Santa Felicia Dam Fish Passage
Feasibility Assessment Study Plan

February 2013

Prepared for: The United Water Conservation District, in association with the National Marine Fisheries Service, and the California Department of Fish and Game

Prepared by: The Santa Felicia Dam Fish Passage Panel, represented by the following firms:

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Santa Felicia Dam Fish Passage Panel

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Photo source: United Water Conservation District

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ACRONYMS AND ABBREVIATIONS

AACE	American Association of Cost Engineers International
BO	Biological Opinion
CDFG	California Department of Fish and Game
CFR	Code of Federal Regulations
CEII	Critical Energy Infrastructure Information, FERC Regulations
DPS	Distinct Population Segment
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
Group	Project stakeholders guiding this study, composed of United, NMFS, and CDFG,
NMFS	National Marine Fisheries Service
NTP	Notice to Proceed
OPCC	Opinion of Probable Construction Cost
Panel	Santa Felicia Fish Passage Panel
Project	Santa Felicia Project, including Santa Felicia Dam, Lake Piru, and associated facilities
RPA	Reasonable and Prudent Alternative
SF Dam	Santa Felicia Dam
Study Plan	The Santa Felicia Dam Fish Passage Feasiblity Assessment Study Plan
United	United Water Conservation District

EXECUTIVE SUMMARY

BACKGROUND

In May 2008, the National Marine Fisheries Service issued its final Biological Opinion for the Federal Energy Regulatory Commission's proposal to issue a new license to United Water Conservation District (United) for operation of the Santa Felicia Project on Piru Creek in the Santa Clara River watershed, Ventura County, California. The Project is operated to yield water for aquifer recharge and hydropower generation (FERC Proejct P-2153-012) and consists of a dam, reservoir and appurtenant facilities. The Biological Opinion addressed the effects of the proposed action on the endangered Southern California Distinct Population Segment of steelhead (*Oncorhynchus mykiss*) and critical habitat for this species in accordance with Section 7 of the Endangered Species Act. The Biological Opinion contains a reasonable and prudent alternative that directs United to provide conditions that the National Marine Fisheries Service believes are likely to avoid jeopardy of the Distinct Population Segment or adversely affect its designated critical habitat. One element of the reasonable and prudent alternative, Element 3, requires United to fund and prepare a study plan that will guide the feasibility assessment of steelhead passage at or around Santa Felicia Dam. The FERC License requires United to prepare and implement the required study plan. It calls for United convene a panel of professional fishery biologists, fish-passage biologists, and fish-passage engineers with expertise in the evaluation and design of fish passage at dams to participate in the assessment. In coordination with National Marine Fisheries Service (NMFS) and California Department of Fish and Game (CDFG), United convened the panel with the required expertise to prepare the study plan with the understanding that the panel would function as an independent body. This document constitutes the Santa Felicia Dam Fish Passage Feasibility Analysis Study Plan.

PREPARING THE STUDY PLAN

The Panel has collaborated with the aforementioned organizations, collectively referred to as the Group, to develop the Study Plan. During the preparation of the Study Plan, the Panel met with the Group a number of times over the course of a year to update progress on the plan, clarify purpose and scope of the study, clarify positions of the parties, request technical information, and receive feedback on concepts and draft versions. A draft Study Plan was prepared by the Panel in October 2011, which was provided to the Group for review and comment. The Panel addressed those comments and revised the Study Plan accordingly to result in this plan.

PROCESS FOR EVALUATING FEASIBILITY

The goal of the Study Plan is to define a process to assess the technical and biological feasibility, including biological performance of steelhead passage at Santa Felicia Dam. The Study Plan

will document development and the resulting conceptual design configurations of fish passage alternatives, the evaluation criteria, the evaluation process and results, and one (or possibly more) recommended fish passage alternative(s).

Decision criteria for determining feasibility include a combination of both technical and biological performance evaluations, which will provide a comparative evaluation of fish passage alternatives. As defined in this Study Plan, "technical feasibility" is governed by engineering aspects and fish passage aspects. The engineering aspects include the physical dam and reservoir characteristics, hydrology, and primary water storage and release operations. The fish passage aspects include steelhead behavioral responses to site conditions, including migration timing, response to flows and temperatures, and migratory pathways. Volitional and non-volitional steelhead passage will be explicitly considered by the Panel, and following an objective evaluation, the Panel will provide a recommendation regarding fish passage at Santa Felicia Dam. If fish passage is considered infeasible or impractical, the justification for this conclusion will be documented, and then an evaluation of alternatives to fish passage will be recommended as a follow-up step.

The study's feasibility assessment will consider structural, operational, environmental, and biological conditions to develop and evaluate fish passage facilities. These factors will be integrated and the process conducted iteratively, such that intermediate results from each analysis will be used to refine and optimize alternatives throughout this process.

