CALAVERAS DAM REPLACEMENT PROJECT ADAPTIVE MANAGEMENT IMPLEMENTATION PLAN FOR CENTRAL CALIFORNIA COAST STEELHEAD

1 INTRODUCTION

This chapter provides a discussion on the project background, the purpose of the adaptive management implementation plan (AMIP), the approach for the AMIP process, and key uncertainties to be resolved.

1.1 PROJECT BACKGROUND

The San Francisco Public Utilities Commission (SFPUC) is undertaking the Calaveras Dam Replacement Project (CDRP or proposed action) to comply with California Department of Water Resources, Division of Safety of Dams (DSOD) requirements related to seismic stability, and to restore reservoir storage operations to provide water supply to its customers. Calaveras Reservoir has been held below its historic storage since 2001 under restrictions specified by the DSOD because of the vulnerability of the dam to failure in a large potential earthquake. The CDRP would replace the existing Calaveras Dam on Calaveras Creek and restore maximum pool elevations to those existing prior to 2001, when DSOD restrictions were implemented. The proposed action includes restoring Calaveras Reservoir to historic pool elevations (normal elevation of 756 feet), resuming routine flow diversions at the Alameda Creek Diversion Dam (ACDD), and implementing minimum flow releases and/or bypasses for environmental purposes. Additional measures, including a fish screen and ladder at the Alameda Creek Diversion Dam, fish screens on the lower two adits at Calaveras Dam, water quality best management practices, and enhancements to provide suitable habitat conditions for fish communities in the portions of the southern Alameda Creek Watershed potentially affected by the proposed project, are also proposed by the SFPUC.

The SFPUC is requesting authorization from the U.S. Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act for the discharge of dredged or fill materials into waters of the United States that could result from implementation of the CDRP. In April 2008, the SFPUC requested that the USACE consider initiating formal consultation with the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS) for Central California Coastal steelhead (*Oncorhynchus mykiss*) distinct population segment (DPS) to ensure that the project would not preclude the future recovery of steelhead to the Alameda Creek Watershed. A biological assessment (BA) was prepared in accordance with Section 7 of the Endangered Species Act (ESA), (16 USC 1536[c]) as amended, to evaluate whether the proposed project could affect federally listed threatened or endangered anadromous fish species and their designated critical habitat under the jurisdiction of the NMFS (SFPUC 2009). The BA also evaluates the effects of the proposed action on Essential Fish Habitat (EFH) for Pacific salmon, consistent with the

requirements of the Magnuson-Stevens Fishery Conservation and Management Act, as amended (16 U.S.C. 1801 et seq.).

The species addressed in the BA and EFH assessment are:

< Central California Coast (CCC) steelhead DPS (federally listed as threatened); and

< Central Valley fall- and late fall-run Chinook salmon evolutionary significant unit (ESU) (*O. tshawytscha*) (federal and state species of concern, Pacific salmon covered under EFH).

Central California Coast coho salmon (*Oncorhynchus kisutch*) ESU (federally and state listed as endangered) do not occur in the action area and therefore are not addressed in the BA. Chinook salmon are occasionally observed below the Bay Area Rapid Transit (BART) weir but are not able to pass it. Designated EFH for Pacific salmon occurs in Alameda Creek only downstream of the BART weir, a complete and long-standing barrier to upstream fish migration in lower Alameda Creek. Critical habitat for CCC steelhead does not occur in the action area.

Evaluation of potential effects on a future CCC steelhead DPS population unit which could result from the proposed action are made by considering the potential project-related effects on a functioning condition of habitat primary constituent elements (PCEs) for steelhead in the action area (i.e., freshwater PCEs) (70 FR 52488; September 2, 2005).

The PCE approach allows for evaluation of a future steelhead population unit given that one does not currently exist. Furthermore, while the Alameda Creek Watershed is not currently designated as critical habitat for CCC steelhead DPS, this approach to the analysis in the BA allows for an evaluation of project effects on critical habitat in the primary and extended study areas, assuming that these areas are likely to be designated as critical habitat once downstream passage barriers have been remedied.

The BA determines that direct effects to CCC steelhead are currently unlikely because the species can only access habitat below the BART weir in Alameda Creek, approximately 16.5 miles downstream of the project construction site, and because of avoidance and minimization measures included in the proposed action. However, steelhead access to upper Alameda Creek will be restored in the future; therefore, potential effects of the proposed action to CCC steelhead are discussed in this BA associated with a future condition when steelhead are present in the upper watershed. Accordingly, the BA addresses the following scenarios:

1. The potential effects of the proposed action to CCC steelhead under the current baseline condition (i.e., fish passage barriers exist downstream and no steelhead presence in the watershed); and

2. The potential effects of the proposed action to CCC steelhead with potential future projects that would require federal approval (i.e., fish passage is restored and steelhead have potential to occur in the watershed).

Table 1.1 summarizes the potential effects of the proposed action to CCC steelhead for both scenarios identified in the BA.

