

The fish barrier Assessment has seven tasks:

1. Applicants shall review existing literature for descriptions of fish passage barriers in study reaches.
2. Applicants shall interview knowledgeable stakeholders and seek out and interview other knowledgeable persons (including scientists and whitewater boaters) familiar with the physical characteristics of these reaches.

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<sup>10</sup> Draft Recovery Plan, p. 100.

<sup>11</sup> *Id.* at 101.

<sup>12</sup> See NMFS, “Don Pedro Requests for Information,” eLibrary no. 20110610-5160 (June 10, 2011), Enclosure F.

3. Applicants shall compile information gathered from steps 1 and 2.
4. Applicants shall use compiled information to plan and conduct a helicopter survey of suspected or known fish barriers. Applicants shall conduct this survey and photo-video stream reaches in the study area and shall photo-document barriers and suspected barriers.
5. Applicants shall ground-truth suspected fish passage barriers in, at minimum, the mainstem Tuolumne River, the Clavey River, and Cherry Creek. Surveys should continue upstream to the first complete barrier.
6. Where barriers are determined to exist at low flows, applicants shall return to site at high flows to determine ability of fish to pass.
7. Applicants shall compile results of the tasks described above into a single report. The report should be reviewed by a qualified technical editor and senior engineer to ensure that the report meets applicable standards of professional quality and formatting and is free of technical and grammatical errors. The contractor shall submit a final report and all supporting information and technical data.

#### **2.4. Conduct Water Temperature Monitoring and Create a Water Temperature Model**

Applicant will gather water temperature data in the study area and use it to develop a water temperature model for the study area.

The Water Temperature Study has eight tasks:

1. Applicants shall collect, review, and evaluate water temperature collected by SFPUC and others, including scientists from the U.C. Davis Watershed Center along with water temperature information and data from sources identified in the Pre-Application Documents from the upper Tuolumne River above Don Pedro Reservoir.
2. In consultation with the TWG, applicants shall develop species and life stage temperature criteria for spring-run salmon and steelhead in the study area. Applicants shall develop criteria for optimal and upper tolerable temperatures.
3. In consultation with the TWG, applicants shall develop additional monitoring locations of appropriate geographic and temporal scales to develop an upper Tuolumne River temperature model. Where possible, temperature data loggers should be installed where accurate stream gage data are available. Additional data locations include: Tuolumne River below Early Intake, mainstem Tuolumne River above and below Cherry Creek (Holm Powerhouse), South Fork at confluence of Tuolumne River; Tuolumne River above and below South Fork;

Clavey River above confluence with Tuolumne River and below fish barrier; Tuolumne River above and below Clavey River confluence; and RM 83 Indian Creek Trail. Applicants shall monitor water temperatures in no greater than one hour increments for a minimum of two full years.

4. Applicants shall develop a simple water temperature model for the Upper Tuolumne River watershed, in consultation with the TWG. The model should be able to accurately predict water temperature in the upper Tuolumne River watershed, including all major tributaries, diversions, and accretions under seasonal and annual ranges of meteorological and operational scenarios.
5. Applicants shall use the temperature monitoring and the temperature model to characterize baseline (current) thermal conditions. Applicants will evaluate baseline thermal conditions using the temperature criteria developed in Step 2.4(2) to describe river reaches in the study area that are suitable and unsuitable for the lifestages of both salmon and steelhead.
6. In consultation with the TWG and, if it is willing, specifically with the City and County of San Francisco, applicants shall seek to identify feasible options to adjust San Francisco's operations to improve thermal suitability for salmon and steelhead of river reaches affected by those operations. These options shall consider the City's peaking operations at Holm Powerhouse and existing whitewater recreation that makes use of releases from these peaking operations.
7. Applicants shall compile results of the tasks described above into a single report. The report should be reviewed by a qualified technical editor and senior engineer to ensure that the report meets applicable standards of professional quality and formatting and is free of technical and grammatical errors. The contractor shall submit a final report and all supporting information and technical data.
8. Applicants shall provide copies (or online access) to the temperature model and provide sufficient documentation and/or training to allow computer-proficient technical Relicensing Participants to operate the model and inputs independently.