STUDY ELEMENTS

The study is broken into nine tasks; seven tasks to determine feasibility and identify a recommended fish passage alternative, one task (Task 8) as a Group decision point, and a final task (Task 9) to consider biological feasibility of SF Dam fish passage and off-site alternatives. These tasks will be conducted with continued, structured coordination with the Group. Following is a brief summary of the tasks:

- **Task 1:** Compile and review background information necessary for development of fish passage concepts.
- **Task 2:** Develop a spreadsheet-based biological performance tool to be used to estimate the biological performance of fish passage alternatives.
- **Task 3:** Develop an initial set of fish passage concepts and refine this set by eliminating those with fatal flaws.
- **Task 4:** Develop the fish passage concepts into fish passage alternatives applicable at Santa Felicia Dam to address site-specific applicability, hydraulic functional design, construction and operating cost estimates, general layout, and identify any uncertainties

for further examination. The alternatives' performance using the biological performance tool will also be identified. These initial results will be presented to the Group.

- **Task 5:** Evaluate the fish passage alternatives to estimate their relative effectiveness and ability to meet evaluation criteria, and to identify further improvements for the alternatives. Results of this initial alternatives evaluation will be presented to the Group.
- **Task 6:** Further refine alternatives, including preparation of refined opinions of probable construction cost, final runs of the biological performance tool, and final quantitative evaluation of the alternatives.
- **Task 7:** Prepare a Fish Passage Feasibility Report to summarize fish passage alternatives receiving detailed evaluation, and the Panel's recommendations. The Panel can either:
    - recommend a feasible fish passage alternative (or alternatives),
    - recommend additional studies, or
    - conclude that fish passage is not feasible
- **Task 8:** The Group will consider the alternatives and recommendations of the Fish Passage Feasibility Report. If the Group agrees by consensus on the selection of a fish passage alternative to be implemented, the Study is complete and the implementation process may proceed. If there is no consensus, the Study continues with Task 9.
- **Task 9:** Complete an examination of biological feasibility, including non-passage alternatives and a recommended economic analysis. The analysis will include three components**:**
    - Identify alternatives to fish passage facilities at SF Dam;
    - Evaluate biological feasibility of alternatives including fish passage at SF Dam; and
    - Conduct cost effectiveness analysis of all alternatives, including fish passage at SF Dam

  A framework is defined to address the future implementation process.

1. BACKGROUND

On May, 5, 2008, the National Marine Fisheries Service (NMFS) issued its final biological opinion (BO) for the Federal Energy Regulatory Commission's (FERC) proposal to issue a new license to United Water Conservation District (United) for operation of the Santa Felicia Project (Project) on Piru Creek in the Santa Clara River watershed, Ventura County, California. The Project is operated to yield water for aquifer recharge and hydropower generation (FERC Proejct P-2153-012) and consists of the dam, reservoir and appurtenant facilities. The BO addressed the effects of the proposed action on the endangered Southern California Distinct Population Segment (DPS) of steelhead (*Oncorhynchus mykiss*) and critical habitat for this species in accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*.).

Regulations (50 CFR §402.02) implementing Section 7 of the ESA define reasonable and prudent alternatives (RPAs) as alternative actions, identified during formal consultation, that: (1) can be implemented in a manner consistent with the intended purpose of the action; (2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; (3) are economically and technically feasible; and (4) would, NMFS believes, avoid the likelihood of jeopardizing the continued existence of a listed species or resulting in the destruction or adverse modification of critical habitat. With the BO, NMFS issued the following RPA requiring implementation of a Santa Felicia Dam Operations Plan that:

> *" …requires establishing and preserving essential features of critical habitat for the endangered Southern California DPS of steelhead in Piru Creek and the Santa Clara River, and restoring anadromy of steelhead to the Piru Creek drainage. This reasonable and prudent alternative has three sub-elements, and all three elements must be implemented to avoid jeopardizing the continued existence of the Federally endangered Southern California steelhead DPS, and destroying or adversely modifying critical habitat for this species." (NMFS 2008)*

The following are paraphrased from the BO (NMFS 2008, pp. 96-104) describing the three sub-elements of the RPA:

> *RPA Element 1 – Prepare and implement a plan to "quantify the geomorphic effects (e.g., effects to channel-bed morphology, substrate characteristics and condition) of Santa Felicia Dam and its operations on the quality and quantity of habitat for steelhead in Piru Creek downstream of the dam,"* and *"implement habitat-improvement measures to minimize individual geomorphic effects…"*