Table 1.1: Summary of Potential Effects of the Proposed Action

Effects / Locations	Species Status	Effect Conclusion	Mechanism
Effects of the Proposed Action under the Baseline Condition			
Construction-Related Effects (Primary Study Area)	CCC steelhead are not present in Primary Study Area	No Effect	Not present
Construction-Related Effects (Extended Study Area)	CCC steelhead are present downstream of BART weir	Not Likely to Adversely Affect	Avoidance and minimization measures, distance downstream from construction activities
Operations-Related Effects (Primary Study Area)	CCC steelhead are not present in Primary Study Area	No Effect	Not present
Operations-Related Effects (Extended Study Area)	CCC steelhead are present downstream of BART weir	Not Likely to Adversely Affect	Proposed action will have indiscernible effect on highly modified and degraded habitat conditions below BART weir
Effects of the Proposed Action with Potential Future Projects that would require Federal Approval			
Construction-Related Effects (Primary Study Area)	CCC steelhead are present in Primary Study Area	Could result in Adverse Effect Incidental take permit would be required	Bypass of flows at ACDD may contribute flow to extended study area during winter months; flow releases with suitable cold water may not be feasible during two summer rearing periods when CDRP construction is being implemented
Construction-Related Effects (Extended Study Area)	CCC steelhead are present throughout Extended Study Area	Not Likely to Adversely Affect	Bypass of flows at ACDD may contribute flow to extended study area during winter months; summer rearing habitat functions would remain limited
Operations-Related Effects (Primary Study Area)	CCC steelhead are present in Primary Study Area	Potential to Adversely Affect	Habitat conditions would generally be improved compared to the baseline with implementation of project flow releases and avoidance and minimization measures. Further, the project is expected to provide functioning habitat primary constituent elements (PCEs) for steelhead in the action area (i.e., freshwater PCEs) (70 FR 52488; September 2, 2005), which include migration (immigration and emigration), spawning (including egg incubation), and rearing. The provision of functioning habitat PCEs would, in turn, be expected to contribute to recovery of steelhead in the Alameda Creek Watershed. However, due to uncertainties associated with the current absence of a steelhead population in the watershed and the future habitat conditions with potential future projects, it is possible that the proposed conservation measures would not be fully sufficient to avoid potential adverse affects to ESA-listed steelhead, when they gain access to the watershed. Because of these uncertainties, the SFPUC is requesting incidental take coverage for potential operations-related effects to steelhead.
Operations-Related Effects (Extended Study Area)	CCC steelhead are present in Extended Study Area	Not Likely to Adversely Affect	Project-related changes to flow conditions in extended study area would be relatively small; changes to habitat functions would be indiscernible

1.2 PURPOSE OF THE ADAPTIVE MANAGEMENT IMPLEMENTATION PLAN

This AMIP commits the SFPUC to a management strategy that will support steelhead in the southern Alameda Creek Watershed. Actions taken under this management strategy will include minimum water releases from Calaveras Dam, restricted diversions and minimum bypasses at the Alameda Creek Diversion Dam (ACDD) to support aquatic ecosystems and native species, installation of fish protection screens and low flow release valves at Calaveras Dam, installation of fish protection screens and a flow bypass facility at the ACDD, and the construction of a fish ladder around the ACDD. The purpose of the management strategy is to achieve specific AMIP goals that act to support broader species level goals within the entire watershed. These AMIP and broader goals are described below.

The SFPUC and NMFS (and USFWS and CDFG) are also working together to develop, approve, and implement the SFPUC Alameda Watershed Habitat Conservation Plan (HCP). While the actions described in the CDRP BA and this AMIP are not dependent on the HCP being implemented, both the SFPUC and NMFS recognize the value of the long-term framework provided by the HCP, and intend to incorporate and update as appropriate the measures described in the CDRP BA and AMIP into the HCP, which is currently scheduled to be adopted in 2012.

AMIP GOALS

Short Term:

- Improve habitat conditions in the southern Alameda Creek Watershed for steelhead. Habitat conditions will be improved by providing flows downstream of the Alameda Creek Diversion Dam and Calaveras Dam for: (1) the upstream and downstream migration of adults; (2) spawning during the winter; (3) outmigration for smolts; (4) rearing and foraging habitat; and (5) natural channel maintenance and riparian health associated with winter precipitation events.
- Improvements will also include passage upstream to additional spawning and rearing habitat above the Alameda Creek Diversion Dam.
- Implement a research and monitoring program that informs long-term management of steelhead and steelhead habitat in the southern Alameda Creek Watershed as well as in the entire Alameda Creek Watershed.[1]

Long Term:

- Establish sufficient habitat conditions so that the southern Alameda Creek Watershed supports a significant and productive component of a self-sustaining steelhead population in the entire Alameda Creek Watershed.

1 References to the "entire Alameda Creek watershed" assume that others also have a responsibility to improve conditions and conduct monitoring, in addition to the SFPUC.

The SFPUC recognizes that achieving these project goals is an important element to achieving steelhead restoration and recovery goals on larger scales, which are described as follows:

ALAMEDA CREEK STEELHEAD RESTORATION GOALS

< Establish a viable self-sustaining steelhead run in Alameda Creek and its tributaries with a high probability of long term (more than 100 years) persistence.

< Protect unique genetic or adaptive characteristics of the adfluvial Alameda Creek steelhead population.

SFPUC WATER ENTERPRISE GOALS

< Provide San Francisco and SFPUC Bay Area customers with reliable, high quality, and affordable water, consistent with the Levels of Service goals described in the Water System Improvement Program.

< Protect and restore viable populations of all native species (including warm-water fishes, amphibians, and riparian plants) and protect the integrity of the native ecosystems that support these species for current and future generations, consistent with the SFPUC Water Enterprise Environmental Stewardship Policy.

1.3 SUMMARY OF THE ADAPTIVE MANAGEMENT APPROACH

Adaptive management is an approach and process that incorporates monitoring, research and evaluation to allow projects and activities, including projects designed to produce environmental benefits to go forward in the face of some uncertainty regarding consequences. It is an iterative process of evaluating and refining management based on the results of management activities and the status of the managed resource. Consequently, the integral components of adaptive management are designed to narrow and/or resolve uncertainties, increase scientific understanding, and evaluate unproven restoration techniques, all of which will inform ongoing and future actions. The approach to the AMIP includes the following key components:

< A conceptual model that identifies relevant hydrology, habitat and biological performance measures.

