REPLY COMMENTS
ON LICENSEE REVISED STUDY PLAN
MERCED RIVER HYDROELECTRIC PROJECT NO. 2179-042

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E-Filing

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, NE Room 1-A
Washington D.C. 20426

Dear Ms. Bose:

Thank you for the opportunity to submit comments on behalf of the Merced River Conservation Committee, Trout Unlimited, the California Sportfishing Protection Alliance, Friends of the River, Golden West Women Flyfishers, Northern California Council of Federation of Fly Fishers, and American Rivers (collectively, "Conservation Groups") regarding the Licensee Revised Study Plan for the relicensing of the Merced Irrigation District's Merced River Hydroelectric Project (P-2179) filed by Merced Irrigation District (Merced ID).

Merced ID's Revised Study Plan is notable for its extreme nature and naked disdain for the jurisdiction of FERC and the conditioning agencies. For example, although the only streamflows that exist in the Merced River are what Merced ID releases through the Project, the District disclaims any responsibility for downstream flows and fish habitat. Although the current license sets instream flow requirements in the lower Merced River, Merced ID claims there is no nexus to its Project for such a requirement. Although SD2 states that the entire Merced River, downstream to the Delta, is the geographic focus for listed species of fish, Merced ID claims that there are no such fish.

A. The Commission's July 16, 2009 Order For the New Don Pedro Project Addressed Many of the Issues That Have Arisen in the Relicensing of the Merced River Hydroelectric Project

The Merced River Hydroelectric Project is like the neighboring New Don Pedro Project on the Tuolumne River in every significant way. (See 128 FERC ¶ 61,035, Order on Rehearing, Turlock Irrigation District and Modesto Irrigation District, Project No. 2299; hereinafter, Tuolumne Rehearing Order).[1] The two rivers are the southernmost rivers that flow continuously into the San Joaquin River. Each river has an enormous reservoir (greater than 1,000,000 acre-feet) capable of impounding the average annual full flow of its river, with a powerhouse at the reservoir. Downstream of each project is a significant non-project consumptive diversion owned by the respective licensee(s). Downstream of each licensee-owned diversion dam on each river are smaller diversions owned and operated by senior water right holders. On each river, the compliance point for the minimum instream flow set by the FERC license is downstream of the licensee-owned consumptive diversion.[2]

Although the New Don Pedro project will not begin relicensing until 2011, salmon and steelhead populations on the Tuolumne River downstream from that project are so compromised that the Commission recently ordered a hearing on interim measures to improve downstream flows and salmonid survival. Almost all of Merced ID's arguments in the Merced proceeding were at issue in the proceeding on the Tuolumne River, and the Commission decided each of them in a manner contrary to the position that Merced ID has taken on the Merced River.

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[1] Available on FERC e-library, accession number 20090716-3060: Order on Rehearing, Amending License, Denying Late Intervention, Denying Petition, and Directing Appointment of a Presiding Judge for a Proceeding on Interim Conditions, New Don Pedro Project, FERC P-2299..

[2] See Tuolumne Rehearing Order, paragraph 4: "The Districts also own La Grange Dam, a non-project diversion dam built in 1893 and located on the Tuolumne River 2.3 miles downstream of Don Pedro Dam. It is 130 feet high and impounds about 500 acre feet. The Districts use it to divert water into their canal systems for consumptive purposes upstream of La Grange Dam. The license for the Don Pedro Project requires the Districts to maintain minimum flow releases from the Don Pedro Project to the Tuolumne River, as measured downstream of La Grange Dam." [Note: it is the diversion that is located just upstream of La Grange dam; the "purposes," i.e., places of use, are located downstream of the La Grange diversion.]

In particular, the Commission determined that there are steelhead in the Tuolumne River. The Commission ordered an instream flow study on the lower Tuolumne River to evaluate habitat conditions for both salmon and steelhead at a minimum of five different base flows from 150 to 400 cfs, plus habitat conditions during spring pulse flows of between 1,000 to 5,000 cfs, and during fall pulse flows of 1,500 cfs. The Commission ordered all these evaluations to be performed downstream of the New Don Pedro licensees' non-project consumptive diversion. In addition, the Commission ordered a water temperature model for the lower Tuolumne River from La Grange diversion dam twelve miles downstream to Roberts Ferry Bridge in order to ascertain flows necessary to maintain suitable summer water temperatures suitable for steelhead.

If these measures are appropriate for an interim license order, they are certainly appropriate for a relicensing proceeding. Yet in the present debate over the scope of studies for this project, Merced ID rejects the request by Resource Agencies (NMFS, SWRCB, USFWS, BLM, CDFG, and NPS) and Conservation Groups for equivalent studies.

B. Merced ID Must Study Project Effects on Anadromous Fish, Including Steelhead

Merced ID's case against the studies it rejects depends primarily on its argument that there are no steelhead in the river. This is the same argument put forward by the Turlock and Modesto Irrigation Districts in the New Don Pedro Project (FERC P-2299) proceeding regarding the Tuolumne River, which is the next major San Joaquin River tributary north of the Merced River. This argument was soundly rejected by the Commission in the Tuolumne Rehearing Order on the basis of the same documents available here.

The National Marine Fisheries Service has designated the Central Valley steelhead as threatened under the Endangered Species Act, and has designated the lower Tuolumne and Merced rivers critical habitat. The Turlock and Modesto Irrigation Districts argued, as Merced ID has, that there are no steelhead in the river. NMFS, FWS, and others relied on Zimmerman, et al. 2008. That study, "Maternal origin and migratory history of *Oncorhynchus mykiss* captured in rivers of the Central Valley, California," a contract report for the Department of Fish and Game, concluded that steelhead are present in both rivers. The Commission set forth Turlock's and Modesto's arguments, which are identical to Merced ID 's arguments regarding the Merced, and firmly rejected them:

> "59. The Districts argue that "the low numbers of anadromous *O. mykiss* found in samples from the San Joaquin tributaries indicate little evidence of a successful ocean-type life history strategy, particularly south of the Stanislaus River." They add that it is "unclear whether anadromous *O. mykiss* found in the Tuolumne River arrive from a self-sustaining population within the Central Valley Steelhead [DPS] or are from strays from nearby rivers …." They therefore urge the Commission not to rely on the study ….

> 60. We do not regard the Districts' arguments that few fish were found, or that the population might not be self-sustaining, as providing a basis to disregard this study. …
> 61. … We agree that this information is sufficient to support the conclusion that steelhead are present …."[3]

Like Merced ID, Turlock and Modesto had also argued that Zimmerman had not been peer-reviewed and published. The Commission rejected that argument as well. Nevertheless, the work by Zimmerman et al. has now been published in the prestigious journal *Transactions of the American Fisheries Society.* (See Zimmerman CE, Edwards GW, Perry K. 2009. Maternal origin and migratory history of steelhead and rainbow trout captured in rivers of the Central Valley, California. Trans Amer Fish Society 138: 280-291).

Merced ID goes to great lengths and tortuous argument to discredit Zimmerman et al. on the basis of what Merced ID presents as an apparent technical ambiguity:

> "However, Merced ID is unaware of any documented occurrences of naturally-spawned anadromous *O. mykiss* populations in the Merced River below Crocker-Huffman Diversion Dam. Zimmerman (2006) [sic], often cited by the comment letters as proof of steelhead in the Merced River, merely concluded that one trout out of 23 sampled from the Merced River could have been the progeny of a female who may have spent time in the ocean. Furthermore, Zimmerman eliminated from his study any *O. mykiss* captured in the San Joaquin River due to the high concentration of naturally-occurring strontium. Therefore, the one fish caught in the Merced River could have been the progeny of a female that spent time in the ocean or in the San Joaquin River. Further, over 10 years of fish sampling in the river has not caught one steelhead."

This supposed technical ambiguity, however, is based on a misreading of Zimmerman. On page 288 of the AFS-published 2009 report, Zimmerman et al. state:

> "The otoliths collected from juvenile rainbow trout in the San Joaquin River at Mossdale (location 5 in Figure 1) were presumed to be from steelhead smolts based on coloration but turned out to be from fish of both steelhead and rainbow trout maternal origin, suggesting that rainbow trout can produce smolts in the Central Valley. With such a small sample size we are unable to draw conclusions about the contribution of progeny of rainbow trout females to the emigration of smolts. Similarly, in presumed steelhead smolts collected in an estuary of a small central California coastal stream (Pilarcitos Creek at Half Moon Bay), juveniles of both steelhead and rainbow trout maternal origin were present (C. E. Zimmerman, unpublished data). Further work is needed to assess the contribution of rainbow

[3] Tuolumne Rehearing Order.

> trout progeny as smolts and the fate of these fish compared with smolts of steelhead maternal origin."

As stated by Zimmerman et al. 2009, Mossdale elevation is 4 meters above sea level. It is located toward the bottom end of the lower San Joaquin River. Merced ID has gone to extensive lengths to argue the lack of habitat for *O. mykiss* in the lower San Joaquin for anything except as a migration corridor.[4] Zimmerman et al., making a similar assumption, assumed that any *O. mykiss* captured at Mossdale were simply passing through and were thus anadromous. Zimmerman et al. did not exclude from their study *O. mykiss* captured at Mossdale. On the contrary, based on their knowledge of conditions at Mossdale and otolith sampling of the *O. mykiss* captured there, they drew a conclusion that anadromous *O. mykiss* may be the progeny of resident females.

Conservation Groups respectfully suggest that the Mossdale evidence cited by Zimmerman et al. argues for a management response diametrically opposite Merced ID's interpretation that no study or management of steelhead in the Merced River should be required. Resident rainbow trout in the lower San Joaquin basin may have steelhead as offspring. The designated critical habitat in the lower Merced River is known to contain *O. mykiss* that exhibit a resident life history. Since these resident *O. mykiss* as well as anadromous *O. mykiss* may produce anadromous *O. mykiss* (steelhead), it is therefore doubly important to optimize critical habitat in order to support the steelhead fishery.

Moreover, we must comment on Merced ID's casting of methodological stones. In several references in its Revised Study Plan, as in the citation above, Merced ID claims that it "has not caught one steelhead" in ten years of sampling. Despite criticizing the wildlife agencies' methods, Merced ID is absolutely silent on the methodology it has used to determine the life history of the *O. mykiss* it has captured (how would it know if it caught a steelhead?). By Merced ID's own standards, the district's surveys should be given no weight.

Following are the most salient facts about Zimmerman et al.:

- The methods and techniques used by Zimmerman et al. (2008 & 2009) are generally accepted "state of the science" measures of *O. mykiss* anadromy versus non-anadromy, using otolith microchemistry.

- Zimmerman et al. (2009) is peer-reviewed and published in a widely recognized, reputable international scientific journal for fisheries science and management.

[4] For example, in the Revised Study Plan: "Juvenile steelhead that migrate from the San Joaquin River system are exposed to degraded migration corridors that includes unscreened or poorly screened diversions, behavioral impediments to migration, and degraded water quality in the lower San Joaquin River basin and the Stockton Deep Water Ship Channel." (p. 3-10)

- Even with the acknowledged constraints on sample size and age class distribution for the Merced River population, the authors concluded that a "progeny of steelhead maternal origin**"** was found in the Merced River.

Merced ID's argument that "there is no definitive evidence that steelhead occur in the river" misstates the appropriate applicable standard of "substantial evidence." This and the other lines of argument against Zimmerman repeated by Merced ID were rejected by the Commission in the Tuolumne Rehearing Order. See ¶ 58 n.55 (discussing Zimmerman et al. and stating "As NMFS and FWS correctly point out, Commission decisions must be supported by substantial evidence," not conclusive evidence).

It should be noted that Zimmerman et al. are not alone in confirming steelhead presence in the Merced River. The National Marine Fisheries Service's Biological and Conference Opinion for the Operations Criteria and Plan for the Central Valley Project and the State Water Project found at page 107-108:

> "Recent monitoring has detected small, self-sustaining populations (i.e., non-hatchery origin) of steelhead in the Stanislaus, Mokelumne, and Calaveras rivers, and other streams previously thought to be devoid of steelhead (McEwan 2001).
>
> "It is possible that naturally-spawning populations exist in many other streams but are undetected due to lack of monitoring programs (IEP Steelhead Project Work Team 1999). Incidental catches and observations of juvenile steelhead also have occurred on the Tuolumne and Merced Rivers during fall-run monitoring activities, indicating that steelhead are widespread throughout accessible streams and rivers in the Central Valley (Good et al. 2005). CDFG staff have prepared catch summaries for juvenile migrant CV steelhead on the San Joaquin River near Mossdale, which represents migrants from the Stanislaus, Tuolumne, and Merced rivers. Based on trawl recoveries at Mossdale between 1988 and 2002, as well as rotary screw trap efforts in all three tributaries, CDFG (2003) stated that it is "clear from this data that rainbow trout do occur in all the tributaries as migrants and that the vast majority of them occur on the Stanislaus River" (figure 4-5). The documented returns on the order of single fish in these tributaries suggest that existing populations of CV steelhead on the Tuolumne, Merced, and lower San Joaquin rivers are severely depressed."

Merced ID makes a final argument that is worth discussion. Merced ID states that, even if there are some steelhead, they are "certainly not in enough number to assess their habitat preference" (p. ES-8). The Conservation Groups acknowledge that there are too few steelhead in the River. Indeed, that is the point. Neither the Federal Power Act, nor NEPA, nor the Endangered Species Act provide an exemption for mitigation to species merely because their numbers have declined. It is just the opposite. For this reason, the Commission correctly rejected that argument. (Tuolumne Rehearing Order, ¶¶ 60-61).

Of course, steelhead are not the only species in the River. Even Merced ID cannot dispute that Chinook salmon exist in the river, so it ignores them. Merced ID argues that salmon are not federally listed, so SD2 does not say the studies should consider the project's impact on the species.[5] This has nothing to do with whether the project effects on the species should be considered in the proceeding; licenses routinely require mitigation and enhancement for non-endangered species.

Conservation Groups direct the Commission to our July 16, 2009 comments regarding the need to study salmon in this relicensing.[6]

C. Merced ID **Seeks to Place Most Impacts on the Merced River, Including Impacts to Salmon and Steelhead, "Outside FERC's Jurisdiction"**

Merced ID's second argument against accepting the study plans put forward by the Resource Agencies and Conservation Groups is that the district plans to conduct similar studies as part of an MOU with DFG, but only "*outside of the Merced River Hydroelectric Project Relicensing*." (3-44 [emphasis in original]). The rationale for the so-called "MOU Studies" is stated plainly in the MOU:

> "Through its operation, MERCED's Merced River Development Project, ("Project") as licensed by the Federal Energy Regulatory Commission ("FERC") can materially affect the amount, quality and timing of instream flows downstream of Crocker-Huffman Diversion Dam (lower Merced River), thereby potentially affecting the welfare and success of salmon stocks and other fishery resources in that stretch of the Merced and San Joaquin Rivers." (Recital paragraph B, pp.2-3).

This point cannot be emphasized enough. In Merced ID's own words, there is therefore a nexus between project operations and the "amount, quality, and timing of instream flows" in the lower Merced River, and the "welfare and success of salmon stocks and other fishery resources" downstream through the San Joaquin River. (Id.) That is the entire premise behind the MOU Studies. Nevertheless, Merced ID wants to keep all of the studies that could evaluate these consequences—instream flows, water balance and water temperature models, and salmonid productivity, habitat, habitat use, behavior and survival—"outside relicensing."

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[5] Merced ID argues that SD2 states that only "listed" species have a geographic area of the Merced River beyond the project boundaries, and that steelhead are "listed" as threatened but fall-run Chinook are merely a "species of concern" under the ESA. We believe that the Commission has clarified its intent in the July 16, 2009 Order on the New Don Pedro Project: it is necessary to evaluate project impacts on salmon as well as on steelhead. This is consistent with the Federal Power Act and NEPA. See Tuolumne Rehearing Order, ¶¶ 86, 88, 91, 92 and 114(F), among others.

[6] 20090716-5008. Pages 2-13; 16-23.

The reason, plainly, is that Merced ID is concerned that FERC might issue a new license with PM&E terms that the district does not like. The benefit of the MOU approach (to Merced ID) and its drawback (to everyone else) is that the studies would not necessarily result in any changes to project management, because Merced ID has a veto over any changes resulting from the MOU. (See paragraph 2.6.1 providing that the MOU flows continue until a mutual agreement of the parties to change them, or until action of another agency with jurisdiction adopts new instream flows). Merced ID knows that hydropower license conditions are sometimes imposed on a licensee even if the licensee would prefer not to have them.

In short, Merced ID is attempting to avoid FERC's jurisdiction. This is not hyperbole. It is Merced ID's stated goal. "Merced ID's intent, which continues to this day, is to approach ecosystem restoration in a broader forum *that is not jurisdictional to FERC*." (p. 3-43 [emphasis added]).

What is more, Merced ID is actually attempting to roll FERC's jurisdiction back to a scope narrower than the original license. The original license established the amount, quantity and timing of instream flows in the Merced River below Crocker-Huffman. (See Articles 40, 41). In the PAD, however, Merced ID proposes to eliminate that requirement, replacing it with an instream flow compliance point measuring only releases from McSwain powerhouse and dam. (See PAD, Existing and Licensee Proposed Measures, section 9.2.2, Proposed Measure 37). Merced ID proposed to eliminate existing Articles 40-44, including minimum streamflows. (Id., section 9.3.2).

This is a brazen tactic, but it is consistent with Merced ID's rationale for rejecting the studies requested by the agencies and Conservation Groups, in which Merced ID repeatedly argues that there is no nexus between the studies and the project, and that the studies could not inform potential PM&Es. If there were no connection between the Lower Merced River and the project, it would follow that the existing license terms for instream flows were illegitimate.[7]

Merced ID's third major argument against the Resource Agency and Conservation Group studies, that the studies could not inform license conditions, takes on clearer meaning in this light. If one believes, as Merced ID apparently does, that there is no basis for maintaining Articles 40 and 41, then it is possible to follow the district's logic. However if one believes, as Resource Agencies and Conservation Groups do, that the question is whether and how to modify the license's existing instream flow articles to account for today's information and current law, then plainly the proposed studies can inform potential PM&Es.

[7] The agencies and Conservation Groups first understood the full import of Merced ID's argument at the relicensing meeting on anadromous fish studies (a meeting Merced ID still insists was held "outside the relicensing"). The non-Merced ID parties asked how FERC could possibly decide whether and how to modify Articles 40 and 41 without, for example, the requested instream flow study. Merced ID answered that it is simple: it proposes to eliminate the requirement.

Once again, the Commission's recent Tuolumne Rehearing Order is informative. That project also has a licensee-operated diversion just downstream from its large project reservoir, and the Commission mandated a new instream flow study and temperature model to evaluate the project's impacts on salmon and steelhead survivorship. Again, if such steps are appropriate to inform potential PM&Es as interim measures, then they are surely appropriate in a relicensing.

Finally, Conservation Groups would also like to remind the Commission that not only did the Federal Power Commission, in the licenses issued in 1964 for both the "Exchequer Hydro-Electric Development" (as modified, now the Merced River Hydroelectric Project) and the New Don Pedro Project, require minimum instream flows to be measured at compliance points downstream of the large licensee-owned consumptive diversions (Crocker-Huffman and La Grange respectively), it also, in the case of the New Don Pedro Project, provided a rationale in the issuing order. In its Opinion and Order Issuing License for the New Don Pedro Project, the Federal Power Commission referenced Section 10(a) of the Federal Power Act:

> "The basic question presented in this case is whether the Commission should condition its license to Turlock and Modesto to require specified releases of water from New Don Pedro for the protection of King salmon which spawn in the Tuolumne below La Grange dam. …
>
> The applicants contend that … a license condition requiring the fish water releases requested by California or the Secretary would impair and infringe their vested water rights to water for irrigation which are protected by Section 27 of the Power Act. …
>
> Both California and staff construe Section 27 as imposing no restriction on the Commission's authority to condition the license to require minimum water releases for fish protection. … They argue that if the necessary water releases required to make the project best adapted to a comprehensive plan as contemplated by Section 10(a) should result in interference with the applicants' vested water rights under state law, the applicants are at liberty to accept the license as so conditioned or to reject it. (March 10, 1964. See pp. 2-3).
>
> Upon review of the record presented at the hearing, … it is our judgment that a license should be issued to Turlock and Modesto with the conditions for fish water releases recommended by staff." (p. 6).

This Opinion and Order was challenged in Court by the licensees; in a May 18, 1965 ruling, the United States Court of Appeals Ninth Circuit upheld the Opinion and Order (see 59 P.U.R.3d 175, 345 F.2d 917).

D. The MOU Studies Are Inadequate for Relicensing

The MOU Studies have other flaws beyond the fact that Merced ID wishes them to be "outside the relicensing." Procedurally, they are not subject to the checks and balances that come with relicensing study plans. In particular, there is no guarantee that they will be done on schedule if they are not part of the proceeding. Given Merced ID's the history of delay in addressing the condition of anadromous salmonid in the Merced River, and in performing the MOU studies in particular, this is a real concern.

Substantively, they are just as flawed. In particular, the MOU Studies evaluate water quantity, water quality, and habitat only in the context of current operations. Relicensing studies are intended to inform the Commission about instream flows, water quality, and habitat impacts over a range of potential license conditions. For instance, the Commission's Tuolumne order mandates studies of a range of base flow conditions, as well as of higher spring pulse flows and fall pulse flows. In the Merced relicensing, the Resource Agencies and Conservation Groups have proposed studies that would require specific study flows in order to measure response. The MOU studies propose to limit study flows within the quantity of water that licensee would otherwise release below Crocker-Huffman Dam.

The MOU studies do not address *O. mykiss* in the lower Merced River. Having denied the existence of steelhead in the Merced River, Merced ID will make sure that its studies do not contradict this conclusion.

FERC has already acknowledged in SD2, as it did in the Tuolumne, that water quality and quantity impacts, as well as impacts on salmonids, extend throughout the river by defining the geographic scope for listed species and water resource impacts far more broadly than Merced ID is willing to accept. Merced ID selectively quotes SD2's statement that the project's direct effects end at Crocker-Huffman in support of its more limited scope. The argument is unconvincing for a number of reasons.

First, the ILP regulations do not limit studies to "direct effects." Rather, the regulations require a "nexus between project operations and effects," which can be "direct, indirect, and/or cumulative." (18 CFR section 5.9(b)).

Second, SD2 cannot support the interpretation Merced ID gives it without eliminating the basis for existing articles in the current license, as discussed above. We do not believe that FERC staff would eliminate the possibility of those license articles in a scoping document without stating so directly.

Third, Merced ID releases from the Project *are* the main determinant of the timing and magnitude of streamflows, and habitat values that depend on streamflow, in the Lower Merced River. Ironically, Merced ID's Reply to Study Requests makes that point definitively. Section 3.4, pages 3-33 and 3-34 in particular, explains that stream flows in the river are the total of either the FERC flows or the Davis-Grunsky flows, plus

whatever flows are required for downstream diversions. (Of course, the latter water makes it only so far as those diversions). Merced ID's reply also shows that for much of the year, there are no diversions, and flows above and below Crocker-Huffman are the same. (Figures 3.4-6 to 3.4-8).

In that regard, it should be emphasized that the other processes that are "non-jurisdictional to FERC" are not currently structured to be a substitute for FERC-mandated PM&Es to protect the Merced River. As stated above, the MOU Studies will not necessarily result in any enforceable conditions.[8] The Davis-Grunsky contract expires in 2017. (Merced ID 3-34). The flows required for the Cowell Agreement and other diverters exist only until those diverters take the water. The other processes are focused on the San Joaquin River and the Delta, and have been fought over without resolution for more than 25 years. (See Merced ID 3-38 to 3-41). If Merced ID's proposed elimination of the license terms goes into effect, there would be a regulatory gap between the McSwain development and the San Joaquin River, a 55-mile-long stretch of the entire lower Merced River.

E. The Merced River Hydroelectric Project Blocks Anadromous Fish Passage on the Merced River

In our July 16, 2009 comments on licensee's proposed study plan[9], Conservation Groups showed how project operations historically and presently affect fish passage at Crocker-Huffman Dam. We traced the history by which the operability of fish passage facilities was eliminated both at Crocker-Huffman and Merced Falls dams, and how this resulted from the inundation of anadromous salmonid spawning habitat by McSwain Reservoir. We showed how the elimination by New Exchequer Dam of high flows in the Merced River reduced the ability of fish to pass Crocker-Huffman Dam under present conditions.

In response, Merced ID states on page 3-8:

> "While the various comment letters contain considerable discussion regarding the Crocker-Huffman Diversion Dam and its role in impeding fish passage and delve into many "*but for*" arguments (*e.g., but for the Project there would be fish passage at Crocker-Huffman Diversion Dam*[13], and *but for the Project there would be steelhead in Yosemite Valley*), the facts are …"

[8] Even if the MOU Studies result in collaboratively-agreed upon changes to project operations, it could well be too late for salmon and steelhead in the Merced River. When one of the Conservation Groups petitioned the Commission in 1995 for interim measures to improve conditions in the river, MID resisted that petition, and in 2001 told the Commission that "the relicensing process will be the appropriate forum to address the needs for any permanent modification to the project's minimum flow requirements or other terms and conditions.". (See discussion in CG comments on the PSP, pages 19-21). Given the severely depressed populations of anadromous fish in the Merced River, the Commission should ensure that the relicensing serves that purpose.

[9] 20090716-5008. See pages 13-16

Before addressing some of these facts, Conservation Groups point out that licensee did very little to answer our comments, or explain why our "but for" logic is deficient. (For example, Merced ID stated that Crocker-Huffman pre-dated the hydropower project, but the district did not dispute the fact that Crocker-Huffman had fish passage facilities until project operations rendered those facilities less useful.)

More generally, leaving aside the inaccurate paraphrasing (substituting "would" for "could" regarding passage to Yosemite Valley), the Conservation Groups simply described project effects and how they need to be mitigated. *The fact is*, if the project did not exist, fish passage facilities at Crocker-Huffman and Merced Falls dams would either be in service or easily re-constructed, lack of fish passage would not need to be mitigated, and we would not be here.

Further on in the Revised Study Plan, when a different approach suits the position of Merced ID in its quest to avoid FERC's jurisdiction, Merced ID states:

> "Merced ID has always asserted that the Sacramento/San Joaquin ecosystem cannot be restored piecemeal, that is one water body at a time, because ecological systems simply do not work like that. Merced ID began early on to advocate a holistic or systematic approach to restoration." (p. 3-42).[10]

The "holistic" approach apparently does not apply to re-connecting the upper and lower watersheds, or to addressing the barriers that cumulatively prevent that re-connection.[11] Merced ID states:

> "Crocker-Huffman Diversion Dam is not under FERC jurisdiction: the dam includes no power facilities, includes no Project No. 2179 facilities or facilities that connect directly to Project 2179 facilities or other facilities under FERC's jurisdiction, and does not perform any function related to operation of a FERC-jurisdictional facility for power generation."

As opposed to the holistic concept, this paragraph frames direct physical effects and connections as the only meaningful ones, and addresses them "piecemeal." It even goes so far as to deny "any function related to operation of a FERC-jurisdictional facility for power generation."

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[10] Curiously, when it comes to its own contribution to that restoration, Merced ID suggests that it is already doing its share. In an August 8, 2008 letter to the Delta Vision Blue Ribbon Task Force, Merced ID takes the State Water Resources Control Board to task for failing to recognize that the Merced River is "protected by instream flow standards." The first flows cited by Merced ID are those flows required by FERC. Merced ID further notes: "Merced ID's FERC license associated with the construction of New Exchequer Dam calls for Merced ID to provide water … for instream fishery enhancement." That would presumably be the enhancement that Merced ID refuses to study in a proceeding where FERC, the jurisdictional agency, might actually continue to have jurisdiction over the flows that allegedly provide that enhancement.

[11] As mentioned above, the applicable term in Section 10(a) of the Federal Power Act would be "comprehensive."

This carefully drafted assertion is misleading. Crocker-Huffman is used for project purposes. Specifically, it is the point of diversion for 15,000 acre-feet of water per year to wildlife refuges west of Merced pursuant to a requirement in Merced ID's existing FERC license. Moreover, Crocker-Huffman diverts water that is passed through three powerhouses (two owned by Merced ID) and that has been stored in a 1,000,000 acre-foot FERC-jurisdictional storage reservoir. Together, these project features determine the flow provided to Crocker-Huffman.

Licensee asserts on page 3-58 that "project facilities do not block upstream migration of steelhead." However, the *operation* of project facilities does. Reduction by the project of the magnitude, timing and duration of high flows have reduced the opportunities for steelhead (and salmon) to ascend Crocker Huffman Dam. This reduction has also confined the channel between Crocker-Huffman and Merced Falls and reduced the habitat value of the reach (Vogel 2007). An apparent project effect is thus the reduction of the potential value of volitional passage at Crocker-Huffman, which only makes more pressing the need to examine passage on a watershed-wide, "holistic," *comprehensive* basis.

Finally, Conservation Groups must address the efforts by Merced ID to discount the evidence cited by Conservation Groups from Volume II of Stillwater Science's *Merced River Corridor Restoration Plan Baseline Studies* (2001). As background, Stillwater Sciences has conducted dozens if not hundreds of studies for FERC relicensings, many of them as a subcontractor for Merced ID's principal consultant in this proceeding. On page 9 of its report, Stillwater stated: "Presently, anadromous fish generally do not pass upstream of Crocker-Huffman Dam, although some fall chinook salmon may surmount the dam during high flows (M. Cozart, pers. comm., 2000)."

Note first that Stillwater says that anadromous fish *generall*y do not pass upstream of Crocker-Huffman. Merced ID says, rather, that they don't.

Second, in choosing to make this citation, Stillwater has in some measure provided a de facto expert opinion about the credibility of the person it has elected to quote. Licensee's principal consultant, as past and present employer of Stillwater, is hardly in a position to disparage that opinion.

Third and most important, licensee is deceptive in its characterization of Stillwater's description: "The cited reference actually states that, based on one individual's personal conjecture, some salmon *may* surmount the dam during high flows." (Revised Study Plan, p. 3-9). For about thirty years, Mr. Cozart has been the operator of a fish hatchery located directly adjacent to Crocker-Huffman Dam. There are probably less than five people on earth who have made more direct observations of that dam and of fish in the Merced River just downstream of it and in the diversion pool directly upstream of it; there may well be zero. Additionally, he has spent ten thousand days working with fish; there can be little question that he knows his fish. To dismiss Mr. Cozart's opinion as "one individual's personal conjecture" is misleading because it fails to identify the

qualifications of the individual, discounts his professional experience and expertise, and denies the deference due to his opinion in calling it conjecture. Conservation Groups readily concede that this person's experience is not conclusive evidence in and of itself, but it is evidence nonetheless. As explained in the next section, NEPA dictates that the evidence may not be disregarded.

F. NEPA Requires Investigation of *Potential* Project Impacts, Mitigation Measures and Alternatives

Throughout Merced ID's Reply to Proposed Studies, there is the assumption that its studies need consider project impacts only where those impacts are certain. (This is most pronounced in its discussion of steelhead, which it asserts are not absolutely certain to exist in the river, but it is common to all of Merced ID's responses.) That is not the way NEPA works. The purpose of the statute is to require decision makers to investigate and assess potential impacts of a project and to disclose those impacts to itself and to the public, and to investigate potential mitigation measures and alternatives.

It is established under NEPA that uncertainty regarding a project's impacts is no excuse to avoid investigating those potential impacts and developing appropriate alternatives and mitigation measures. See *National Parks & Cons. Assn. v. Babbitt*, 241 F.3d 722, 733 (9th Cir. 2001) (an agency's lack of knowledge about a potential impact "does not excuse the preparation of an EIS; rather it requires the [agency] to do the necessary work to obtain it"). Merced ID's position that it is required to study a project effect only where the effect is precisely and conclusively known turns the statute on its head.