> *RPA Element 2 – Prepare and implement a plan to "ensure that the magnitude, timing, frequency, duration, and rate-of-change of water released from Santa Felicia Dam into Piru Creek will provide unimpeded migration of adult and juvenile steelhead in Piru Creek downstream of Santa Felicia Dam and in the Santa Clara River from the confluence of Piru Creek downstream to the Vern Freeman Diversion Dam, formation and preservation of freshwater rearing sites for steelhead throughout Piru Creek downstream of Santa Felicia Dam, and creation and maintenance of freshwater spawning sites (including incubation and emergence life stages of steelhead) for steelhead throughout Piru Creek downstream of Santa Felicia Dam…"*
>
> *RPA Element 3 – "…provide passage of steelhead at or around Santa Felicia Dam, or other suitable alternative to passage. Prior to implementing this action, the Licensee shall implement a plan after receiving written agreement on the plan from NMFS to assess the feasibility of providing passage of adult and juvenile steelhead around or over Santa Felicia Dam…"*

Per RPA Element 3, United is required by its FERC License to fund and prepare a study plan that will guide the feasibility assessment of steelhead passage at or around Santa Felicia Dam (SF Dam). It calls for United to convene a panel of professional fishery biologists, fish-passage biologists, and fish-passage engineers with expertise in the evaluation and design of fish passage at dams to participate in the assessment. In coordination with NMFS and CDFG, United convened the panel with required expertise to prepare the study plan with the understanding that the panel would function as an independent body. This document constitutes the Santa Felicia Dam Fish Passage Feasibility Analysis Study Plan (Study Plan).

The Study Plan has been prepared to meet the requirements of RPA Element 3, to assess the feasibility of providing passage of adult and juvenile steelhead at or around SF Dam. The Study Plan addresses the RPA Element 3 within the context of Elements 1 and 2 as described above. The Study Plan is structured to initially focus on options to provide fish passage only; non-passage options may be assessed later in the process (if no suitable passage options are identified in the Study Plan implementation), per the framework outlined in the Study Plan. The Panel has collaborated with NMFS, CDFG, and United to develop the Study Plan. The Panel has maintained the responsibility to independently prepare the Study Plan based on the Panel's professional and technical expertise and experience supported by the best available information.

Per the RPA, the approach to assess feasibility and implement a preferred alternative shall involve five principal steps:

- preparation and implementation of a plan that will guide the conduct of the steelhead-passage feasibility assessment,
- implementation of the assessment of steelhead-passage feasibility according to the plan,
- preparation of a steelhead-passage feasibility report,
- development of criteria to guide implementation timing of the preferred alternative, and
- implementation of the preferred alternative.

These steps for RPA Element 3 are described more fully in the BO, as quoted below (from NMFS 2008, pp. 101-102):

> ***"(a) Preparation and implementation of a plan that will guide the conduct of the steelhead-passage feasibility assessment.***
>
> *The Licensee shall fund and prepare a plan that will guide the conduct of the steelhead-passage feasibility assessment and submit this plan to NMFS' Southwest Regional Office (501 W. Ocean Blvd., Suite 4200, Long Beach, California 90802) for review no later than 8 months after the Commission's issuance of the license to the Licensee. The Licensee must receive written NMFS agreement for this plan prior to implementing the plan. The purpose of this plan is to describe the methods and schedules that will be used to guide the conduct and completion of the assessment of the steelhead-passage feasibility. To develop the plan, the Licensee shall comply with the following:*
>
> *(1) no later than 60 days after the Commission's issuance of the license to the Licensee, the Licensee shall convene at least one meeting with NMFS and the California Department of Fish and Game (interagency meeting) for the purposes of outlining the details and elements that will form the basis of the plan, and defining schedules, including a schedule for submitting the draft steelhead-passage feasibility report to NMFS in accordance with reasonable and prudent alternative 3(c);*
>
> *(2) the Licensee shall assemble and develop the information obtained from the interagency meeting to produce the draft plan for guiding the conduct of the steelhead-passage feasibility assessment; and*
>
> *(3) this plan shall include:*

(a) a clear statement of objectives to guide the conduct of the assessment of the steelhead-passage feasibility,

(b) a clear description of science-based investigations of steelhead behavior, ecology, and habitat requirements (to inform the assessment of steelhead-passage feasibility) as well as an analysis of the full range of physical steelhead-passage alternatives (volitional[1] and non-volitional) and alternatives to steelhead passage, and engineering and cost analyses,

(c) the requirement to convene a panel of professional technical fishery biologists, fish-passage biologists, and fish-passage engineers with expertise in the evaluation and design of fish passage at dams, who will participate in the assessment of steelhead-passage feasibility at Santa Felicia Dam,

(d) a clear description of the specific methods that will be used to perform the various tasks related to the assessment of the steelhead-passage feasibility, including objective decision criteria for judging feasibility[22] in accordance with the information obtained through reasonable and prudent alternative 3(a)(3)(B),

(e) task schedules and milestones to monitor and track performance of the assessment of the steelhead passage feasibility over time, and

(f) a contingency program to effectively address and resolve unforeseen circumstances in a timely manner.