< A research and monitoring program to evaluate performance and narrow and/or resolve uncertainties.

< A transparent process for reporting and incorporating new scientific knowledge into management activities, which, if necessary, result in the implementation of appropriate changes in operations to benefit steelhead, other native aquatic species, and their habitat within the southern Alameda Creek Watershed.

The adaptive management provisions incorporated into this AMIP are an outgrowth of ongoing work that has been conducted in coordination with NMFS and CDFG, and other interests in the watershed. In addition to the BA

prepared for the proposed action, numerous other studies have been completed by SFPUC to address comments received by NMFS and CDFG. The information contained in these studies help formulate future measures that will be taken to minimize effects of the proposed action to fish and their habitat. These studies provide support and direction for this AMIP and include, but are not limited to, the following:

< *Alameda Creek Streamflow Study* (ENTRIX, Inc. 2006).

< *Geologic Evaluation of Potential Barriers to Upstream Fish Migration in the Upper Alameda Creek Sub-Watershed* (URS 2009).

< *Feasibility of Fish Passage at Calaveras Dam* (URS HDR 2009a).

< *Feasibility of Fish Passage at Alameda Creek Diversion Dam* (URS HDR 2009b).

< *Assessment of Fish Upstream Migration at Natural Barriers in the Upper Alameda Creek Sub-Watershed* (URS HDR 2010a).

< *Assessment of Fish Migration at Riffles in Sunol Valley Quarry Reach of Alameda Creek* (URS HDR 2010b).

< *Outlet Works Technical Memorandum, Calaveras Dam Replacement Project, Project NO. CUW 37401* (SFPUC 2009).

1.4 KEY UNCERTAINTIES TO BE RESOLVED

Because a steelhead population does not currently exist in the watershed, the time required to understand and address different uncertainties will vary. The general categories of uncertainties can be divided into short-term and long-term and are described below.

SHORT-TERM (1 TO 10 YEARS, 2 TO 3 GENERATIONS)

(1) The appropriateness of the proposed flow schedules in relation to the ability of adult and juvenile steelhead to migrate through the primary study area with future improvements proposed in the Sunol Valley (e.g., installation of slurry cutoff walls isolating quarry pits, riparian habitat restoration, recommendations from the Sunol Valley Restoration Plan) and Little Yosemite areas (e.g., development and implementation of performance criteria and physical modifications).

(2) The response of steelhead, in terms of migratory timing, spawning success and rearing tactics, to the proposed flow schedules.

(3) The current and appropriate future relationship between the *O. mykiss* populations above and below migration barriers like Calaveras Dam and the risks and benefits of moving *O. mykiss* within the watershed above and/or below currently impassable barriers.

(4) The response of other native species (vertebrates, invertebrates, and riparian vegetation) to the proposed flow schedules.

LONG-TERM (10 TO 20 YEARS, MANY GENERATIONS)

(5) The extent and quality of habitat in the southern Alameda Creek Watershed that would be required in order to contribute to a sustainable steelhead population within the entire Alameda Creek Watershed that would ultimately contribute to the survival and recovery of the CCC steelhead DPS.

(6) The long term response of channel morphology and hydrology in the southern Alameda Creek Watershed, particularly the reaches below ACDD and Calaveras Dam, to the proposed flow schedules and feedbacks on steelhead habitat quantity and quality.

(7) The long term response of the aquatic biological community to the proposed flow schedules and other AMIP management actions.

1.5 BIOLOGICAL GOALS

As described above, the overarching biological goal for the proposed management strategy is to provide suitable habitat conditions within the southern Alameda Creek Watershed to support a self-sustaining population of steelhead in the entire watershed. Similar to the approach to evaluation used in the BA, AMIP biological goals for a future CCC steelhead DPS population unit are largely based on a functioning condition of habitat PCEs for steelhead in the action area (i.e., freshwater PCEs) (70 FR 52488; September 2, 2005). As a result, biological goals for the AMIP are generally as follows:

< Freshwater Adult Upstream Migration Corridors and Spawning Habitat

- Sufficient base flow for holding adults.
- Sufficient base flow for spawning.
- Adequate stream flows during and following storms for adult attraction and upstream passage.
- Periodic high flow events that maintain channel form, geometry, and other geomorphic functions.

< Freshwater Smolt Outmigration Corridors

- Sufficient base flow for downstream movement of juveniles.
- Adequate stream flows during and following storms (for smolt outmigration).

< Freshwater Juvenile Rearing Habitat

- Sufficient flow for rearing and foraging.
- Sufficient flow for maintaining riffles and associated benthic invertebrate productivity.
- Suitable water temperatures (typically 18 degrees Celsius or less in central California).
- Adequate flows for upstream and downstream movement of rearing juveniles.

2 ADDITIONAL CONSERVATION MEASURES AND MONITORING PROGRAM

This chapter describes additional conservation measures, performance criteria, and monitoring activities that will be implemented as part of the AMIP. Contingency actions are proposed if the proposed conservation measures do not meet the specified performance criteria.

2.1 ADDITIONAL CONSERVATION MEASURES

The AMIP includes a list of additional conservation measures that will be implemented in addition to the conservation measures described in the Biological Assessment. These additional conservation measures are directly related to the goals and uncertainties described above. Implementation of these additional conservation measures will further address the migration, spawning, and rearing conditions necessary to support steelhead in the southern Alameda Creek Watershed to meet the goals of the AMIP. Two categories of additional conservation measures are proposed: (1) actions to protect and enhance migrating steelhead and resident rainbow trout (modification of existing facilities); and (2) data collection, studies, and analyses to inform future decisions (supplemental studies).