G. Coordinated Resource Agency and Conservation Group Comments on Specific Study Plans Are Included in Attachment

Merced ID noted in its Revised Study Plan that it was confused by the various filings of the Resource Agencies and Conservation Groups on or about July 16, 2009. In particular, several study plans were given final minute edits in some filings that were not reflected in the documents filed by other parties somewhat earlier. Conservation Groups apologize for any confusion.

In order to avoid a repetition of similar confusion, Resource Agencies and Conservation Groups have consolidated their comments on particular study plans. Some Resource Agencies were compelled by internal procedures or staff limitations to file their responses to the Revised Study Plan prior to August 28, 2009. However, those Resource Agencies that have been able to hold their filings until the August 31 deadline, as well as Conservation Groups, have arranged to file identical comments on individual study plans, and, where applicable, revised study plans, as an attachment to their overarching comments. Such an attachment is included as part of this document.

For studies for which revised study plans are not submitted in this attachment, Conservation Groups and Resource Agencies refer Commission staff to the study plans

submitted by the California Department of Fish and Game (20090716-5104) on July 16, 2009 as the definitive study plan submittals.

Conclusion

Merced ID's effort to undermine the Commission's authority should not be allowed. The Commission should adopt the study requests made by the Resource Agencies and Conservation Groups.

Respectfully submitted,

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Zimmerman CE, Edwards GW, Perry K. 2009. Maternal origin and migratory history of steelhead and rainbow trout captured in rivers of the Central Valley, California. Trans Amer Fish Society 138: 280-291.

Attachment

Response to Licensee Comments and Revised Study Plan
Merced River Project, FERC No. 2179

This document presents comments on Merced ID's Revised Study Plan, which was filed with the Commission on August 14, 2009. It also includes recommendations for consideration by the Federal Energy Regulatory Commission (Commission or FERC) in its Study Plan Determination made pursuant to 18 CFR 5.13(c). These comments and recommendations are supported by the following State and federal Resource Agencies participating in the Merced River Project (Project) relicensing process: the California Department of Fish and Game (CDFG), the Bureau of Land Management, the California State Water Resources Control Board, the NOAA National Marine Fisheries Service, the US Fish and Wildlife Service, and the National Park Service. The comments and recommendations are also supported by numerous conservation groups, including: the Merced River Conservation Committee, Trout Unlimited, the California Sportfishing Protection Alliance, Friends of the River, Golden West Women Flyfishers, Northern California Council of Federation of Fly Fishers, and American Rivers.

The following table summarizes the recommendations by the Resource Agencies and Conservation Groups.

	Adopt Modified Study Included in the Appendix to this Document	Adopt Study Included in CDFG's Comments on Merced ID's Proposed Study Plan (7/16/09)	Adopt Merced ID Study Included in Revised Study Plan (8/14/09)
Hydrologic Alteration Study			X
Water Balance/Operations Model Study		X	
Water Quality Monitoring Study	Appendix A		
Water Temperature Model Study		X	
Bioaccumulation Study		X	
Reservoir Fish Populations Study	Appendix B		
Fish Entrainment Study	Appendix C		
Riparian Habitat and Wetlands Study			X
Reservoir Water Temperature Management Feasibility Study		X	
Anadromous Fish Passage Study		X	
Upper River Fish Populations Study		X	
Anadromous Conservation Hatchery Study		X	

	Adopt Modified Study Included in the Appendix to this Document	Adopt Study Included in CDFG's Comments on Merced ID's Proposed Study Plan (7/16/09)	Adopt Merced ID Study Included in Revised Study Plan (8/14/09)
Anadromous Fish Passage Facilities Study		X	
Gravel Sediment Budget and Mobility Study		X	
Chinook Salmon Egg Viability Study		X	
Anadromy Salmonid Habitat Study	Appendix D		
Salmonid Floodplain Rearing Study		X	
Instream Flow Study	Appendix E		
Recreational Boating Study	Appendix F		

2.1 – Hydrologic Alteration Study

In its Revised Study Plan, Merced ID modified the Hydrologic Alternation study to include the Merced River at the Crocker-Huffman Diversion Dam. The Resource Agencies and Conservation Groups support this study modification. We believe that, with this change, the study will help address the interest of evaluating the effects of the project below the Crocker-Huffman Diversion Dam. Therefore, we accept the use of Merced ID's revised Hydrologic Alteration study and recommend that the Commission adopt the study in its Study Plan Determination.

Merced ID comments, however, that "output from the newer Environmental Flow Component module will not be used, due to glitches in the algorithm used to generate the statistics" and states that "[t]his approach is consistent with the approach currently being used on other relicensings in California (e.g., the Yuba-Bear Hydroelectric Project, FERC No. 2266, and the Drum-Spaulding Project, FERC No. 2310) per the FERC Study Determination for those projects."

While the Resource Agencies and Conservation Groups concur that the February 23, 2009 Study Plan Determination for the Yuba-Bear and Drum-Spaulding hydroelectric projects only required the licensees to include the original five Indicators of Hydrologic Alteration (IHA) groups of statistics to analyze hydrologic variability, the resource agencies participating in the Yuba-Bear and Drum-Spaulding relicensing projects specifically recommended including the Environmental Flow Components in the Hydrologic Alternation study. In their February 9, 2009 comments on the licensees' revised study plan, the resource agencies state that:

> "The IHA methodology has been widely used in a myriad of hydrologic assessments, and the strengths and weaknesses of the Environmental Flow Component (EFC) portion of the analysis have also been widely documented. Therefore, the resource agencies disagree that the EFC portion of the IHA analysis is not a generally accepted practice as asserted by the licensee.
>
> The licensees have repeatedly stated that they do not agree with the definitions provided by the authors of the IHA methodology for the five EFC components. The resource agencies have agreed that the study plan can include a statement that usage of this method does not imply endorsement of the definitions provided by the Nature Conservancy.
>
> The EFC portion of the IHA methodology allows users to vary parameters to modify the computation of environmental flow components. This is analogous to selecting from the various suites of curves that can be used in a PHABSIM analysis and result in different flow conclusions. To provide consistency, the resource agencies proposed using the standard parameters provided in IHA Version 7 rather than trying to determine what flow values should be set to determine the parameters."

In summary, while the Resource Agencies and Conservation Groups accept Merced ID's revised Hydrologic Alteration study, we disagree with Merced ID's suggestion that it would not be appropriate to consider the Environmental Flow Component module of IHA.

Recommendation: Adopt the Hydrologic Alteration study included in Merced ID's August 14, 2009 Revised Study Plan.

2.2 – Water Balance/Operations Model Study

In its Revised Study Plan, Merced ID modified the Water Balance/Operations Model study to include the minimum flow requirements specified in the Davis-Grunsky Act as the second release priority. In addition, Merced ID agreed to consider the San Joaquin Valley Water Year Hydrologic Classification Index and agreed to compare all recommended water year type classification indices. The Resource Agencies and Conservation Groups appreciate Merced ID adopting these recommendations.

Merced ID did not, however, adopt the recommendation by the Resource Agencies and Conservation Groups to add "Metropolitan water use demands" to the list of model priorities and asserted that they did not understand the term. As was clearly described in the Water Balance/Operations Model study filed by the resource agencies on July 16, 2009, "Metropolitan water use" is intended to include all of the riparian diversion demand supplied by Merced ID.

In addition, Merced ID did not adopt the recommendation by the Resource Agencies and Conservation Groups to extend the geographic scope of the Water Balance/Operations Model to the Shaffer Bridge or to incorporate additional model nodes below the project. The Resource Agencies and Conservation Groups are concerned that, by not adopting these recommendations, the model will not allow relicensing participants to fully understand the effects of the project on instream flow and water quantity including downstream of the Crocker-Huffman Diversion Dam (Issue WR-1). In addition, the model will not be able to assist relicensing participants, including the Commission, in evaluating the effect, from a hydrologic perspective, of Merced ID's proposal to change the minimum flow compliance point from the Shaffer Bridge to McSwain Dam.

In the comments, Merced ID suggests that the San Joaquin River HEC-5Q water temperature model (SJR5Q model) could be used to evaluate the cumulative effects downstream of the Crocker-Huffman Diversion Dam. While we recognize the potential utility of the SJR5Q model for evaluating the cumulative effects of project operations on water temperature in the lower Merced River down to the Snelling Road Bridge, the SJR5Q model does not appear to simulate hydro power generation. Therefore, relicensing participants, including the Commission, will not be able to quantify the generation impact associated with Merced ID's proposal to move the lower Merced River instream flow compliance point from the Shaffer Bridge to McSwain Dam.

It is important to note that in other FERC relicensing projects, the water balance/operations models extend well downstream to allow an evaluation of the cumulative effects of changes in project operations. For example, the water balance model developed by the Placer County Water Agency for the Middle Fork American River Project (FERC No. 2079) extends approximately 29 miles downstream of the project to Folsom Reservoir.

Due to Merced ID's reluctance to extend the geographic scope of the Water Balance/Operations Model Study to the Shaffer Bridge which will allow an evaluation of

the cumulative effects of changes in project operations (including the proposed change in compliance point), the study is not consistent with generally accepted practice as required by 18 CFR 5.9(b)(6).

Recommendation: Adopt the Water Balance/Operations Model study included in the California Department of Fish and Game's July 16, 2009 comments regarding Merced ID's proposed study plan.

2.3 – Water Quality Monitoring Study

The Resource Agencies and Conservation Groups requested several modifications to Merced ID's proposed water quality study plan. These included an additional sampling period during the spring run-off period, additional sampling locations for the collection of water quality data downstream of the Crocker-Huffman Diversion Dam, additional dissolved oxygen monitoring, and a request to include consultation with the relicensing participants regarding the need for additional water quality data collection based on preliminary results obtained from the study plan.

In the Revised Study Plan, Merced ID agreed to add a sampling effort during the spring run-off period, but also removed the second summer low flow sampling contained in the earlier version of the study plan. As justification for this, Merced ID states they believe there is no value to repeat the low flow sampling given the results of the August 2008 sampling, which is in some ways misleading, since flow conditions below Project reservoirs downstream to the Crocker-Huffman Diversion Dam are actually augmented in August due to the delivery of irrigation water. The Resource Agencies and Conservation Groups believe that sampling during both the spring run-off and late summer periods is required. It is common in most relicensing proceedings that water quality sampling take place during different times of the year to cover the full range of conditions.

With respect to dissolved oxygen monitoring, Merced ID points out that the language was not very clear in the study plan submitted by the Resource Agencies and Conservation Groups concerning additional monitoring during the spring and fall in the vicinity of the Project when flow releases from the Project reservoirs are not being made for irrigation water demand. Consequently, Merced ID included a provision to consult with the State Water Board on the need to conduct additional dissolved oxygen monitoring during spring and/or fall low flow periods. The Resource Agencies and Conservation groups recommend that the Commission include a requirement for additional dissolved oxygen monitoring during spring and/or fall low flow periods, and that any provision for consultation focus on when, rather than if such monitoring will take place. This information **will** be needed by the State Water Board to determine compliance with the dissolved oxygen objective as part of its review of the Project pursuant to Section 401 of the Clean Water Act.

Merced ID did not agree to include additional sampling locations downstream of the Crocker-Huffman Diversion Dam, but instead included a provision to consult with the relicensing participants and collaboratively review historic water quality data from Merced ID's 2008 and 2010 water quality sampling immediately upstream of the Crocker-Huffman Diversion Dam to determine whether the release of a constituent of interest from the Project has a reasonable potential to have a significant cumulative effect on the constituent downstream of the Crocker-Huffman Diversion Dam to the Snelling Road Bridge. Only at that point, would a study plan be developed for additional water quality sampling at locations downstream of the Crocker-Huffman Diversion Dam.

The Resource Agencies and Conservation Groups are concerned that by not including the additional sampling sites, the resulting data set will not allow relicensing participants to fully understand the potential effects of the project on water quality downstream of the Crocker-Huffman Diversion Dam. Moreover, the data produced through implementation of the study plan will not be able to assist relicensing participants, including FERC, the State Water Board and Merced ID themselves for purposes of CEQA, in evaluating the effect, from a water quality perspective, of Merced ID's proposal to change the point of compliance from the Shaffer Bridge to McSwain Dam. Additionally, the collection of water quality data in the downstream section of the Merced River, presumably within the same time frame that data is being collected on anadromous fish, will provide a more complete picture of the quality of the aquatic habitat in that segment of the river.

Due to the limited geographic and temporal scope, Merced ID's proposed Water Quality Study is not consistent with generally accepted practice in accordance with 18 CFR 5.9(b)(6). The Resource Agencies and Conservation Groups have modified the Water Quality Study to address the deficiencies discussed above. The modified study is presented in Appendix A.

Recommendation: Adopt the Water Quality Monitoring Study included in Appendix A.

2.4 – Water Temperature Model Study

The Resource Agencies and Conservation Groups requested that Merced ID extend the geographic scope of the water temperature modeling study downstream to the confluence with the San Joaquin River and to include requirements for temperature monitoring downstream to the Shaffer Bridge. We also requested that any model chosen for use in the relicensing proceeding include the ability to simulate thermodynamics and temperature distribution in both the Project impoundments and those located downstream of the Project (i.e. Merced Falls Reservoir and Crocker-Huffman Diversion Dam impoundment). Merced ID added additional clarification to the revised version of the Water Temperature Model Study Plan to address this request. The Resource Agencies and Conservation Groups appreciate the additional detail provided by Merced ID.

The Resource Agencies and Conservation Groups also appreciate the inclusion of temperature monitoring activities in Merced ID's revised version of the Water Temperature Model Study Plan; however, not all of the locations requested in our request were included. Moreover, the furthest downstream temperature monitoring location included in Merced ID's revised study plan does not correspond with the Commission's geographic scope for cumulative effects on water resources, which extends an additional 7 miles downstream. It is also worth noting that Study 5 in Attachment 3A to Merced ID's revised study plan describes additional temperature monitoring activities that Merced ID is proposing to implement outside of the FERC proceeding. The Resource Agencies and Conservation Groups believe that temperature monitoring should be required as part of the Commission's study plan determination and should include the downstream locations described in the study plan filed by the Resource Agencies and Conservation Groups on July 16, 2009. One coordinated effort to obtain water temperature data in the Merced River is necessary and should occur simultaneous with the other studies.

The Resource Agencies and Conservation Groups are concerned about the ability of the relicensing participants to utilize the modified version of the SJR5Q model that appears will be used during this proceeding. For example, without having had an opportunity to work with the model, it is difficult to assess how easy it will be to obtain model output for locations downstream of Crocker-Huffman. The Resource Agencies and Conservation Groups are also concerned that the model will not provide easy access to the data needed to assess Merced ID's proposal to move the compliance point for instream flows to a location immediately below McSwain Dam. We encourage the Commission to include a requirement for model output nodes downstream of the Project at least to Shaffer Bridge to facilitate the use of the model by the relicensing participants. Access to this information **will** be needed by the State Water Board as part of its review of the Project pursuant to Section 401 of the Clean Water Act.

Recommendations; Adopt the Water Temperature Model study included in the California Department of Fish and Game's July 16, 2009 comments regarding Merced ID's proposed study plan.

2.5 – Bioaccumulation Study

In its proposed study plan Merced ID included a Bioaccumulation study that addressed mercury bioaccumulation in Merced ID's reservoirs, however Merced ID has chosen to remove this entire study plan from the revised study plan submitted on August 14, 2009. This appears to be in response to comments filed by the Resource Agencies and Conservation Groups that requested additional fish sampling locations for fish tissue analysis in the Merced River downstream of the Project and sediment sampling for mercury at specific locations. At the same time, Merced ID states in their revised study plan comments that they will proceed with the earlier version of the study outside of relicensing in 2009 because they believe these data will be useful in other ongoing proceedings, such as total maximum daily loads (TMDL) planning. It is somewhat disingenuous that Merced ID does not acknowledge the need for the data in the relicensing proceeding since the original request for this information came from the State Water Board, a participant in the relicensing.

Merced ID cites the Commission's April 17, 2009 Scoping Document 2 that *"The applicant does not propose any activities typically associated with the release or mobilization of mercury"* as justification for removal of the Bioaccumulation study from the revised study plan. As stated in previous filings, the Resource Agencies and Conservation Groups disagree with the Commission's determination regarding the nexus between mercury bioaccumulation and Merced ID's Project. The existence of the Project impoundments is a factor that affects mercury methylation and likely leads to geochemical conditions that enhance that process. Additionally, the presence of the impoundments provides opportunities for recreational fishing that would otherwise not occur, and can therefore create a risk to public health when mercury accumulates in reservoir fish beyond levels considered safe. In fact, in a recent study, the average mercury concentration for fish samples collected in the Project reservoirs was higher than the threshold of 0.44 µg/g wet-weight established by the California Office of Environmental Health Hazard Assessment that warrants advising the public not to consume fish from the reservoirs[1]. The Commission has approved the inclusion of studies that address mercury bioaccumulation in other relicensing proceedings (e.g. the Yuba-Bear Project, FERC No. 2266, and the Drum-Spaulding Project, FERC No. 2310), and it is likely that this issue will continue to require studies in future proceedings. Moreover, this information **will** be required by the State Water Board for use in developing the Section 401 Water Quality Certification that will need to accompany any new license issued by the Commission.

Merced ID objects to the inclusion of additional sampling locations downstream of the Project. In general, the collection of fish tissue data at locations downstream of the Project is important not only for the purpose of assessing the potential impacts to human health associated with recreational fishing, but it will also provide insight into wildlife

[1] Davis, J.A., A.R. Melwani, S.N. Bezalel, J.A. Hunt, G. Ichikawa, A. Bonnema, W.A. Heim, D. Crane, S. Swenson, C. Lamerdin, and M. Stephenson. 2009. Contaminants in Fish from California Lakes and Reservoirs: Technical Report on Year One of a Two-Year Screening Survey. A Report of the Surface Water Ambient Monitoring Program (SWAMP). California State Water Resources Control Board, Sacramento, CA.

exposure to mercury. The effects of Merced ID's Project on instream flows downstream of the Crocker-Huffman Diversion Dam may lead to conditions that enhance mercury methylation by creating low flow side channels. Moreover, fish sampling for mercury bioaccumulation outside of project boundaries has been included in other proceedings, including the relicensing studies for the Upper American River and Chili Bar Projects (FERC Project No. 2101 operated by the Sacramento Municipal Irrigation District, and FERC Project No. 2155 operated by Pacific Gas and Electric Company, respectively), with which Merced ID's consultant was also involved. In this instance, fish sampling for mercury bioaccumulation took place at locations more than 10 miles downstream of Chili Bar Reservoir. There is no reason that sampling downstream of Merced ID's Project shouldn't also be required as part of the current proceeding.

Since bioaccumulation studies are common in other FERC relicensing projects, as discussed above, Merced ID's exclusion of the Bioaccumulation study from relicensing process is not consistent with generally accepted practice in accordance with 18 CFR 5.9(b)(6), and it is not supported by the Resource Agencies and Conservation Groups.

Recommendation: Adopt the Bioaccumulation study included with the California Department of Fish and Game's July 16, 2009 comments on Merced ID's proposed study plan.

3.1 – Reservoir Fish Populations Study

In the Revised Study Plan, Merced ID adopted the Resource Agency and Conservation Group recommendation to conduct nighttime electro-fishing in Project Reservoirs. We appreciate Merced ID including this method in the study.

Merced ID, however, did not adopt three modifications to the Reservoir Fish Population Study that were recommended by the Resource Agencies and Conservation Groups. These recommended changes included: 1) performing fish sampling in the Crocker-Huffman Diversion Dam impoundment and upstream of flowing tributaries; 2) performing fish sampling quarterly; and 3) performing creel surveys twice monthly.

After considering Merced ID's comment regarding the Crocker-Huffman Diversion Dam impoundment fishery surveys conducted by Stillwater Sciences in 2007 and 2008, the Resource Agencies and Conservation Groups believe the data from these surveys is adequate, and we agree that additional surveys of the Crocker-Huffman Diversion Dam impoundment are not necessary.

Merced ID proposed a limited 3-day creel survey during each of the Memorial Day, Independence Day and Labor Day weekends. The Resource Agencies and Conservation Groups believe that the 3 holidays creel surveys (i.e. high use periods) will strongly bias the result of the creel survey due to uneven survey effort and higher than normal usage of the Project area. We recommend that a periodic creel survey to provide even and unbiased data with survey intensity to cover both high and low fishing pressure days will provide scientifically valid data that can be used by Merced ID and other relicensing participants.

In addition, Merced ID proposed only surveying the Project reservoirs once at a time that coincides with typical seasonal movement of lacustrine fishes. The Resource Agencies and Conservation Groups believe that a single sampling event is not adequate to provide a year-round reservoir fish population assessment. A quarterly sample will provide information on fish cohort, seasonal movement, and reaction to different reservoir water surface elevations. It is important to note that the reservoir fish population study adopted in the Yuba-Bear Project (FERC No. 2266) and the Drum-Spaulding Project (FERC No. 2310) proposed reservoir fish population 3 times per year each at different reservoir water surface elevations.

Since Merced ID has not adopted a more frequent sampling methodology that is comparable to the methods used in other relicensing projects, Merced ID's Reservoir Fish Population Study is not consistent with generally accepted practice in accordance with 18 CFR 5.9(b)(6). The Resource Agencies and Conservation Groups have prepared a modified version of the study included in our July 16, 2009 comments that eliminates sampling in the Crocker-Huffman Diversion Dam as discussed above. This modified study is included in Appendix B.

Recommendation: Adopt the Reservoir Fish Population study included in Appendix B.

3.2 – Fish Entrainment Study

In the Revised Study Plan, Merced ID modified the Fish Entrainment study to specify that hydroacoustic monitoring will be considered as a potential entrainment monitoring option if the relicensing participants, including the licensee, collaboratively agree that there is a high likelihood of significant levels of entrainment at the project powerhouse intakes. While the Resource Agencies and Conservation Groups appreciates the licensee incorporating this change into the study plan, it appears that Merced ID misunderstood the primary intent of the Resource Agencies and Conservation Groups recommendation.

In the July 16, 2009 comments on Merced ID's proposed Fish Entrainment study, the resource agencies set-out a process that would allow Merced ID to initiate entrainment monitoring without first having to spend precious time developing and seeking approval of a new study plan. Given the tight deadlines associated with the Integrated Licensing Process, the resource agencies believe that this pro-active approach will ensure that entrainment monitoring data, if deemed necessary, will be available for inclusion in the Preliminary Licensing Proposal or Draft License Application.

In addition, Merced ID rejected the recommendation by the Resource Agencies and Conservation Groups to evaluate entrainment at the intakes to the Northside Canal and the two private canals on PG&E's Merced Falls Reservoir, and at the intake to the Main Canal on the Crocker-Huffman Diversion Dam. Upon further consideration, the Resource Agencies and Conservation Groups believe that PG&E's Merced Falls Project (FERC No. 2467) relicensing is a more appropriate forum to request an assessment of potential entrainment into the Northside Canal and the two private canals on Merced Falls Reservoir.

However, the Resource Agencies and Conservation Groups still believe that it is necessary and appropriate for Merced ID to evaluate entrainment into the Main Canal on the Crocker-Huffman Diversion Dam since a portion of the water diverted into the Main Canal supplies the Merced National Wildlife Refuge via Project facilities in accordance with Merced ID's current license. Specifically, Article 45 of the license requires Merced ID to deliver up to 15,000 acre-feet of ***project*** water and return flow waters to the Merced National Wildlife Refuge. In a May 22, 1992 Order, the Commission directed Merced ID to install a new system to deliver the 15,000 acre-feet using the Benedict Lateral, Deadman Creek, a new lift station on Deadman Creek, and other appurtenant facilities. As part of this Order, the Commission noted that "the installation of the… water delivery system would add new facilities to the project" and directed Merced ID to file new exhibit F and G drawings. (Note: Exhibit G is a map that shows the boundary of the Project.) Based on this information, the Resource Agencies and Conservation Groups believe that the Main Canal diversion at the Crocker-Huffman Diversion Dam is an element of the project, and therefore that it is appropriate for Merced ID to evaluate fish entrainment into the Main Canal as part of this study.

The Resource Agencies and Conservation Groups have modified the study included in the July 16, 2009 comments on Merced ID's proposed study plan to remove reference to

the intakes into the Northside Canal and the two private canals on PG&E's Merced Falls Reservoir. The modified study plan is presented in Appendix C.

Recommendation: Adopt the Fish Entrainment study included in Appendix C.

6.1 – Riparian Habitat and Wetlands Study

In the Revised Study Plan, Merced ID states that "[a]s part of the USFWS AFRP, extensive geomorphic and riparian vegetation studies have already been conducted on the lower Merced River, including vegetation baseline evaluations (Merced River Corridor Restoration Plan Baseline Studies, Volume II: Geomorphic and Riparian Vegetation Investigations Report, Stillwater 2001)." Merced ID notes that this report is available online at http://www.fws.gov/stockton/afrp/documents/MercCorr2.pdf.

The Resource Agencies and Conservation Groups appreciated Merced ID referencing this existing information. The Stillwater report was reviewed and determined to be acceptable for our study interests.

Recommendation: Adopt the Riparian Habitat and Wetlands Study included in Merced ID's August 14, 2009 Revised Study Plan.

2.6 – Reservoir Water Temperature Management Feasibility Study

In the Revised Study Plan, Merced ID did not adopt the Reservoir Water Temperature Management Feasibility study recommended by the Resource Agencies and Conservation Groups. Merced ID states that the study is not consistent with the geographic scope identified by the Commission in Scoping Document 2 (SD2), and that it is a PM&E measure rather than a study.

The Resource Agencies and Conservation Groups disagree with, and are baffled by, Merced ID's suggestion that the recommended study is not consistent with the scope identified by the Commission in SD2. In section 6.1 of the Reservoir Water Temperature Management Feasibility study filed by the Resource Agencies and Conservation Groups on July 16, 2009, the study area is clearly identified as the McSwain and New Exchequer developments, which are the two primary Project facilities. In SD2, the Commission tentatively extended the geographic scope downstream from the project boundary to the Snelling Road Bridge for the purposes of evaluating the cumulative affects of the project on water quality, including water temperature.

The Resource Agencies and Conservation Groups also disagree with Merced ID's comment that the Reservoir Water Temperature Management Feasibility study "…immediately jumps to a PM&E measure without any basis." The purpose of the study is to develop information on water temperature management alternatives, including their associated costs and benefits, to support future PM&E discussions and decisions. Based on our understanding of Merced ID's interests, we believe it is also important to evaluate non-flow related alternatives for reducing water temperatures downstream of the Project. In addition, based on our collective experience with hydro power relicensing, we recognize that more productive PM&E discussions occur when all relicensing participants have information on the costs and benefits of various resource management alternatives.

As an example, during the relicensing process for the DeSabla-Centerville Project (FERC No. 803), the Pacific Gas and Electric Company commissioned a study to evaluate engineering alternatives for reducing heat gain through the DeSabla Forebay. The results indicated that the alternative preferred by the resource agencies and other relicensing participants was more effective and less expensive than other engineering options. The benefit of reduced heat gain through the DeSabla Forebay was a factor that was seriously considered during the development of minimum flow recommendations for Butte Creek and the West Branch of the Feather River.

Notwithstanding the need for, and the value of, the study information, as discussed in the previous paragraph, Merced ID makes several good points, including that: 1) access to the cold water pool in Lake McClure may not be a problem due to the depth of the intake structure; and 2) the Water Temperature Model Study will be valuable in evaluating alternative operational scenarios. We agree that, given the depth of the intake on Lake McClure, access to the cold water pool should not be a problem. We also agree that the

Water Temperature Model Study will be valuable for evaluating the effects of alternative operating scenarios on water temperatures in the Merced River below the project.

Unfortunately, neither of these points helps relicensing participants, including the Commission, understand the range of non-flow related engineering alternatives for reducing water temperatures below the project. From a practical perspective, however, we would expect the study to focus on options for delivering cold water from Lake McClure to below the McSwain powerhouse in a manner that minimizes heat gain.

Finally, the Resource Agencies and Conservation Groups believe that the seven study plan criteria specified in 18 CFR 5.9(b) are adequately and appropriately addressed in our July 16, 2009 comments on Merced ID's proposed study plan. In fact, given the benefits to the DeSabla-Centerville Project relicensing, we believe that Merced ID's reluctance to adopt the Reservoir Water Temperature Management Feasibility Study does not represent good science.

Recommendation: Adopt the Reservoir Water Temperature Management Feasibility Study included in the California Department of Fish and Game's July 16, 2009 comments on Merced ID's proposed study plan.

Anadromous Fish Passage Study
Anadromous Fish Passage Facility Study
Upper River Fish Populations Study
Anadromous Conservation Hatchery Study

Anadromous Fish Passage and Anadromous Fish Passage Facility feasibility

Merced ID suggests that the information that would be developed by the Anadromous Fish Passage study proposed by the Resource Agencies and Conservation Groups has been gathered in significant part in a study by Vogel in 2007 (*A Feasibility Investigation of Reintroduction of Anadromous Salmonids Above Crocker-Huffman Dam on the Merced River*).

However, Vogel's study was designed only to evaluate a very limited subset of potential passage options for anadromous salmonids that ascend the lower Merced River. It addresses the limited question: should anadromous salmonids be re-introduced into the reach between Merced Falls Dam and the Crocker-Huffman Diversion Dam?

Vogel looks primarily at one aspect of the issue: existing habitat conditions in the reach between Merced Falls and Crocker-Huffman. The study heavily emphasizes salmon over steelhead, although a rainbow trout population that is highly prized by anglers is present in the reach. The study is directed from the viewpoint of enhancement rather than mitigation, and concludes that the expense is likely not worth the cost and effort. No detailed technical analysis is made regarding either fish ladder options at the Crocker-Huffman Diversion Dam or fish screening options for the Main Canal whose point of diversion is just upstream of the Crocker-Huffman Diversion Dam.

The Anadromous Fish Passage study proposed by Resource Agencies and Conservation Groups is far more comprehensive. It would

- Analyze fish migration barriers upstream of the project
- Analyze fish migration barriers in (and out from) project reservoirs
- Evaluate how fish passage facilities at the project reservoirs might be operated jointly, and coordinated with facilities at Merced Falls and Crocker-Huffman dams
- Develop a fish passage assessment model that assesses fish passage conditions and interactions and quantifies the available spawning habitat upstream of project reservoirs
- Develop feasibility options for upstream and downstream fish passage, particularly past the project reservoirs. This would include analysis of the feasibility of trap and truck alternatives.

The Anadromous Fish Passage Facility feasibility study part 1 (fish passage facility feasibility) would specifically examine the engineering alternatives for providing fish passage from the lower Merced to the upper Merced River watershed. It would require the licensee to

- Perform a desktop review of fishery agencies' engineering standards and requirements and identify those that would be applicable on the Merced River
- Perform site reconnaissance and document the conditions at locations where fish passage facilities may be needed
- Develop conceptual design plans for passage facilities and drawings of selected potential structures
- Provide cost estimates.

Part 2 of the Anadromous Fish Passage Facility feasibility study addresses migration of salmon and steelhead adults and smolts in the Merced River downstream of the Crocker-Huffman Diversion Dam. Its overarching purpose is to develop a Migration Corridor Protection Plan; this plan can then be used to develop license conditions. In particular, these studies are designed to address license conditions regarding instream flow. This defined goal stands in distinction to the MOU studies, particularly MOU study 1 (adult migration), and studies 3 and 4 (rearing and outmigration), which seek only to determine what flow changes might voluntarily be made by licensee.