## **2.5. Perform a Habitat Suitability Evaluation**

The Habitat Suitability Study has five tasks:

1. Applicants shall document, using Hyperspectral Remote Sensing, habitat components up to the upstream extent of potential reintroduced anadromous fish habitat: substrate characterization of surface and sub-surface material, including spawning gravel; frequency of available morphologic habitat types (pools, high/low riffle, glides); and frequency and volume of large woody debris within bankfull channel.

2. Applicants shall evaluate size and depth of pools that may be suitable for spring-run Chinook holding. The evaluation will differentiate pools greater than and less than 10 feet in depth. It shall also describe how the depth and extent of pools downstream of Holm Powerhouse vary between representative high daily pulses and current summer base flows. Applicants shall perform an initial observation by helicopter survey or using Hyperspectral Remote Sensing. If the TWG determines that a finer scale of resolution is necessary, applicants will perform on-the-ground reconnaissance of pools in question.
3. Applicants shall document fine scale topography along stream corridors potentially suitable for anadromous salmonid reintroduction with LIDAR ground topography methods. Applicants shall also provide new aerial photographs, with low altitude orthorectified photographs with >0.5 foot pixel resolution.
4. Applicants shall provide watershed map(s), aerial and site specific digital photographs of major project features, habitat areas of interest, and potential fish handling and collection, counting, tracking, and/or transport locations.
5. Applicants shall compile work products from tasks into a single report. The report shall be reviewed by a qualified technical editor and senior engineer to ensure that the report meets applicable standards of professional quality and formatting and is free of technical and grammatical errors. The contractor shall submit a final report and all supporting information and technical data.

## **2.6. Assess Spawning Gravel Quality, Quantity, and Use**

This Spawning Gravel Assessment has five tasks:

1. The applicants shall identify sediment sources and volumes occurring above and below all Dams to calculate the volumes of sediments being captured in reservoirs and diversion facilities. Using sediment transport equations and unimpaired and regulated flows, they shall assess the change in the sediment budget from baseline (unimpaired) flows compared with regulated flows.
2. Applicants shall evaluate quantity and duration of sediment supplied to mainstem Tuolumne by tributaries in the study area.
3. Applicants shall assess volumetric and geographic alternatives for sediment supplementation to improve anadromous salmonid spawning, incubation, and rearing. They shall determine bed mobility thresholds within various alluvial features and streambed contours, and compare to historic and modeled hydrology to evaluate opportunities to improve geomorphic habitat conditions for anadromous salmonids.

4. Applicants shall survey representative reaches of the upper Tuolumne River and any currently accessible tributaries between Don Pedro Reservoir and Early Intake Dam for suitable sized trout and salmon spawning, incubation, and rearing habitats; applicants shall consult with the TWG in selecting representative reaches. During autumn and early winter seasons, and during the spring rainbow trout spawning season, applicants shall survey and assess current spawning use by salmonids, including Chinook salmon, Kokanee salmon, and resident or upstream-of-lake migrating trout. Level of effort will be commensurate with the level of effort employed in the spawning surveys by applicants downstream of La Grange Dam for the La Grange relicensing.
5. Applicants shall compile work products from tasks into a single report. The report shall be reviewed by a qualified technical editor and senior engineer to ensure that the report meets applicable standards of professional quality and formatting and is free of technical and grammatical errors. The contractor shall submit a final report and all supporting information and technical data.

## **2.7. Modification and Additions to Districts' Operations Model**

The applicants shall modify the Don Pedro Project Operations Model to improve understanding of the hydrology and habitat of portions of the Tuolumne River watershed upstream of Don Pedro Reservoir in five tasks:

1. Applicants shall disaggregate inflow to Don Pedro Reservoir. The Districts should add the following nodes to the model: Tuolumne River below Early Intake; Cherry Creek below Holm Powerhouse (including powerhouse flows and Cherry Creek flows bypassed past Holm Powerhouse); Middle Fork Tuolumne River above confluence with South Fork; South Fork Tuolumne River above confluence with Tuolumne River; Clavey River above confluence with Tuolumne River; nodes on Tuolumne River immediately above confluences with Cherry Creek, South Fork Tuolumne River, Clavey River.
2. Adding these nodes will require refinement of the hydrology dataset that informs the model upstream of Don Pedro Reservoir. Applicants shall convene a workshop or workshops with the TWG and other interested technical relicensing participants to review development of this refined hydrology.
3. Adding flow downstream of Early Intake and flow from Holm Powerhouse will require adding operating logic and assumptions about the City and County of San Francisco's operations in the watershed upstream of Don Pedro Reservoir. The incorporation of these operations into the Operations Model should allow the user to modify the operation of Holm Powerhouse through user input. We encourage the applicants to collaborate with the City and County of San Francisco in the execution of this task; however, in the absence of such collaboration, the applicants shall base modeled operations on recent historic operations consistent

with recent operating procedures previously described by the City to relicensing participants.

4. Applicants shall perform these revisions and present the revised model to interested relicensing participants in a technical workshop.
5. Applicants shall develop a report that describes the modifications to the Operations Model and distribute it to relicensing participants.

### **3.0. Consistency with Integrated Licensing Process Study Criteria**

1. *Describe the goals and objectives of each study proposal and the information to be obtained.*

The purpose of this study is to evaluate habitat in the Tuolumne River and tributaries upstream of Don Pedro Reservoir for potential reintroduction of spring-run Chinook salmon and steelhead to areas historically used by these species. Such reintroduction may be required by NMFS under authority of FPA section 18 or by agreement between applicants and other stakeholders.

2. *If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied.*

Proponents are neither a resource agency nor an Indian tribe.

NMFS' Public Draft Recovery Plan identifies the Upper Tuolumne River above Don Pedro Reservoir as a candidate area for reintroduction of spring-run Chinook salmon and steelhead to further recovery of these threatened species. Information produced during this study may also be used to inform NMFS' exercise of authority under FPA sections 10(j) and 18 and ESA section 7 for the licensing/relicensing of the La Grange and Don Pedro projects.

The State Water Resources Control Board is responsible for protecting the beneficial uses of the state's waters. Beneficial uses that may be affected by this study request include spawning and migration of anadromous fish.

3. *If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study.*

NMFS has estimated that 90% of the historic habitat for spring-run Chinook salmon and steelhead has been rendered inaccessible by dams in California's Sacramento – San Joaquin watershed. Spring-run Chinook are no longer extant in the San Joaquin watershed, although a program is currently underway to restore them to the San Joaquin River mainstem. NMFS, in its

Draft Recovery Plan, has identified the upper Tuolumne River as a as a candidate area for reintroduction of spring-run Chinook salmon and steelhead to further recovery of these species.<sup>13</sup>

At the Scoping Meeting for this project, NMFS stated its resource goals for anadromous fish include “providing access to suitable habitats” and “restoring fully functioning habitat conditions, including riparian areas for migration and holding, spawning and rearing and feeding.”<sup>14</sup>

4. *Describe existing information concerning the subject of the study proposal, and the need for additional information.*

Some water temperature data from the upper Tuolumne River and tributary areas likely to support anadromous fish has been collected by applicants for use in the Don Pedro relicensing. Additional water temperature data has been collected by the City and County of San Francisco and by scientists from the University of California at Davis Watershed Center studying frog populations in the Clavey River. There is no known water temperature model of the upper Tuolumne River and tributary areas likely to support anadromous fish.

The City and County of San Francisco has historic gauge data downstream of its Early Intake and Holm Powerhouse facilities. Gauges data from discontinued gauges for the Tuolumne River near Buck Meadows gaging station (near Lumsden Bridge downstream of the South Fork Tuolumne River) and Clavey River near Buck Meadows gaging station (at the 1NO1 Bridge) may provide additional historic hydrology data.

The City and County of San Francisco commissioned a number of studies by McBain and Trush to evaluate aquatic conditions in the study area. These studies include:

McBain & Trush, Inc. and RMC Environmental, *Upper Tuolumne River: Available Data Sources, Field Work Plan, and Initial Hydrology Analysis* (2006). Technical Memorandum prepared for San Francisco Public Utilities Commission, San Francisco, California.