2.1.1 ACTIONS TO PROTECT AND ENHANCE STEELHEAD AND RESIDENT TROUT POPULATIONS

The SFPUC commits to implementing the following supplemental actions to protect steelhead and resident trout:

Installing screens at the Alameda Creek Diversion Dam Tunnel by 2015. Although the SFPUC believes that many of the fish diverted to Calaveras Reservoir via the Diversion Tunnel survive (particularly with a restored maximum pool elevation), the SFPUC also recognizes the potential contribution these *O. mykiss* may provide to the

genetic diversity of the southern watershed and entire watershed populations. The screens at the Diversion Tunnel will meet NMFS and CDFG criteria, and will be designed in consultation with both agencies2. The screens will be designed and constructed as part of the proposed project based on the description in the "Feasibility of Fish Passage at Alameda Creek Diversion Dam" report.

Constructing a fish ladder at the Alameda Creek Diversion Dam to provide passage to additional upstream spawning and rearing habitat above the Alameda Creek Diversion Dam by 2015. The SFPUC commits to installing a fishway (ladder) around ACDD by 2015. SFPUC will complete ladder design in coordination with NMFS and CDFG3.

Installing screens on the two lower most adits on the Calaveras Reservoir Intake Tower by 2015 to protect the existing resident population of *O. mykiss* from entrainment. These proposed screens will meet NMFS and CDFG criteria for adult trout4 and will be designed in consultation with both agencies. Note that the upper most adit is already screened and meets NMFS and CDFG criteria.

Modification of natural barriers in the Alameda Creek Watershed. Additional information is necessary to assess the need and required actions for improving adult steelhead passage conditions through the Little Yosemite reach of upper Alameda Creek below the Alameda Creek Diversion Dam (ACDD). The proposed ACDD minimum bypass flow rate (30 cfs) was selected with the intention of improving *O. mykiss* spawning conditions below ACDD, and is not anticipated to provide for passage of upstream moving adult steelhead at Little Yosemite under existing conditions. The high flow events that typically overtop ACDD during wet periods (within or outside of the 12/1-3/31 diversion period), however, are expected to provide the best opportunity for upstream adult passage through the Little Yosemite reach. The SFPUC has provided a Natural Barrier Fish Passage Report (2010) that includes an assessment of existing passage conditions and potential modifications that would improve existing conditions if and when made. Building from this foundation, the SFPUC will:

1) Develop adult steelhead performance criteria which can be used to assess current and future passage conditions within Little Yosemite and prepare conceptual physical modification design plans for locations identified as not meeting those criteria under the proposed operation of ACDD. The performance criteria will be submitted to NMFS and CDFG for review and approval no later than January 31, 2011.

2) Prepare draft design plans to physically modify Features 9 and 10 (similar to the description in the Natural Barrier Fish Passage Report) and/or other identified passage impediments. Plans will modify Little Yosemite

2 As requested by NMFS and CDFG, SFPUC will submit the 60 percent design of the fish screen to NMFS and CDFG for review and approval.
3 The SFPUC will submit 60 percent design details of the fishway to NMFS and CDFG for review and approval.
4 As confirmed by NMFS via e-mail on June 3, 2010, the screens would not need to comply with the criteria for steelhead fry because fry are not expected to be present in the reservoir.

to the extent that adult steelhead passage is facilitated at flows as low as 30 cfs (if possible) at natural channel features by modifying portions of the identified impediments. The extent of modification is limited in scope to multiple rock weirs set at different elevations, increasing staging/takeoff/launching pool depth, and/or decreasing vertical height and horizontal range (as described in the Natural Barrier Fish Passage Report, section 5.1, p. 5-4). Draft plans will be submitted by the SFPUC to NMFS and CDFG for review and approval no later than January 31, 2012.

3) Prepare final design plans incorporating comments received from NMFS and CDFG , by December 31, 2012. Implementation and construction of the modifications will be completed by October 31, 2014.

4) Identify the lead agency and funding for implementation and construction of the physical modifications.

5) Monitor all physically modified features within Little Yosemite, following the completion of the modifications, to verify adult steelhead passage success based on the approved performance criteria.

Additional information is also necessary to assess the need and required actions for improving adult steelhead passage conditions through the Sunol Valley. The "Assessment of Fish Migration at Riffles in Sunol Valley Quarry Reach of Alameda Creek" (February 2010) describes the current conditions in this reach, and estimates the minimum flows to support steelhead migration at key locations within this reach (see Table 4-1 and Figure 4-1). Upon further review and assessment, any location estimated to limit adult passage at flows substantially greater than 40 cfs will be physically modified to provide passage at approximately 20 cfs. These modifications may be incorporated into projects implementing the Sunol Valley Restoration Plan, including the Upper Alameda Creek Filter Gallery Project.

SFPUC will monitor fish migration at instream features as detailed in Section 2.1.2.

2.1.2 Data Collection, Studies, and Analyses to Inform Future Decisions

In addition to the additional conservation measures (modification of existing facilities) described above, the SFPUC commits to the following supplemental studies. These efforts will evaluate the efficacy of all the conservation measures included in the BA and the AMIP, and provide information necessary to inform and evaluate the need for additional actions to support the goals of the AMIP.

Southern Alameda Creek Sub-Watershed Conceptual Model and Analysis: The SFPUC commits to evaluate conditions in the southern watershed with the goal of identifying limiting factors for steelhead within this sub-watershed. As results become available from the viability analysis for the entire Alameda Creek Watershed, the southern watershed analysis would be modified and updated as appropriate. The specific issues to be examined include: extent and quality of spawning and rearing habitat; connectivity (upstream/adult migration, downstream/smolt migration, low flow and high flow passage constraints, etc); and genetic population structure. Until specific targets for performance criteria are developed, the existing framework for evaluating relative cost/benefit to management actions that address these issues will be applied.