More specifically, the Anadromous Fish Passage Facility feasibility study is specifically designed to address flows needed to support successful upstream migration and outmigration. It proposes to use calibration flows of 1,500 cfs and 3,000 cfs to track the outmigration of smolts. In addition to collecting new rotary screw trapping data, Part 2 will assemble and statistically analyze juvenile outmigrant data that has been previously collected but that heretofore has not been developed into a usable report.

To the degree that data can be generated, Part 2 will specifically seek to generate data on O. mykiss in the Merced River. The MOU studies apparently assume up front Merced ID's premise that steelhead in the system do not exist, and in contrast target only salmon.

The Upper River Fish Populations and Habitat study would make much the same kind of evaluations that Vogel (2007) made for the reach between Merced Falls and Crocker-Huffman, only upstream of Lake McClure Reservoir. The analysis would address issues where anadromous fish might most productively be transported to the upper Merced River, how they might fare in various segments of the watershed if they were transported there, and what existing habitat conditions would inform issues such as where downstream migrants might most efficiently be captured.

Except for a single seasonal study (Stillwater, 2008), no other information is available on the current populations of resident fish, fish habitat, or possible limiting factors, e.g. predation by native (Sacramento pikeminnow) or introduced species (Brown trout). The Stillwater study did not consider: a) seasonality of populations of resident fish nor habitat (when present, steelhead spend more than one year in residency), b) potential habitat use by steelhead; c) potential competition between resident fish and re-introduced anadromous fish; d) water temperature suitability for re-introduced anadromous fish; and e) the genetic compositions of resident rainbow or steelhead trout (O. mykiss). None of this information is available from other sources.

The information developed from this study proposal would assist in development of potential license requirements:

- Reservoir operations to manage connectivity between Lake McClure and upper Merced River;
- Reservoir stocking of resident fish;
- Evaluation of the feasibility of the reintroduction of anadromous salmonids to the Upper Merced River;
- Evaluation of desired life-cycle of reintroduced anadromous salmonids;
- Evaluation of best locations for downstream capture facilities for reintroduced anadromous salmonids.

Merced ID also declined inclusion of the Anadromous Conservation Hatchery study proposed by Resource Agencies and Conservation Groups. Merced ID claims that it is inappropriate for Merced ID to evaluate CDFG's policies, procedures, and regulations, and for Merced ID to evaluate CDFG's operation of the Merced River Fish Hatchery. The Resource Agencies and Conservation Groups agree that these matters fall under CDFG's statutory responsibilities. The proposed study did not seek evaluation of these topics. It did propose evaluation of: a) existing facilities for possible re-use as a conservation hatchery; b) the feasibility of constructing new facilities; c) the feasibility of Merced River steelhead trout supplementation; d) environmental compliance evaluation for a Merced River steelhead trout conservation hatchery; and e) development of a hatchery genetic management plan.

The fundamental reason for consideration of a conservation hatchery for steelhead trout is the current precarious population status (an imminent threat of extinction) of the Southern Sierra Nevada Diversity Group (NMFS, 2009a). Once that genetic stock is extinct, it is gone.

Conservation hatcheries are frequently used to preserve critical or threatened genetic stocks and to provide broodstock and planting stocks for re-introduction of extirpated species (e.g., Pyramid Lake, Nevada, re-populated with Lahontan cutthroat trout). The current Merced River Hatchery is limited to rearing and releasing fall- and late fall-run Chinook salmon for "enhancement" of the lower Merced River populations, as mitigation for the Merced River Project, using Davis-Grunsky (State of California), funding for construction of the initial spawning channel (Vogel, 2007). While Vogel (2007) discussed Merced River Hatchery operations, his report was a historical account, description of facilities, and results of recent water quality monitoring. Vogel's report did not address or consider steelhead trout conservation. The Merced River Hatchery is a conventional hatchery operation, specifically for Chinook salmon husbandry, not steelhead trout. There are many differences in how conventional and conservation hatcheries operate, including different water quality parameters, flow requirements, physical facilities differences, and production goal/objective differences.

There are no studies of the feasibility of development and impacts of a conservation hatchery for steelhead supplementation on the Merced River. The requested study will evaluate the feasibility of a steelhead supplementation conservation hatchery, as well as a management plan for re-introduction of steelhead trout, above Merced River Hydroelectric Project anadromous fish passage barriers.

The information developed from this study proposal would assist in development of potential license requirements and assessment of Project effects:

- Evaluation of desirability of constructing a conservation hatchery;
- Evaluation of high level construction options for a conservation hatchery;
- Assessment of hydroelectric project operations relative to their potential effects on a conservation hatchery operation;
- Determination of conservation hatchery water supplies and needs;
- Development of conservation hatchery management plan.

Recommendation: Adopt the Anadromous Fish Passage Study, the Anadromous Fish Passage Facility Study, the Upper River Fish Populations Study, and the Anadromous Conservation Hatchery Study included in the California Department of Fish and Game's July 16, 2009 comments on Merced ID's Proposed Study Plan.

Gravel Sediment Budget and Mobility Study

In its Revised Study Plan, Merced ID did not adopt the Gravel Sediment Budget and Mobility Study recommended by the Resource Agencies and Conservation Groups. Merced ID states that the request did not provide evidence of an existing steelhead population and did not provide an assessment of existing information that addresses Project cumulative effects on spawning gravel for steelhead.

Merced ID argues that sediment availability (e.g., gravel augmentation) and channel shape have been primarily affected by the legacy of aggregate and gold mining along the lower Merced River. The Resource Agencies and Conservation Groups agree that these activities have had historic (and current) effects upon the lower Merced River; nonetheless, the Resource Agencies and Conservation Groups believe that the Project's operations contribute to cumulative effects on sediment and gravel resource impacts below the Project, by trapping natural sediment and gravel, as well as by severely modifying natural flow regimes, both quantitatively and qualitatively. The Resource Agencies and Conservation Groups support investigating the issue raised by the Commission in SD2 regarding the potential effects of the project on sediment transport.

Merced ID points to seven studies and one table, which it believes have already met the objectives and information needs of the Study Request. The Resource Agencies and Conservation Groups disagree with Merced ID's opinion. The Resource Agencies and Conservation Groups reviewed all of the studies that Merced ID believes meet the objectives and information needs of the Study Requests. The Resource Agencies and Conservation Groups point out that all of the studies have a lack of specific data, information, or relation to the issue in some cases.

The MID-NRS (2003) study fails to include higher flows (> 3,000 cfs) to evaluate bed load migration and changes in sediment distribution. Evaluation of sediment behavior at higher flows was included in the original MID-NRS study plan design and ignored when the study was done. Consequently, information on quantitative gravel and bedload movement is lacking for flows >1,400 cfs on the Merced River, which is exclusively controlled by Merced River Hydroelectric Project flow releases at New Exchequer Dam.

The sediment transport model (Stillwater 2004) provides information on current sediment transport conditions and the effectiveness of potential restoration strategies in the Dredger Tailings Reach (DTR), immediately below the Crocker Huffman Diversion Dam. It does not provide information and data on narrowing the main channel, re-grading the floodplain, and augmenting gravel. It does not address information needed to improve the dynamics (e.g., texture, thickness of deposit mobility) of the channel bed. The sediment transport model has not considered: a) increasing coarse sediment storage in the Merced River channel, b) balancing bed texture with sediment transport competence, c) removing dredger tailings to create diverse floodplain surfaces at functional elevations, and d) reconstructing a channel through a portion of the DTR. Stillwater (2004) found that coarse sediment supply in the DTR is limited, due to the construction and operation of Merced River Project dams. It did not evaluate the annual

natural sediment supply to the Merced River. A second issue that has not been evaluated by this study was the determination of sediment loads (quantitatively and qualitatively) that are required to maintain or enhance "good" migratory fish and benthic organism habitats in the lower Merced River.

Merced ID suggests that two technical memos on the bathymetry of Lake McClure and Lake McSwain provide estimates of the amount of "sediment capture" by the Project. These are not quantitative (nor qualitative) estimates of sediment loading and capture. The Resource Agencies and Conservation Groups do not believe that this information can be used to identify gravel sediment budgets or mobility of bedload materials in the river.

Merced ID asserts that many of the components (unidentified) of the requested study are, in essence, "research" projects or potential PM&E measures. The Resource Agencies and Conservation Groups used current and recent studies, being conducted by the principal restoration teams (government agencies) on the lower Merced River, for its summary of past work and Study Request design. These programs or studies include USFWS AFRP restoration program, MID/NRS (2003) study, California Department of Water Resources (2006) study and others as a basis to design a practically-based study to determine restoration alternatives to impaired sediment transport, which may affect anadromous (ESA listed) species. No PM&E measures were suggested in the Resource Agencies and Conservation Groups study request.

Merced ID refers to the PAD Table 7.3.3-6 and suggests that "16 completed anadromous fish restoration projects, many of which focused on channel morphology…(emphasis added)." Actually, only 3 of the 16 projects focused on issues related to the Resource Agencies and Conservation Groups study request: a) Razcliff Restoration Project; b) Robinson Restoration Project; and c) MID-NRS Wing Dam Gravel study. As stated above, Resource Agencies and Conservation Groups fully considered the results of these studies in its Study Request design.

Merced ID states that the MOU Study 2 (a CDFG-Merced ID Study, outside of FERC relicensing process) will provide information related to "quality, quantity, and utilization of spawning areas, including gravel, by Chinook salmon." However, the study will not evaluate issues of quality, quantity, and utilization of spawning areas by ESA listed anadromous fish, including Central Valley steelhead trout, which has different requirements for spawning substrate than salmon. Further, the Resource Agencies and Conservation Groups believe that MOU Study 2 will not be adequate to inform license conditions, and will not address many potential gravel-sediment cumulative impacts for NEPA, ESA, and CEQA.

Merced ID stated that the cost of additional studies is substantially underestimated, and refers to velocity profiling at the sites (PHABSIM). The Resource Agencies and Conservation Groups presumed that an Instream Flow Study (PHABSIM) would be conducted separately, and coordinated with the Gravel Sediment Budget and Mobility study, thus sharing the costs between the studies. The Resource Agencies and

Conservation Groups have not amended their study request budget estimate, but appreciate Merced ID providing an opportunity to clarify the budget issue.

The Resource Agencies and Conservation Groups (2009) Study request included: a) hydraulic and sediment transport modeling; and b) field measurements of hydraulic/hydrological effects, geomorphic changes, channel bed characteristics, bed mobility, channel geometry and profiling, bedload sampling, suspended and turbidity, and sediment storage, under various flow regimes. These data and information will be evaluated and used to provide optimum design flows for the maintenance and enhancement of anadromous fish spawning and rearing channel bed sediments and gravels.

Recommendation: Adopt the Gravel Sediment Budget and Mobility study included in the California Department of Fish and Game's July 16, 2009 comments on Merced ID's proposed study plan.

Salmonid Floodplain Rearing Study and Chinook Salmon Egg Viability Study

The Salmonid Floodplain Rearing study takes an approach to juvenile rearing habitat that is comparable to the approach taken toward juvenile outmigration in Part 2 of the Anadromous Fish Passage Facilities feasibility study. The Salmonid Floodplain Rearing study proposes to examine floodplain usage at prescribed flows. These flows would take place earlier in the season than the proposed outmigration study. Both studies require prescribed flow amounts to test response.

The failure to prescribe flow amounts in MOU study 3 is the principle deficiency in that study, and is the reason why the Salmonid Floodplain Rearing study proposed by the Resource Agencies and Conservation Groups is necessary. Licensee has long recognized the need to evaluate the relative importance of juvenile rearing, but has been unwilling to use the water needed to evaluate differences in habitat use depending on availability of habitat at high flows in particular. The work by Mesick et al (2007) suggests that years when there were long periods of floodplain inundation in the Tuolumne River correlated with high numbers of outmigrating smolts, and in most cases with escapement from that outmigrating age class two to three years later. The Salmonid Floodplain Rearing study will gather empirical evidence in the Merced River in connection with that hypothesis.

The Chinook Salmon Egg Viability study seeks to gather evidence that can be used in setting license conditions for the magnitude, timing and duration of fall attraction flows for adult Chinook salmon migration. Merced River Chinook have fallen to very low numbers since 2007. Fall attraction flows are one of the principal management tools available for the adult life stage that can be used to preserve the run. Embedded within the objective of maintaining the run are two principal issues: the desire to avoid straying of Merced River Chinook, and the desire to maximize the fecundity of Chinook that return to the system.

Licensee has suggested that observation and correlation of escapement relative to Delta conditions and straying outside the Merced River makes this study a “research” project. Elsewhere, however, licensee has claimed that factors outside its control are determinant of escapement success. The consideration of factors outside the Merced River in a desktop exercise seeks to address and account for some of those factors outside licensee control in order to better understand the factors that licensee can control. Foremost among these factors is water temperature within the Merced River.

Recommendation: Adopt the Salmonid Floodplain Rearing Study and the Chinook Salmon Egg Viability Study included in the California Department of Fish and Game’s July 16, 2009 comments on Merced ID’s proposed study plan.

Anadromy Salmonid Habitat Study

In reviewing the Anadromy Salmonid Habitat study submitted by Resource Agencies and Conservation Groups on July 16, 2009, it became clear that there was overlap and even possible conflict between the Anadromy Salmonid Habitat study and Part 2 of the Anadromous Fish Passage Facilities Study.

In the interest of clarity, Resource Agencies and Conservation Groups have therefore revised the Anadromy Salmonid Habitat Study to focus exclusively on juvenile O. mykiss in ten miles of the lower Merced River downstream of Crocker-Huffman Dam.

Also in the interest of clarity, we have retained the title Anadromy Salmonid Habitat. We have added a subtitle: Baseline Juvenile O. mykiss Abundance and Distribution. The modified study is included in Appendix D.

Very little is known about the use of the lower Merced River by O. mykiss. As revised, the Anadromy Salmonid Habitat study seeks to establish a baseline for the use of the Merced River by O. mykiss, filling in much of the information that neither is available in other existing documents nor will be collected in other studies.

In addition to providing data about the use and extent of juvenile O. mykiss in the lower Merced River, this study will provide additional data to shed light on the extent of O. mykiss anadromy in the Merced River, and will look for genetic similarities between O. mykiss in the lower river and those in the upper watershed.

While a study of O. mykiss in the lower Merced is one of the projected MOU studies, that study has not been funded, and a timeline for its performance has not been defined. It also lacks details of how an assessment of O. mykiss genetic similarities and extent of anadromy will be accomplished. The Anadromy Salmonid Habitat study proposed by Resource Agencies and Conservation Groups is thus critically necessary to inform not only PM&E measures for the relicensing, but also to inform the Section 7 consultation for this proceeding.

Recommendation: Adopt the Anadromy Salmonid Habitat Study in Appendix D.

Instream Flow Study

In its Revised Study Plan, Merced ID rejected the Instream Flow study recommended by the Resource Agencies and Conservation Groups. Merced ID asserts that, because there are potentially factors other than instream flow that limit anadromous fish in the Merced River, an instream flow study is not appropriate. The Resource Agencies and Conservation Groups disagree with Merced ID's argument. Instream flow studies are the cornerstone of hydropower relicensing studies in California. The Resource Agencies and Conservation Groups are unaware of any other relicensing in California where an instream flow study was not specified.

Merced ID also comments that there are several inconsistencies with the Instream Flow study recommended by the Resource Agencies and Conservation Groups. The recommended Instream Flow study was developed based on the instream flow study plan that was developed for the Yuba-Bear Project (FERC Project No. 2266) and the Drum-Spaulding Project (FERC Project No. 2310). The Yuba-Bear Project and Drum-Spaulding Project instream flow study was developed through a collaborative process. As is evidenced in an August 11, 2008 filing for these projects, the study plan was supported by numerous relicensing participants, including: the Pacific Gas and Electric Company, the Nevada Irrigation District, the California Department of Fish and Game, the State Water Resources Control Board, the US Forest Service, the Bureau of Land Management, the National Park Service, and the National Marine Fisheries Service. The study was also supported by many non-governmental organizations, including: American Rivers, American Whitewater, the California Sportfishing Protection Alliance, the Northern California Council Federation of Flyfishers, Trout Unlimited, and the South Yuba River Citizens League.

We do, however, appreciate Merced ID's efforts to identify the inconsistencies, as this affords us an opportunity to correct the issues and present an improved study plan for consideration by the Commission. The updated Instream Flow study is presented in Appendix D. Merced ID notes an incorrect statement in step 3 of the instream flow study regarding montane areas. This was a carry-over from the Yuba-Bear and Drum-Spaulding study; and the reference has been corrected. Merced ID also describes an inconsistency in the study area description between section 1 and section 6.1. The correct study area is from the Crocker-Huffman Diversion Dam to the San Joaquin River; the study area identified in section 1 has been corrected.

One difference between the Instream Flow Study recommended by the Resource Agencies and Conservation Groups and the study adopted for the Yuba-Bear and Drum-Spaulding projects is the requirement to develop site-specific habitat suitability criteria. Merced ID argues that it may be "problematic" to develop site-specific habitat suitability criteria for steelhead, Sacramento Splittail, and Chinook salmon given their low occurrence in the Merced River. The Resource Agencies and Conservation Groups understand the challenges described by Merced ID. Therefore, the study has been modified to allow Merced ID to develop HSC from data and information collected in any

appropriate tributaries in the San Joaquin River watershed after consultation with the relicensing participants.

Merced ID questions the need for a minimum of four calibration flows. The Resource Agencies and Conservation Groups recognize that, typically, three calibration flows are specified of one dimensional PHABSIM studies. However, given the broad range of flows included in the study, and based on the recommendations of resource agency hydraulic engineering staff, we believe that at least one additional calibration flow is needed to properly calibrate the hydraulic model and improve accuracy over the range of flows specified in the study.

Finally, Merced ID comments that the Instream Flow study provides limited guidance regarding the development of weighted usable areas, and that it does not include a habitat time series component. The habitat modeling element is unchanged from the study plan developed collaboratively for the Yuba-Bear and Drum-Spaulding projects, and the licensees for these two projects are currently implementing the instream flow study without questioning the guidance provided regarding development of weighted usable areas. With regard to the lack of a time series analysis, the Resource Agencies and Conservation Groups have yet to be presented with a quality implementation of a time series analysis and have relied on flow versus weighted usable area relationships for the development of minimum flow recommendations. Thus, the habitat time series component was omitted in an effort to reduce the cost of implementing the study.

Given that instream flow studies are standard in hydropower relicensing, Merced ID's reluctance to adopt an Instream Flow Study for the Merced River Project is not consistent with generally accepted practice in the scientific community as specified in 18 CFR 5.9(b)(6).

Recommendation: Adopt the Instream Flow study included in Appendix E.

8.2 – Recreational Boating Study

In the comments on Merced ID's proposed study plan, the National Park Service (NPS) reiterated its request for a recreational boating study from Crocker-Huffman Diversion Dam to the Highway 59 Bridge. While Merced ID considered this to be a request for a new study, it should be viewed as a request to expand the geographic scope of the boating study (Study 8.2) that was included in Merced ID's revised study plan. Recreation, including boating and canoeing, is a beneficial use assigned to the Merced River from McSwain Dam to the confluence with the San Joaquin River in the Water Quality Control Plan for the Sacramento and San Joaquin River Basins. Consequently, the State Water Board should be included among the agencies with resource management goals that deal with recreation in the Merced River. As noted in the Basin Plan, designations for canoeing and rafting imply that certain flows are required for this beneficial use. The Resource Agencies and Conservation Groups disagree with Merced ID's assertion that the Project does not affect flows in the reach between Crocker-Huffman Diversion Dam to the Highway 59 Bridge. All of the water that is released to the downstream portions of the Merced River, including the reach between Crocker-Huffman Diversion Dam to the Highway 59 Bridge, originates from the Projects facilities.

In support of the request from the NPS, the Resource Agencies and Conservation Groups are filing a revised version of Study 8.2 that adds a second study reach (Crocker-Huffman Diversion Dam to Snelling Road Bridge) in addition to the study reach found in Merced ID's version of the study (Merced Falls Dam to Crocker-Huffman Diversion Dam). This modified study is presented in Appendix E.

Recommendation: Adopt the Recreational Boating Study included in Appendix F.

Study 2.3

WATER QUALITY MONITORING

August 28, 2009

Deleted: July 16

1.0 Project Nexus and Issue

Merced Irrigation District's (Merced ID or Licensee) continued operation and maintenance (O&M) of the Merced River Hydroelectric Project (Project) may have an adverse effect on water quality. The effect may be direct (*e.g.*, result of poor water quality from a Project reservoir or release of a pollutant from a Project facility), indirect (*e.g.*, due to changes in flow that result in poor water quality downstream) or cumulative (*i.e.*, caused by a Project activity in association with a non-project activity). This study focuses on these potential Project effects to water quality. Due to potential impacts to water quality, operation of the Project may also result in direct, indirect, and/or cumulative impacts to the aquatic resources of the lower Merced River, from Lake McClure downstream to the confluence with the San Joaquin River, including native anadromous salmonid fishes.

For the purpose of this study proposal, water quality parameters are considered those listed in Table 1.0-1.

Table 1.0-1. Water quality parameters addressed in the Water Quality Monitoring Study.[1]

Analyte		Method	Target Reporting Limit ug/L (or other)	Hold time
BASIC WATER QUALITY- IN SITU				
Dissolved Oxygen	DO	SM 4500-O	0.1 mg/L	Field
Specific conductance	-----	SM 2510A	0.001 µmhos	Field
pH	-----	SM 4500-H	0.1 su	Field
Turbidity	-----	SM 2130 B	0.1 NTU	Field
BASIC WATER QUALITY—LABORATORY				
Total Organic Carbon[2]	TOC	SM 5310	0.2 mg/L	28 d
Dissolved Organic Carbon	DOC	EPA 415.1 D	0.5/0.1	28 d
Total Dissolved Solids	TDS	EPA 2540 C SM 2340 C	1 mg/L	7d
Total Suspended Solids	TSS	EPA 2520 D SM 2340 D	1 mg/L	7d
INORGANIC IONS				
Total Alkalinity	-----	SM 2340 B	2000	14 d
Hardness (measured value)	-----	EPA 2340 B SM 2340 C	1 mg/L as $CaCO_3$	
Calcium	Ca	EPA 6010 B	30	180 d
Magnesium	Mg	EPA 6010 B	1	
Potassium	K	EPA 6010 B	500	180 d
Sodium	Na	EPA 6010 B	29	180 d
Chloride	Cl	EPA 300.0	20	28 d
NUTRIENTS				
Nitrate-Nitrite	-----	EPA 300.0	2	28 d <pH 2
Total Ammonia as N	-----	EPA 4500-NH3 SM 4500-NH3	0.02	28 d <pH 2

Table 1.0-1. (continued)

Analyte		Method	Target Reporting Limit ug/L (or other)	Hold time
NUTRIENTS (continued)				
Total Kjeldahl Nitrogen as N	TKN	SM 4500 N	100	28 d <pH 2
Total phosphorous	TP	SM4500 P	20	28 d <pH 2
Dissolved Orthophosphate	PO_4	EPA 365.1 EPA 300.0	0.01	48 h at 4 °C
METALS (total and dissolved)				
Arsenic (total and dissolved)	As	EPA 200.8/1632	53/0.004	180 d
Cadmium (total and dissolved)	Cd	EPA 200.8/1638	3.4/0.003	180 d
Copper (total and dissolved)	Cu	EPA 200.8/1638	5.4/0.01	180 d
Iron (total and dissolved)	Fe	EPA 200.8/1638	6.2/2.2	180 d
Lead (total and dissolved)	Pb	EPA 1638	0.005	180 d
Mercury (total)	Hg	EPA 1631	0.0002	28 d
Methylmercury (total and dissolved)	CH_3Hg	EPA 1630	0.00005/0.00002	90 d
Selenium (total)	Se	EPA 200.8/1638	75	180 d
Silver (total and dissolved)	Ag	EPA 200.8/1638	7/0.03	180 d
Zinc (total and dissolved)	Zn	EPA 200.8/1638	1.8/0.3	180 d
HERBICIDES AND PESTICIDES				
Aldrin	----	EPA 8081A	0.05/0.01	7d
Alpha-BHC	----	EPA 8081A	0.05/0.01	7d
Beta-BHC	----	EPA 8081A	0.05/0.008	7d
Chlordane	----	EPA 8081A	0.5/0.08	7d
Chlorpyrifos	----	EPA 8141A	0.005/0.0024 mg/L	7d
Delta-BHC	----	EPA 8081A	0.05/0.017	7d
Dieldrin	----	EPA 8081A	0.05/0.01	7d
Diazinon	----	EPA 8141A	0.005/0.0029 mg/L	7d
Endosulfan I	----	EPA 8081A	0.05/0.005	7d
Endosulfan II	----	EPA 8081A	0.05/0.01	7d
Endrin	----	EPA 8081A	0.05/0.0118	7d
Gamma-BHC	----	EPA 8081A	0.05/0.02	7d
Heptachlor	----	EPA 8081A	0.05/0.007	7d
Heptachlor Epoxide	----	EPA 8081A	0.05/0.02	7d
Toxaphene	----	EPA 8081A	2/0.3	7d
BACTERIA				
Total coliform	----	SM 9221	1.1 MPN	24 h
Fecal coliform	----	SM 9221	1.1 MPN	24 h
Escherichia coli	*E. coli*	SM 9221	1.1 MPN	24 h
PETROLEUM HYDROCARBONS				
Total Petroleum Hydrocarbons (gasoline range)	TPH-g	SW 8015B	50	14 d
Oil & Grease	O&G	Visual Observation	----	----

1 Sampling locations will be co-located with temperature profile sites and with flow gauges, as much as possible.
2 Total organic carbon data may be used in calculations required to assess conformance with water quality objectives needed.

In addition, this study addresses the following preliminary issue as identified in Section 8 of Licensee's Pre-Application Document (PAD):

- Issue WR-3: Effects of the Project and Project recreation on water quality (excluding water temperature), and compliance with Basin Plan Standards

- Issue WR-6: Effect of the Project on compliance with the Central Valley Regional Water Quality Control Board's (CVRWQCB) Clean Water Act (CWA) Section 303(d) List of Total Maximum Daily Load (TMDL) Priority Schedule

Additionally, the Licensee proposes to move the point of compliance for lower Merced River instream releases 23.6 miles upstream from the existing compliance point. Articles 40 and 41 of the existing license establish minimum instream release requirements for the lower Merced River, and they specify that compliance is to be determined at the Shaffer Bridge (RM 32.5). However, in section 9.3.2 of the Pre-Application Document (PAD), the licensee proposes to eliminate license articles 40 and 41, and in section 9.2.2 of the PAD, the licensee proposes to set the flow measurement point of compliance at McSwain Dam (RM 56.1). Consequently, the Water Quality Monitoring Study will also be used to help evaluate the effect, from a water quality perspective, of the Licensee's proposal to change the point of compliance from Shaffer Bridge to McSwain Dam.

Water temperature is addressed in a separate study proposal: Water Temperature Model Study Proposal.

2.0 Resource Management Goals of Agencies with Jurisdiction Over the Resource to be Studied

The State Water Resources Control Board (SWRCB) is the primary agency with jurisdiction over water quality in the Project Area.[1] SWRCB's management goals are put forth in the CVRWQCB's *Water Quality Control Plan (Basin Plan) for the Sacramento and San Joaquin Rivers*, the fourth edition of which was initially adopted in 1998 and most recently revised in 2007 (CVRWQCB 1998).

The Merced River Hydroelectric Project and the area downstream of the Project falls within three Basin Plan Hydro Units: Hydro Unit 537.22, which includes Lake McClure; Hydro Unit 537.1, which includes McSwain Reservoir; and Hydro Unit 535, which includes the Merced River from McSwain Reservoir to the confluence with the San Joaquin River. Designated beneficial uses in these three Hydro Units are described in Table 2.0-1.

Table 2.0-1. Beneficial uses of the Merced River in the vicinity of the Merced River Hydroelectric Project and the area downstream of the Project as designated by Hydro Unit (HU) in the Central Valley Regional Water Quality Control Board and listed in the Basin Plan (CVRWQCB 1998).

Designated Beneficial Use Description from Basin Plan, Section II		Designated Beneficial Use by Hydro Unit from Basin Plan, Table II-1			
		Use	Lake McClure	McSwain Reservoir	McSwain Reservoir to San Joaquin River
			HU 537.22	HU 537.1	HU 535
Municipal and Domestic Supply (MUN)	Uses of water for community, military or individual water supply systems including, but not limited to, drinking water supply.	MUNICIPAL & DOMESTIC SUPPLY	Potential	Potential	Existing

[1] For the purposes of the Relicensing, the Project Area is defined as the area within a border of about 0.5 mile surrounding the Federal Energy Regulatory Commission (FERC) Project Boundary.

Agricultural Supply (AGR)	Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation (including leaching of salts), stock watering, or support of vegetation for range grazing.	IRRIGATION	Existing	Existing	-----
		STOCK WATERING	-----	-----	Existing
Industrial Process Supply (PRO)	Uses of water for industrial activities that depend primarily on water quality.	PROCESS	-----	-----	Existing
Industrial Service Supply (IND)	Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well repressurization.	SERVICE SUPPLY	-----	-----	Existing
		POWER	Existing	Existing	Existing

Table 2.0-1. (continued)

Designated Beneficial Use Description from Basin Plan, Section II		Designated Beneficial Use by Hydro Unit from Basin Plan, Table II-1			
		Use	Lake McClure	McSwain Reservoir	McSwain Reservoir to San Joaquin River
			HU 537.22	HU 537.1	HU 535
Water Contact Recreation (REC-1)	Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.	CONTACT	Existing	Existing	Existing
		CANOEING & RAFTING	-----	-----	Existing
Non-Contact Water Recreation (REC-2)	Uses of water for recreational activities involving proximity to water, but where there is generally no body contact with water, nor any likelihood of ingestion of water. These uses include, but are not limited to, picnicking, sunbathing, hiking, beach-combing, camping, boating, tide-pool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.	OTHER NON-CONTACT	Existing	Existing	Existing
Warm Freshwater Habitat (WARM)	Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.	WARM1	Existing	Existing	Existing
Cold Freshwater Habitat (COLD)	Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.	COLD1	Existing	Existing	Existing
Migration of Aquatic Organisms (MGR)	Uses of water that supports habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.	WARM2	-----	-----	Existing
		COLD3	-----	-----	Existing
Spawning (SPWN)	Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.	WARM2	-----	-----	Existing
		COLD3	-----	-----	Existing
Wildlife Habitat (WILD)	Uses of water that support terrestrial or wetland ecosystems including, but not limited to, preservation or enhancement of terrestrial habitats or wetlands, vegetation, wildlife (*e.g.*, mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.	WILDLIFE HABITAT	Existing	Existing	Existing

[1] Resident does not include anadromous. Any hydrologic unit with both WARM and COLD beneficial use designations is considered COLD water bodies by the SWRCB for the application of water quality objectives.
[2] Striped bass, sturgeon and shad.
[3] Salmon and steelhead.

In addition, Section 303(d) of the CWA requires that every two years each State submit to the United States Environmental Protection Agency (EPA) a list of rivers, lakes and reservoirs in the State for which pollution control or requirements have failed to provide for water quality. Based on a review of this list and its associated TMDL Priority Schedule, the Merced River from McSwain Dam to the confluence with San Joaquin River has been identified by the CVRWQCB as CWA § 303(d) State Impaired for the following constituents: chlorpyrifos, diazinon, Group A Pesticides, and mercury (CVRWQCB 2006). Group A Pesticides consists of aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexanes (including lindane), endosulfan, and toxaphene. In 2009, the CVRWQCB proposed adding *E. Coli*, temperature and Unknown Toxicity to the 303(d) list for this stretch of river and adopted a resolution to approve the 2008 305(b) and 303(d) Integrated Report (which includes the proposed listings) at the June 11, 2009 Regional Water Board meeting. The 2008 Integrated Report will then be presented to

the State Water Board for approval. At this time, there are no approved TMDL plans for the Merced River.