[22] Because United recently expressed concern regarding "the lack of sideboards" to guide the economic aspect of the feasibility study (pers. comm., J. Dickenson, United Water Conservation District, April 15, 2008), we here reiterate that regulations (50 CFR §402.02) implementing section 7 of the ESA in part define reasonable and prudent alternatives as alternative actions identified during formal consultation that "…are economically and technically feasible." We therefore expect that economic consideration will be included in the feasibility study that is required in this reasonable and prudent alternative." (NMFS 2008)

Hereafter, United, NMFS, and CDFG will be collectively referred to as the Group. The Group and FERC helped develop, review, and guide this process.

[1] Volitional passage is the concept of giving fish the choice of moving upstream or downstream based on their own motivation.

1.1 DRAFT STUDY PLAN REVIEW MEETING (JANUARY 6, 2012)

During the preparation of the Study Plan, the Panel met with the Group a number of times to update progress on the plan, clarify purpose and scope of the study, clarify positions of the parties, request technical information, and receive feedback on draft versions (Appendix A). A draft Study Plan was prepared by the Panel and provided to the Group for review and comment. The Panel addressed those comments and revised the Study Plan accordingly (Appendix B). The last Group meeting was on January 6, 2012 at which time the Panel and Group discussed pertinent issues expressed in the Group's comments. The following clarifications and conclusions were made during the January meeting, some of which vary from the language of the RPA and have guided development of the Study Plan:

- The Panel will consider recommendations made by members of the Group regarding the Study Plan, but the Panel is to function independently in developing the final version of the Study Plan. The Panel understands that the Study Plan is subject to change after final review by FERC or the Group; however, this document is intended to be sufficient to begin implementation of the study.
- The Panel should not confine its review to limit fish passage alternatives based solely on existing Project operations. If specific alternatives might affect operations, such as changing the current flow release protocols from the dam to improve a fish passage alternative's performance, the Group is willing to consider what that would mean operationally.
- Implementation phasing might be considered, and therefore can be included in the feasibility analysis for further review.
- The feasibility study might conclude with more than a single Panel recommended alternative.
- Volitional alternatives will be considered concurrent with others and at least one upstream and downstream passage volitional alternative will be carried throughout the study.
- Economic feasibility will be addressed initially in the technical feasibility evaluation focused on relative cost of alternatives. After the feasibility analysis of passage alternatives is completed, a comprehensive economic feasibility analysis, including a cost effectiveness analysis of fish passage at Santa Felicia Dam and any alternatives other than fish passage at Santa Felicia Dam will be conducted.
- Dam removal will not be included as a specific passage alternative; however, the concept of dam removal will be included for comparison with passage alternatives.

1.2 PANEL ORGANIZATION AND CONDUCT

The following items provide additional information on the Panel's organization and conduct guidelines for implementation of the Study Plan:

- **Panel Composition** – United has determined that the current membership will form the core of the Panel that will be tasked with conducting the feasibility assessment (i.e., implementing the Study Plan) and preparing the feasibility report. Additional disciplines may be added to the Panel if considered necessary, and if agreed upon by the Panel and Group.
- **Panel Function to be Independent** – The Panel will function independently (i.e., not be controlled by others in matters of opinion, conduct, so forth) and maintain the responsibility to objectively conduct the feasibility evaluation and prepare the feasibility report based on the Panel's professional and technical expertise and experience, supported by the best available information. Per the Study Plan, the Panel will seek and receive information from NMFS, CDFG, and United in the implementation of the Study Plan. The Study Plan specifies how and at what points in the evaluation Group participation will be required to assure that the Panel is fully informed prior to completion of the various Study Plan tasks, and ultimately the evaluation and reporting.
- **Facilitated** – The Panel anticipates that it will continue to include a facilitator to act as representative of the Panel and as lead when necessary, during workshops and related interactions with the Group. The Panel does not anticipate that the interactions among the Group members will require independent third party facilitation.
- **Responsibility** – As stated in RPA Element 3, the Licensee is ultimately responsible for implementation of the Study Plan and preparation of an evaluation report. United has indicated that it intends to task Panel to implement the Study Plan in an independent, transparent, open, and objective manner. It is the Panel's responsibility to assure that the Study Plan is implemented and supported by the best available information, including input from the Group. The Panel is responsible for soliciting input from the Group as defined in the Study Plan, determining the utility of the input in implementation of the Study Plan, openly conducting the evaluation by providing the products identified in the Study Plan, including meetings and product review, and objectively conducting and reporting the evaluation as defined in the Study Plan. The Panel believes that total Group representation at in-person workshops, as well as timely Group review and comment on critical products as they are developed is essential to assure Group participation and ultimately an objective, useful evaluation and conclusion regarding steelhead fish passage feasibility at SF Dam.