< Complete sub-watershed conceptual model by 2012.

< Complete sub-watershed viability analysis by 2016.

Alameda Creek Watershed Conceptual Model and Analysis: The SFPUC commits to participating in and supporting the development of a conceptual model and viability analysis for steelhead in the entire Alameda Creek Watershed (and/or larger geographic scale, if appropriate). This will be done in partnership with NMFS (and others, as appropriate) and will require further study and data collection within the watershed. The goal is to determine population-level viability criteria for the Alameda Creek Watershed steelhead population (productivity, abundance, spatial structure, diversity, persistence) and to develop attributes or indicators to be used for monitoring these criteria at the population level. The conceptual model will also need to consider influences outside of the watershed (marine, climate, etc), stochastic demographic effects, and any other sources of uncertainty and variability.

< Complete watershed conceptual model by 2014.

< Complete watershed viability analysis by 2018.

Evaluate Steelhead Spawning, Rearing, and Migration in the Southern Alameda Creek Watershed: While the conceptual models and viability analyses are being completed, the SFPUC commits to the following studies. These studies will be reevaluated within in the context of the conceptual models and viability analyses, Southern Alameda Creek and entire Alameda Creek Watersheds, by 2014 and 2018, respectively.

1. Spawning and rearing habitat: The SFPUC will evaluate the effectiveness of the proposed flow schedule on spawning and rearing habitat quantity, quality, and the timing of these flows as described in the monitoring program above. Note that under existing conditions, rearing habitat may be a primary limiting factor for the resident *O. Mykiss* population – this may or may not be the case under the proposed future condition.

   In addition to monitoring the effectiveness of the proposed flow schedule, the SFPUC commits to evaluating the spawning and rearing habitat upstream of the Alameda Creek Diversion Dam, and upstream of Calaveras Reservoir. This evaluation will be completed by the end of 2016 (note that much of the area described above is on private property, and access to these areas may limit this evaluation).

2. Fish migration past instream features such as riffles and waterfalls: The SFPUC will evaluate the effectiveness of the proposed flow schedule to support fish migration at existing instream features, including the riffles in Sunol Valley and the exposed bedrock and large boulder reach of Little Yosemite (URS HDR 2010a). Each location will be reevaluated after any proposed physical modifications are assessed and implemented to improve passage conditions.

3. Fish passage at the Alameda Creek Diversion Dam: In conjunction with the SFPUC conservation measure to construct a fish ladder at ACDD, providing upstream adult steelhead passage to spawning and rearing habitat at this location by 2016 (Section 2.1.1), the SFPUC will develop a monitoring program to assess the use and efficacy of the fish ladder.

Population Management Study Plan: The SFPUC commits to supporting genetic and demographic studies related to *O. mykiss* within the Alameda Creek Watershed to evaluate management alternatives for *O. mykiss* on SFPUC property. Planned removals of fish passage barriers in lower Alameda Creek will allow the re-establishment of anadromy to portions of Alameda Creek, and providing passage at the Alameda Creek Diversion Dam will further increase the anadromous range of *O. mykiss* in the watershed. However, without human intervention, the anadromous *O. mykiss* will remain mostly separated from resident *O. mykiss* above Turner and Calaveras Dams. Alternative options for managing the resident and anadromous forms will be evaluated in the context of the restoration goals described in Section 1.2. Some of the questions to be answered include the following:

< Are resident fish above Calaveras and Turner dams important for the establishment of a steelhead run, the avoidance of inbreeding depression, and/or the enhancement of adaptive and evolutionary potential of the new steelhead population? If so, then how many fish of each life history stage would need to be moved, and at what intervals? What monitoring should be done to evaluate the outcome?

< If *O. mykiss* from SFPUC reservoirs were used to "supplement" the anadromous population, would there be risks to either the anadromous or resident forms? How likely is it that this management action would cause significant demographic or genetic loss to the above-reservoir population, outbreeding depression in the anadromous population, stress to *O. mykiss* below the reservoirs resulting from competition or disease, and/or loss of existing sustainable *O. mykiss* populations through reduced recruitment? Are there ways to minimize risks through careful design of a supplementation program?

< If steelhead below SFPUC reservoirs were given access (such as by capture and relocation) to stream reaches above SFPUC facilities, how much benefit to the steelhead population might be expected to result from the increased access to the upper watershed and increased spawning and rearing habitat? Would there be risks of outbreeding depression for steelhead or resident trout, unintentional movement of invasive species or disease over existing barriers, and/or stress to reservoir populations through competition or predation? Are there ways to minimize risks and maximize benefits (in the context of the goals in Section 1.2)?

< What degree of uncertainty is associated with answers to the above questions? What scientific information would be needed to answer the questions more completely? Are there questions that are not being considered that should

be? Are there clear low-risk management options that would help achieve the restoration goals outlined in Section 1.2?

SFPUC staff, with assistance from NMFS and CDFG staff, will develop a study plan and identify appropriate experts to address these questions. Two research elements are identified as important initial studies to be included in this population management analysis.

Arroyo Hondo and Calaveras Reservoir Study – To determine current conditions above Calaveras Dam, the *O. mykiss* above Calaveras Dam will be studied in terms of migration and habitat use in Arroyo Hondo and Calaveras Reservoir, and secondly predation impacts to *O. mykiss* by largemouth bass in Calaveras Reservoir. Report to be finalized by December, 2012.