3.0 Potential License Condition

Study results may be used in the development of Project facilities and/or activities Licensee will undertake as a condition of the new license for the purpose of protecting or mitigating impacts to water quality that would result from continued Project O&M, or for the purpose of enhancing water quality that would be affected by continued Project O&M. These facilities, operations and management activities, which are referred to as protection, mitigation and enhancement (PM&E) measures, could include:

- Application of Best Management Practices
- Implementation of Spill Prevention, Control and Countermeasure (SPCC) Plans as required in 40 CFR 112
- Implementation of hazardous materials management plans

Development of PM&E measures is not part of the study

4.0 Study Goals and Objectives

The goal of this study is to characterize existing water quality conditions in Project reservoirs and Project-affected reaches of the Merced River downstream to Shaffer Bridge, the current FERC license compliance point for instream flows.

5.0 Existing Information and Need for Additional Information

Existing, relevant and reasonably available information found at the Project Area is documented in Section 7.2.9 of the PAD. Historic information suggests that water quality in the Project Area meets Basin Plan Water Quality Objectives. A data collection effort is needed to verify the water quality in the Project Area.

Water entering Lake McClure and McSwain Reservoir from the Wild and Scenic Upper Merced River is well-oxygenated, cold water of high quality with few exceptions. As water flows through the two lakes, there are few sources of water quality degradation, as only the recreation infrastructure surrounding the Upper Merced River and Lake McClure (*e.g.* campsites and fuel stations) provide potential contaminant sources. Subsequently, water leaving McClure Reservoir remains of high enough quality and generally meets Basin Plan criteria.

Seasonal temperature stratification processes can play an important role in lake water quality conditions. With a residence time on the order of one year (Vogel 2003), Lake McClure becomes thermally stratified each spring and maintains a separation between the warmer waters of the top layer (*i.e.*, epilimnion) and the cold water pool comprising the bottom layer (*i.e.*,

hypolimnion) until fall. Monthly temperature profiles collected in 2001 suggest that thermal stratification begins in March, is complete by June, and holds into October (Vogel 2003). During the summer of 2001, the epilimnion temperature averaged 80.6°F, while water 140 feet and deeper measured around 55.4°F (Vogel 2003).

In data reported by EPA since New Exchequer Dam was completed in 1967, dissolved oxygen levels in Lake McClure's epilimnion ranged between 7.6 and 10.8 mg/L for the years 1975-1988 (EPA STORET 2008). While similar measurements were not found for the hypolimnion, samples taken just downstream of New Exchequer Dam offer insight into hypolimnion water quality: water temperatures of 41°F to 62.3°F and dissolved oxygen measurements between 5.6 and 12.1 mg/L with a median value of 9.6 mg/L were recorded in McSwain Reservoir measured just downstream of New Exchequer Dam for the same time interval (EPA STORET 2008). Vogel (2003) confirms the EPA observations with a Lake McClure temperature profile collected in 2001 in which he found hypolimnion temperatures of approximately 50°F to 60°F throughout the year.

It is expected that McSwain Reservoir does not thermally stratify, or only weakly stratifies, because it is a re-regulating reservoir. Water released into McSwain Reservoir from Lake McClure flows through quickly - from less than 3 days to over 3 weeks during summer periods (Vogle 2003). Typical summer water temperatures in McSwain Reservoir are not known; however, data collected by Merced ID and others from the years 1998-2008 suggest that water temperatures downstream of McSwain Reservoir are less than 68°F and well oxygenated, regardless of the season.

Existing information provides a recent and fair description of the general water quality of the Merced River upstream and substantially downstream of the Project area, while less is known about the water quality within and just downstream of the Project and little to no data available with respect to metals. Information regarding water quality in the Project and its vicinity could be gathered during the low flow summer season during a period when effects are expected to be most pronounced, if they occur. Samples from upstream, within, and downstream of the Project that would characterize both the ambient water quality conditions while providing insight into the in-reservoir chemical dynamics. A difference between upstream and downstream chemical concentrations, could suggest the potential for project-related impacts.

6.0 Study Methods and Analysis

Water quality sampling will occur in the Merced River upstream of Lake McClure, within Lake McClure and McSwain Reservoir, in the Merced River between Merced Falls Dam and the normal maximum water surface elevation of the Crocker-Huffman Diversion Dam impoundment and in the Merced River at selected locations downstream to Shaffer Bridge (RM 32.5) during low flow conditions in the late summer. Bacteria samples will be collected from adjacent to recreation areas. Continuous dissolved oxygen monitoring will be conducted upstream, downstream, between reservoirs and at Shaffer Bridge.

6.1 Study Area

The study area includes the Federal Energy Regulatory Commission (FERC) Project Boundary[2] and the Merced River between Merced Falls Dam and the normal maximum water surface elevation of the Crocker-Huffman Diversion Dam impoundment. It also includes the Crocker-Huffman Diversion Dam impoundment and the Merced River downstream of Crocker-Huffman Diversion Dam to Shaffer Bridge, the current FERC license compliance point for instream flows.

If additional Project facilities, features, or recreation facilities are identified during the Relicensing, the study area will be expanded, if necessary, to include these areas. If, at a later time, Licensee proposes Project activities that are outside of the study area that may affect resources addressed by this study proposal, the study area will be expanded, if necessary, to include these areas.

6.2 General Concepts

The following general concepts apply to the study:

- Personal safety is an important consideration of each fieldwork team. If Licensee determines the information cannot be collected in a safe manner, Licensee will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

- Licensee will make a good faith effort to obtain permission to access private property where needed well in advance of performance of the study. If access is not granted or river access is not feasible or safe, Licensee will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

- The schedule for each proposed study is reasonably flexible to accommodate unforeseen problems that may affect the schedule. If a schedule changes, Licensee will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

- Field crews may make minor modifications to the study proposal in the field to accommodate actual field conditions and unforeseen problems. When modifications are made, Licensee's field crew will follow the protocols in this study proposal. If minor modifications are made, Licensee will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

- Licensee's performance of the study does not presume Licensee is responsible in whole or in part for PM&E measures that may arise from that study.

[2] The FERC Project Boundary encompasses all Project facilities and features as well as all land needed by Licensee for the normal operation and maintenance of the Project. The boundary is shown in Exhibits J and K, Project Maps of the existing FERC license for the Project.

- The estimated level of effort and cost is not a firm commitment by Licensee to expend all the funds. If the study costs more, Licensee is committed to completing the study. If the study costs less, Licensee is not committed to expending the remaining funds on other Relicensing studies or PM&E measures.

- Global Positioning System (GPS) data will be collected in a manner that meets or exceeds the federal government's "*National Map Accuracy Standards*" for published maps. All GPS data will be in the Universal Transverse Mercator (UTM) Coordinate System, using the North American Datum 1983 and stored in Environmental Science Research Institute (ESRI) Shapefile format. After a Shapefile has undergone a quality assurance/quality control (QA/QC) review to Licensee's satisfaction and after all metadata have been documented, Licensee will provide the Shapefile to resource and land management agencies upon request.

6.3 Study Methods

The study methods will consist of the following nine steps:

Step 1 – Select Water Quality Sampling Locations. To better understand the dynamics of the water chemistry and physical structure of Lake McClure and McSwain Reservoir, water quality information will be collected: in the Merced River upstream of Lake McClure; within Project reservoirs; in the Merced River downstream of the Project; and at a location between Pacific Gas and Electric Company's (PG&E) Merced Falls Dam and the normal maximum water surface elevation of the Crocker-Huffman Diversion Dam impoundment. Additional water quality samples will be collected in the Merced River at four locations between Crocker-Huffman Diversion Dam downstream to Shaffer Bridge (RM 32.5).

Timing of Sampling Events. Water chemistry samples will be collected during the spring run-off period (June/July) and during the late summer low flow season (late August/early September). The low flow sampling in the vicinity of the Project should be conducted when irrigation deliveries are not occurring.

Sample Locations and Depths. In-reservoir samples will be co-located with reservoir temperature profiles at two sites: one between Arnold Bay and Barrett Cover Recreation Areas[3] and one near the main dam. (Table 6.3-1). At each reservoir location, water chemistry samples will be collected for laboratory analysis at two depths: within the hypolimnion and just below the surface, in the epilimnion. *In situ* water quality measurements will be made at these same depths with a Hydrolab DataSonde 5 (Hydrolab).[4]

In-stream samples will be located upstream and downstream of the Project reservoirs, below Merced Falls Dam and in the Merced River below Crocker-Huffman Diversion Dam. Water chemistry samples will be grab samples collected for laboratory analysis from the moving water. *In situ* measurements with the Hydrolab[5] will also be collected.

[3] Or, if water levels are low, a location in flowing water upstream of the reservoir pool.
[4] Or other similar instrument that has the same precision and accuracy.
[5] *Ibid.*

Table 6.3-1. Reservoir and Stream Reach Sample Locations.

Reservoir/Stream Reach	Sample Depth	Location
Lake McClure Inflow	Surface	In flowing water, upstream of reservoir pool.[1]
Lake McClure	Surface	Between Arnold Bay and Barrett Cover Recreation Area[2]
	Bottom	
Lake McClure—Near Dam	Surface	At the deepest point in the reservoir near the dam
	Bottom	
New Exchequer Powerhouse Release into McSwain Reservoir	Surface	Below Exchequer Dam
McSwain Reservoir—Near Dam	Surface	At the deepest point in the reservoir
	Bottom	
McSwain Powerhouse Release into Merced Falls Reservoir	Surface	Below McSwain Dam
Merced Falls Powerhouse Release into Merced River	Surface	Below Merced Falls Dam
Crocker-Huffman Impoundment	Surface	At the deepest point in the reservoir
	Bottom	
Merced River, downstream of Crocker-Huffman	Surface	RM 47 (Thermograph site)
Merced River	Surface	RM 42 (Thermograph site)
Merced River	Surface	Between RM 32 and 42 (location to be determined based on access)
Merced River	Surface	RM 32 Shaffer Bridge

[1] Or, if water levels are low, a location in flowing water upstream of the reservoir.
[2] Or, if water levels are low, at another location near the head of the reservoir.

Analytical Parameters. All samples associated with the reservoir sampling will be analyzed for the following parameters:

- Basic Water Chemistry - *In Situ*
- Basic Water Chemistry - Laboratory
- Inorganic Ions
- Metals
- Nutrients
- Herbicides and Pesticides

The analytes associated with each parameter are listed in Table 1.0-1.

Step 2 – Select Sampling Locations for Recreation-related Surveys. Data collected by Licensee to assess the condition of existing recreation facilities and dispersed recreation areas suggest that some near-shore locations adjacent to unmanaged and low-managed recreation facilities have the potential to affect water quality.

Timing of Sampling Events. In accordance with bacteria sampling protocols, bacteria samples will be collected on five different days within a 30-day period including either the Independence Day or Labor Day holiday weekends (CVRWQCB 1998). A single petroleum hydrocarbon

sample will be collected at each location during the holiday weekend included in the bacteria sampling.

Sample Locations and Depths. Recreation sample locations are listed in Table 6.3-2. At each sample location, surface water will be collected from the near surface (bacteria) and/or the surface (petroleum hydrocarbons).

Table 6.3-2. Recreation Survey Locations.

Recreation Area	Bacteria Sampling Site	Latitude	Longitude
LAKE MCCLURE[1]			
McClure Point	Boat ramp	37°36'17.05"N	120°16'40.63"W
	Undeveloped boat ramp & marina	37°36'34.36"N	120°16'14.86"W
Barrett Cove	North boat ramp & marina	37°38'54.28"N	120°17'37.77"W
	South boat ramp	37°38'17.18"N	120°17'04.62"W
Horseshoe Bend	Boat ramp	37°41'49.88"N	120°14'18.02"W
	Drainage/inlet at campground	37°41'54.90"N	120°14'36.47"W
Bagby	Boat ramp	37°36'37.33"N	120°08'04.41"W
	Main campground loop	37°36'48.01"N	120°07'38.89"W
	Shepherd's Point Primitive Area	37°36'21.90"N	120°06'42.92"W
MCSWAIN RESEROIR			
McSwain Reservoir	Swim Beach	37°31'12.76"N	120°18'20.94"W
	Boat Launch	37°31'09.53"N	120°18'11.80"W
	C,D,E, & F Loop of the Campground	37°31'09.99"N	120°17'52.12"W
	Picnic Area	37°31'14.66"N	120°18'27.14"W

[1] Recreation use of McClure Reservoir appeared low in Summer 2008, most likely due to the very low water levels. Bacteria sampling was not performed on Lake McClure in 2008.

Analytical Parameters. Water samples associated with the recreation-related survey will be analyzed for the recreation suite of surface water analytical parameters:

- Bacteria
- Petroleum Hydrocarbons

Visual observations of oil and grease will be recorded in the field notebook.

Step 3 – Select Continuous Dissolved Oxygen Monitor Locations. The Basin Plan provides a water-body Specific Water Quality Objective for dissolved oxygen (DO) in the Merced River from Cressy to New Exchequer Dam (Table III-2 of CVRWQCB 1998). To better understand DO dynamics, continuous DO monitors will be installed: 1) at the Highway 49 Bridge in the Merced River upstream of Lake McClure; 2) in McSwain Reservoir downstream of New Exchequer Powerhouse; 3) in Merced Falls Reservoir downstream of McSwain Powerhouse; 4) in the Merced River downstream of Merced Falls Powerhouse; 5) in the Merced River upstream of the Crocker-Huffman Diversion Dam impoundment, and 6) in the Merced River downstream of Crocker-Huffman at Shaffer Bridge (RM 32). Each monitor will be placed in flowing water near the surface.

Timing of Sampling Events. Continuous DO monitors will be deployed for a minimum of 14 days in the late summer low flow season (late August/ early September). Additional DO data collection will also be undertaken during the spring and fall when flow releases from the Project reservoirs are not being made to provide for irrigation water demand, with the specific time periods determined based on consultation with the SWRCB.

Deleted: may

Deleted: required

Sample Locations and Depths. Continuous DO monitor locations are described above. Sondes will be located upstream and downstream of the Project reservoirs and below Merced Falls Dam, upstream of Crocker-Huffman Reservoir and downstream of Crocker-Huffman Reservoir at Shaffer Bridge (RM 32).

Analytical Parameter. A sonde will be deployed to collect DO measurements at a minimum of every 1 hour for the period of study.

Step 4 – Collect Data and Samples. All data will be acquired in accordance with standard quality assurance practices.

Reservoir and Stream Surveys. Water temperature (±0.1°C), dissolved oxygen (±0.2 mg/L), pH (±0.2 standard unit, or su), specific conductance (±0.001 µomhos/cm), and turbidity (± 1 NTU) will be measured *in situ* using a Hydrolab DataSonde 5 or other similar instrument that has the same precision and accuracy. Prior to and after each use, the instrument will be calibrated using manufacturer's recommended calibration methods. Any variances will be noted on the field data sheet and final report and recalibration or repair done as necessary. Licensee will note relevant conditions during each sampling event on the field data sheet (*i.e.*, air temperature, flow, description of location, floating material, and evidence of oil and grease). Sampling equipment will be thoroughly cleaned between sampling sites.

Each laboratory sample will be collected into laboratory-supplied clean containers. Water samples to be analyzed for metals will be taken using "clean hands" methods consistent with the EPA's Method 1669 sampling protocol *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria* (EPA 1995). Samples requiring filtration before metals analysis will be filtered in accordance with standard protocols in the field.

All sample containers will be labeled with the date and time that the sample is collected, sampling site or identification label and handled in a manner consistent with appropriate chain-of-custody protocols. The sample container will be preserved (as appropriate), stored and delivered to a State of California-certified water quality laboratory for analyses of the parameters listed in Table 1.0-1 in accordance with maximum holding periods for each parameter. A chain-of-custody record will be maintained with the samples at all times. The sampling site location will be recorded using a GPS unit and the coordinates will be recorded in a field logbook. Sampling equipment will be thoroughly cleaned between sampling sites.

As part of the field quality assurance program, a single field blank and equipment rinsate will be collected and submitted to the laboratory for analysis. A field blank is a sample of analyte-free water poured into the container in the field, preserved and shipped to the laboratory with samples. A field blank assesses the contamination from field conditions during sampling. A

rinsate is a sample of analyte-free water poured over or through decontaminated filed sampling equipment prior to the collection of samples. It assesses the adequacy of the decontamination processes.

Continuous Dissolved Oxygen Monitoring. The United States Geological Survey has published a method for the operation of continuous water quality stations (Wagner *et. al.* 2006). Dissolved oxygen (±0.3 mg/L or less) will be measured *in situ* using a Hydrolab sonde or similar device with the appropriate precision and accuracy.

Step 5 – Laboratory Analysis of Water Samples. All laboratory analyses will be conducted using EPA Standard Methods or the equivalent sufficiently sensitive to detect and report at levels necessary for evaluation against state and federal water quality standards. A state-certified laboratory will prepare and analyze water samples for the following surface water analytical parameters:

- Basic Water Chemistry—Laboratory
- Inorganic Ions
- Metals
- Nutrients
- Herbicides and Pesticides
- Bacteria
- Petroleum Hydrocarbons

The analytes and target reporting limits associated with each parameter are listed in Table 1.0-1.

Step 6 – Prepare Format and Quality Assurance/Quality Control Data. All data will be verified and/or validated as appropriate. In brief, following field surveys and laboratory analysis, which includes the laboratories' own QA/QC analysis, Licensee will subject all data to QA/QC procedures including, but not limited to: spot-checks of transcription; review of electronic data submissions for completeness; comparison of results to field blank and rinsate results; and, identification of any data that seem inconsistent. If such a datum is found, Licensee will consult with the laboratory to identify any potential sources of error before concluding that the datum is correct.

All verified chemical detections, including data whose results are "J" qualified[6], will be used for this assessment. Should the laboratory need to re-extract samples and re-run the sample under different calibration conditions, the data identified by the laboratory, as the most certain, will be used. If field-sampling conditions, as measured by the field blank and the rinsate sample results, indicate that samples have been corrupted, Licensee will qualify the data accordingly.

Step 7 – Determine if Parameters are consistent with Water Quality Objectives. Table 6.3-3 shows the benchmark values that will be used to assist with in the assessment of sample results and their consistency with the Basin Plan and other water quality objectives. The benchmark

[6] Results with a "J" qualifier are results where the chemical was detected, but there is uncertainty in the quantity. The quantity is above the method detection limit, but below the reporting limit.

values in Table 6.3-3 were gleaned from the California Toxics Rule (CTR) (EPA 2000); the Basin Plan (CVRWQCB 1998); and bacterial water quality standards for recreational waters from EPA (2003).

Table 6.3-3. Benchmark values suggested for use in evaluating the protection of designated Beneficial Uses of Project waters.[1]

Basin Plan Water Quality Objective (Potentially Affected Beneficial Uses)	Symbol or Abbreviation	Benchmark Values	Reference	Notes
BACTERIA (MUN, REC-1)				
Total coliform	----	< 10,000 MPN per 100 mL < 240 MPN per 100 mL (geometric mean);	EPA 2003	Water contact recreation, Single Day Sample; Water contact recreation, 30 Day geometric mean
Fecal coliform	----	< 200 MPN per 100 mL (geometric mean); < 10% of samples > 400 MPN per 100 mL	CVRWQCB 1998	Water contact recreation, 30 Day geometric mean; with individual samples not > 400 mpn/100
Escherichia coli	*E. Coli*	< 126 MPN per 100 mL (geometric mean) <235 MPN per 100 mL in any single sample	EPA 2003	Water contact recreation, 30 Day geometric mean
BIOSTIMULATORY SUBSTANCES (COLD, SPAWN)				
Nitrate-Nitrite	NO_3-N + NO_2-N	None	----	----
Total Kjeldahl Nitrogen	TKN	None	----	----
Total Phosphorous	TP	None	----	----
CHEMICAL CONSTITUENTS (AGR, COLD, MUN)				
Alkalinity	----	None	----	----
Arsenic	As	0.05 mg/L	CDHS 2005 cited in CVRWQCB 1998	Title 22 Primary MCL[2]
Cadmium	Cd	0.005 mg/L	CDHS 2005 cited in CVRWQCB 1998	Title 22 Primary MCL[2]
Calcium	Ca	None	----	----
Chloride	Cl	250 mg/L	CDHS 2005 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Specific conductance	----	150 umhos	CVRWQCB 1998	Aquatic Life Protection
Copper	Cu	1 mg/L	CDHS 2005 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Iron	Fe	0.3 mg/L	CDHS 2005 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Mercury	Hg	0.002 mg/L	CDHS 2005 cited in CVRWQCB 1998	Title 22 Primary MCL[2]
Potassium	K	None	----	----
Selenium	Se	0.05 mg/L	CDHS 2005 cited in CVRWQCB 1998	Title 22 Primary MCL[2]
Silver	Ag	0.1 mg/L	CDHS 2005 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Sodium	Na	None	----	----
Zinc	Zn	5 mg/L	CDHS 2005 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
DISSOLVED OXYGEN (COLD, SPAWN)				
Dissolved Oxygen	DO	8 mg/L year-round Merced River from Cressy to New Exchequer Dam > 7 mg/L (minimum) Upstream of Exchequer Dam	CVRWQCB 1998	Aquatic life protection
FLOATING MATERIAL (REC-1, REC-2)				
Floating Material	-----	Narrative Criteria	CVRWQCB 1998	Aesthetics – Absent by visual observation
OIL & GREASE (REC-1, REC-2)				
Oil & Grease	-----	Narrative	CVRWQCB 1998	Aesthetics – Absent by visual observation

Total Petroleum Hydrocarbons	TPH	None	----	----

Table 6.3-3. (continued)

Basin Plan Water Quality Objective (Potentially Affected Beneficial Uses)	Symbol or Abbreviation	Benchmark Values	Reference	Notes
pH (COLD, SPAWN, WILD)				
pH	-----	6.5-8.5	CVRWQCB 1998	Aquatic life protection
SEDIMENT AND SETTLEABLE SOLIDS (REC-2, SPAWN, WILD)				
Sediment	-----	Narrative	CVRWQCB 1998	See Geology and Soil Resources
TASTES & ODOR (MUN)				
Ammonia as N	----	----	----	----
Chloride	Cl	250 mg/L	CDHS 2005 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Specific conductance	-----	900 umhos	CDHS 2005 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Copper	Cu	1.3 mg/L	CDHS 2005 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Iron	Fe	0.3 mg/L	CDHS 2005 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Silver	Ag	0.1 mg/L	CDHS 2005 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Sodium	Na	30-60 mg/L	EPA 2004	Sodium Restricted Diet
Zinc	Zn	5 mg/L	CDHS 2005 cited in CVRWQCB 1998	Title 22 Secondary MCL[2]
Temperature	-----	20°C (mean daily), T > 3-5°C (min)	Elliott 1981, Frost and Brown 1967	See Water Temperature Study
TOXICITY (COLD, SPAWN, MUN) CTR values listed below generally assume Total Recoverable Concentrations (unfiltered)[2,3]				
Ammonia as N (pH and Temp dependent)	NH_3-N	24.1 mg/L (CMC); 4.1-5.9 mg/L (CCC)	EPA 2000	CTR criteria over 0-20°C assuming pH 7.0
		5.6 mg/L (CMC); 1.7-2.4 mg/L (CCC)	EPA 2000	CTR criteria over 0-20°C assuming pH 8.0
		0.9 mg/L (CMC); 0.3-0.5 mg/L (CCC)	EPA 2000	CTR criteria over 0-20°C assuming pH 9.0
Arsenic	As	0.34 mg/L (CMC); 0.15 mg/L (CCC)	EPA 2000	CTR criteria
Cadmium (hardness dependent)	Cd	0.23 ug/L (CMC); 0.15 ug/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 5 mg/L as $CaCO_3$
		0.4 ug/L (CMC); 0.34 ug/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 10 mg/L as $CaCO_3$
		0.56 ug/L (CMC); 0.53 ug/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 15 mg/L as $CaCO_3$
		0.83 ug/L (CMC); 0.95 ug/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 25 mg/L as $CaCO_3$
Copper (hardness dependent)	Cu	0.83 ug/L (CMC); 0.72 ug/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 5 mg/L as $CaCO_3$
		1.6 ug/L (CMC); 1.3 ug/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 10 mg/L as $CaCO_3$
		2.34 ug/L (CMC); 1.84 ug/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 15 mg/L as $CaCO_3$
		3.79 ug/L (CMC); 2.85 ug/L (CCC)	EPA 2000	CTR for unfiltered sample assuming hardness of 25 mg/L as $CaCO_3$
Mercury	Hg	0.050 ug/L	EPA 2000 40 CFR 131.38	CTR/Federal Register. 5/18/00
Nitrate-Nitrite	NO_3-N+NO_2-N	10 mg/L (combined total)	CDHS 2005 cited in CVRWQCB 1998	Title 22 Primary MCL ("Blue baby Syndrome")

Table 6.3-3. (continued)

Basin Plan Water Quality Objective (Potentially Affected Beneficial Uses)	Symbol or Abbreviation	Benchmark Values	Reference	Notes
Silver (hardness dependent)	Ag	0.02 ug/L (CMC) instantaneous	EPA 2000	CTR for unfiltered sample assuming hardness of 5 mg/L as $CaCO_3$
		0.08 ug/L (CMC) instantaneous	EPA 2000	CTR for unfiltered sample assuming hardness of 10 mg/L as $CaCO_3$
		0.16 ug/L (CMC) instantaneous	EPA 2000	CTR for unfiltered sample assuming hardness of 15 mg/L as $CaCO_3$
		0.37 ug/L (CMC) instantaneous	EPA 2000	CTR for unfiltered sample assuming hardness of 25 mg/L as $CaCO_3$
Lead (hardness dependent)	Pb	0.54 ug/L (CCC) 14 ug/L (CMC)	EPA 2000	CTR for unfiltered sample assuming hardness of 25 mg/L as $CaCO_3$
Zinc (hardness dependent)	Zn	9.47 ug/L	EPA 2000	CTR for unfiltered sample assuming hardness of 5 mg/L as $CaCO_3$
		17.03 ug/L	EPA 2000	CTR for unfiltered sample assuming hardness of 10 mg/L as $CaCO_3$
		24.01 ug/L	EPA 2000	CTR for unfiltered sample assuming hardness of 15 mg/L as $CaCO_3$
		37.02 ug/L	EPA 2000	CTR for unfiltered sample assuming hardness of 25 mg/L as $CaCO_3$
Aldrin	----	3.0 ug/L	Marshack 2008	Ambient Water Quality Criteria
Chlordane	----	0.0043 ug/L	Marshack 2008	Ambient Water Quality Criteria
Chlorpyrifos	----	0.014 ug/L	Marshack 2008	Ambient Water Quality Criteria
Diazinon	----	0.05 ug/L	Marshack 2008	Ambient Water Quality Criteria
Dieldrin	----	0.056 ug/L	Marshack 2008	Ambient Water Quality Criteria
Endosulfan	----	0.056 ug/L	Marshack 2008	Ambient Water Quality Criteria
Endrin	----	0.036 ug/L	Marshack 2008	Ambient Water Quality Criteria
Heptachlor	----	0.0038 ug/L	Marshack 2008	Ambient Water Quality Criteria
Heptachlor epoxide	----	0.0038 ug/L	Marshack 2008	Ambient Water Quality Criteria
alpha-Hexachlorocyclohexane	----	0.08 ug/L[5]	Marshack 2008	Ambient Water Quality Criteria
beta-Hebachlorocyclohexane	----	0.08 ug/L[5]	Marshack 2008	Ambient Water Quality Criteria
delta-Hexachlorocyclohexane	----	0.08 ug/L[5]	Marshack 2008	Ambient Water Quality Criteria
gamma-Hexachlorocyclohexane	----	0.08 ug/L	Marshack 2008	Ambient Water Quality Criteria
Toxaphene	----	0.0002 ug/L	Marshack 2008	Ambient Water Quality Criteria

Table 6.3-3. (continued)

Basin Plan Water Quality Objective (Potentially Affected Beneficial Uses)	Symbol or Abbreviation	Benchmark Values	Reference	Notes
TURBIDITY (COLD, SPAWN, WILD, MUN)				
Turbidity	NTU	increase < 1 NTU for 1)5 NTU background; increase < 20% for 5-50 NTU background	CVRWQCB 1998	Aesthetics, disinfection, egg incubation

[1] Note a chemical may be listed under more than one beneficial use.
[2] CDHS Title 22 identified as minimum WQ thresholds, but acknowledged as insufficiently protective in some cases (CVRWQCB 1998)
[3] CMC: Criterion Maximum Concentration (1-hour acute exposure) for aquatic toxicity as defined by EPA (2000b)
[4] CCC: Criterion Continuous Concentration (4-day chronic exposure) for aquatic toxicity as defined by EPA (2000b)
[5] Value is for gama-hexachlorocyclohexane.

The CVRWQCB has adopted, by reference, California Title 22 maximum contaminant levels (MCL) for drinking water as Basin Plan objectives (CVRWQCB 1998), with the exception that more stringent criteria may apply as necessary for protection of specific beneficial uses. Hence, these values are adopted herein. It should be noted, however, that chemical concentrations that were originally intended to apply to finished tap water, rather than to untreated sources of drinking water, would be applied to the untreated reservoir or river water.

For water quality objectives related to aquatic toxicity[7], the CTR (EPA 2000) will be used. Section 131.38 of 40 CFR establishes Criterion Maximum Concentrations (CMC) as the highest concentration to which aquatic life can be exposed for a short period without deleterious effects and must be based on extended sample collection and one-hour averaging. The Criterion Continuous Concentrations (CCC) is defined as the highest concentration to which aquatic life can be exposed for an extended period of time (*i.e.*, 4 days) without deleterious effects. When single grab samples are collected, it is assumed that constituent concentrations are representative of the continuous ambient condition, and CCC values are therefore used as the appropriate criteria to compare against environmental samples. Because of differences in acute and chronic toxicity to aquatic organisms of many elements and compounds in Table 6.3-3 as well as variations with ambient water quality such as pH or hardness, several entries have multiple benchmarks to assist with their evaluation. The benchmarks for four of the metals addressed in this study plan (*i.e.*, cadmium, copper, silver and zinc) are reported for unfiltered (*i.e.*, total metals) samples from the CTR (EPA 2000) and calculated in 5 mg/L increments of hardness since the level at which each of these metals is reportedly toxic to aquatic life is lower at lower hardness levels. In addition, the CMC and CCC levels for ammonia are a function of both pH and temperature and are presented over a range of 0ºC to 20˚C in pH increments of 1 su.

Step 8 – Consult with Licensee's Project Operations Staff. If a water quality result suggests Basin Plan objectives are not being met, Licensee will consult with Project Operations staff to identify Project O&M activities that typically occur in the area with the potential to adversely-affect the parameter.

[7] ammonia, nitrate, and trace metals

Step 9 – Prepare Report. As defined in Section 4.0, this sampling plan is intended to inform Licensee and Relicensing Participants on both the potential for Project operations to be the cause of a Basin Plan Objective not to be met. Licensee will prepare a report that includes the following sections: Study Goals and Objectives; Methods and Analysis; Results; Conclusions; and Description of Variances from the FERC-approved study proposal, if any. A complete water quality data set will be provided as appendices to the report. Licensee plans to make the report available to Relicensing Participants in both electronic and hardcopy format when completed, and ideally in time to be included in the Initial Study Report. The report will be included in the License Application.

6.4 Study Proposal Consultation

The Licensee will consult with the Relicensing Participants to determine whether any additional water quality data collection is required based on preliminary results from this sampling plan, and will consult with the SWRCB regarding the timing for additional in situ dissolved oxygen monitoring.