1.3 STUDY PLAN AUDIENCE

The intended audience for this document includes:

a) The Panel, as a guidance document which will be utilized to develop a scope of work, budget, and schedule to implement the Study Plan;

b) United, for scope comment and approval, for consultation needs to communicate the approach to address RPA Element 3, and for study implementation; and

c) NMFS and CDFG for effective collaboration with the Panel and United, and to monitor how the study is conducted.

d) FERC, for its assessment of compliance with the Project license.

2. STUDY PLAN OBJECTIVE

The objective of this Study Plan was prepared in consultation with the Group during the spring and summer of 2011. The final objective statement reads:

> *"The objective of developing the Study Plan is to define a process, including the technical analytical approach and related information needs, that will lead to an impartial assessment of the biological and technical feasibility for allowing upstream and downstream steelhead passage at Santa Felicia Dam, while incorporating cost and time efficiency to the extent consistent with Reasonable and Prudent Alternative 3 of NOAA's National Marine Fisheries Service's May 5, 2008, biological opinion for the Santa Felicia Hydroelectric Project."*

3. APPROACH

This Study Plan will direct the Panel's independent evaluation of fish passage feasibility at SF Dam. As described in Section 2, the goal of the Study Plan is to define a process to assess the technical and biological feasibility of steelhead passage at SF Dam. The Panel's approach for conducting the study is similar to that utilized by the Vern Freeman Diversion Dam Fish Panel (United 2010a) though there are differences in that this is a study of the feasibility of a new fish passage facility rather than a study to find improvements to an existing facility. This process as described in further detail below will document development and the resulting conceptual design configuration for the alternatives, the evaluation criteria, the evaluation process and results, and a recommended fish passage alternative.

For this process the Panel recommends that the decision criteria for determining feasibility include a combination of technical and biological evaluations which will provide information on the applicability of fish passage alternatives. Technical feasibility is governed by engineering aspects and fish passage aspects. The engineering aspects include the physical dam and reservoir characteristics, hydrology, and primary water storage and release operations. The fish passage aspects include steelhead behavioral responses to site conditions, including migration timing, response to flows and temperatures, and migratory pathways. Volitional and non-volitional steelhead passage will be considered by the Panel, and following an objective evaluation, the Panel will provide a recommendation regarding fish passage at SF Dam. If fish passage is considered infeasible or impractical, the justification for this conclusion will be documented, and then alternatives to fish passage will be considered as a follow-up step to the feasibility evaluation study.

The feasibility assessment will consider structural, operational, environmental, and biological conditions to develop and evaluate fish passage facilities. These factors will be integrated and the process conducted iteratively such that intermediate results from each analysis will be used to refine and optimize alternatives throughout this process.

3.1 DEFINITIONS AND APPLICATIONS OF FEASIBILITY

In this Study Plan, the Panel outlines its independent evaluation of fish passage feasibility at SF Dam. However, in the Study Plan, the term "feasibility" is used in many different contexts. In this section, the various applications of "feasibility" as they are used in this report are defined for clarity.

As described in Section 2, the objective is to define a process to assess the technical and biological feasibility of steelhead passage at SF Dam.

Technical Feasibility

"Technical feasibility" is both engineering and fish passage feasibility. Engineering feasibility is governed by physical dam and reservoir characteristics, hydrology, primary water storage and release operations, and operating and construction cost. Fish passage feasibility is governed by steelhead behavioral responses to site conditions, including migration timing, and migratory pathways.

Will the fish passage alternative be effective in safely collecting and passing fish? Can the fish passage alternative be constructed and operated while maintaining the original purpose of SF Dam?

Technical feasibility will be judged using criteria that are "yes" or "no" (feasible or not) or scalar (presenting relative feasibility among alternatives). The Panel will use thresholds in the scoring of evaluation criteria, such as constructability and safety to assess feasibility. For example, dam safety might have a threshold that any alternative must score high to be considered feasible; alternatives that do not score at least the minimum value will be considered fatally flawed. Thresholds, or minimum values and scores are subjective; consistent definitions will be necessary establish these values.

Biological Feasibility

Does the proposed fish passage alternative satisfy the requirements of the Project avoiding the likelihood of jeopardizing the continued existence of the Southern California steelhead DPS or the destruction or adverse modification of critical habitat, as defined in the BO?

Economic Feasibility

The Panel's objective is to recommend a feasible fish passage alternative(s) for SF Dam. However, the evaluation may result in a series of fish passage alternatives that meet the test of technical feasibility, but have inherent risks or uncertainties, and may also significantly vary in cost. This may prompt the Group to further recommend studying "economic feasibility." As applied here, economic feasibility has two components:

1. **Financial feasibility** – Can the proponent afford to implement the recommended fish passage alternative(s)? This will likely require a cost examination by United, including impacts assessment on its operations and customers. The evaluation develops and provides much of the information base for United to make their decision.
2. **Cost effectiveness analysis –** How do fish passage and alternatives other than passage at SF Dam compare in terms of implementation cost while also avoiding jeopardy to listed

species? This action would require that additional studies be conducted to develop a full set of information for non-passage alternatives.