Southern Alameda Creek Sub-Watershed Genetics Study – Biological samples taken from throughout the southern Alameda Creek Watershed will be used to do a genetics study that will identify small scale phylogeographic population patterns and genetic diversity above and below reservoirs. Report to be finalized by December, 2012.

2.2 MONITORING PROGRAM

Monitoring programs should be developed to adequately support decision-making. Although monitoring programs can be adaptively adjusted if they prove inadequate, changes to data collection methodologies can compromise the ability to evaluate long-term trends and compare performance measures over time. As such, the monitoring program should be designed at the outset with clear goals and lists of measurable indicators (i.e., performance criteria) that allow for the evaluation of whether or not progress has been made towards the goals.

In addition to the routine monitoring program outlined here, other research and data collection programs have been described above in Section 2.1.2, Data Collection, Studies, and Analyses to Inform Future Decisions. Both the routine monitoring program and the supplemental studies (see Section 2.1.2) are expected to help reduce uncertainties and inform the adaptive management process.

The objectives of the monitoring program are to measure operational implementation performance, short- and long-term biological responses, and trends in habitat conditions. Specific components outlined in the program include streamflow monitoring, temperature monitoring, steelhead migration monitoring, steelhead/rainbow trout spawning monitoring, aquatic population and community characteristics monitoring, in-stream conditions monitoring, and riparian conditions monitoring (Table 2.1). All of these components are described in detail below under the categories of implementation, biological response, and habitat monitoring. Each monitoring component includes specific information on:

< Measurement Points (locations where measurement would be taken);

< Measurement Parameters (metrics used to make measurements);

< Measurement Intervals (frequency/intervals in time when measurements would be taken);

< Performance Criteria (performance standard used to evaluate if intended outcomes/goals are being achieved); and

< Contingency Action(s) (potential actions that would be implemented to correct potential deficiencies identified during monitoring and analysis).

It is important to note that information developed through the implementation of supplemental studies (see Section 2.1.2 above) would be used in combination with monitoring results to inform the implementation of any potential contingency actions.

Table 2.1: Monitoring Program Components by CCC Steelhead DPS Primary Constituent Element

Monitoring Component	Migration	Spawning	Rearing
Streamflow*	■	■	■
Temperature		■	■
Steelhead Migration	■		
Steelhead/Rainbow Trout Spawning		■	
Aquatic Population and Community Characteristics			■
In-Stream Conditions		■	■
Riparian Conditions			■
* Streamflow data to be used in conjunction with other monitoring data to inform the evaluation of habitat suitability for steelhead migration, spawning, and rearing.			

2.2.1 IMPLEMENTATION MONITORING

The goal of implementation monitoring is to document that minimum water releases are being employed as proposed and to calibrate and evaluate modeled water temperatures downstream of Calaveras Dam and the Alameda Creek Diversion Dam. These data are expected to allow operational managers to fine-tune water releases to provide suitable habitat conditions. The information is also expected to aid in more accurate interpretations of observed biological responses.

< **Streamflow:** Streamflow will be monitored to establish compliance below both the ACDD and Calaveras Dam. This information, together with other information on fish populations and communities and habitat conditions (see additional monitoring parameters below), is expected to provide a basis for evaluating performance for and

adjustment of the conservation measures if necessary to achieve performance criteria for steelhead migration, spawning, and rearing.

Measurement Points:	USGS Gage 11172945: Alameda Creek above ACDD Gage to be installed: Immediately below the ACDD in Alameda Creek USGS Gage 11173500: Calaveras Creek below Calaveras Dam USGS Gage 11173510: Alameda Creek below Calaveras Creek USGS Gage 11173575: Alameda Creek below Welch Creek
Measurement Parameter: Streamflow in cubic feet per second (cfs).	
Measurement Interval:	Continuous, averaged on a daily basis.
Performance Criteria:	Maintain minimum flows below Calaveras Dam and minimum bypasses below ACDD as described in the proposed minimum flow schedule. In addition to existing flow gages, add additional flow measurement devices as necessary to inform performance monitoring related to steelhead/rainbow trout migration, spawning, and rearing. Regarding migration, the network of flow gages will be sufficient to relate flows to the physical conditions (e.g., depths, velocities, etc) to evaluate passage of steelhead adults and juveniles at key locations, including Little Yosemite and the Sunol Valley, in the primary study area reaches.
Contingency Action(s):	Adjust bypass and/or release rates to achieve streamflow compliance consistent with the minimum flow schedules.

Streamflow measurement and documentation at compliance points and in all reaches in the primary study area, including Alameda Creek below ACDD and in the Sunol Valley, could be accomplished through the temporary installation of devices (flow meter, pressure transducer, or other device) to establish a network that would allow correlations with the existing USGS gages on Alameda Creek (upstream of the ACDD and downstream of the confluence with Calaveras Creek) and Calaveras Creek (downstream of the dam) to be developed.

< **Temperature:** Water temperature will be monitored to establish accuracy of modeling below Calaveras Dam. This information, along with temperature monitoring at other key locations (see measurement points below), is also expected to provide a basis for evaluating performance for and adjustment of the conservation measures if necessary to achieve performance criteria for steelhead spawning and rearing.

Measurement Points:	Water temperature monitoring will be conducted using remote sensors installed at several locations in the primary study area consistent with those

points already being monitoring by the SFPUC and at existing USGS gages.

Measurement Parameter: Temperature in degrees Celsius (°C).

Measurement Intervals: In real-time at the Calaveras Dam outlet works and continuous at ½-hour intervals at all other locations.