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6.5 Schedule

Licensee anticipates the schedule to complete the study proposal as follows assuming FERC's Study Plan Determination is deemed final on October 20, 2009:

Planning (Step 1)..... January 2010 – May 2010
Field Work (Steps 2, 3 & 4)..... June 2010 – October 2010
Office Work (Steps 5 - 8)..... August 2010 – October 2010
Consultation with Relicensing Participants ..... October – November 2010
Report Preparation (Step 9) ..... September 2010 – December 2010

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6.6 Consistency of Methodology with Generally Accepted Scientific Practices

The study methods discussed above are consistent with the study methods followed in several other relicensings. The methods presented in this study plan also are consistent with those used in recent relicensings in California.

7.0 Products

Licensee plans to prepare an Excel table that will include for each parameter measured the result of all seasons collected, sorted by sampling location. The table will be on compact disc (CD) and appended to reports. Data that that are greater than the benchmarks provided in Table 6.3-3 will be highlighted.

8.0 Level of Effort and Cost

The estimated estimated cost to complete this study in 2009 dollars is between $100,000 and $125,000.

9.0 References Cited

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Elliott, J.M. 1981. Some aspects of thermal stress on freshwater teleosts. Pages 209-245 In A. D. Pickering editor, Stress and Fish. Academic Press, London.

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Study 3.1

RESERVOIR FISH POPULATIONS[1]

August 26, 2009

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1.0 Project Nexus and Issue

Merced Irrigation District's (Merced ID or Licensee) continued operation and maintenance (O&M) of the Merced River Hydroelectric Project (Project) may have an adverse effect on special-status[2] fish populations. These effects could result from Project activities such as reductions in flow in the section of Merced River from Merced Falls Dam to the normal maximum water surface elevation of the Crocker-Huffman Diversion Dam that results in fish stranding, changes in flow or reservoir elevation that affects habitat, and reservoir drawdown that effects ability of fish to migrate from the reservoir into streams during important life stages. This study focuses on these and other effects to fish populations.

This study addresses the following preliminary issue as identified in Section 8 of Licensee's Pre-Application Document (PAD):

- Issue AR-1: Effect of the Project on special-status coldwater fishes in the Merced River watershed
- Issue AR-2: Effect of the Project on warm water special-status fishes in Lake McClure and upstream of Lake McClure

Effects of the Project due to entrainment of fish into Project intakes are addressed in a separate Relicensing study proposal: Fish Entrainment.

2.0 Resource Management Goals of Agencies with Jurisdiction Over the Resource to be Studied

Licensee believes two agencies have primary jurisdiction over special-status fishes to be studied. The agencies are the California Department of Fish and Game (CDFG), and the United States Department of Commerce (USDOC), National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS).

[1] Licensee chose to initiate this study in 2008.

[2] For the purpose of this Relicensing, special-status fishes are considered those fish species: as potentially-occurring on United States Department of Interior (USDOI), Bureau of Land Management (BLM) land and formally listed by BLM as a Sensitive Species; listed by the United States Department of Commerce (USDOC), National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS).as Sensitive; listed under the federal Endangered Species Act (ESA) as Proposed or a Candidate for listing as endangered or threatened or proposed for delisting; listed under the California Endangered Species Act (CESA) as proposed for listing; or formally listed by the California Department of Fish and Game (CDFG) as a Species of Concern. Species listed as threatened or endangered under the ESA or CESA are addressed separately and not considered special-status for the purpose of the Relicensing proceedings.

As described in Section 7.3 of the PAD, four special-status fish species are known to occur in the Merced River. These special-status fishes include: Kern Brook lamprey (*Lampetra hubbsi*); hardhead (*Mylopharodon conocephalus*); Sacramento splittail (*Pogonichthys macrolepidotus*); and Central Valley fall- and late-fall-run Chinook salmon (*Oncorhynchus tshawytscha*). All four species are considered Species of Concern (CSC) by CDFG. CDFG also manages the fisheries and overall fish resources in Lake McClure, McSwain Reservoir and the Merced River upstream and downstream of the Project. Additionally, the Central Valley fall- and late-fall-run Chinook salmon is considered Sensitive (NMFS-S) by NMFS. The two agencies known management goals for the four special-status fishes are described in Section 4.0 below.

3.0 Potential License Condition

Study results may be used in the development of Project facilities and/or activities Licensee will undertake as a condition of the new license for the purpose of protecting or mitigating impacts to special-status fishes that would result from continued Project O&M, or for the purpose of enhancing special-status fish species habitat that would be affected by continued Project O&M. These facilities, operations and management activities, which are referred to as protection, mitigation and enhancement (PM&E) measures, could include:

- Ramping rates to avoid stranding
- Changes in Project operations

Development of PM&E measures is not part of this study.

4.0 Study Goals and Objectives

The goal of this study is to provide information to the Relicensing Participants concerning the distribution and occurrence of special-status fishes in the Project reservoirs and in the Merced River at locations where these fishes might be affected by the Project. The objectives of the study are to:

- Characterize fish species composition, relative abundance (*e.g.*, catch per unit effort (CPUE)), and size in Project reservoirs and in the Merced River from Merced Falls Reservoir to Crocker-Huffman Diversion Dam.
- Characterize management of reservoir water surface elevations and its relationship to availability of fish habitat under existing Project operations and potential Project operations.
- Characterize flow fluctuations as it relates to possible fish stranding
- Characterize timing of flows in relation to spawning periods
- Characterize fish growth, condition factor, and population age structure

5.0 Existing Information and Need for Additional Information

As described in Section 7.3 of the PAD, except for hardhead, which has been found in the foothills section of the Merced River upstream of Lake McClure, each of the four special-status fishes are known to occur only downstream of the Project. The Kern Brook lamprey has been reported as far upstream as Merced Falls Dam, while the other three special-status fish species have been reported below Crocker-Huffman Diversion Dam, with the Sacramento splittail only reported in the lowest few miles of the Merced River.

Warm water fishes dominate immediately upstream of Lake McClure. Fish surveys conducted in the summer and fall of 2006 and 2007 found ten fishes with the smallmouth bass (52%), largemouth bass (20%) and common carp (16%) dominating the catch by number. CDFG manages this portion of the river as a Put-and-Grow, catchable rainbow trout fishery.

Only fish stocking records and game fish reports are available for Project reservoirs. Largemouth bass, spotted bass, bluegill, crappie, catfish, rainbow trout, Kokanee salmon and king salmon are reportedly caught in Lake McClure. Rainbow trout and spotted bass are caught in McSwain Reservoir. CDFG manages Lake McClure for trout, salmon and bass fishing, and manages McSwain Reservoir as a Put-And-Take trout fishery. CDFG plants rainbow trout and salmon in Lake McClure; and rainbow trout in McSwain Reservoir.

About 40 fish species have historically been documented or are suspected to occur in the Merced River downstream of McSwain Dam. In the section of river between Merced Falls Dam and Crocker-Huffman Diversion Dam, seven fishes were captured in summer and fall 2006 and 2007. These included Pacific lamprey, Kern Brook lamprey, rainbow trout, Sacramento sucker, riffle sculpin, prickly sculpin and western mosquitofish.

Licensee considers existing information regarding fish species in the Merced River immediately upstream of the Project and downstream of the Project between Merced Falls Dam and Crocker-Huffman Diversion Dam adequate to address the issues in these sections of river. However, as described above, little empirical information is available regarding fish in Project reservoirs. There is a need to accurately characterize current fish communities in order to assess the interaction of Project operations and maintenance with fish communities.

6.0 Study Methods and Analysis

6.1 Study Area

The study area includes Lake McClure, McSwain Reservoir, and flowing tributaries.

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If additional Project facilities, features, or recreation facilities are identified during the Relicensing, the study area will be expanded, if necessary, to include these areas. If, at a later time, Licensee proposes Project activities that are outside of the study area that may affect

resources addressed by this study proposal, the study area will be expanded, if necessary, to include these areas.

6.2 General Concepts

The following general concepts apply to the study:

- Personal safety is an important consideration of each fieldwork team. If Licensee determines the information cannot be collected in a safe manner, Licensee will notify the Federal Energy Regulatory Commission (FERC) and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

- Licensee will make a good faith effort to obtain permission to access private property where needed well in advance of performance of the study. If access is not granted or river access is not feasible or safe, Licensee will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

- The schedule for each proposed study is reasonably flexible to accommodate unforeseen problems that may affect the schedule. If a schedule changes, Licensee will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

- Field crews may make minor modifications to the study proposal in the field to accommodate actual field conditions and unforeseen problems. When modifications are made, Licensee's field crew will follow the protocols in this study proposal. If minor modifications are made, Licensee will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

- Licensee's performance of the study does not presume Licensee is responsible in whole or in part for PM&E measures that may arise from that study.

- The estimated level of effort and cost is not a firm commitment by Licensee to expend all the funds. If the study costs more, Licensee is committed to completing the study. If the study costs less, Licensee is not committed to expending the remaining funds on other Relicensing studies or PM&E measures.

- Global Positioning System (GPS) data will be collected in a manner that meets or exceeds the federal government's "*National Map Accuracy Standards*" for published maps. All GPS data will be in the Universal Transverse Mercator (UTM) Coordinate System, using the North American Datum 1983 and stored in Environmental Science Research Institute (ESRI) Shapefile format. After a Shapefile has undergone a quality assurance/quality control (QA/QC) review to Licensee's satisfaction and after all metadata have been documented, Licensee will provide the Shapefile to resource and land management agencies upon request.

All special-status species observations will be submitted to the California Natural Diversity Database (CNDDB).

6.3 Study Methods

Sampling will occur in one year using boat electrofishing and gill nets. In McSwain Reservoir, sampling efforts will be coordinated with reservoir operators to avoid periods of reservoir fluctuation that could affect safety and sampling efficiency. Sampling will be scheduled quarterly to provide a complete year round reservoir fish population assessment.

In addition to reservoir sampling, Licensee proposes to conduct several additional assessments. These supplemental investigations include an assessment of tributaries surrounding Lake McClure, a creel, a bass nesting assessment and a desktop study of historic stocking practices. These additional studies will supplement knowledge gained from the reservoir sampling assessment to allow for a better understand of the current health of reservoir fish populations in light of Project O&M.

The study methods will consist of the following five steps:

Step 1 – Field Reconnaissance. A field survey will be conducted prior to sampling to view the existing lacustrine habitat and identify suitable areas for reservoir sampling. Boat electrofishing and gillnet sampling require specific characteristics in order to accurately sample fishes. Upon documenting habitat with photos and GPS, sampling locations will be selected for each methodology.

Sampling units for electrofishing stations will be approximately 100 meters (m) in length and established around the Project reservoirs using a stratified, random sampling scheme to obtain representative samples among the diversity of identified near-shore habitats that are feasible to sample by boat electrofishing. To address level of sampling effort, it is currently estimated that five boat electrofishing sites will be conducted for McSwain Reservoir and fifteen will be conducted on Lake McClure; however, the exact number of sampling stations to be used will depend on the diversity of near-shore habitat conditions, including depth, cover, substrate, and proximity to sources of inflow assessed during field reconnaissance. Sampling stations will be designated on orthophotographs of the Project reservoirs and documented using GPS.

Similarly, gillnet sample locations will be established around the Project reservoirs using a stratified, random sampling scheme to obtain representative samples among the diversity of identified pelagic habitats. A total of four sample stations will be attempted for gillnetting in McSwain Reservoir, and ten sample stations in Lake McClure. If randomly selected locations between electrofishing and gillnets overlap, gillnet locations will be moved sufficiently enough to not overlap with boat electrofishing. Sampling stations will be designated on orthophotographs of the Project reservoirs and documented using GPS.

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Step 2a – Boat Electrofishing. Boat electrofishing will be used to sample reservoir near-shore habitat at both McSwain Reservoir and at Lake McClure. Boat electrofishing sampling will occur during summer or fall. Boat electrofishing will take place using standard methods (Reynolds 1996). Ideally, all electrofishing surveys will be conducted at night to help improve the effectiveness of catching fish. Surveys will be conducted at night by a crew of three or more biologists, including one boat operator, and at least two netters to collect and handle fish.

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Collected fish will be held in an on-board live well. One or two electrode booms will be employed, and the booms and boat will be outfitted with standard non-conductive material in appropriate places for safety. Electrofisher "time on" will be recorded for each sampling site and a consistent effort and pace will be employed at all sites. All captured fish will be processed immediately at each survey site, and then returned at or near the survey site where the fish were captured. Fish will be identified, where possible, as to origin hatchery or wild stock (*i.e.*, basic visual identification, such as a clipped adipose fin). Data recorded for each fish will include species identification, fork length, weight, and, if applicable, notes on general condition. Scale samples will be collected from a sub-sample of appropriate game fish species to assess age composition as described below. Any mortality of any fish species will be properly stored by MID.

Electrofishing efforts will be coordinated with the gillnetting effort. Electrofishing and gillnet sampling sites will be located sufficiently far apart to avoid interference and frightening fish into or away from sampling sites. Electrofishing will be performed mostly during a crepuscular period.

General information recorded will include impoundment name, GPS sample site location, crew member names, weather conditions, air temperature, and water chemistry at approximate fish sampling location (*i.e.*, water temperature, dissolved oxygen, pH, and conductivity). Minimum, maximum, and mean water depths will be recorded.

Step 2b – Gillnetting. Gill net sampling will occur during summer or fall using variable mesh gillnets (*i.e.*, adult net: 1-in. to 4-in. mesh, and juvenile net: 0.5-in to 0.75-in. mesh). Eight gillnets will be deployed at each location: one adult and juvenile net along the shoreline; one adult and juvenile net in pelagic water near the surface; one adult and juvenile net in pelagic water at the midwater column; and one adult and juvenile net in pelagic deepwater. The times of deployment and locations of each gillnet set will be recorded, and photographs will be taken of each gillnet after deployment to document both location and placement relative to the shoreline. The gillnets will be set for two consecutive day and night periods (*i.e.*, approximately 48 hours) to facilitate good coverage and will be checked each morning and evening to separate diel periods.

Fish will be identified, where possible, as to origin hatchery or wild stock (*i.e.*, basic visual identification, such as a clipped adipose fin). After fish are captured, each fish will be processed, and information will be collected regarding species identification, fork length, weight, and, if applicable, notes on general condition. Scale samples will be collected from a sub-sample of appropriate game fish species to assess age composition, as described below. All captured fish must be returned at or near the survey locations. Any mortality of any fish species will be properly stored by MID.

General information recorded will include impoundment name, GPS sample site location, crew member names, weather conditions, air temperature, and water chemistry at approximate fish sample depth (*i.e.*, water temperature, dissolved oxygen, pH, and conductivity). Minimum, maximum, and mean water depths will be recorded along with the depth placement of the each gillnet.

Step 2c – Creel Survey. A periodic creel survey will be conducted to gather information on species composition, habitat use and angling effort. Creel surveys will be conducted twice a month, and a volunteer survey box will be set up at each recreational area to increase the amount of information gathered. Two types of data will be collected for each area sampled: angler party interviews for catch rates and angler or boat counts for effort. An angler party is defined as one or more anglers who fished together. Angler parties will be interviewed at the completion of their fishing trips at boat launching ramps, marinas, and along the shoreline. Anglers will be queried as to their mode of fishing (*i.e.*, boat or shore), how they fished (*e.g.*, trolling, still fishing and casting) where they fished, how long they fished, what they fished for, the numbers by species of fish they kept, and the number of fishing trips they made or intended to make that day. These data will be recorded on an angler interview form by census personnel. Anglers will be requested to voluntarily allow for length and weight data to be collected from any fish kept during the trip.

Step 2d – Reservoir Tributary Assessment. A reservoir tributary assessment will be conducted to assess accessible streams from Lake McClure. Notable tributary habitat was not identified from McSwain Reservoir. The Lake McClure tributary assessment will provide needed information on available habitat above the reservoir, determine existing stream fish populations and assess the potential affect of warm water species on native coldwater stream inhabitants. The tributary assessment will be conducted in two parts: a passage assessment; and a species composition assessment.

The tributary passage assessment will be conducted at varying period of reservoir capacity. During the survey, field teams will access tributaries by boat or vehicle (as required). The potential for fish passage will be identified by estimating the gradient at the confluence and available connective flow. Accessible streams will be marked with GPS and potential shallow water or leaping barriers mapped. Surveyors will move upstream from the mouth to a potential barrier following the thalweg of the tributary. At major changes in stream habitat or any identified potential barrier, a point ID will be assigned and measurements of tributary attributes will be collected. At the point ID surveys will collect a width, max depth, and depth range of the thalweg and a wetted width as well as the dominate/sub-dominate substrate of the tributary. Photos will be taken to document the tributary visually. Surveyors will continue from the mouth of the tributary to the full pool elevation.

A qualitative backpack electrofishing assessment will be conducted at all streams that were identified as accessible during the high reservoir capacity survey. Sampling will focus on habitat proximal to the stream/reservoir confluence (*i.e.*, from the reservoir confluence to the Project boundary). The backpack electrofishing assessment (*i.e.*, from the reservoir confluence to the Project boundary) will be conducted between June and September to assess stream fish inhabitants. Collected fish will be placed in buckets and processed. During processing fish information will be collected. This information will include: species identification, weight, fork length, and if applicable notes on fish condition or removed scales. During the electrofishing assessment species length and weight will be collected in order to develop a condition factor. Electrofishing effort will be measured as 'time on' to determine relative abundance reported as

catch per unit effort (CPUE). All captured fish must be returned at or near the survey locations. Any mortality of any fish species will be properly stored by MID.

Sampling conditions within tributaries exceeding depths of 1.5 m will be considered unsafe for backpack electrofishing. Qualitative direct observation snorkeling will be conducted as an alternative. Snorkelers (*i.e.*, number of snorkelers to be determined by stream width) will occupy lanes and move in tandem upstream. Observed individual fish will be identified to species and size will be estimated in two-inch intervals (0>2 in, 2>4in, etc.). Surveys will be conducted during the day when sufficient light is present.

Catch will be reported as number per area sampled. This is not intended to be a statistically quantifiable estimate, but only to provide relative abundance.

General site information for all stream survey locations will include stream name, sampled stream length and mean width, crew members, time of day, environmental (weather) conditions, riparian/channel conditions (*i.e.*, percent canopy, substrate, mean depth, and maximum depth), aquatic habitat condition (*i.e.*, habitat type(s), and cover), air temperature, water chemistry (water temperature, dissolved oxygen, pH, and conductivity), and GPS location. Photographs will also document the specific location and conditions of the site. Site information will be collected in similar fashion regardless of the use of backpack electrofishing or snorkeling.

Step 2e – Bass Nesting Assessment. Black bass (*i.e.*, largemouth, smallmouth or spotted bass) are a prized game fish that provide an important recreational resource. Largemouth and spotted bass are common species within McSwain Reservoir. Spotted bass were also identified in Lake McClure. CDFG manages Lake McClure as a year around black bass fishery. Spotted bass are noted to occur in McSwain Reservoir; however, the characteristic high gradient banks provide little habitat for spotted bass nest construction. Given the recreational importance and potential for bass reproduction in Lake McClure, an assessment of nest habitat presence and potential success will be conducted.

The spotted and largemouth bass nest assessment will take place in two phases. The first phase will be composed of a boat and snorkel field survey. Prior to going in the field, a Geographic Information System (GIS) technician will assess existing Lake McClure bathymetry data to identify low-gradient bass spawning habitat at existing reservoir levels. These areas will be prioritized for field surveys, to minimize searching. Literature has generally identified that bass nest construction occurs from February through July, with primary activity occurring March through May (Lee 1999). Therefore, a field team will actively seek out constructed nests once a month from, March through May (three surveys total).

In the field, staff will navigate by boat to pre-selected low gradient habitat or other likely habitat such as bulrush beds to visually seek out nests. Searching will include snorkeling along the bank in depths over 0.5 meter and searching from the bow of the boat. Upon identifying a nest, a snorkeler will discretely search for tending adult bass. Bass construct and guard their nests, generally permitting for identification of the species that constructed the nest. Upon identification of species, additional information will be collected that will include: depth of nest, diameter of the nest, GPS location, water temperature, surrounding substrate, nest distance from

cover, size of cover and type of cover. General information such as water turbidity, search time and weather will be noted to characterize the ability of the field team to find nests.

The second phase of the assessment will use collected field data to assess the potential for nest survival. Deeper nests have a greater potential for survival. Historical reservoir stage fluctuation data from Lake McClure will be assessed during the months from March through May. If maximum reservoir fluctuation during the course of each month does not exceed the depth of the observed nests, then those observed nests will be considered successful. These analyses will allow for an estimation of the nesting success relative to current operations. Lee (1999) stated that if the nesting success is over 60 percent, then a population of bass would be able to independently subsist. This criterion will be applied to assess the nesting populations within Lake McClure.

Step 2f – Spawning Habitat. Identify potential or observed spawning habitat for game species including but not limited to all species of black bass and salmonid species, anadromous fish, and native species including but not limited to Pacific lamprey (*Lampetra tridentate*), Kern Brook lamprey (*Lampetra hubbsi*); hardhead (*Mylopharodon conocephalus*); Sacramento splittail (*Pogonichthys macrolepidotus*) within the Project boundary. Species, location, time of year, and river composition will be recorded. The location of observed spawning habitat will be recorded using GPS.

Step 3 – Scale Analysis. As described above, a select portion of sampled game fish will have scales removed for analysis of age. Length-age indices will be used to create a regression. Length-age indices are fairly predictable for smaller (<100 millimeters (mm)) fishes. Therefore, only a subsample of smaller fish will be sampled. Effort will be made to collect samples from all larger (>100 mm) fish, as error increases in age estimates in correlation with fish size.

Fish size and weight will be summarized by game fish species by site. Length-weight regressions will be generated to calculate a relative condition factor (K_n) for game fish species.

Step 4a – Data Entry and Data Analysis. Data will be entered into a database. The database will be organized, compiled and subjected to QA/QC procedures. Data will be analyzed graphically and summarize species composition, relative abundance, length frequency, and location.

Catch Per Unit Effort. Gill net, backpack electrofishing, and boat electrofishing results will be reported both as total catch and in terms of CPUE. CPUE for fishes captured by boat electrofishing will be calculated by dividing number of fish of each species captured by the total area of water sampled multiplied by the length of time fished (*e.g.*, fish/(ft_2x second)). CPUE for fishes captured by backpack electrofisher will be calculated by dividing the number of fish sampled by the length of timed fished (*e.g.*, fish/second). CPUE for fishes captured by gill net will be calculated by dividing number of fish of each species by the dimensions of the gill nets multiplied by the length of time fished (*e.g.*, fish/(ft_2 x hour)). CPUE will be summarized by reservoir or tributary location and species.

Species Composition. The relative abundance of fish at each site will be calculated to identify fish species composition and distribution patterns throughout the Project Area.[3]

Age Class Distribution. Length frequency histograms will be developed for all fish species observed in the Study Area. Breaks or modalities within the histogram will be evaluated for analysis of approximate age class structure.

Condition Factor. Fish size and weight will be summarized by game fish species by site. Length-weight regressions will be generated to calculate a relative condition factor (K_n) for game fish species.

Habitat Assessment. Existing habitat as determined by the Lake McClure tributary assessment will be summarized by percent of available habitat. To determine percent of available habitat, field technicians will take length measurements of habitat breaks and type each habitat unit. The proportion of each identified habitat type will be converted into a percentage and reported. Data will also be entered into a GIS database and mapped for visual representation. Discussion will be made of existing habitat relative to identified species composition from tributary sampling.

Step 4b – Literature and Stocking Record Assessment. To better understand the life history requirements of identified species within the reservoir and tributaries, a literature assessment will be conducted. Information from the literature regarding the habits of game fish found in the reservoirs will also be provided and summarized in light of the Project.

Licensee is aware that CDFG has operated various hatcheries (*e.g.*, Calaveras Trout Fish Hatchery) in the upper Merced River watershed, and stocking of fish in Yosemite Valley precedes the establishment of the Wawona Fish Hatchery in 1895 (Magladry, undated material). Presumably, these stocked fish migrated or were washed downstream periodically and populated lower elevation reaches if conditions were adequate for that species. As mentioned prior, CDFG also plants rainbow trout and salmon in Lake McClure; and rainbow trout in McSwain Reservoir

Fisheries management activities in Lake McClure and McSwain Reservoir, specifically stocking of fish in the lake, could potentially affect the composition of fish species in Lake McClure tributaries and overall reservoir fish populations in both lacustrine systems. A review of current lake fishery management practices and a review of Lake McClure and McSwain Reservoir stocking records will be conducted. Any alterations to current fish management practices by CDFG will also be documented.

Expected products from the fisheries management and stocking review will include a detailed description of planting records. Further data will be tabulated to the extent possible and summarized by year. This data will be addressed in light of the results of the lake and tributary field sampling in order to better understand how the past activities are reflected in the current fish populations.

[3] For the purposes of the Relicensing, the Project Area is defined as the area within a border of about 0.5 mile surrounding the Federal Energy Regulatory Commission (FERC) Project Boundary.

Step 5 – Prepare Report. Licensee will prepare a report that will present a summary methods, analysis, results and conclusion for each component of the research described above. The report will also address any variances from the FERC-approved study plan, if any. The report will also contain GIS maps of sampled areas and relevant summary tables and graphs. Further, the report will describe daily water surface elevation patterns and approximate pool volumes. The report will include a summary of water quality information with respect to thermocline location, epilimnion and hypolimnion water temperatures and dissolved oxygen concentrations for each Project reservoir during the sampling period.

6.4 Study Proposal Consultation

The study proposal includes the following study-specific consultation:

- Licensee will consult with CDFG regarding CDFG's fish stocking programs and policies in Lake McClure and McSwain Reservoir.

6.5 Schedule

Licensee anticipates the schedule to complete the study proposal as follows assuming FERC's Study Plan Determination is deemed final on October 20, 2009:

Planning (Step 1).....February 2010 – April 2010
Field Work (Step 2a through 2f).....March 2010 – September 2010
Office Work (Step 3, 4a, and 4b).....September 2010 – October 2010
Report Preparation (Step 5) .....October 2010

6.6 Consistency of Methodology with Generally Accepted Scientific Practices

The study methods discussed above are consistent with the study methods followed in several other relicensings. The methods presented in this study plan also are consistent with those used in recent relicensings in California.

7.0 Products

Besides the report described above, Licensee will provide a database of collected data from field sampling. Data will include:

- GIS maps of sampled or surveyed areas
- Comprehensive stocking assessment
- Creel data summary
- Analysis of bass nesting habitat and assessment of survivability
- Water surface elevation patterns and approximate pool volumes
- Fish species composition, relative abundance (*i.e.*, CPUE), location, and condition factor by species in the reservoir and surrounding tributaries
- Age structure of game fish within the reservoir
- Water quality information with respect to thermocline location, epilimnion and hypolimnion water temperatures and dissolved oxygen concentrations will be summarized from the current study and the separate water quality study, as pertinent
- Photo documentation of survey efforts and areas assessed or sampled

8.0 Level of Effort and Cost

Licensee estimates that the cost to complete this study in 2009 dollars is between $480,000 and $580,000.

9.0 References Cited

Lee, D. P. 1999. Water Level Fluctuation Criteria for Black Bass in California Reservoirs. Reservoir Research and Management Project: Informational Leaflet No. 12:

Reynolds, J. B. 1996. Electrofishing. Pages 221-253 in B. R. Murphy and D. W. Willis, editors. *Fisheries techniques*, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Study 3.2

FISH ENTRAINMENT[1]

(August 30, 2009)

Deleted: As modified by the NMFS and filed with FERC, July

1.0 Project Nexus and Issue

Merced Irrigation District's (Merced ID or Licensee) continued operation and maintenance (O&M) of the Merced River Hydroelectric Project (Project or P-2179), operation of the Merced Falls Project (P-2467), and operation of the two MID water diversion canals (Northside Canal at Merced Falls Reservoir and Main Canal at Crocker-Huffman Dam) has potential to affect populations of current resident fish, such as rainbow trout (*Oncorhynchus mykiss*), and potential future anadromous fish such as steelhead (*O. mykiss*) and Chinook salmon (*Oncorhynchus tshawytscha*). In addition, there are two additional private canal diversions off of Merced Falls Reservoir that could also entrain fish. The Study Area includes Lake McClure, McSwain Reservoir, and Crocker-Huffman Reservoir (including the river reach between Merced Falls Dam and Crocker-Huffman Dam). Fish could be affected due to entrainment into and passage through the P-2179 and P-2467 powerhouses, MID's water diversion canals, and the two private canal diversions.

Deleted: Merced Falls Reservoir,

Deleted: MID operates the P-2467 Project, owned by Pacific Gas and Electric Company (PG&E), and coordination and cost-sharing between MID, PG&E, and other private parties will be necessary to conduct this study.

Resident rainbow trout and anadromous steelhead are the same species (*Oncorhynchus mykiss*) and have been shown to exhibit both fresh water and marine life histories. NMFS believes that juvenile or adult rainbow trout within the study area could become entrained into the above facilities. Therefore, a percentage of steelhead (smolts and perhaps kelts) from the *O. mykiss* population passing downstream through the study area may become entrained into the intakes of the powerhouses or water canals, and fish from that population could exhibit a marine life history. It is conceivable that rainbow trout could successfully travel downstream through the study area into the lower Merced River, smolt, and continue on as potential steelhead. Although some juveniles may survive passage through these facilities, we consider that most are seeking habitats downstream of the Projects, are susceptible to such entrainment, and a high proportion would be killed. These *O. mykiss* may be important for the recovery of the Central Valley steelhead Distinct Population Segment (DPS), which is listed as Threatened under the Endangered Species Act (ESA). In addition, it is also conceivable that other anadromous salmonids designated under the ESA, such as the Central Valley spring-run and fall- /late fall-run Chinook salmon (designated under the ESA as Threatened and as a Species of Concern, respectively) could range into the study area if fish passage facilities are restored or as a result of future potential recovery actions for listed salmonids. Finally, NMFS believes that if this fish entrainment study is not implemented with our proposed modifications, then it is likely that recommendations for fish screens on the intakes to the powerhouses and water diversion canals would be made to protect potential *O. mykiss* that may be important for future steelhead recovery actions and to protect anadromous salmonids should they gain passage in the future.

This study addresses the following preliminary issue as identified in the P-2179 Pre-Application Documents (PAD) filed by MID (MID 2008):

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Deleted: ; PG&E 2009a

[1] The proposed modifications to this Study Plan have been collaboratively developed between the CG and resource agencies and reviewed and supported by the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS).

Deleted: The NMFS is also filing this modified study plan with the Commission.

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- Issue AR-3 (P-2179): Effect of the Project on fishes due to entrainment into the Projects' powerhouse intakes and water diversion canals.

Deleted: and Issue AR-2 (P-2467)

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2.0 Resource Management Goals of Agencies with Jurisdiction Over the Resource to be Studied

Licensees believe that four agencies have jurisdiction over populations of current resident fish and potential future anadromous fish within the P-2179 Project and downstream to the Crocker-Huffman Dam: (1) United States Department of Commerce, National Oceanic and Atmospheric Administration, Marine Fisheries (NMFS) with regards to anadromous fishes;
(2) United States Department of Interior (USDOI), Bureau of Land Management (BLM) on United States-owned land administered by BLM; (3) USDOI, Fish and Wildlife Service (USFWS); and (4) California Department of Fish and Game (CDFG).

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3.0 Potential License Condition

Study results may be used in the development of Project facilities and/or activities Licensee will undertake as a condition of the new licenses for the purpose of protecting or mitigating impacts to fish in the reservoirs affected by the
P-2179 Project. These facilities, operations and management activities, which are referred to as protection, mitigation and enhancement (PM&E) measures, could include:

Deleted: , in coordination with PG&E and others as needed,

Deleted: and P-2467

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- Fish stocking
- Installation of fish screens
- Placement of spawning gravels
- Other PM&E measures

Development of PM&E measures is not part of this study.