3.2 STUDY OVERVIEW

The feasibility evaluation includes conduct of nine tasks; seven tasks to determine feasibility and identify a recommended fish passage alternative, one for a Group decision point, and one task (Task 9) to evaluate the feasibility of fish and non-fish passage alternatives. These tasks are summarized below, and additional detail is provided in Section 4. A Gantt chart schedule is provided in Section 4.9 that outlines this work plan.

- Task 1: Feasibility Study Preparation
    - Task: Compile and review background information necessary for development of fish passage concepts.
    - Outcome: The deliverable will be base drawings, maps, and operational protocols necessary to conduct the study. Additional information needs will be identified and communicated to the Group.
- Task 2: Prepare Biological Performance Tool
    - Task: Develop a spreadsheet-based biological performance tool to be used to estimate the biological performance of fish passage alternatives.
    - Outcome: The deliverable for this task is a draft of the biological performance tool with initial data set and sensitivity run output.
- Task 3: Identify Fish Passage Concepts
    - Task: Develop an initial list of fish passage concepts and refine the list by eliminating those with fatal flaws.
    - Outcome: The deliverables for this task are a full list of potential fish passage concepts, a discussion of the fatal flaw analysis, documentation of concepts eliminated from further consideration, and a short list of fish passage concepts for further development.
- Task 4: Concept Development and Alternative Definition
    - Task: The Panel will develop the fish passage concepts identified in Task 3 into fish passage alternatives applicable at SF Dam to address site-specific applicability, hydraulic functional design, construction and operating cost estimates, general layout, and identify any uncertainties for further examination. Performance of the alternatives will be identified using the biological performance tool (Task 2). Alternatives that are not technically feasible will be dropped from consideration and reasons for them being dropped, will be

described. The alternatives and explanation of their operation and biological performance will be presented to the Group at a workshop.

- Outcome: Descriptions and drawings, including estimates of biological performance, of remaining feasible fish passage alternatives will be developed.

- Task 5: Initial Evaluation
  - Task: The Panel will perform and document an evaluation of the alternatives to estimate the effectiveness of selected facilities, and to identify further improvements. Updated descriptions, drawings and the results of the initial evaluation of alternatives will be presented to the Group during a workshop.
  - Outcome: Updated descriptions, drawings and the results of the initial evaluation process will be developed.
- Task 6: Fish Passage Alternative Refinement
  - Task: Fish passage alternatives will be further refined, including preparation of opinions of probable construction and operating costs, operational issues, considering comments from the Group, final runs of the biological performance tool, and quantitative evaluation of the alternatives.
  - Outcome: A summary of changes to the alternatives and the final evaluation will be developed and provided to the Group. At least one volitional fish passage alternative will be included in the final list of alternatives.
- Task 7: Reporting and Fish Passage Recommendations
  - Task: This will consist of four components:
    - The Panel will document progress and decisions made and provide or present them to the Group for their input at key milestones. The Panel will prepare a final report to document:
      - the process followed to prepare the report,
      - development of technically and biologically feasible fish passage alternatives,
      - evaluation criteria,
      - summary of alternatives including those that were eliminated and reasons why they were eliminated, and
      - the results of the Panel's final evaluation and recommendations for fish passage alternatives at SF Dam.
    - The final evaluation will summarize fish passage alternatives receiving detailed evaluation, including descriptive text and drawings for each,

opinions of probable construction and operating costs, an implementation schedule, and listing of pros and cons for each and a summary of evaluation details.

- Recommendations will be developed as part of this task, with consideration of the relative certainty of the capability of an alternative to provide fish passage around SF Dam, relative risk, and uncertainties. Recommendations might include identification of fish passage alternative(s) to be pursued, further studies needed to reduce uncertainties, or recommendation to explore non-passage alternatives and fish passage alternatives at sites other than Santa Felicia Dam (off-site alternatives).
- A draft Fish Passage Feasibility Report will be issued.

- Outcome: Final Panel Fish Passage Feasibility Study report with Panel recommendations for a preferred fish passage alternative, or additional study, will be developed and provided to the Group.
- Task 9, below, will have additional reporting sub-tasks.