Performance Criteria: Calibrate and evaluate modeled temperatures and the suitability of steelhead/rainbow trout spawning and rearing, below Calaveras Dam and the Alameda Creek Diversion Dam. Achieve maximum temperature of 20°C at the Sunol Regional Park/SFPUC property boundary (flow schedule C) or at a yet to be identified point further downstream (flow schedules A and B).

Contingency Action(s): Adjust operation of Calaveras Dam outlet works to manage cold water releases to meet downstream temperature targets.

2.2.2 Biological Response Monitoring

The purpose of monitoring biological response is to directly evaluate performance in terms of both short- and long-term goals. The proposed flow schedules are expected to result in immediate improvements in connectivity, spawning and rearing habitat for steelhead/rainbow trout in the primary study area. This monitoring element is expected to provide short-term feedback to the AMIP, but should be continued as stream morphology, hydrology and riparian vegetation could have long-term responses which have the potential to change related primary biological responses.

< **Steelhead Migration:** Monitoring will be conducted to determine migration success into, out of, and within the primary study area and to estimate the relative success of in and out migration of adult and juvenile steelhead.

Measurement Points: Several locations in the primary study area below Calaveras Dam and the Alameda Creek Diversion Dam, including the Sunol Valley and Little Yosemite, to document and evaluate passage conditions associated with the proposed minimum flow schedules and natural flow accretions. Also evaluate the operation of the ladder and screen at the Alameda Creek Diversion Dam.

Measurement Parameters: Monitoring the timing and movement of adult immigration shall be coordinated with the resource agencies and other entities in the watershed

	(e.g., Alameda County Water District and operation of the ladders in the Alameda Creek Flood Control Channel). The SFPUC shall provide radio tags or other devices and coordinate monitoring to detect the movement of adults within the portions of the watershed under its jurisdiction. Although outside SFPUC jurisdiction, SFPUC recommends that radio tags or other devices be applied to adult fish captured/trapped at the future BART weir ladder(s). The movements of tagged fish shall be monitored, at either fixed detection sites or manual tracking, as they move through the watershed. To evaluate movement patterns of juvenile steelhead within Alameda Creek, timing of migration and relative abundance by size class shall be monitored using downstream migrant traps (e.g. rotary screw traps – locations TBD after consultation with NMFS and CDFG). Pit tags will be employed to assess migrational success and survival rates.
Measurement Interval:	During February, March, April and May; continuing through June only if significant numbers of fish are being collected in late May.
Performance Criteria:	Suitable migration conditions for adult steelhead without substantial flow-related interference that causes biologically relevant delay. Natural features such as Little Yosemite will be further evaluated to also consider physical conditions (e.g., vertical jump height) that may create interference regardless of flow conditions (see Section 2.1.2 above). Evidence of downstream moving juvenile steelhead undergoing the process of smoltification. Fish monitoring data will be used in conjunction with physical (e.g. streamflow) data.
Contingency Action(s):	In the short term, if fish stranding is documented, implement fish relocation activities. In the long term and as detailed in Section 2.1.1, contingency actions include SFPUC provision of specific funding amounts in support of NMFS and CDFG modification of physical features in the stream channel (e.g., modification of bedrock and boulder features the Little Yosemite reach) as described above in Section 2.1.1..

< **Steelhead/Rainbow Trout Spawning:** Monitoring will be conducted to determine the distribution of spawning activity within the project area and to estimate the relative size of spawning populations over time and provide an indication of adult upstream migration success.

Measurement Points:	Portions of stream reaches between the ACDD and confluence of Calaveras and Alameda Creeks and downstream to Welch Creek. Portions of Calaveras Creek between Calaveras Dam and its confluence with Alameda Creek, Alameda Creek between Welch Creek and Arroyo de la Laguna, and upstream of ACDD (may be limited due to access agreements with private landowners).
Measurement Parameters:	Number of spawning steelhead/rainbow trout and number of steelhead/rainbow trout redds by location and survey date.
Measurement Interval:	Twice per month, with not less than two weeks between surveys, in January, February, March and April. Surveys to be conducted only when conditions allow for viewing spawning adults and/or redds.
Performance Criteria:	Suitable spawning sites used by steelhead/rainbow trout: spawning population of steelhead post-project at comparable levels to rainbow trout under existing conditions at reference sites and increased levels in the primary study area.
Contingency Action(s):	Potential contingency actions include adjusting flow schedules to achieve desired flow velocity and depth conditions and/or restoring and enhancing spawning habitat (e.g., gravel augmentation, channel improvements).

< **Aquatic Population and Community Characteristics:** Monitoring will be conducted annually during the pre-project and post-project periods to document changes in aquatic species composition, relative abundances, and distributions in response to water releases and other operational and management activities. Standard quantitative methods for fish, amphibian and invertebrate sampling will be used (e.g. Dolloff, Hankin & Reeves, "Basinwide Estimation of Habitat and Fish Populations in Streams", Gen. Tech. Report SE-83, USDA, 1993; National Marine Fisheries Service, "Guidelines for Electrofishing Waters Containing Salmonids Listed Under the Endangered Species Act", June 2000; U.S. Fish and Wildlife Service, "Revised Guidance on Site Assessments and Field Surveys for the California Red-legged Frog", August 2005; State Water Resources Control Board, "Collecting Benthic Macroinvertebrate Samples and Associated Physical and Chemical Data for Ambient Bioassessments in California", February 2007).

Measurement Points: Representative habitats throughout the primary study area consistent with those points already being sampled and more recently expanded by the SFPUC.

Measurement Parameters: Relative abundances and densities (e.g. individuals /mile) by size class for vertebrate species (steelhead, other native and introduced fishes and amphibians) and goal-specific metrics for invertebrates (e.g. diversity) at sample sites, including length, weight, and age characteristics for steelhead/rainbow trout.