4.0 Study Goals and Objectives

The goal of the study is to determine the likelihood that entrainment into the various powerhouses and water canal intakes within the study area occurs and, if so, is it likely that this entrainment would have significant affect on fish populations. If the results of the study suggest additional information is needed, Licensee will consult with CDFG, USFWS, BLM, NMFS and other Relicensing Participants regarding the design of the study, and will file the study proposal with the Federal Energy Regulatory Commission (FERC).

5.0 Existing Information and Need for Additional Information

Section 7.3.3.2 of the P-2179 PAD describes the known fish populations in Lake McClure and McSwain Reservoirs, and Section 8.2.3.3 describes Project power intakes in the reservoirs and powerhouse conditions. Information regarding Lake McClure and McSwain Reservoirs in provided in Table 5.0-1.

Deleted: PG&E described their dam, reservoir, and powerhouse information as well as fish occurring in the vicinity of P-2467 in Sections 4.0 and 5.3, respectively, of their PAD (MID 2008; PG&E 2009a)

Table 5.0-1. Morphometric information regarding Merced ID's Merced River Hydroelectric

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Project reservoirs.

Project Reservoir	Upstream Drainage Area	Usable Storage Capacity	Normal Max. Water Surface Elevation	Surface Area	Shoreline Length	Maximum Length	Estimated Maximum Depth
	(sq mi)	(ac-ft)	(ft)	(ac)	(mi)	(mi)	(ft)
Lake McClure[1]	1,035 sq mi	1,024,600 ac-ft	867 ft	7,110 ac	82 mi	19 mi	400
McSwain Reservoir	1,054 sq mi	9,730 ac-ft	400 ft	310 ac	12.5 mi	4.8 mi	80

[1] Lake McClure inundated Exchequer Reservoir which was constructed in 1926-27.

Information regarding the power intakes and powerhouses associated with Lake McClure and McSwain Reservoir is presented in Table 5.0-2 and 5.0-3.

Table 5.0-2. Characteristics of the New Exchequer and McSwain power intakes.

Intake Structure	Outlet Size	Control Valve/Gate	Depth of Intake At Full Pool	Estimated Maximum Capacity
	(in)	(type)	(ft)	(cfs)
THROUGH POWERHOUSE				
New Exchequer Intake[1]	12 ft wide	See Table 8.2.3-2	382 ft	3,200 cfs
McSwain Intake[2]	10 ft wide	See Table 8.3.2-2	40 ft	2,700 cfs
THROUGH POWERHOUSE BYPASS				
New Exchequer Intake[1]	Same as for Powerhouse	108 in Diameter Howell-Bunger Valve	Same as for Powerhouse	9,000 cfs
McSwain Intake[2]	Same as for Powerhouse	96 in Diameter Howell-Bunger Valve	Same as for Powerhouse	2,580 cfs

[1] New Exchequer Powerhouse and Bypass discharge directly into McSwain Reservoir
[2] McSwain Powerhouse and Bypass discharge directly into Pacific Gas and Electric Company's (PG&E) Merced Falls Reservoir

Table 5.0-3. Characteristics of the Francis (Reaction) and Kaplan (Impulse) turbine runners at New Exchequer and McSwain powerhouses.

Powerhouse	Turbines	Revolutions per Minute	Head	Runner Blades	Diameter	Type of Turbine
	(number)	(number)	(ft)	(number)	(in)	(Francis/Kaplan)
New Exchequer	1	180 rpm	397 ft	17	138 in	Francis (Reaction)
McSwain	1	180 rpm	54 ft	5	84 in	Kaplan (Impulse)

As a summary of fishes in the two P-2179 reservoirs, Lake McClure supports the following game fish: largemouth bass, spotted bass, bluegill, crappie, catfish, rainbow trout, Kokanee salmon and Chinook salmon. In comparison, a sport fishery for rainbow trout and spotted bass occurs in McSwain Reservoir. CDFG annually stocks rainbow trout and Chinook salmon in Lake McClure and rainbow trout in McSwain Reservoir. CDFG manages Lake McClure as a Put-and-Take fishery for trout and salmon and McSwain Reservoir as a Put-and-Take trout fishery. CDFG manages Lake McClure as a bass fishery.

PG&E referenced fish information from MID's PAD for Merced Falls Reservoir and the downstream reach and reservoir on the Merced River between Merced Falls Dam and Crocker-Huffman Dam. Fish found is these areas are largely stocked by the Calaveras Trout Farm and CDFG and include rainbow, Eagle Lake, brown, and brook trout and spotted bass. However, there is a self-sustaining population of rainbow trout within the river reach and reservoir downstream of Merced Falls Dam (NRS 2007).

MID proposed fish population studies in their reservoirs and MID proposed to asses the fish population in the river reach between Merced Falls Dam and Crocker-Huffman Dam (MID 2009;

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PG&E 2009b). Additional information regarding the movements of fishes in the reserviors and river reach within the study area and the associated intakes would be useful to meet the study goal.

6.0 Study Methods and Analysis

6.1 Study Area

The study area includes the intakes, powerhouses, and water diversion canals associated with Lake McClure and McSwain Reservoir (P-2179), and the river reach between Merced Falls Dam and Crocker-Huffman Dam. The associated P-2179 Project intakes and powerhouses are described in Tables 5.0-2 and 5.0-3.

Deleted: Merced Falls Reservoir (P-2467),

If additional Project facilities or features are identified during the Relicensing, the study area will be expanded, if necessary, to include these areas. If, at a later time, Licensee proposes Project activities that are outside of the study area that may affect resources addressed by this study proposal, the study area will be expanded, if necessary, to include these areas.

6.2 General Concepts

The following general concepts apply to the study:

Personal safety is an important consideration of each fieldwork team. If Licensee determines the information cannot be collected in a safe manner, Licensee will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

Licensee will make a good faith effort to obtain permission to access private property where needed well in advance of performance of the study. If access is not granted or river access is not feasible or safe, Licensee will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

The schedule for each proposed study is reasonably flexible to accommodate unforeseen problems that may affect the schedule. If a schedule changes, Licensee will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

Field crews may make minor modifications to the study proposal in the field to accommodate actual field conditions and unforeseen problems. When modifications are made, Licensee's field crew will follow the protocols in this study proposal. If minor modifications are made, Licensee will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

Licensee's performance of the study does not presume Licensee is responsible in whole or in part for PM&E measures that may arise from that study.

The estimated level of effort and cost is not a firm commitment by Licensee to expend all the funds. If the study costs more, Licensee is committed to completing the study. If the study costs less, Licensee is not committed to expending the remaining funds on other Relicensing studies or PM&E measures.

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Global Positioning System (GPS) data will be collected in a manner that meets or exceeds the federal government's "National Map Accuracy Standards" for published maps. All GPS data will be in the Universal Transverse Mercator (UTM) Coordinate System, using the North American Datum 1983 and stored in Environmental Science Research Institute (ESRI) Shapefile format. After a Shapefile has undergone a quality assurance/quality control (QA/QC) review to Licensee's satisfaction and after all metadata have been documented, Licensee will provide the Shapefile to resource and land management agencies upon request.

6.3 Study Methods

The study methods will consist of the following steps in phases :

Phase I

Step 1 - Review Scientific Literature and Information from Other Relicensing Studies. Relevant entrainment and other studies from the literature, including any relevant studies solicited from Relicensing Participants will be reviewed to determine how fish species in the study area likely utilize the reservoirs and river reach (*e.g.*, movement and habitat preference). Information from Licensee's proposed Water Quality and Reservoir Fish Survey studies will also be considered in the assessment. Additional information regarding CDFG's and Calaveras Trout Farm's fish stocking practices and policies in the study area will also be gathered.

Step 2 - Determine Likelihood of Entrainment. The location of intakes for powerhouses and water diversion canals in the study area, including elevation and flow at different times of the year; will be described. In combination with results of Step 1, the timing of when fish are likely to be in the vicinity of the powerhouse and canal intakes will be determined. In addition, the relationship of approach velocity at the intake to the fishes' ability to avoid entrainment (*i.e.*, swim speed) and other fish habits will be evaluated.

Step 3 – Prepare Report. Licensee will prepare a report that includes the following sections: Study Goals and Objectives; Methods and Analysis; Results; Discussion; and Description of Variances from the FERC-approved Study Proposal, if any. Licensee plans to make the report available to Relicensing Participants when completed, and ideally in time to be included in the Initial Study Report. The report will be included in Licensee's License Application.

Phase II

Step 1 – Consult with Relicensing Participants. Licensee will review the results of Phase I with Relicensing Participants. If Licensee and Relicensing Participants collaboratively agree that a high likelihood of significant levels of entrainment into one or more powerhouses and/or water canals might occur in the study area, Licensee will conduct entrainment sampling and monitoring at the intakes to the specified powerhouses and/or water canals. The entrainment sampling and monitoring study will utilize hydroacoustics so as to ascertain where the fish go in relation to the various intakes. This would provide more quantitative data as to potential numbers and sizes of fish entrained relative to those that would not become entrained. The hydroacoustic sampling methods are described in Step 2 below, and are similar to the methods identified in the P-2266/P-2310 Fish Entrainment Study 2.3.5 (PG&E and NID 2009).

Step 2 – Conduct the entrainment sampling as described below; analyze results; and do QA/QC of study results.

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Licensee will install a split-beam sonar device at the diversion or in the intake facility to the diversion from April 15, or as soon as weather permits, through August 15 to monitor the direction fish move (e.g., upstream or downstream in the conduit) and size of fish. Licensee will read and analyze the resulting split-beam sonar record on each sixth day (20 readings) of the recording, and will discuss the results with Relicensing Participants. The entire record will be retained and provided to Relicensing Participants in its raw form upon request. If Licensee and Relicensing Participants collaboratively agree (e.g., if a substantial change in fish movement occurs between adjacent readings) additional portions of the record will be read up to a total of 60 days. License will invite interested Relicensing Participants to one 1-day long meeting prior to commencing work to provide information such as installation configuration and location and data reading protocols. If the hydro-acoustic monitoring system does not cover the entire cross section of the intake, the data from the area covered will be extrapolated using an appropriate method to estimate fish movement for the entire cross-section of the intake. Based on the data, for each intake Licensee will calculate total number of fish entrained for each reading, and over the 120-day period that entrainment is monitored.

Step 3 – Prepare Report. Licensee will prepare a report that includes the following sections: Study Goals and Objectives; Methods and Analysis; Results; Discussion; and Description of Variances from the FERC-approved Study Proposal, if any. Licensee plans to make the report available to Relicensing Participants when completed, and ideally in time to be included in the Initial Study Report. The report will be included in Licensee's License Application.

6.4 Study Proposal Consultation

The study proposal includes the following study-specific consultation:

Licensee will consult with Relicensing Participants regarding fish stocking programs within the study area.

Licensee and PG&E will consult with Relicensing Participants regarding an entrainment sampling and monitoring study proposal as described in Phase II.

6.5 Schedule

Licensee anticipates the schedule to complete the study proposal is as follows assuming FERC's Study Plan Determination is deemed final on October 20, 2009:

Phase I

Compile/Review Information (Step 1).....January 2010 – June 2010
Assess Potential for Entrainment (Step 2) .....July 2010 – September 2010
Report Preparation (Step 3) .....September 2010 – October 2010

Phase II

Consultation and Phase II Study development (Step 1).....October 2010 – April 2011
Fieldwork (Steps 2) ..... ……April 2011 – September 2011
QA/QC Review (Step 2) ..... October 2011 – November 2011
Report Preparation (Step 3) ..... November 2011 – December 2011

6.6 Consistency of Methodology with Generally Accepted Scientific Practices

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This study is consistent with the methods used in other FERC hydroelectric relicensing efforts in California, including the Middle Fork Project (FERC Project No. 2079), the Drum-Spaulding Project (FERC Project No. 2310), and the Yuba-Bear Project (FERC Project No. 2266).

7.0 Products

The products from the study will be the study reports described above.

8.0 Level of Effort and Cost

NMFS and CDFG estimate that the cost to complete Phase I of this study in 2009 dollars is between $45,000 and $65,000, based on MID's original study plan (MID 2009). NMFS and CDFG estimate that the cost to complete Phase II of this study in 2009 dollars is up to between $150,000 and $375,000, depending on the number and site characteristics of intakes to be sampled. The total cost estimate in 2009 dollars is up to between $195,000 and $440,000,

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CG Study Request 3.1b

ANADROMY SALMONID HABITAT

Baseline Juvenile *O. Mykiss* Abundance and Distribution

August 30, 2009

1.0 Project Nexus and Issue

A federally listed fish species, California Central Valley Steelhead trout DPS (FT), *Oncorhynchus mykiss*, and its designated critical habitat occurs in the Project Area.

Merced Irrigation District's (MID or applicant) continued operation and maintenance (O&M) of, and new development in, the Merced River Hydroelectric Project (Project) directly affects volitional anadromous fish passage. Because aquatic and riparian habitats below these facilities in the Merced River can be negatively affected, those habitats may be modified in a different manner than if the project was not operated. Since inception of the project from the early1900's, project dams (in 1967) have partially or totally blocked volitional anadromous fish passage, as they were constructed without fish bypass capabilities, or those with fish bypass structures were blocked in the early 1970's (Vogel, 2007). Since the completion of Exchequer Dam in 1926, the direct and cumulative effect of these dams is that access to greater than 96% of the original historically available spawning and rearing habitat on the Merced River for anadromous *O. mykiss* (Steelhead trout) and other anadromous fishes (spring-run, fall-run and late fall-run Chinook salmon, lamprey) has been eliminated by impassable barriers and/or inundation. (Martin 2008, Schick *et al* 2005)

Suitable *O. mykiss* spawning and juvenile rearing habitat is now restricted to the Merced River reach between Crocker-Huffman Diversion Dam (RM 52) and the Highway J59 Bridge Crossing (RM 42). Reduction and modification of seasonal flow from the operation of the Project dams has adversely impacted the restricted *O. mykiss* accessible spawning and rearing habitat in this reach through interference with spawning gravel replenishment and armoring of gravel beds and instream flow regimes. The habitat is partially maintained by spawning gravel restoration (for Fall run Chinook salmon, but not for Steelhead trout) and temperature-dependent flow releases from the Project.

In addition to other concerns, this Study Request addresses the following preliminary issues, which have been identified in Section 6 of the applicant's Pre-Application Document (MID, 2008):

- Issue AR-1. Effect of the Project on special-status coldwater fishes in the Merced River watershed

- Issue AR-3: Effect of the Project on fishes due to entrainment into Project intakes
- Issue AR-7. Effect of the Project on trout and salmon upstream of Lake McClure, including the populations and fishing
- Issue AR-8. Effect of the Project on special-status fishes, especially fall- and late fall-Run Chinook salmon (NMFS Species of Concern), due to blockage of passage.
- Issue T&E-1. Effect of the Project on the federal Endangered Species Act (ESA)- and the California Endangered Species Act (CESA)-Listed anadromous fishes due to water temperature.
- Issue T&E-2. Effect of the Project on ESA- and CESA-Listed anadromous fishes due to attraction flows.
- Issue T&E-3. Effect of the Project on ESA-and CESA-Listed anadromous fishes adult holding habitat, juvenile holding habitat, and spawning habitat.
- Issue T&E-5. Effect of the Project (*e.g.*, physical barriers) on upstream and downstream migration of ESA- and CESA-Listed anadromous fishes, including Spring-run Chinook salmon (FT and CT) and Central Valley steelhead (FT).
- Numerous Issues Described by Relicensing Participants as "Potential Studies Requested by Relicensing Participants" (MID, 2008, § 10.3, Page 10-5)

2.0 Resource Agency and Tribal Management Goals

The applicant must confer with Resource Agencies and American Indian Tribes that participate in development of this study proposal. At this time, Resource Agencies have not yet identified specific management goals relevant to this study proposal. General management and restoration goals for Steelhead trout have been published by the agencies (see Martin, 2007 for a summary). Potential management goals should be considered:

- Improve production of native Steelhead trout by improving adequate temperature and flow regimes, especially for juvenile rearing (CDFG, 1996)
- Improve project operations, outlet modifications, and establishment of minimum pools for reservoirs so that cool water temperatures could be provided in late-summer and fall (CDFG, 1996)
- Install fishways on presently unladdered dams to allow access to tailwater habitat (CDFG, 1996)
- Improve stock production through hatchery facility supplementation to native Steelhead trout populations (CDFG, 1996)
- Maintain, enhance, and restore populations of Steelhead trout in tailwater aquatic habitats caused by project dams and lack of volitional fish bypass

- Maintain, recover, and restore streamflow regimes sufficient to sustain desired conditions for populations of Steelhead trout, defined as keeping the tailwater fishery in 'good condition' *sensu* California Fish and Game Code 5937
- Maintain, enhance, or restore populations of native aquatic biota, including fish, benthic macroinvertebrates, and riparian species to be viable with adequate habitat consistent with species' needs
- Maintain, enhance, or restore all life stages of native aquatic species by ensuring connectivity between project-affected stream reaches, between reaches of mainstem river and their tributaries, and between reservoirs and reaches of mainstem river
- Maintain, recover, and restore streamflow regime sufficient to sustain desired conditions of native riparian, aquatic, wetland, and meadow habitats
- Protect and enhance river fishing opportunities consistent with overall watershed recreation
- Protect aquatic systems to which species are uniquely adapted
- Reestablish, maintain, and enhance traditional cultural properties and anadromous salmonid species to provide for tribal retrieval of fish for ceremonial and spiritual purposes

3.0 Relevant Public Interest Consideration and Potential License Condition

The requester is not a resource agency and states the public interest consideration in regard to the proposed study:

Study is needed to provide data, information, and alternatives to protect and enhance the beneficial uses of the lower Merced River, including coldwater habitat, fisheries, water contact recreation, Migration of Aquatic Organisms, & Spawning Habitat. Study is needed to establish data and information to be used in National Environmental Policy Act (NEPA) environmental impact statement(s), potential Endangered Species Act consultations, and a Water Quality Certification per Section 401 of the Clean Water Act. Study is needed for the development of potential conditions of a new license for the purpose of protecting, mitigating, or enhancing the Steelhead trout for public benefit in the public interest.

Study is needed to provide data, information, and alternatives to assess conditions of the Merced River with regard to compliance with California Fish and Game Code. The public has an interest in fishing, in the use and utilization of anadromous fisheries resources, and in the maintenance of the Merced River by allowing sufficient water at all times to pass through a fishway, or in the absence of a fishway, allowing sufficient water to pass over, around or through the dam, to keep in good condition any fish that may be planted or exist below the dam.

The applicant's proposed alternative studies are not sufficient to meet these information needs.

The results of this Study Request will inform the Commission with information useful in development of protection, mitigation and enhancement (PM&E) measures relating to the effects project structures, operations and maintenance, which may include:

- Modifications of Project Operations
- Modification of Project Facilities
- Development of protection measures relative to Project O & M
- Development of protection measures relative to Project recreation activities
- Development of site-specific management plans, if needed
- Instream flow releases.
- Seasonal reservoir elevation constraints for coldwater temperature management

Development of PM&E measures is not part of the study.

4.0 Study Goals and Objectives

The goal of this Study Request is to provide information to the Relicensing Participants concerning California Central Valley Steelhead trout DPS, *O. mykiss* associated with Merced River reaches affected by the Merced River Hydroelectric Project. This will be achieved through the evaluation of the juvenile life stage of *O. mykiss* present in the lower Merced River. It is recognized that not all of the juvenile *O. mykiss* studied will exhibit an anadromous life history. The objectives of the study are to:

- Assess baseline juvenile *O. mykiss* abundance and distribution
- Assess the population structure
- Assess habitat type utilization
- Develop a monitoring protocol to evaluate juvenile population structure and habitat type utilization
- Investigate the relationship between physical features within habitat types and location of *O. mykiss*, including aggregate mining pools and restoration plans
- Develop a baseline with which to compare available habitat and fish populations under different flow regimes
- Confirm *O. mykiss* anadromy lineage and population distributions of the Merced River.

5.0 Existing Information and Need for Additional Information

No directed baseline abundance and distribution surveys have been conducted to assess *O. mykiss* populations in the Lower Merced River. Due to this lack of information, it is impossible to make informed instream flow, management and habitat restoration decisions necessary to sustain or recover that portion of these populations that exhibit an anadromous life history. This is of particular importance because anadromous Central Valley *O. mykiss* (steelhead) are listed as threatened under the ESA.

The decline of *O. mykiss* populations throughout the San Joaquin River basin has been well documented, principally due to loss of spawning and rearing habitat above impassable dams and associated water diversions (McEwan 2001). Similarly, Merced River *O. mykiss* populations likely have been reduced to a fraction of their historic numbers primarily due to the construction of the Exchequer Dam in 1926, with some restrictions by the Merced Falls Dam in 1913 and Crocker-Huffman Diversion Dam in 1907. The construction of Crocker-Huffman Dam, with a poorly functional fish ladder, resulted in partial loss of access of almost all anadromous fish spawning/rearing habitat. The concomitant drastic reductions in streamflows below the Crocker-Huffman Diversion Dam had negative effects on the remaining limited downstream anadromous habitat. Both the historic and current status of Merced River *O. mykiss* populations has been controversial in the regulatory arena. While there is little scientific controversy over the presence of *O. mykiss* in the Merced River, scientific knowledge of *O. mykiss* juvenile populations in the Lower Merced River is based upon very limited study.

Most, if not all, of the previous research on the Lower Merced River has focused upon fall- and late fall-run Chinook salmon management issues, with only cursory or ancillary observations on *O. mykiss*. It is known that an *O. mykiss* population exists in the Lower Merced River. Observations of the population status have been obtained through incidental capture during the course of ongoing fall- and late fall-run Chinook salmon research. The following observations, data, and information is evidence of an anadromous *O. mykiss* presence in the Lower Merced River:

- Incidental catch of spawning *O. mykiss* in Merced River Hatchery (CDFG, 1996)
- Captures of young of year specimens during seining and electro-fishing surveys, as well as observations during snorkeling surveys (Stillwater Sciences, 2008)
- Observation of large adult *O. mykiss* in the lower river, in reaches inhabited by anadromous Chinook salmon (Stillwater Sciences, 2008).
- Kodiak trawl captures of smolts in the San Joaquin River at Mossdale (San Joaquin River Group Authority, 2008)
- Sportfishing catch statistics report large *O. mykiss*, greater than 18 inches in the Lower Merced River (Jackson, 2007)
- In a limited samples of *O. mykiss* otoliths (Sr:Ca ratios), a steelhead progeny in Lower Merced River was verified (Zimmerman *et al*., 2008, 2009).

6.0 Study Methods and Analysis

6.1 Study Area

The study area includes aquatic habitats within the normal high water line of Project-affected stream reaches, including the section of the Merced River from Pacific Gas and Electric Company's (PG&E) Merced Falls Dam to RM 2 at Hatfield State Park, Merced County.

6.2 General Concepts

The following general concepts apply to the study:

- Personal safety is an important consideration of each fieldwork team. If applicant determines the information cannot be collected in a safe manner, applicant will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.
- Applicant shall make a good faith effort to obtain permission to access private property where needed well in advance of performance of the study. If access is not granted or river access is not feasible or safe, applicant will notify FERC and Relicensing Participants as soon as possible via email to determine if Relicensing Participants can assist in gaining access or to discuss alternative approaches to perform the study.
- The schedule for each proposed study is reasonably flexible to accommodate unforeseen problems that may affect the schedule. If a schedule changes, applicant will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.
- Field crews may make minor modifications to the study proposal in the field to accommodate actual field conditions and unforeseen problems. When modifications are made, applicant's field crew will follow the protocols in this study proposal. If minor modifications are made, applicant will provide a detailed description of the conditions that led to the decision to modify the study to FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.
- Applicant's performance of the study does not presume applicant is responsible in whole or in part for resource management measures that may arise from that study.
- The estimated level of effort and cost is not a firm commitment by applicant to expend all the funds. If the study costs more, applicant is committed to completing the study. If the study costs less, applicant is not committed to expending the

remaining funds on other Relicensing studies or resource management measures.

- Field crews will be trained as appropriate to identify all special-status amphibians, reptiles, and fish that may be encountered coincidentally. Training will include instruction in diagnostic features and habitat associations of special-status species. Field crews will also be provided with laminated identification sheets showing special-status species, compared to other common species.
- All special-status species observations will be submitted to the California Natural Diversity Database.
- Field crews will include a list of native and non-native species that may be encountered using the sampling methods described in the plan and their State and Federal (if any) status. Crews will make sure there are codes for all these species on the data forms.

6.3 Study Methods

The proposed scope of work will take place in the Lower Merced River from Crocker-Huffman Diversion Dam at river mile 52 (N 37° 31.345 W 120° 19.858), downstream to the J-59 Bridge at river mile 42 (N 37° 28.187 W 120° 30.046) (Figure 1)

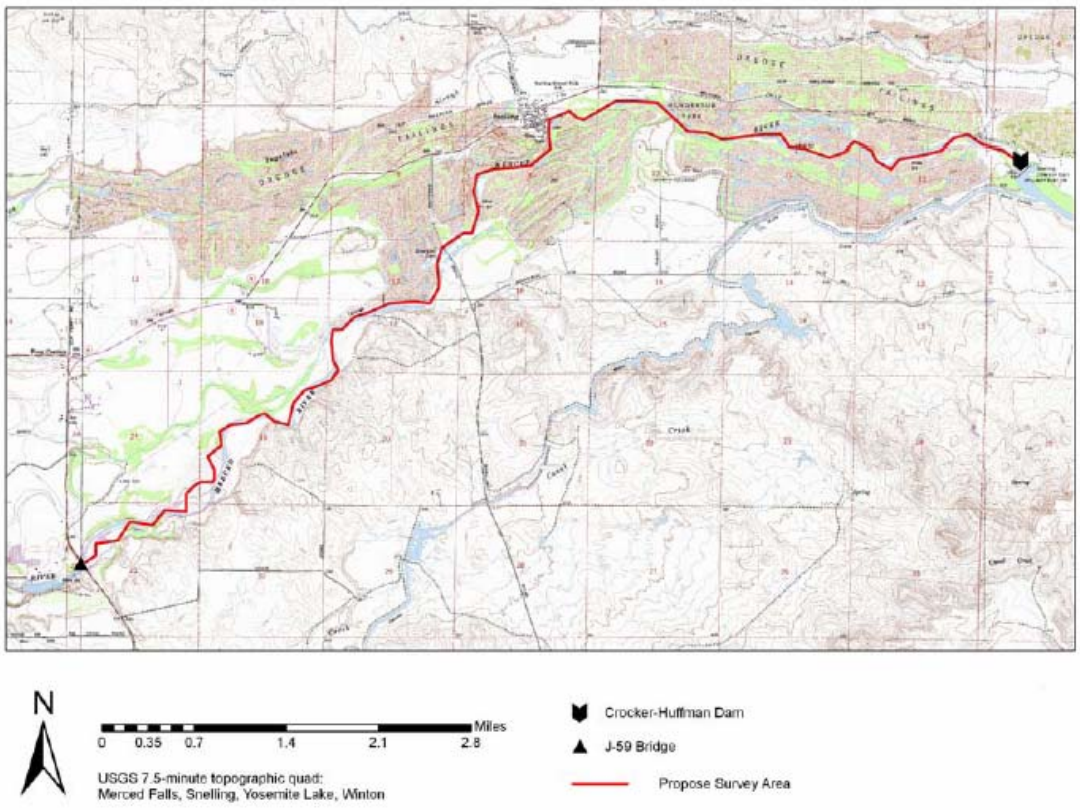

Figure 1. Location of river study area for electroshocking and snorkeling surveys.

The survey locations will be selected based on habitat characteristics most suitable for *O. mykiss* (i.e. riffle, run, and pool). Ten survey locations will be selected within the 10 river miles below Crocker-Huffman Dam. The study will provide information and data compatible for analyses and comparisons with adjoining rivers of the San Joaquin River basin.

Step 1 – Document baseline (in 2010-2011) juvenile and (and incidentally captured adult) *O. mykiss* abundance and distribution in the Lower Merced River.

The study goals will be addressed with a simple stratified random sampling design in which the most appropriate methodology is used to estimate population within strata. The Lower Merced River is a typical medium/large low gradient valley stream characterized by deep pool habitat, interspersed with wide low gradient riffles, side channel, and margin habitat. Total population estimates on large Central Valley rivers are difficult because researchers tend to rely on a single methodology to collect fish specimens or focus on one habitat type. Because of the diversity in habitat types, no single sampling methodology is adequate. For example, visual estimation (snorkeling) is effective in deep pool habitat but is not effective in shallow side channels with complex instream habitat diversity. Similarly, side channels can be electro-fished effectively but large deep pools may or may not be electro-fished adequately dependent on allowable electro-fishing equipment and pool morphology. By utilizing different sampling methodologies within a stratified sampling design, a more complete resource assessment will be attained. A total juvenile rearing population estimate for the river reach study will be calculated for *O. mykiss*. Total population estimation requires data from two factors, which have not been accounted for in the limited studies conducted to date:

- Assessment of the range/distribution of *O. mykiss*;
- Assessment of the abundance of *O. mykiss*

For estimates of juvenile *O. mykiss* and abundance and distribution, the following methodology will be employed. Capture method will include angling and/or backpack electro-fishing depending on survey locations and numbers of fish caught. All fish captured will have their biological data recorded (included but not limited to length, weight, and life stage). Scale samples will be taken from all fish. Scales will be analyzed for age structure purposes. Fish that meet the minimum requirement for marking will be marked with T-bar anchor tag (Floy tag). Floy tags will be used as identification of a surveyed fish if repeated sampling is required. A sub-sample of 25 fish will have acoustic tags surgically implanted, and marked with different color Floy tag at each location. The total number in the acoustic tagged sample will be 150 for each year. Marked fish will be held in a recovery container until full equilibrium is restored. All fish will be release to slow water habitat near the capture location. All acoustic tagged samples will be digitally

photographed, and tag information (acoustic tag and Floy tag) will be attached to its photo.

Snorkel surveys will be used as the recapture method by visibly detecting the presence of Floy tags. All *O. mykiss* (fin clipped or unclipped) will be enumerated, along with size and life stage estimated. All other observed fish species will be enumerated and recorded. A mobile acoustic tag detector will be used to detect the presence of acoustic-tagged fish prior to snorkel surveys. The data from the acoustic tagging will be used as a control group (known number of fish in water). Stationary acoustic detectors will be deployed in all survey locations. Two detectors will be installed for each survey locations at its upper and lower end. A total of 20 stationary detectors will be installed in the Merced River study reach. Acoustic tags will provide more extensive information such as survival, movement, and migration patterns. Floy tags provide information about relative population abundance and distribution. Any mortality resulting from angling or electrofishing survey will be kept and recorded on datasheet.

Scales samples and fin clips will be collected for age determination and anadromy. Any mortality observed from snorkel survey will be collected, and recorded. Scales will be collected for age determination and fin clips for anadromy determination.

All field survey will occur during June, July, and August for two years. Fish sampling for mark-recapture study will be conducted in June. Intensity of fish sampling will depend on number of acoustic tagged fish released. July and August will be recapture survey and habitat survey.

Step 2 - Assess the age structure.

The population age class structure will be determined through fork length histograms and confirmed through reading scales. Assessment of population structure within the instream life history stage is vital to understanding the limiting factors on overall *O. mykiss* population. Each life history stage requires different environmental and habitat conditions. For example, age 0+ may utilize different habitats and have different flow requirements than age 1+ and older specimens. Lack of suitable habitat for age 0+ fish may limit the overall *O. mykiss* population even if the requirements for age 1+ and older fish are sufficient.