- Task 8: Group Fish Passage Decision
  - Task: The Group will review the Final Panel Fish Feasibility Study report, and consider its recommendations at a meeting of the Group and Panel. A possible outcome of the meeting is for the Group to agree upon the Panel's recommendation of Task 7 of a recommended fish passage alternative or further study. If there is a consensus of the Group, the Study terminates, and the implementation process can begin. If there is no consensus among the Group, the Study continues with Task 9, an examination of off-site alternatives including an economic analysis.
  - Outcome: Decision to either continue with evaluation of off-site alternatives and economic analysis, or to proceed directly to implementation.
- Task 9: Biological and Economic Feasibility Analysis and Off-Site Alternatives Assessment
  - The process for Task 9 will follow a process similar to that established in the Study Plan for passage alternatives at Santa Felicia Dam.
  - The Panel will identify and develop feasible off-site alternatives (other than fish passage at Santa Felicia Dam) that might satisfy the biological goal of the Project avoiding jeopardizing the continued existence of the Southern California steelhead DPS.
  - Biological performance will be examined to assess contributions of these alternatives to the increased viability of the DPS and provide a means of comparison among all alternatives.

- The overall economic assessment will include the off-site alternatives and the recommended fish passage alternatives from Task 7, including capital investments and recurring operating costs. A cost effectiveness analysis will be conducted. The *preferred* alternative will be the one that meets the goal at *least cost* among all feasible alternatives.
- Outcome: Identification of off-site alternatives, if any, that satisfy the goal of the Project avoiding jeopardizing the continued existence of the Southern California steelhead DPS and biological and economic comparisons of all alternatives to select a preferred alternative.

4. STUDY METHODS AND WORK PLAN

This section provides additional study detail pertaining to a work plan that is intended to guide the conduct of the feasibility analysis. A work breakdown structure with major task headings is provided with defined tasks that can be used as the basis of a scope of work for the Panel members to implement this study. A Gantt chart schedule, showing each task and its relationship to other tasks along with a start date, duration, and planned completion date per the descriptions below is provided in Section 4.9.

An important component of the study will be frequent communication among and between Panel members, as well as between Panel members and the Group. This will be accomplished through meeting notes associated with the tasks described below, and with the distribution of Draft and Final Fish Passage Feasibility Reports. In terms of direct communication, the Panel proposes a series of meetings and web calls that will serve to discuss the Panel's progress on activities that will be used to present and discuss the fish passage concepts under consideration. A series of four (4) Group meetings is proposed to keep the Group informed of the Panel's progress and decisions throughout the study, and for the Panel to receive timely feedback from the Group. The meetings are scheduled to take place at specific milestones in the Panel's work, when results are available to present. Input from the Group will then be used by the Panel described in the work plan below.

Panel and Group meetings recommended for each task of the Study Plan are identified within each task below, and are designed with a meeting identification as follows:

- Meeting P1 Denotes Panel Meeting #1
- Meeting G2 Denotes Group Meeting #2

The Panel recommends the following Meeting Protocols for the Study implementation, and has incorporated these suggestions into the Study Plan schedule presented in Section 4.9.

- Panel meetings are intended to be facilitated and physically attended by all Panel members. Additionally, the Panel will invite technical experts from United, NMFS, CDFG, and potentially others as necessary for specific meetings as described below to assure that the Panel has proper and accurate technical information so that technical questions can be answered in a timely manner.
- Group meetings assume that all Group members can attend the stated meetings in person, and the Panel will decide on whether all or select Panel members must attend in person or can attend via a web meeting.

- Reasonable meeting schedule dates and distribution of information prior to the meetings will be managed by the Panel with assistance from United. Meetings will be scheduled at least six weeks in advance, and will be announced with a time, place, expected attendee list, and a preliminary agenda. Preliminary meeting dates are identified in Section 4.9, and in the Gantt Chart schedule, which will be updated once the Panel receives a formal notice to proceed date from United.
- Information to be discussed at Group meetings will be distributed by the Panel at least two weeks prior to the scheduled meetings.
- Meeting notes will be taken by the Panel, and a draft meeting record will be distributed within two weeks of each meeting for review and approval. All meeting agendas and notes are intended to be part of the FERC consultation record regarding this study.

4.1 TASK 1 – FEASIBILITY STUDY PREPARATION

Task 1 is focused on the technical preparation for the concept development brainstorm session described in Task 3. The Panel will compile and review salient background information needed to prepare for a concept development brainstorming workshop, and will prepare workshop materials including further development of evaluation criteria and an evaluation process. The review will allow Panel members to become familiar with the operational, physical, hydrologic, and biological setting of the SF Dam. This information will be important for identifying alternatives that can reasonably and realistically fit within the construct of the existing Project operations, are compatible with hydrological and physical constraints, and that meet the stated objectives of the RPA Elements.

This background information will be utilized and added to as necessary throughout all tasks of the Study, and will be documented as described in Task 7.