Measurement Interval: Snorkel survey once during summer and electrofishing survey once during fall for fishes. One annual comprehensive protocol survey for frogs. Targeted-riffle composite and/or multi-habitat reach-wide benthos composite survey once during spring for invertebrates.

Performance Criteria: Increased abundance of steelhead/rainbow trout in the primary study area; includes a self–reproducing population of steelhead/rainbow trout with some individuals greater than six inches in total length. The steelhead/rainbow trout population shall contain a minimum of three viable age classes documenting an acceptable level of recruitment for size and type of stream (i.e., upper Alameda Creek).

Contingency Action(s): Potential contingency actions include adjusting flow schedules to achieve desired habitat conditions and/or restoring/enhancing spawning and rearing habitat.

2.2.3 HABITAT MONITORING

The goals of habitat monitoring are to collect data useful for understanding observed biological responses, and to help predict future biological responses where time lags are expected.

< **In-Stream Conditions:** Monitoring will be conducted to evaluate habitat/flow relationships by assessing in-stream morphology, hydrology, and a variety of other steelhead/rainbow trout habitat attributes.

Measurement Points: Alameda Creek in the primary study area at locations consistent with those locations being surveyed as part of ongoing monitoring efforts and more recently expanded by the SFPUC (Brian – same questions).

Measurement Parameters: Areal extent, width and depth, water velocity and cover characteristics of different stream habitat types (i.e. pool, riffle, etc.) as measured by an established habitat mapping protocol (e.g. Flosi and Reynolds, "California Salmonid Stream Habitat Restoration Manual", CDFG Inland Fisheries Division, 1994).

Measurement Interval: Pre-project: once during each of three successive flow regimes: 0-10 cfs, 11-20 cfs, 21-30 cfs and 31-40 cfs. Post-project: once within three years during each of three successive flow regimes: 0-10 cfs, 11-20 cfs, 21-30 cfs, and 31-40 cfs. Subsequent monitoring within selected flow ranges will occur once every ten years to evaluate habitat/flow relationship, stream morphology and hydrology responses to flow alterations, changes in riparian cover, and habitat restoration activities.

Performance Criteria: A post-project increase in the quality and quantity of steelhead/rainbow trout spawning and rearing habitat based on parameters described above.

Contingency Action(s): Potential contingency actions include adjusting flow schedules to achieve desired habitat conditions and/or restoring/enhancing spawning and rearing habitat.

< **Riparian Conditions:** Monitoring will be conducted to evaluate vegetative cover by assessing plant community composition and condition. If changes are significant, there may be feedbacks on the quality of steelhead/rainbow trout habitat conditions including water temperature, benthic macroinvertebrate productivity, and channel morphology.

Measurement Points: Alameda Creek from ACDD to its confluence with Arroyo de la Laguna and Calaveras Creek from Calaveras Dam to its confluence with Alameda Creek.

Measurement Parameters: The community composition and extent of vegetative cover will be mapped using aerial photographs and field mapping methods established by the "California Native Plant Society Manual of California Vegetation Protocols." Condition and stand age of target species (including sycamores) will be evaluated. Non-native invasive plant species will also be noted, but not mapped in detail.

Measurement Interval:	Once every five years.
Performance Criteria:	A post-project increase in the quality and quantity of steelhead/rainbow trout spawning and rearing habitat based on parameters described above.
Contingency Action(s):	Potential contingency actions include adjusting flow schedules to achieve desired habitat conditions and/or restoring/enhancing spawning and rearing habitat.

3 REPORTING, SCIENTIFIC REVIEW, AND DECISION MAKING PROCESS

Each summer (by September 1st) the SFPUC shall prepare and submit annual monitoring reports to NMFS and CDFG detailing the monitoring activities and any significant deviations from normal operations. The annual monitoring reports will include the status and/or results from the implementation of the monitoring program described in the AMIP, implementation of supplemental actions, including the studies and analyses, and any recommendations for adaptive management (e.g., implementation of contingency or other actions that could arise from review of monitoring results or supplemental studies).

NMFS, CDFG, and SFPUC will meet to review these annual monitoring reports and assess progress towards meeting the goals of the AMIP. At the request of NMFS, CDFG, or the SFPUC, an independent review of the annual monitoring report (or its components) may be recommended. In these situations, NMFS, CDFG, and SFPUC must agree on the selection of the convener for this independent review. Based on discussions with NMFS, CDFG, and SFPUC, the convener will be responsible for establishing the scope of the review, and selecting a panel of experts to conduct the review. The findings of the independent review panel will then be provided to NMFS, CDFG, and SFPUC for their consideration. Note that at least a portion of the independent review deliberations will be conducted in a public forum.

NMFS, CDFG, and the SFPUC will continue to coordinate on individual issues and collaborate on decisions to assure that future contingency actions are coordinated across the watershed. Where there are disputes, issues will be elevated and resolved at the appropriate level. Decisions about the need (or trigger) to implement a contingency action are ultimately the responsibility of NMFS and CDFG, while decisions regarding the implementation of contingency actions are the responsibility of the SFPUC.

SFPUC, NMFS, and CDFG will commit the resources necessary to implement this AMIP. However, if funding issues or other circumstances arise (e.g., regional coordination or scientific review delays) that either change the assumptions under which the AMIP was created or new scientific data indicates different goals are more appropriate, changes in the AMIP will be the product of a transparent "change management" process. An entity that desires a change will provide the rationale and supporting documentation for the proposed modification in advance to making the change. Once coordinated through this process, which may be elevated, changes will be reported in the annual progress report.

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