All scale samples will be cleaned and mounted on microscope slides. Digital images of scale samples will be taken. Age-reading technicians will then identify age of a sample by use of a digital image on a personal computer.

Step 3 – Assess the condition of anadromy and verify genetic origin.

The condition of anadromy will be determined by performing Sr:Ca ratio analyses of otolith samples to determine resident or anadromous life history of *O. mykiss*

(Zimmerman *et al.* 2008, 2009). 150 specimens will be sampled; an incidental take permit from the National Marine Fisheries Service shall be obtained prior to collection of fish for otolith samples.

Genetic origin will be examined by analyzing genetic markers (Single Nucleotide Polymorphism or SNP) from DNA extracted from fin clips from thirty of the fish sampled for otiliths(Aguilar and Garza, 2007; Donohoe *et al*., 2008). Compare these with samples from thirty individual *O. mykiss* specimens taken upstream of Lake McClure in the course of performing the Upper River Fish Populations and Habitat study. In such case as the latter study is not performed, licensee will collect samples from the upper Merced River following a protocol determined by CDFG, SWRCB, and NMFS.

Step 4 - Assess habitat utilization.

The nature of the survey design necessitates assessment of population density and age class structure within habitat strata. Because minimum requirements for summer flows are highly variable (50 to 1000 cfs, *e.g.* CDEC flows MSN station, yr. 2000 versus 2005), available habitat is likewise highly variable. Some habitat strata, particularly side channels, are not present during the lowest minimum flow conditions. It is vital to assess habitat strata utilization in order to evaluate the potential effects of varied summer flow regimes.

This task will be carried out when mark-recapture snorkel survey is conducted. Environmental data will include air and river temperature, river flow, turbidity, snorkel visibility, and habitat typing. Survey area will be marked by using Trimble GPS unit to show boundaries and sampling areas. Water velocities will measured with either a Price AA flow meter or an Acoustic Doppler Current Profiler (ADCP) over a range of low to high flows to characterize water velocities in juvenile *O. mykiss* habitats at the 10 sites.
Habitat typing will be surveyed by varieties of methods included direct observation from a drift boat or kayak, and underwater observation by snorkel or underwater surveillance equipment.

Habitat will be characterized into pool, riffle, run/glide, and side channel. Substrate will be categorized into silt, sand, gravel, cobble, boulder, and bedrock. Cover will be categorized into none, overhanging, instream, and both overhanging and instream.

Step 5 - Investigate the relationship between physical features within habitat types and location of *O. mykiss*

During the course of population assessment within habitat units, physical habitat features, such as current speed and structural complexity, will be related to fish position within the habitat units. Fundamental understanding of the locations fish prefer will assist in the planning of habitat enhancement/restoration efforts. This assessment will be carried out

qualitatively, with extensive use of GIS to allow geographical representation of observations and captures within habitat units.

Step 6 - Data Analysis

Data will be entered into MS Access database by data management personnel. Quality control will be performed to ensure the accuracy and integrity of the data entered by using existing database and data management procedures of the research group. QA/QC procedures and process will be reported to and agreed upon by the Relicensing Participants.

Data collected from acoustic telemetry and habitat typing will be analyzed by using ArcView GIS database to form range/distribution map. *O. mykiss* abundance can be formulated from both telemetry and mark-recapture data at the selected survey locations.

O. mykiss and abundance at each location will be calculated by using this formula:

$$N = \left(\frac{A_M \bullet T_S}{A_S} \right) + M$$

N = Number of *O. mykiss* at a survey location
A_M = Observed acoustic tagged fish via a mobile detector
A_S = Observed acoustic tagged fish via snorkel survey
T_S = Total number of *O. mykiss* observed (marked and unmarked) via snorkel survey
M = Observed mortality from both sampling and snorkel surveys
By using this formula we assume the following to be true:

- 100% tag retention
- marked fish is distributed evenly at each survey location
- marked fish is mixed with unmarked fish at each survey location

Step 7 – Prepare Report. –

Applicant will prepare a report that includes the following sections: 1) Study Goals and Objectives; 2) Methods and Analysis; 3) Discussion; and 4) Description of Variances from the FERC-approved study proposal, if any. Data will be provided on CD in Microsoft Excel spreadsheets. Applicant plans to make the report available to Relicensing Participants when completed. The report will be included in the License Applications as appropriate. Besides the reports described above, the study results will be displayed in Geographic Information System (GIS) maps that show the habitat utilization and range of distributions of juvenile Steelhead trout in the Merced River, below Merced Falls Dam.

6.4 Consultation and Communication

This study proposal includes 6 study-specific Agency, Tribe, and Relicensing Participant consultations regarding final details of study plans, locations, protocols, and field reconnaissance activities:

- Consult on Step 1 Document Baseline of juvenile and adult *O. mykiss*
- Consult on Step 2Assess Age Structure
- Consult on Step 3 Assess Anadromy
- Consult on Step 4 Assess Habitat Utilization
- Consult on Step 5 Investigate Physical Features/Habitat Types and Location
- Consult on Step 6 Data Analyses

A quarterly report on overall study progress, with any notations of change from agree-to protocols or timelines, will be filed with FERC and posted on its Relicensing Website periodic reports as required by the FERC in the Study Plan Determination. Applicant will coordinate with FERC and other Relicensing Participants as described in this section.

6.5 Schedule

The schedule to complete the proposed study is:

- Step 1. Baseline of juvenile O. mykiss.…….June-Sept 2010; June-Sept 2011
- Step 2 Assess Age Structure…….…..Oct-Nov 2011
- Step 3 Assess Anadromy…… ……Oct-Nov 2011
- Step 4 Assess Habitat Utilization ……..June-Sept 2010; June-Sept 2011
- Step 5 Investigate Physical Features/Habitat Types and Location……. ……June-Sept 2010; June-Sept 2011
- Step 6 Data Analyses.……Nov-Dec 2011
- Step 7 Report Preparation……..Nov-Dec 2011

It is anticipated that the study will be completed in 2011.

6.6 Consistency of Methodology with Generally Accepted Scientific Practices

This study is consistent with the goals, objectives, and methods outlined for recent FERC hydroelectric relicensing studies in California, and uses well-recognized scientific

methodologies and protocols from US Fish & Wildlife Service, California Department of Fish and Game, and National Marine Fisheries Service.

7.0 Products

After data are collected, tabulated, and quality checked the data will be made available to the Relicensing Participants in an Excel format or other format as appropriate.

Products will include but not be limited to the following:

An overall Project Report will be prepared. Data will be provided on CD in Microsoft Excel spreadsheets. Besides the report, the study results will be displayed in Geographic Information System (GIS) maps that show locations of any identified potential barriers to upstream or downstream anadromous fish species movement.

8.0 Level of Effort and Cost

Step in Study	Study Task	Estimate person time	Cost
Step 1	**Baseline Abundance Distribution**	**12 person-months & Supplies**	**$110,000**
Step 2	**Assess Age Structure**	**2 person-months**	**$ 15,000**
Step 3	**Assess Anadromy with SNAP DNA analysis and Sr:Ca ratios**	**400 fin punch samples @ $45; 100 otolith samples @ $90**	**$ 18,000** **$ 9,000**
Step 4	**Assess Habitat Utilization**	**12 person-months**	**$90,000**
Step 5	**Physical Features Habitat types & Locations**	**4 person- months**	**$30,000**
Step 6	**Data Analyses**	**4 person-months**	**$30,000**
Step 7	**Report Preparation**	**6 person-months**	**$45,000**
	TOTAL STUDY COST		**$347,000**

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Appendix E

INSTREAM FLOW STUDY

August 27, 2009

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1.0 Project Nexus

Operation of the Merced River Project includes the impoundment of the Merced River into Lake McClure Reservoir (approx. 1 million acre-feet), and the subsequent controlled release of impounded waters through the New Exchequer Powerhouse to downstream power and diversion facilities. This operation results in direct, indirect, and cumulative impacts to the aquatic resources of the lower Merced River from Lake McClure downstream to the confluence with the San Joaquin River, including native anadromous salmonid fishes and their habitat.

Additionally, the licensee proposes to move the point of compliance for lower Merced River instream releases nearly 24 miles upstream from the existing compliance point. Articles 40 and 41 of the existing license establish minimum instream release requirements for the lower Merced River, and they specify that compliance is to be determined at the Shaffer Bridge (RM 32.5). However, in section 9.3.2 of the Pre-Application Document (PAD), the licensee proposes to eliminate license articles 40 and 41, and in section 9.2.2 of the PAD, the licensee proposes to set the flow measurement point of compliance at McSwain Dam (RM 56.1).

This instream flow study will estimate the habitat versus flow relationships in four subreaches in the lower Merced River between the Crocker-Huffman Diversion Dam (RM 52.0) and the confluence with the San Joaquin River using the Physical Habitat Simulation system (PHABSIM). The study results, along with other information, will be used to develop minimum instream flow requirements for the lower Merced River. The study results will also be used to evaluate the effect of changing the point of compliance from the Shaffer Bridge to McSwain Dam.

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2.0 Resource Agency Management Goals

Several agencies may have jurisdiction over releases and stream flow. These include: the United States Department of the Interior (USDOI), Bureau of Land Management (BLM) for public land administered by BLM; USDOI, Fish and Wildlife Service (USFWS); the United States Department of Commerce (USDOC), National Marine Fisheries Service; the State Water Resources Control Board (SWRCB); and the California Department of Fish and Game (CDFG).

The resource agency management goals for the Merced River Project include, but are not limited to, the following:

- Restoring disturbed or altered habitat for all life stages of native fish species including fish spawning, fish passage, and both adult immigration and juvenile (smolt size) outmigration corridor habitat.

- Protecting, conserving, enhancing and recovering native anadromous fishes and their habitats by providing access to suitable habitats and by restoring fully functioning habitat conditions.

- Maintaining, enhancing and restoring all life stages of native aquatic species by ensuring connectivity between Project-affected stream reaches and between Project reservoirs.

- Maintaining, recovering and restoring streamflow regimes sufficient to sustain desired conditions of native riparian and aquatic habitats in Project-affected stream reaches.

- Identifying and implementing measures to protect, mitigate or minimize direct, indirect and cumulative impacts to, and enhance native anadromous fish resources, including relate

- Maintaining, recovering, and restoring riparian resources, channel condition, and aquatic habitat.

- Maintaining, recovering, and restoring streamflow regime sufficient to sustain desired conditions of native riparian, aquatic, wetland, and meadow habitats.

- Protecting aquatic systems to which species are uniquely adapted.

3.0 Potential License Conditions

The study results, along with other information, will be used to develop minimum stream flow requirements for the lower Merced River. Development of protection, mitigation and enhancement measures is not part of this study.

4.0 Study Goals and Objectives

The overall goal of the study is to evaluate the relationship between flow and fish habitat in the lower Merced River between the Crocker-Huffman Diversion Dam (RM 52.0) and the confluence with the San Joaquin River using PHABSIM modeling. The target species and lifestage for this study include the following:

Table 1. Target species and life stages to be analyzed.

Species	Lifestage
Oncorhynchus mykiss (Steelhead Rainbow trout)	Adult Juvenile (inc, smolt outmigration) Fry Spawning
Oncorhynchus tshawytscha (Fall-run Chinook salmon)	Adult Juvenile (inc. smolt outmigration) Fry Spawning
Mylopharodon conocephalus (Hardhead)	Adult Juvenile
Pogonichthys macrolepidotus (Sacrament splittail)	Adult Juvenile

The study results will also be used to evaluate the effect to fish and other aquatic resources of changing the flow measurement compliance point from the Shaffer Bridge to McSwain Dam.

5.0 Existing Information and Need for Additional Information

The PAD does not identify any previous instream flow studies conducted in the lower-Merced River. However, the resource agencies are aware of several previous instream flow studies, including a 1994 study of salmon spawning habitat conducted by CDFG, and a 2000-2002 study conducted by the US FWS of habitat restoration sites. However, it is unclear whether this information is sufficiently complete and/or suitable for use in this study effort.

To achieve the study goals, information that is needed includes but is not limited to:

- Preparation of habitat mapping of the lower-Merced River
- Selection of PHABSIM study sites and 1-D transect locations
- Development of site-specific habitat suitability criteria for target species and lifestages
- Field measurement of physical parameters required for PHABSIM modeling
- Calibration of PHABSIM hydraulic models
- Development of flow versus habitat relationships using PHABSIM modeling

6.0 Study Methods and Analysis

6.1 Study Area

The study area includes the lower Merced River between the Crocker-Huffman Diversion Dam (RM 52.0) and the confluence with the San Joaquin River. There are four PHABSIM subreaches within the study area, including:

- Crocker-Huffman Diversion to the Snelling Road Bridge;
- Snelling Road Bridge to the Highway 59 Bridge; and
- Highway 59 Bridge to Shaffer Bridge;
- Shaffer Bridge to confluence with San Joaquin River

6.2 General Concepts

The following general concepts apply to this study:

- Personal safety is an important consideration of each fieldwork team. If Licensees determine the information cannot be collected in a safe manner, Licensees will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

- Licensees shall make a good faith effort to obtain permission to access private property where needed well in advance of performance of the study. If access is not granted or river access is not feasible or safe, Licensees will notify FERC and Relicensing Participants as soon as possible via email to determine if Relicensing Participants can assist in gaining access or to discuss alternative approaches to perform the study.

- The schedule for each proposed study is reasonably flexible to accommodate unforeseen problems that may affect the schedule. If a schedule changes, Licensees will notify FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

- Field crews may make minor modifications to the study proposal in the field to accommodate actual field conditions and unforeseen problems. When modifications are made, Licensees' field crew will follow the protocols in this study proposal. If minor modifications are made, Licensees will provide a detailed description of the conditions that led to the decision to modify the study to FERC and Relicensing Participants as soon as possible via email to discuss alternative approaches to perform the study.

- Licensees' performance of the study does not presume Licensees are responsible in whole or in part for resource management measures that may arise from that study.

- The estimated level of effort and cost is not a firm commitment by Licensees to expend all the funds. If the study costs more, Licensees are committed to completing the study. If the study costs less, Licensees are not committed to expending the remaining funds on other Relicensing studies or resource management measures.

- All special-status species observations will be submitted to the California Natural Diversity Database.

6.3 Study Methods

For 1-D PHABSIM studies, the general steps include (not necessarily in the order shown):

- selection of target species and life stages
- stream reach identification, segmentation, and consolidation
- study site and transect selection including review and agreement with interested and available Relicensing Participants
- field data collection
- development of habitat suitability criteria
- hydraulic and habitat modeling

Selection of Target Species and Life Stages

The species and life stages that will be used for PHABSIM modeling are based on management importance and/or sensitivity to project operations. Target species and life stages are shown in Table 1.

Stream Reach Identification, Reach Segmentation, and Consolidation

Project-affected reaches are stratified in three steps.

Step 1 is identification of the project-affected reaches and preparation of habitat mapping. Habitat mapping shall be conducted through field assessments made in accordance with the CDFG's Salmonid Habitat Restoration Manual (DFG Restoration Manual) to Level IV.

Step 2 is segmentation of project-affected reaches into homogeneous stream segments, where necessary, based on geomorphology, hydrology, and channel metrics. A series of very similar reaches having a common channel morphology and flow regime comprise a river segment (Bovee 1982). Data used in Step 2 includes the habitat mapping prepared in Step 1, topographic maps, and the hydrologic record.

Step 3 is consolidation of these river segments (or sub-reaches) into one or more PHABSIM study reaches, where appropriate. Bovee (1982) describes different strategies for river segment consolidation from little or no consolidation (higher effort and higher cost) to more consolidation (lesser effort and lesser cost). Either sampling strategy can be employed in a particular study (Bovee 1982).

Study sites (transect or transect cluster locations) are selected within the consolidated reach to represent the range of channel and habitat types in the reach (Bovee 1982). The characteristic feature of a (PHABSIM) study reach is homogeneity of the channel structure and flow regime. In the upper foothill regions of the project, channel characteristics are primarily formed by bedrock control rather than fluvial processes. Bedrock channels are generally insensitive to short-term changes in sediment supply or discharge. Only a persistent decrease in discharge and/or an increase in sediment supply sufficient to convert the channel to an alluvial morphology would significantly alter fluvial bedrock channels (Montgomery and Buffington 1993). For this reason, flow accretion is not used as a dominant factor in river segmentation.

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Meso Habitat Stratification

Meso habitat stratification will be based on the habitat mapping prepared in Step 1. The mapping data will be used to develop a habitat unit frequency analysis for the instream flow studies. This cumulative frequency sampling approach is an extremely efficient way to inventory meso habitats over long distances (Bovee, 1997).

The Level IV habitat types referenced in the DFG Restoration Manual have been aggregated to a lower level of detail for the purpose of transect placement, hydraulic data collection, and transect weighting consistent with river stratification for PHABSIM modeling. The aggregated meso habitat types will be split into two categories – modelable and non-modelable. These are listed below:

Modelable Habitat Types:

- High Gradient Riffle (where channel hydraulics permit – identified in the field during transect selection)
- Low Gradient Riffle
- Run/Step-run
- Glide
- Pocket Water (where channel hydraulics permit – identified in the field)
- Pools (Mid-Channel, Trench, Lateral, Plunge)

Non-modelable habitat types include:

- Falls
- Cascade
- Chute
- Sheet Flow
- High Gradient Riffle (where channel hydraulics do not permit – identified in the field during transect selection)

Study Site and Transect Selection Including Relicensing Participant Review

Meso habitat study site and transect selection within each reach will be coordinated and determined in collaboration with interested and available Relicensing Participants. The goal is to obtain a relatively accurate representation of the habitat index versus flow relationship for each PHABSIM reach. This goal will be achieved by distributing study sites (transects and transect clusters) throughout the PHABSIM study reach in such a way that all modelable habitat types are represented with at least two representative habitat units. For habitat types with a high diversity in a particular reach, such as pool meso habitat type, the habitat type may need to be represented by three or more representative units.

Meso habitat unit and transect selection is made in conjunction with field review for two reasons. The first is that some PHABSIM reaches have greater (or lesser) importance in relation to the amount of habitat they provide (e.g., length of the reach or quality of the habitat) or the potential the project has to modify habitat; therefore, the sampling effort will be adjusted as appropriate. The second reason is because of the difficulty in determining *a priori* sampling effort (number and type of habitat units sampled) necessary to provide accurate habitat index versus flow relationships.

The specific locations and lengths of the study sites will be selected in the field as described below, in consultation with the interested and available Relicensing Participants. Prior to study site selection in the field, the Licensees will summarize the geomorphic and hydrological data and work with the Relicensing Participants to finalize the demarcation of PHABSIM reaches. The Licensees will also summarize the aquatic habitat characterization data and study site access data and work with the Relicensing Participants to make a preliminary recommendation of study site, meso habitat unit, and possibly transect locations. Licensees will offer a pre-field presentation and orientation meeting ahead of each field visit. The pre-field meeting will include a description of the study site, meso habitat units, and possibly selected transects. The basis for selection, still photos, aerial video (if available), and maps of these features will also be provided. Pre-field meetings and field site visits will be scheduled with a goal of 30 days advance notice to allow the Relicensing Participants the opportunity to participate in the selection of final study sites, specific habitat units, and transects. Less than 30 days advance notice may be necessary if a site visit needs to be rescheduled due to unforeseen circumstances such as weather, sudden and unavoidable changes in operations, or unavoidable late arising scheduling conflicts affecting key participants.

Meso Habitat Unit Sampling

In general, it is proposed that within a study reach, meso habitat types will be sampled approximately in proportion to their abundance. Adjustments to the proportional sampling may be made based on the importance or variability of particular meso habitat types. While the number of transects is dependent on the diversity of channel and habitat types in a study reach, the target number of transects per PHABSIM subreach will

generally be in the range of 17-20, up to as many as 25. This provides enough sampling flexibility to replicate each of the 4-5 predominant (>5% frequency) modelable meso habitat types. Meso habitat types with complex hydraulics (e.g. cascades, falls, chutes, and sheet flow) that cannot be modeled using standard PHABSIM and do not contain significant habitat for the primary target species will not be sampled with transects.

Transect Selection and Placement

The study sites used for transect placement to represent the different geomorphic and hydraulic conditions will be selected using a stratified random sampling approach based on the least-available sampled meso habitat type (Payne 1992). Other more-available meso habitat types will be represented using transects placed in meso habitat units in close proximity to the least-available selector. This approach minimizes the effect of selection bias, results in transect clustering that limits travel time, and assures transect representation in proportion to habitat availability.

Actual transect selection and placement is typically accomplished with a combination of random selection and professional judgment through the following procedure:

1. All project-affected reaches that are accessible and open to study are identified and designated for random transect placement.

2. Within the accessible areas, the habitat type with the lowest percentage of abundance (from the habitat mapping data) is used as the basis for random selection (provided that the habitat type is ecologically significant and modelable). If the distribution of the initial least common selector is too limited to provide an adequate choice of representative habitats, the next least common selector will be used.

3. All habitat units of this type within the accessible distance and that are judged to be modelable during the habitat survey are sequentially numbered and a minimum of five units selected by random number.

4. In the field, the first selected unit is relocated and, if it was judged to be modelable and reasonably typical of that particular habitat type within the study reach, one or more transects is/are placed to best represent the habitat type.

5. At least one example of each remaining habitat type is then located in the immediate vicinity of the random transect (upstream or downstream) until transects are placed in all significant types.

6. This process is repeated with the second, third, fourth or higher random selector to place additional clusters until the different geomorphic and hydraulic conditions are adequately characterized (as determined in collaboration with interested and available Relicensing Participants) or the target total number of transects is reached.

Although the outlined steps are fairly rigorous, all decisions regarding transect placement are subject to revision through the exercise of professional judgment by study

participants, including the specific inclusion of desirable study areas not randomly selected and the placement of transects across appropriate spawning gravels. The overall objective of the method is to assure stakeholders and reviewers that satisfactory representation of study reaches is achieved.

Final selection of the study sites and transects will be completed in the field in collaboration with the interested and available Relicensing Participants. To facilitate the field-based transect selection process, a field package including reach maps, proposed study site and possible transect locations, photos (aerial and on the ground), and habitat mapping data results will be distributed to Relicensing Participants providing the necessary information for decision making.

Field Data Collection

General Method

Physical habitat and hydraulic parameters will be measured using a combination of standard techniques of the USFWS methodology (Trihey and Wegner 1981; Bovee 1982; Bovee et al. 1998 USGS (Rantz 1982), and techniques outlined in this study plan. PHABSIM data collection methods may vary somewhat between study reaches, depending on hydraulic and channel variations.

Target Calibration Flow

Target calibration flows will be selected with the goal of achieving relatively even logarithmic spacing of flows and allow development of an adequate stage/discharge relationship in the PHABSIM models. In other words, the stage change between calibration flows must be sufficient to test for a linear relationship between the log of discharge and log of stage minus stage of zero flow (IFG-4), or through the use of hydraulic conveyance modeling (MANSQ). Preliminary target calibration flows are 60 cfs, 220 cfs, 815 cfs and 3,000 cfs.

Selection of final target calibration flows will depend on reach specific conditions and will be selected in consultation with the Relicensing Participants. If target calibration flows need to be modified in the field, the modification will be done in collaboration with interested and available Relicensing Participants. The following guidelines will be applied in selecting the target calibration flows.

- Target calibration flows must be within the range of project flow control
- Incremental differences between the three target calibration flows must be within the control capabilities of the flow control mechanism
- High calibration flow should be high enough to model up to 10% or greater on the unimpaired flow exceedance curve or highest flows anticipated in the reach (regulated flow exceedance curve)
- High calibration flow should be within the physical limits of field measurement options using manual meters or an acoustic Doppler current profiler (ADCP).

- An additional (fifth) stage/discharge measurement may be taken in certain circumstances
- Low calibration flow target should be low enough to model down to the current instream flow requirement and adequately capture low flows generated by Project operation
- Middle calibration flow targets will be selected such that their logarithmic values are evenly spaced between the logarithmic values of the high and low calibration flow targets thus providing the necessary spread to assess the relationship between stage and discharge

High flow calibration targets will be set based on the above guidelines and may be adjusted during field reconnaissance in spring or other high flow periods to confirm suitability.

Surveying and Controls

All elevations will be surveyed by standard differential survey techniques using an auto-level or total station instrument. Headpin and tailpin elevations, water surface elevations (WSE), hydraulic controls, and above-water bed and bank elevations will be referenced to a temporary benchmark serving a single transect or transect cluster. Where reasonable (line of sight or 1 turning point), benchmarks will be tied together. At a minimum, all transects surveyed in a single mesohabitat unit will have a common datum. Transect locations will be fixed, to the accuracy level possible, using a handheld GPS instrument.

Water Surface Elevation-Discharge

Stage/discharge measurements will be obtained at no fewer than three discharges. Additional stage/discharge measurements may be collected at higher flows (possibly lower also) in order to model habitat over a greater range of the flow frequency curve. When only a stage/discharge measurement is taken, discharge through the study site will be measured using manual velocity meters or a combination of an ADCP (described below) and manual velocity meters at an appropriate cross section.

Calibration Velocity

One velocity calibration set will be collected at the high or middle flows[1] at each transect using manual velocity meters alone or in combination with an ADCP. At cross sections and flows where predominant depths are greater than 2.5 feet, velocity distributions will be measured using the ADCP mounted on a small inflatable cataraft or a rigid trimaran. According to an extensive evaluation conducted by the USGS (Morlock 1996), an ADCP can be used successfully for data collection under a variety of field conditions.

Because the ADCP will not measure velocities well in depths less than approximately 1.0-2.0 feet, shallower measurements will be taken manually using calibrated digital

[1] The determination of the flow at which velocity calibration data will be collected will be made collaboratively with the Relicensing Participants.

Swoffer® brand or Price AA, or pigmy velocity meters mounted on standard USGS top-set wading rods. To assure adequate characterization of micro habitat for all life stages (e.g. adult, fry, juvenile, and spawning), during manual velocity measurements, sample sites (verticals) along the transect will be purposefully placed to describe points where changes in substrate, bed elevation, and velocity occur. The number of verticals will be adjusted in the field to accomplish micro habitat stratification as dictated by site specific conditions, and will also be increased in stream margin areas where fry or juvenile fish habitat is present. The placement and number of verticals will also be designed to limit discharge in any one cell to no more than 10% of the total discharge.

Temporary staff gage levels and the time of day will be recorded at the beginning and end of each transect measurement to note potential changes in stage. Continuous recording level-loggers may be deployed in certain reaches to monitor changes in stage during the calibration measurements. A continuous record of stage is useful in modeling if flows do change during calibration measurements.

If Project operations allow, all three calibration measurements in a PHABSIM reach may be collected within a 2-3 day period. In this case low flows would normally be collected first, then mid flow, and then high flow. In other cases several weeks may elapse between flow measurements. Discussions with operations managers will determine the most efficient and cost effective methods of obtaining the appropriate calibration discharge. If a reach is run-of-river and has little storage, hydraulic data for the target high calibration flow will be collected in the spring with subsequent measurements obtained on the descending limb of the hydrograph. Note that the target flows are those flows that will be ***released*** into the stream from the nearest upstream project facility. While accretion will be factored into the release on the day of measurement, flows at each transect may be higher than the target calibration flow.

Substrate

Substrate will be classified according to a standard procedure, and will be evaluated visually during low flow conditions.

Percent occurrence of all substrate sizes within the immediate vicinity of each vertical (1-2 feet radius from vertical) will be recorded. Particle size categories are described below:

Organic debris, permanent vegetation
Clay, silt ..... <0.1 inches
Sand ..... 0.1-0.2 inches
Small gravel ..... 0.2-1.0 inches
Medium gravel ..... 1-2 inches
Large gravel ..... 2-3 inches
Small cobble ..... 3-6 inches
Medium cobble ..... 6-9 inches
Large Cobble ..... 9-12 inches
Boulder ..... >12.0 inches

Bedrock

Miscellaneous Field Data Collection Methods

Photographs will be taken of all transects from downstream and other points as necessary at each measured flow. To the extent possible, each photograph will be taken from the same location at each of the three levels of flow.

Data sheets for each study site will be completed as follows:

- Photo Log – for each flow/visit
- Site Documentation – sketch or aerial video capture showing location, type, and numbering of transects – completed once
- GPS UTM Coordinates for each headpin (or mid-channel if headpin reading could not be obtained) and benchmark – completed once
- Water Surface Elevation and Level Loop – WSE completed at each calibration flow, level loop completed once, pin heights validated at each visit
- Cover Description – completed once
- Discharge – for each flow, at one two or more transects
- Depth and Velocity – at each transect for one calibration flow (middle or high)
- Stage of Zero Flow – collected once for each transect
- Cross Section Profile and Substrate – completed once for each transect
- Task Completion Checklist – in field for every visit

Development of Habitat Suitability Criteria

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The following procedures shall be used to develop habitat suitability criteria. They are designed to ensure collection of usable field data and HSC development. They were derived to address the matter of habitat availability in HSC development. These procedures focus on development of site-specific criteria. However, the general concepts apply to development of regional criteria as well. The licensees may apply these procedures in any appropriate tributary within the San Joaquin River watershed after consultation with the relicensing participants. The licensees should consult with interested relicensing participants during each of the following steps.

1. Identify and evaluate at least three river flows (e.g., low, medium, and high) to sample. Extremely low and high flows should be avoided during data collection. Sampling fewer than three flow levels very likely would result in biased criteria, and should be avoided. Flows sampled shall be based on the hydraulic and physical microhabitat variability present within mesohabitat types, and shall be made collaboratively. Regardless of the number of flows sampled, flows sampled and data obtained must allow for development of HSC applicable to PHABSIM models that facilitate extrapolation of WUA/discharge relationships to flows ranging between 90% and 10% unimpaired (i.e., natural) exceedance flows. If all parties cannot agree whether fewer or more than three flows should be sampled, three flows remains the default sample size.

2. Partition the river in question into generally homologous segments. If regional HSC are being developed, riverine systems should be partitioned by stream type, elevation, gradient, and/or other appropriate characteristics.

3. Delineate all mesohabitat types (e.g., run, riffle, pool, etc.) at an unimpaired, moderate river discharge throughout each segment. Extremely low and high flows should be avoided for mesohabitat delineation. Identify each mesohabitat type comprising at least 5% of the total linear distance of each homologous reach, and all biologically important mesohabitat types comprising less than 5% of the total linear distance.

4. Evaluate specific mesohabitat types and/or river flows that may be hazardous to sample. If all interested parties agree that specific mesohabitats and/or flows should be deleted from subsequent HSC data collection, determine how deletion of such data may affect HSC development and utility. Incorporate appropriate measures to reduce identified impacts. Document the decision making process, and conclusions.

5. Prepare a sample design for each homologous stream segment. Randomly select three units of each mesohabitat type comprising 5% or greater of the total linear distance of each homologous segment, and those biologically important mesohabitat types comprising less than 5% of the total linear distance. There are various procedures to introduce randomness into mesohabitat selection. The method selected shall be determined in a collaborative manner. If an acceptable approach cannot be agreed upon by all interested parties, then complete random selection is the default. Document the decision making process and random approach selection.

6. Ground truth selected mesohabitat units to determine whether the unit represents the target mesohabitat type. Randomly select and ground truth additional units as needed.

7. Collect data within each mesohabitat unit. Data may be collected through 100% sampling of each unit, or by a resource agency approved sub-sampling technique (e.g., transects, grids, etc.). Ground truth sub-sampling units selected within each mesohabitat sample unit to determine whether they represent the mesohabitat unit, the hydraulic conditions, and the physical microhabitats available within the unit. Select additional sub-sampling units within the mesohabitat unit(s) needed, with ground truthing. This item does not apply to two dimensional data collection.