McBain & Trush, Inc. and RMC Environmental, *Upper Tuolumne River: Description of River Ecosystem and Recommended Monitoring Actions Final Report* (2007). Technical Memorandum prepared for San Francisco Public Utilities Commission, San Francisco, California.

McBain and Trush, Inc., *Upper Tuolumne Ecosystem Project O’Shaughnessy Dam Instream Flow Evaluation Study Plan* (2007). Prepared for SFPUC, San Francisco.

These sources lack the spatial and temporal resolution to accurately characterize the upper Tuolumne River’s capacity to support anadromous fish. Most of the SFPUC studies have

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<sup>13</sup> Draft Recovery Plan, p. 116.

<sup>14</sup> eLibrary no. 20140618-4015 (June 18, 2014), p. 33.

focused on the reaches directly below Hetch Hetchy Project Dams not likely to be easily accessed by salmonids and not in the reaches identified in the study elements above.

There is no known analysis of fish passage barriers and no systematic compilation or analysis of water temperature data from the upper Tuolumne River and tributary areas likely to support anadromous fish. There is no known analysis of the potential effects of the operations of the City and County of San Francisco on habitat for anadromous fish.

There is no known survey of existing spawning use of the upper Tuolumne River and tributary areas likely support anadromous fish, nor evaluation of available spawning habitat for reintroduced anadromous fish.

The applicants have created a water balance model for the relicensing of the Don Pedro Project, and that model differentiates between regulated and unregulated inflow to Don Pedro Reservoir. However, the model as currently configured does not disaggregate river and tributary areas upstream of Don Pedro, and is therefore of limited utility in evaluating the hydrology of the upper Tuolumne River and tributary areas likely to support anadromous fish.

5. *Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements.*

La Grange Dam is the terminal barrier to upstream migration of anadromous fish in the Tuolumne River today. As stated above, the closest available riverine habitat in the Tuolumne River upstream of La Grange Dam is the Tuolumne River upstream of Don Pedro Reservoir.

The Commission declined to require the La Grange and Don Pedro Project be licensed in a single proceeding, stating: “The La Grange Project requires licensing under FPA section 23(b)(1); there is no need for us to determine whether the La Grange Project might also require licensing as part of a complete unit of development with the Don Pedro Project.”<sup>15</sup> In defending this decision in court, the Commission argued: “Given the Conservation Groups’ ability to raise their environmental concerns in both the Don Pedro and La Grange proceedings, they cannot establish any significant prejudice from the Commission’s failure to decide this issue.”<sup>16</sup> It further argued that the Conservation Groups’ legal challenge “is based on the completely illogical premise that the licensing proceedings – which will analyze fish passage issues and develop any necessary license terms – will actually worsen any existing fish passage issues.”<sup>17</sup>

If the La Grange Project were licensed as part of the Don Pedro Project, fish passage past both dams and reservoirs would be subject to the Section 18 authority of NMFS, and thus

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<sup>15</sup> *Turlock & Modesto Irrigation Dists.*, 144 FERC ¶ 61,051 (July 19, 2013), ¶ 116.

<sup>16</sup> Brief of Respondent at 46, *Turlock Irrigation Dist., et al. v. FERC*, Nos. 13-1250 and 13-1253 (D.C. Cir. July 17, 2014).

<sup>17</sup> *Id.* at 45.

squarely on the table for study in relicensing. Consistent with the Commission’s assurance that separate licensing makes no practical difference to fish passage or to the interests of Conservation Groups and the public interest they represent, OEP Staff must find that study of the habitat upstream of Don Pedro Reservoir is appropriate for the licensing of the La Grange Project.

6. *Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge.*

Many of the methods recommended were recently employed in the Yuba Salmon Forum, a voluntary collaborative process that has evaluated stream reaches in the upper Yuba River watershed for their potential to support reintroduced spring-run Chinook salmon and steelhead. The Yuba Salmon Forum included technical and other representatives from water purveyors, hydroelectric project operators, resource agencies, and non-governmental organizations. Most of the survey methods described are also commonly used in relicensing, including helicopter surveys, habitat mapping, water temperature monitoring and modeling, use of an operations model, use of LIDAR gathering and reporting, spawning surveys, etc. Some of the recommended methods build on existing studies from the relicensing of the Don Pedro Project.