8. Partition data collection by riverine type, flow, and meso- and microhabitat type. Data should be partitioned diurnally and seasonally whenever possible. Data from different categories should be compared, and data for significant individual categories included, as appropriate, within PHABSIM analyses and water allocation decisions.

9. Sample all sample periods/conditions/components/flows/etc. equally. If not sampled equally, appropriate steps (e.g., mathematically adjust sample sizes to attain equality) should be taken to address and minimize potential biases. These steps should be developed collaboratively with interested relicensing participants. However, the resource agencies reserve the option of determining the acceptable technique.

10. The target sample size is at least 150 observations per species life stage per river flow, homologous reach, season, and diurnal period sampled. A single fish or group of fish in the same location is considered an observation. More than 150 observations may be needed to develop HSC. Actual sample sizes and partitioning components are dependent upon specific circumstances, and should be determined in a collaborative manner. Identify and account for influencing factors. Sampling should not be discontinued once 150 observations is reached if doing so would compromise equal sampling design needs (e.g., effort, area, etc.). Each condition is a specific requirement. For example, if 150 observations have been collected, but equal area sampling requirements have not been met, sampling must continue until the sample area requirements have also been met.

11. Address habitat availability for each river flow, mesohabitat, and/or representative reach, season, diurnal period, etc. sampled, and account for habitat availability in HSC development. Habitat availability may be accounted for in the basic fish observation sample design (e.g., sample a wide range of flows, hydraulic conditions, physical conditions, seasons, etc.), or in data compilation (e.g., proportional habitat use divided by proportional habitat availability). If habitat availability data are not included in HSC development, resultant HSC are suitable for habitat analyses only for the limited conditions existing during data collection.

12. Collect hydraulic and physical data. These data include:
    a. Total water depth and average velocity.
    b. Fish focal point velocity.
    c. Stream margin edge type.
    d. Cover type components.
    e. Substrate components.
    f. Vegetative components
    j. Distance to and type of nearest components described above.
    k. Other factors as appropriate.

13. Compile observation and habitat availability data in such a way that unequal sizes do not bias resultant HSC. For example, individual data sets may be normalized or equalized prior to data compilation. The procedures used should be developed collaboratively with interested relicensing participants. However, the resource agencies reserve the option of determining the acceptable technique.

14. Address anomalies in HSC distributions. Determine if additional data are required to address the anomalies, or if the effect of the anomalies should be minimized and/or included in analyses. An example of minimizing anomaly effects is by smoothing or curve fitting techniques, and/or professional judgment. Smoothing and curve fitting techniques are preferred. Procedures used should be developed collaboratively with interested relicensing participants. The resource agencies reserve the option of determining the acceptable technique.

15. Determined whether the above procedures provide sufficient sample sizes and/or do not account for habitat availability. Evaluate and select alternative procedures through a collaborative process with interested relicensing participants. The resource agencies reserve the option of approving appropriate methods.

1-D PHABSIM Modeling

Licensees may use any suitable software to model habitat index versus flow relationship, such as PHABSIM, PHABWin, or RHABSIM. The program will be made available to Relicensing Participants upon requested.

Hydraulic modeling procedures appropriate to the study site and level of data collection will be used for modeling water surface elevations and velocities across each cross-section. For water surface elevations, these procedures include: the development of stage-discharge rating curves using log-log regression (IFG4), Manning's formula (MANSQ), and/or step backwater models (WSP, HecRas); direct comparison of results; and selection of the most appropriate and accurate method. If, for example, rating curves using log-log and MANSQ are nearly identical, then log-log will be used to easily allow changes in simulated flows. But, if the two methods diverge and the transect is a riffle or run, then MANSQ will be selected for flow simulation. Water velocities will be simulated using the Manning's n method of velocity distribution across all transects, with calibrations generally consisting of correction of over- or under-simulated velocities at individual sample points (i.e. velocity adjustment factors or VAFs). Data file construction, calibration, simulation, reporting, review, and consultation will follow standard procedures and guidelines.

Habitat modeling will be conducted using an approach consistent with the Instream Flow Incremental Methodology (IFIM) approach (Bovee et al. 1998). Meso habitat types will be weighted and combined to develop a representation of hydraulic characteristics and fish habitat suitability for the PHABSIM reach or subreach. Meso habitat weighting will be based on the relative proportion of each of the modeled meso habitats within the PHABSIM reach or subreach, as described above.

Products

Instream flow study products will include: a) a study report that includes a summary of field methods, data analysis, and results for all elements of the study (including HSC development, hydraulic modeling, and habitat modeling); b) all PHABSIM digital data

on CD formatted for input to PHABSIM, PHABWin, or RHABSIM, as appropriate; and c) spreadsheet based interactive analytical tools, as necessary.

Field Methods Summary

Field methods for each PHABSIM reach will be summarized to include but not be limited to the following:

- Maps showing study site and transect locations
- Photographs of transects at calibration flows
- Date and discharge of calibration flows
- Description of any deviations from the study plan

Data Analysis Summary

Data analysis for each PHABSIM reach will be summarized to include but not be limited to the following:

- Hydraulic calibration report (detailed modeling procedures and model performance);
- Habitat modeling report (target species, and HSC used)
- Description of any deviations from the study plan

Results Summary

Results for each PHABSIM reach will be summarized to include but not be limited to the following:

- Graphic and tabular results of Weighted Useable Area vs. flow
- Habitat modeling report (target species and HSC used)
- Description of any deviations from the study plan

6.4 Consultation and Communication

Licensees will file with FERC and post on its Relicensing Website periodic reports as required by the FERC in the Study Plan Determination.

Licensees will coordinate with FERC and other Relicensing Participants as described in Section 6.2.

The Licensees will collaborate with the Relicensing Participants on the following items:

- study site and transect selection
- development of habitat suitability criteria
- selection of target calibration flows
- hydraulic and habitat modeling (modeling procedures and model calibration)

6.5 Schedule

The Instream Flow Study should be conducted in 2009 and 2010.

7.0 Consistency of Methodology with Generally Accepted Scientific Practices (18 CFR 5.9(b)(6))

Instream flow studies conducted using PHABSIM are common in California hydropower relicensing. Similar studies are being, or have been, conducted on the Yuba-Bear Project (FERC Project No. 2266), the Drum-Spaulding Project (FERC Project No. 2310), and Middle Fork Projects (FERC Project No. 2079), the Upper American River Projects (FERC Project No. 2101), the DeSabla-Centerville Project (FERC Project No. 803), and the South Feather Project (FERC Project No. 2088), to name just a few examples.

8.0 Considerations of Level of Effort and Cost (18 CFR 5.9(b)(7))

The preliminary cost estimate for the study in 2009 dollars is $600,000.

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Study 8.2

RECREATIONAL RIVER BOATING FROM MERCED FALLS DAM TO SNELLING ROAD BRIDGE ~~CROCKER-HUFFMAN DIVERSION DAM~~

August 27, 2009

1.0 Project Nexus

Merced Irrigation District's (Merced ID or Licensee) continued operation and maintenance (O&M) of the Merced River Hydroelectric Project (Project) has a potential to affect non-motorized, recreational river boating opportunities within the river reach affected by the Project below Merced Falls Dam (non-project) downstream to the Crocker-Huffman Diversion Dam (CHDD, non-project).

2.0 Resource Management Goals of Agencies with Jurisdiction Over the Resource to be Studied

Management plans that cover recreation resources within the Project Vicinity include the United States Department of Interior (USDOI) Bureau of Land Management's (BLM) Sierra Resource Management Plan (SRMP), BLM's Merced Wild and Scenic River Management Plan, the California Department of Parks and Recreation's (CDPR) California Outdoor Recreation Plan (CORP), Mariposa County's General Plan, Merced County's General Plan (to the extent applicable), and the USDOI Fish and Wildlife Service's (USFWS) Recreational Fisheries Policy. Below is a summary of the recreation goals identified in the management plans applicable to the Project Vicinity.

2.1 Bureau of Land Management Sierra Resource Management Plan

The BLM SRMP was adopted in February 2008. The SRMP is nearly identical to the Sierra Proposed SRMP and Final Environmental Impact Statement (EIS) published on June 8, 2007. Specific management decisions, including management activities, mitigations and project design features for public lands under the jurisdiction of BLM's Mother Lode Field Office have been outlined in the SRMP. The SRMP has the following two recreation goals: 1) ensure the continued availability of outdoor recreational opportunities while protecting other resources and uses; and, 2) ensure adequate river flows for boating, fishing, swimming, etc. In addition, the five recreation objectives are: 1) develop recreation management strategies for large blocks of BLM land in wild and scenic river corridors; 2) develop recreation sites that meet public health and safety standards; 3) mitigate conflicts between competing uses; 4) maintain existing visitor center, campground, trail, and day use facilities to accepted BLM standards; 5) manage recreation for a remote experience on the wild segments of the North Fork American, Tuolumne, and Merced rivers pursuant to the Wild and Scenic Rivers Act. (BLM 2008, pp. 26-27)

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The SRMP utilizes a Recreation Opportunities Spectrum (ROS), which identifies broad categories of recreation activities and experiences in the State Recreation Management Areas (SRMA) in the Sierra District. Of note, the Sierra District has one SRMA in the Project Vicinity – the Merced River SRMA. The identified recreation opportunities can be administered by managing the setting, facilities, signing, level of management presence/law enforcement, and types of access to these areas. The BLM has customized the ROS terminology to match the scattered land pattern in the planning area's river corridors. The definitions and categories are directed toward summer, peak use, and water or trail-oriented activities. The recreation opportunities for SRMAs are organized into three major categories (USDI BLM 2008, pp. 27-28):

- High Use areas - opportunities for high levels of social interaction (high levels of use with people in close proximity);
- Transition areas - opportunities for moderate levels of social interaction (moderate levels of use with people in close to moderate proximity); and
- Remote areas - opportunities for low levels of social interaction, with a focus on appreciation for and a sense of solitude or remoteness.

The SRMP details the following specific management actions for recreation: Shooting will not be allowed in the direction, or within 150 yards, of any human-occupied dwelling, house, residence, barn, or other outbuilding used in connection therewith. Shooting will not be allowed in the direction, or within 150 yards, of trails or other recreational developments, transmission towers, telecommunications structures, and other facilities on BLM land. Shooters are responsible for understanding gun safety and finding BLM land that is appropriate and safe for shooting, including land where there is minimal ricochet potential and suitable backstops to prevent continued bullet/projectile travel. For the Merced River SRMA, which contains high use, transitional and remote use areas, the BLM established the following management actions (BLM 2008, pp.28-29):

- Manage in accordance with the Merced River Wild and Scenic Management Plan
- Manage for whitewater and other types of recreation
- Prohibit discharge of firearms in the half-mile wide Merced River corridor
- Limit motorized use to street legal vehicles on the Merced River campground access road
- Prohibit suction dredging on the designated wild segment, except on mining claims that predate the river's wild and scenic designation and have approved plans of operations
- Prohibit camping on the south side of the Merced River unless BLM gives written permission
- Build/support development of a non-motorized trail between Bagby and El Portal

Of note, BLM's Sierra resource area includes five designated open motorized recreation/Off-Highway Vehicle (OHV) routes in the Project Vicinity – Schilling Ranch Road, Bull Creek Road (Burma Grade), Merced River Campground Access Road, Telegraph Hill Road, and Hunter Valley Mountain Road. Of these five designated open OHV routes, the Hunter Valley Mountain

Road provides access to the Project at Lake McClure via entirely BLM lands on the south side of the reservoir between the Bagby arm and main section of the reservoir. This route is accessed from the Town of Hornitos or the Bagby area via County Road J-16 (Bear Valley Road). The other four OHV routes are east of the Project in the Briceburg area.

2.2 BLM Merced Wild and Scenic River Management Plan

In 1987 the Merced River was designated a wild and scenic river by the United States Congress. Five years later, after the passage of Public Law 102-432, 122 miles of the Merced River were placed into the Wild and Scenic Rivers System. Today, the USDOI National Park Service (NPS) manages 81 miles of the Merced River, including the main stem and the South Fork Merced River, which is located in Yosemite National Park.

The BLM, through a Memorandum of Understanding and Letter of Agreement, is the lead agency for managing whitewater boating. The BLM maintains and monitors the permit system on the Merced River and BLM informs the Forest Service on any issues that may affect the Recreational Value.

Outstanding whitewater boating, camping, and hiking account for the outstanding remarkable values (ORV's) for recreation. Hiking and biking are popular with local residents from El Portal, Mariposa County, and visitors from throughout the country in this river segment, who generally utilize the existing Yosemite Valley Railroad grade, which parallels the river. Occasionally equestrian riders have also utilized this section of trail as well. Whitewater boating opportunities run from spring through early July depending on the water levels and winter snow pack.

Overall Management Objectives

The Merced River is managed to preserve and protect the values which led to its designation as a Wild and Scenic River. The free flowing characteristics of the river are preserved, and the remarkable values are protected and enhanced. Recreational opportunities are provided as appropriate. The ORV values found in the Wild section are Recreational (*i.e.*, whitewater boating, hiking, mountain biking, and equestrian riding), Wildlife (*i.e.*, limestone salamander), Scenic (*i.e.*, VRM-1), Geologic, and Historic values.

Land use conflicts are examined and resolved in favor of the preservation and enhancement of natural resources. Unauthorized or destructive land uses are resolved through administrative and criminal remedies. Facility developments are limited and consistent with the undeveloped character of the river. Road maintenance, rustic campground development (*e.g.*, water, sanitation, picnic tables and fire rings) necessary for safe use and enjoyment of the river are provided. Recreational and other uses are managed to minimize use conflicts and to maintain a high degree of user satisfaction.

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Specific Area Objectives

- Preserve and enhance the quality of the viewshed and watershed.
- Preserve and enhance riparian habitat.
- Maintain and enhance water quality.
- Maintain and enhance wildlife and fisheries values with special emphasis and priority given to the Limestone Salamander and its habitat.
- Maintain a diversity of land based and water based recreation opportunities.
- Minimize long term human influence outside of existing and proposed development sites.
- Meet Mariposa County water management needs with minimal environmental impacts to the river.
- Eliminate and prohibit residential occupancy of the Wild and Scenic corridor on public lands.
- Acquire private land within the Wild and Scenic corridor by exchange, easement, sale or other voluntary means.
- Maintain an appropriate level of use in order to provide the desired recreational experience.

2.3 California Outdoor Recreation Plan (CORP)

The 2002 CORP**,** among other things, identifies and prioritizes outdoor recreation opportunities and constraints most critical in California. The plan lists the following as current statewide major recreation issues:

- Improving resource stewardship
- Serving a changing population
- Responding to limited funding
- Building strong leadership
- Improving recreation opportunities through planning and research
- Responding to the demand for trails
- Halting the loss of wetlands

Of note, Licensee will utilize the most recent and available CORP when implementing this study (if a new, final version of the CORP is available). At present, Licensee understands that the latest CORP update may be expected in 2010.

2.4 Mariposa County General Plan

The recreation needs for Mariposa County fall within two categories: local recreation; and regional tourism. The Local Recreation Element focuses on the needs associated with its local residents; whereas the Regional Tourism Element focuses on tourism issues related to the county's character, regional recreation opportunities, and related environmental issues.

The Local Recreation Element identifies the county's need to provide residents with recreation facilities and programs via the County Parks and Recreation Department. This department addresses the following issues: programs, facility development, and maintenance; intergovernmental cooperation; and park and recreation funding. Implementation of the Local Recreation Element revolves around the following five key goals:

- Define and achieve local recreation service levels throughout the County to enhance the quality of life;
- Create a parks and recreation strategic plan to respond to citizen needs;
- Create programs to provide a range of recreation opportunities and facilities to meet diverse needs of the County's population;
- Cooperate with regional agencies to develop a range of recreation opportunities for the County; and
- Continue funding to maintain Parks and Recreation programs.

The regional tourism is the core of Mariposa County's economy, which traditionally has relied greatly on visitors who travel to Yosemite National Park; however in recent years, the County is experiencing a rise in visitors to other areas of the County for recreation. The Regional Tourism Element addresses issues related to enhancement of visitor-oriented attractions such as: 1) the expansion and integration of county regional tourism opportunities, including agri-tourism; and 2) intergovernmental cooperation. To address these issues, the General Plan identifies five Regional Tourism goals that need to be implemented:

- Preserve, protect and enhance regional tourism opportunities and resources;
- Increase appreciation of environmental values and lengths of visitor stays through education programs;
- Increase public access to trails and off-road areas to provide greater opportunities for "in-County" visitor experience;
- Create visitor access to communities and points of interest; and
- Provide job growth and sustain County revenues by enhancing and expanding the visitor-serving sectors of the economy.

2.5 Merced County General Plan

The policies in the pending General Plan Update are still being drafted and are not in effect. However, within the existing plan, there existing concepts under the current plan relevant to recreation, including: Preserving the visual assets of the County; that the enjoyment of the areas with aesthetic amenities depend largely upon the continued maintenance and further improvement of access to them, including highways with scenic view corridors which provide for an enjoyable travel experience, link urban areas with open space areas, and provide access to recreational areas; maintaining scenic qualities through retaining the character of natural slopes and formations and through preservation and enhancement of water courses, wildlife habitats and vegetation; recognizing the major scenic vistas including the views of both the Coastal and Sierra

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mountain ranges and the Merced, San Joaquin and Bear Creek River corridors; preservation of rivers, lakes and reservoirs are features that add to the quality of a scenic corridor as well as the quality of life in the County; there is a need for recreational open space in the countryside outside the urban areas such as regional parks; recreation areas are also needed within urban areas such as community and neighborhood parks.

2.6 USFWS Fisheries Recreational Policy

The USFWS' recreational fisheries management program outlines the following goals: effect the preservation and/or increased productivity of fishery resources; ensure and enhance the quality, quantity and diversity of recreational fishing opportunities; develop and enhance partnerships between governments and the private sector for conserving and managing recreational fisheries; and 4) cooperate to maintain a healthy recreational fisheries industry.

2.7 Central Valley Regional Water Quality Control Board's Water Quality Control Plan

Additionally, the Central Valley Regional Water Quality Control Board's Water Quality Control Plan for the Sacramento and San Joaquin River Basins (Basin Plan) has designated Contact Recreation, including canoeing and rafting, for the Merced River from McSwain Reservoir to the confluence with the San Joaquin River. As noted in the Basin Plan, beneficial use designations for canoeing and rafting imply that certain flows are required for this beneficial use.

3.0 Potential License Conditions

Study results may be used in the development of Project facilities and/or activities Licensee will undertake as a condition of the new license for the purpose of protecting or mitigating impacts to whitewater boating recreation that would result from continued Project O&M, or for the purpose of enhancing recreation resources that would be affected by continued Project O&M. In addition, study results will provide information on non-motorized, recreational river boating opportunities on acceptable flow levels, compatibility or conflicts between other river recreation opportunity flow levels, and the regional recreational significance of the flow-related recreation opportunities on the two Study Reaches – the Merced River from Merced Falls Dam to the normal maximum water surface elevation of the Crocker-Huffman Diversion Dam and from Crocker-Huffman Diversion Dam to the Snelling Road Bridge. PM&E measures could include:

- instream flow releases
- facility modifications
- dissemination of flow information
- public safety measures
- public access needs
- permitting, monitoring, administration, and maintenance

Development of PM&E measures is not a part of this study.

4.0 Study Goals and Objectives

The primary goals of the study are to determine if Project operations can: 1) provide acceptable non-motorized, recreational river boating (or river boating) opportunities in the Study Reach; and 2) be consistent with the needs of the area, the primary purposes or ability of the Project, and other resource management plans.

Licensee will evaluate the primary goals through the following objectives of the study.

1. Determine the acceptable flow range for river boating on the two Study Reaches (see Section 6.1 - Study Area).
2. Use recreation user focus groups and existing information, where possible, to collect river boating information.
3. Utilize natural flows, where possible, or flow releases for an instream flow study, if needed, to determine acceptable river boating flow conditions
4. Determine the number of flow days by month in the acceptable flow range for river boating opportunities (*e.g.* rafting, kayaking and canoeing) under current Project operations and under unimpaired flows.
5. Determine operational constraints of providing acceptable flows for the river boating opportunities on the two Study Reaches.
6. Determine likely put-in and take-out locations for river boating between Merced Falls Reservoir and Crocker-Huffman Diversion Dam and between Crocker-Huffman Diversion Sam and Snelling Road Bridge, including access and other related facility considerations.
7. Evaluate the adequacy of public flow information (*i.e.* availability, reliability and real-time access).

5.0 Existing Information and Need for Additional Information

Some information, not including flow levels, is currently available on both of the Study Reaches at American Whitewater's (AW) website, as well as some other boating websites and forums. A comprehensive search for readily available existing information on the Study Reach will be part of the Licensee's study methods below. Additional information collected within this study will be used to close the gaps in the existing information on river boating opportunities and what the acceptable range of flow levels is for this reach.

6.0 Study Methods and Analysis

6.1 Study Area

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For the purpose of the study, the geographic study area includes the 2.9-mile river reach from Merced Falls Dam (River Mile 54.9) to the normal maximum water surface elevation of the Crocker-Huffman Diversion Dam (River Mile 52.0), and the approximately 7-mile reach between Crocker-Huffman Diversion Dam and Snelling Road Bridge. Licensee notes that direct control of the instream flows in the first Study Reach is controlled by Pacific Gas and Electric's (PG&E) Merced Falls Project (FERC Project No. 2467), which is situated immediately downstream of Licensee's Project. Thus, implementation of Phase 2 of the study plan (*i.e.*, controlled flow releases), as well as providing boaters access to the Merced Falls Dam area, is dependent upon PG&E's willingness to participate in the study plan implementation. Licensee will not be able to implement Phase 2 of this study plan, and ultimately not complete the study plan, without cooperation/coordination from PG&E and its Merced Falls Project.

6.2 Study Methods

A progressive river boating study will be conducted to determine the optimum, acceptable, and minimum instream flows needed for non-motorized river boating as well as other river-related recreational activities on the Study Reaches (Whittaker, Shelby, and Gangemi, 2005; and Whittaker *et al.*, 1993). The methodology incorporates a progressive approach, whereby each stage of the study informs whether or not additional information or a more intensive approach is needed specific to key objectives in data collection. This is based on the ability of each step to characterize the information and Study Reaches.

6.2.1 Phase 1 Assessment

Step 1 - Summarize Existing River Recreation Information on the Study Reaches. Licensee will gather all readily available existing information on river boating (*i.e.*, canoe, kayak and raft) and other recreational activities (*e.g.* public access locations, and constraints to public access) on the Study Reaches. This will include a review of guidebooks, videos, discussions with boaters that have run this particular reach, and field reconnaissance. The objective of this information gathering work will be to identify, document and describe the river boating and other recreational opportunities within this reach.

Step 2 - Summarize the Existing Hydrology and Operational Constraints of the Study Reaches. Licensee will summarize regulated and unimpaired hydrology for the reaches between Merced Falls Dam and the Crocker-Huffman Diversion Dam and between Crocker-Huffman Diversion Dam and Snelling Road Bridge. Hydrologic summaries will be provided by Water Year Type (*e.g.*, normal, wet and dry).

Step 3 - Focus Groups with River Boating Groups and Residents Along the Study Reaches. Licensee will gather additional information about river boating and other recreational activities within the Study Reaches by interviewing local boating experts, residents, and other persons identified that have local boating and recreational knowledge, through focus groups.

Whitewater boaters and residents will be selected for the focus groups through consultation with Relicensing Participants.

Subjects for river boating questions will likely include: 1) location of runs; 2) quality of runs; 3) details of access; 4) estimated class of difficulty; 5) estimated flow at the time the reach was boated; 6) estimated range of acceptable flows; 7) type of craft used; 8) range of crafts that could be used on the run; 9) number and dates of trips; 10) party size; 11) any safety concerns; 12) how flow information is obtained for the Study Reaches; 13) suggestions for improvement (*i.e.*, access, flow and flow information); 14) opportunity for general comments; and 15) listing of other reaches boated by the individual. In addition, focus group members will be asked to identify notable areas where other river recreation activities take place on the Study Reaches.

Focus Group Process

Focus groups and interviews will be semi-structured, with specific topic areas and questions developed for river boaters and residents. Initial questions will focus on how people use the river. The goal is to describe the character of recreation opportunities and identify flow-dependent attributes. A second series of questions will focus on the effects of flows on those attributes and whether interviewees can identify specific flows that affect the quality of opportunities. A final series of questions will focus on prioritizing opportunities and identifying recreation users' need for flow information. Interviews with agency staff will include questions about river access and use information, as well as relevant hydrology information. The Licensee will develop the focus group questionnaires with the Relicensing Participants.

Focus groups will ideally range in size from four to seven study participants, and one or two facilitators. Licensee anticipates that both river boaters and residents with property along the Study Reaches shoreline will be invited to all focus groups. The researcher/discussion-leader will pose open-ended questions to guide discussion, but will draw out participants with follow-up questions as needed. The focus groups would ideally be scheduled after researchers have conducted fieldwork to increase opportunities for shared understanding about the places and issues under discussion.

As with any research methodology, focus groups have strengths and weaknesses. They are most useful for describing consensus opinion of homogenous groups, and they allow participants to "brainstorm" collectively to improve the number or accuracy of ideas. However, generalizing from small groups is more challenging, particularly if there is diversity within a group. The extent of agreement within groups is one input into decisions about whether additional flow evaluation studies would prove useful.

An initial list of participants for interviews and focus groups will be developed with Relicensing Participants and will be supplemented by asking interviewees to provide contact information of additional persons that may have boating experience on the proposed Study Reaches. Researchers will make a good faith effort to reach identified individuals to conduct interviews.

The results of each of the two or more focus groups will be summarized in a final report.

Step 4 - Comparison of Regulated and Unimpaired Opportunity for Whitewater Boating. In Step 3, Licensee will estimate for the Study Reaches the annual number of usable days that occur based on regulated and unimpaired flows. For the purpose of this study, a usable day is defined as a day when a recreationist would have reasonable access to the river and the mean daily flow

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in the Study Reaches is within the acceptable flow range as determined through focus groups and existing information, and using the hydrology data.

Should the Study Reaches lack adequate information to determine an acceptable flow range , and it was determined that controlled flow releases are needed to identify this range, then this comparison of boatable days under regulated and unimpaired conditions would not occur until after the controlled flow releases had been completed in the Phase 2 Assessment.

Step 5 - Determine the Existing or Potential Boating Opportunities on the Study Reaches. The results of the study report will document: 1) put-in and take-out access; 2) demand for whitewater boating; 3) constraints; 4) conflicts or complementary opportunities with other recreational opportunities; 5) whitewater classification; 6) the types of craft suitable for boating the Study Reaches; and 7) the acceptable flows for the class of boating and type of boating that would likely occur. At this point, Licensee will consult with the Relicensing Participants to collaboratively determine if the information gathered in Steps 1 through 4 (Phase 1) are not adequate to determine this within reason. If it is collaboratively determined that additional information is needed, Licensee will perform controlled flow releases (Phase 2 Assessment below) on the Study Reaches.

6.2.2 Phase 2 Assessment – Controlled Flow Releases

The Phase 2 assessment would occur only for refining the river boating acceptable flow ranges, if it were collaboratively determined by Licensee and Relicensing Participants that the flow information gathered in Phase 1 was not adequate to make this determination. Thus, controlled flow releases would be made to better identify the acceptable flow ranges for the Study Reaches.

If Licensee and Relicensing Participants collaboratively agree that this step is necessary, then Licensee will release at least two but no more than three controlled flow releases on the Study Reaches. The exact number of controlled flow releases will depend on the results of the first and second releases.

For each controlled flow release, Licensee will utilize a team of boaters with commensurate skill levels to paddle the Study Reaches, with the likelihood of two times in succession while the independent variable, flow, is changed. The objective is to record how changes in flow alter the quality of the experience for individual participants and the group. The group of participants paddles each pre-selected flow then individually completes a single flow survey questionnaire querying them on a number of whitewater characteristics specific to that flow. Upon completion of the test flows participants complete the comparative survey form enabling them to evaluate one flow over another for specific characteristics. Focus group discussions structured with specific questions are conducted at the conclusion of each test flow and upon completion of the comparative evaluations. Each boater will sign a waiver of liability prior to participating in the study.

The primary data for this study will consist of the boaters' responses to questionnaires completed at the conclusion of each controlled flow release (or boating run). The questionnaire will include a section to gather data for a comparative flow evaluation for each run. Data to be collected will

likely include: 1) boatability; 2) quality of the reach; 3) suitability of the run for different crafts and boater skill levels; 3) quality of the put-in/take-out locations; 4) boater's opinion of the class of difficulty of the run; 5) comparison of each run at its different flows; 6) quality and length of the shuttle; 7) any safety concerns or hazards; 8) scenic quality; 9) number and difficulty of portages; 10) availability of play areas; and 11) boater's opinion of the flows that would represent the general paddling public preference, which is achieved through focus groups and boater surveys. In consultation with Relicensing Participants, Licensee will identify the team of boaters to run the proposed flows at a specified time.

6.2.3 Data Analysis and Study Report Preparation

The study objectives and issues will be addressed through analysis of the responses to interviews, focus groups, and professional evaluations. Licensee will synthesize the data collected and analyzed into a study report, and will include summary data in tables, attachments and/or appendices.

6.3 Consultation and Communication

This study includes the following study-specific consultation:

- Licensee will consult with Relicensing Participants to identify focus group participants for Phase 1, Step 1 of the study.
- Licensee will meet with Relicensing Participants at the end of Phase 1 to collaboratively determine whether or not there is an information gap that necessitates the implementation of Phase 2.
- Licensee will consult with Relicensing Participants to identify river boating participants (or boating team) for the controlled flow releases as part of Phase 2 of the study plan (this consultation will only occur if Phase 2 of this study plan is deemed necessary).

6.4 Schedule

Licensee anticipates the schedule to complete the study proposal is as follows assuming FERC's Study Plan Determination is deemed final on October 20, 2009:

PHASE 1

Summarize Existing Information (Step 1) ..... October 2009 – December 2009
Summarize Hydrology and Constraints (Step 2) ..... October 2009 – December 2009
Focus Groups (Steps 3) ..... March 2010 – April 2010
Comparison of Regulated and Unimpaired Hydrology (Step 4) ..... January 2010 – March 2010

PHASE 2

Controlled Flow Study ..... May 2010 – September 2010
Data Analysis ..... July 2010 – September 2010

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Report Preparation ..... September 2010 – January 2011

6.5 Consistency of Methodology with Generally Accepted Scientific Practices

The proposed methods for this study are consistent with professional practices. The overall phased approach is commonly used in relicensing proceedings (Shelby Whittaker & Gangemi, in progress), and is consistent with FERC study requirements under the newly developed Integrated Licensing Process (FERC 2003). This phased approach has been applied successfully in previous FERC hydropower efforts (*e.g.*, Klamath in OR, Cooper Lake in AK, and Hat Creek, CA). The approach improves studies by focusing resources on river reaches with greater interest to the recreation community or larger impacts from project operations. It includes a decision-point where Licensee and Relicensing Participants explicitly determine whether existing information is sufficient, and if not, what additional information is needed.

Focus groups will be conducted by researchers with social science training and will follow standard qualitative research protocols (Patton 1990). In addition, researchers have experience with focus group efforts from previous studies (*e.g.*, South Feather River, DeSabla-Centerville, and Beardsley/Donnells) using questions tested and refined from those efforts. Field work will be conducted following recommendations provided in Whittaker *et al.* (1993), and studies completed on West Rosebud Creek by PPL Montana. Documentation may include still photos and notes.

7.0 Products

The products resulting from each Phase and associated steps for the study will be in the form of a study report.

8.0 Level of Effort and Cost

Licensee estimates the cost to complete this study in 2009 dollars is between $45,000 and $76,000.

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