7. *Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs.*

Conservation Groups have limited proposed study elements to the type of information that was actually useful in Yuba River watershed investigations. We have not proposed PHABSIM or other expensive studies that might have limited benefit considering the cost. We have detailed above what existing information may be useful and what the limitations of that information are for purposes of reanalyzing the reintroduction of anadromous fish. We are not aware of the details of proposed alternative studies, though we expect that the elements included our study request will in many respects be similar to those proposed by NMFS.

In consideration that this study will evaluate habitat to understand opportunities for fish passage past the Don Pedro Project as well as past the La Grange Project, we believe that the Commission’s consideration of level of effort should be seen in the context of the benefits to applicants of both projects. *See* discussion above relating to Study Criterion #5.

We base our cost estimates on levels of effort for previous work performed by NMFS and Conservation Group members on the Merced River and for the Yuba Salmon. We estimate the following costs for this study:

2.0 Establish and consult with Technical Working Group	\$200,000
2.3 Fish barrier assessment	\$80,000

Fieldwork	\$30,000	
Report	\$50,000	
2.4 Temperature monitoring and model		\$170,000
Fieldwork	\$20,000	
Temperature model	\$100,000	
Report	\$50,000	
2.5 Habitat suitability evaluation		\$210,000
Fieldwork	\$150,000	
Maps	\$10,000	
Report	\$50,000	
2.6 Assess spawning gravel and use		\$210,000
Fieldwork (gravel)	\$130,000	
Fieldwork (use)	\$30,000	
Report	\$50,000	
2.7 Modify operations model		\$120,000
Technical work	\$90,000	
Report	\$20,000	
Consultation	\$10,000	
Total cost		\$990,000

This study may take up to two years.

#### 4.0. References

Brief of Respondent, Turlock Irrigation Dist., et al. v. FERC, Nos. 13-1250 and 13-1253 (D.C. Cir. July 17, 2014).

Lindley, S. T., R. S. Schick, A. Agrawal, M. Goslin, T. E. Pearson, E. Mora, J. Anderson, B. May, S. Greene, C. Hanson, A. Low, D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams, *Historical Population Structure of Central Valley Steelhead and its Alteration by Dams*. *San Francisco Estuary and Watershed Science* 4(1)(3):1-19 (Feb. 2006). Available at: <http://repositories.cdlib.org/jmie/sfews/vol4/iss1/art3>

McBain & Trush, Inc. and RMC Environmental, *Upper Tuolumne River: Available Data Sources, Field Work Plan, and Initial Hydrology Analysis* (2006). Technical Memorandum prepared for San Francisco Public Utilities Commission, San Francisco, California.

McBain & Trush, Inc. and RMC Environmental, *Upper Tuolumne River: Description of River Ecosystem and Recommended Monitoring Actions Final Report* (2007). Technical Memorandum prepared for San Francisco Public Utilities Commission, San Francisco, California.

McBain & Trush, Inc., “Upper Tuolumne Ecosystem Project O’Shaughnessy Dam Instream Flow Evaluation Study Plan” (July 7, 2009). Prepared for SFPUC, San Francisco.

National Marine Fisheries Service (NMFS), *Public Draft Recovery Plan for Sacramento River Winter-run Chinook Salmon, Central Valley Spring-run Chinook Salmon, and Central Valley Steelhead* (Oct. 7, 2009). NMFS, Southwest Region, Sacramento, California. Available at [http://www.westcoast.fisheries.noaa.gov/publications/recovery\\_planning/salmon\\_steelhead/domains/california\\_central\\_valley/public\\_draft\\_recovery\\_plan\\_october\\_2009.pdf](http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/california_central_valley/public_draft_recovery_plan_october_2009.pdf).

*Turlock & Modesto Irrigation Dists.*, 144 FERC ¶ 61,051 (July 19, 2013).

Yoshiyama, R. M., E. R. Gerstung, F. W. Fisher, and P. B. Moyle, "Historical and present distribution of Chinook salmon in the Central Valley drainage of California" (2001), pp. 71-176 in R. L. Brown, "Contributions to the Biology of Central Valley Salmonids," Fish Bulletin 179. California Department of Fish and Game, Sacramento.