4.1.1 Task 1-1 Compile Background Information

Information to be compiled and reviewed will include:

- Project and related operations summary, with a brief narrative on operations in a:
    - Average water year
    - Wet water year
    - Single-dry water year, and
    - Multiple-dry water year scenarios
    - Spill events
    - Pyramid Dam operations such as bypass flows and operational uncertainties

- Biological design criteria and data summary that includes:
    - Migration seasons by species (i.e., periodicity by species)
    - Upstream and downstream fish passage hydrologic windows, and relative to average, wet and dry years including antecedent conditions.
- Key fish passage design flows
- Forebay and tailwater stage-discharge curves
- Project working drawings, simplified and suitable for brainstorming alternatives that include:
    - Overall Project site plan
    - Sections through the dam, with design water surface elevations
    - Sections and applicable details of the powerhouse
    - Enlarged plans at head of reservoir and dam outlet areas
    - A longitudinal profile from below the dam to the upstream limits of the reservoir

Some Project information is protected for security purposes as required by FERC's Critical Energy Infrastructure Information (CEII) regulations, so its distribution and use will be carefully controlled. The Panel assumes United will define an information management protocol throughout the study process to meet the CEII requirements.

4.1.2 Task 1-2 Prepare Evaluation Matrix and Update Criteria

Following the compilation and preparation of background information, the Panel will review the draft evaluation criteria and provide any applicable updates based on this additional information. A draft evaluation matrix will also be developed in this task, for Panel discussion in Task 3.

4.1.3 Task 1-3 Identify Critical Data Gaps

The Panel will discuss the information noted above during planned web calls, and determine its completeness for the fish passage assessment needs. If information is missing or additional information is desired, the Panel will work with the Group to take appropriate steps to acquire the necessary material. This process to address any information gaps will be identified based on the specifics of the necessary information, and a plan to address this information need will be formulated with Group input.

4.1.4 Task 1-4 Meeting Preparation

Using the information developed above, the Panel will identify design flow ranges, select hydrologic design years, develop preliminary working base drawings, and will coordinate with

other Panel members to prepare for the initial Brainstorm workshop. An information package containing a summary suitable for use in the brainstorm workshop will be distributed to the Panel members in advance of the meeting, and to Group technical representatives who will be invited to the Brainstorm session. Six weeks are scheduled for Panel members and Group technical representatives to review and discuss this information prior to the Brainstorm workshop described in Task 3.

4.2 TASK 2 – PREPARE BIOLOGICAL PERFORMANCE TOOL

This task involves development of a biological performance tool that will be used to estimate potential steelhead passage survival using fish passage concepts to be identified and refined in the feasibility study. In addition, compiling information on steelhead migratory behavior, preferably behavior specific to Santa Clara River system steelhead, will help identify the type, location, size, and timing of potential upstream and downstream fish passage facility components. Additional information needs may be defined during the compilation and studies could be designed and implemented to provide such information. Fish passage concepts to be identified in Task 3 represent additional pathways through the Project and are expected to provide increased passage survival compared to existing pathways. The proportion of the migrant population using each migratory pathway, and the estimated survival associated with each migratory pathway, will determine the biological performance and contribute to the feasibility evaluation of fish passage concepts identified and developed in the study.

Successful steelhead passage at the Project must consider both upstream and downstream migratory pathways. Upstream fish passage systems are typically designed around considerations of upstream collection and upstream passage. Upstream collection defines the ability to attract and collect fish from downstream of a barrier. This characteristic includes the ability to behaviorally or hydraulically attract or guide the fish from the river into a fish collection chamber. Typical features of an upstream collection feature include a collection facility entrance (weir, orifice, slot, etc.), attraction flow to draw fish into the entrance, and a collection pool that encourages fish to stay, or traps fish in the facility to prepare for transport past the dam. Upstream passage defines the means to move fish from the collection pool to a release site upstream of the dam. Typical features of the upstream passage component include various styles of fish ladders, fish lifts, fish locks, or trap and transport programs.

Upstream Collection and Passage – The upstream collection component is typically the most challenging upstream passage feature to locate and design. The collection component must accommodate the behavior of the target species, complement other flow control operations, river hydrology, site hydraulics, and water quality. When comparing projects, the entrance component

is typically the most variable of any other fishway feature. As a result, fishway entrances are often modified after their initial construction to help improve their attraction performance. Once fish are collected, the means to transport them past the dam is more straightforward to address.

With respect to upstream passage, effective attraction requires sufficient flows to attract upstream migrants away from other competing flows from spill, generation or other releases. Thus, the frequency, magnitude, and location of flow releases play an important role in determining appropriate attraction flow designs and the feasibility of effective attraction. Effective attraction to fish passage facilities may be further complicated where flow releases occur at separate locations, such as a powerhouse discharge channel separate from a spillway release channel.

Upstream migrants that are successfully attracted to an upstream passage facility must then be effectively collected in such a way that minimizes migratory delay and injury. Dam height and the degree of water surface elevation fluctuations in the upstream reservoir may dictate the relative feasibility of various transport options. Potential thermal shock must also be considered when considering upstream passage facilities. Fish entering an upstream fish passage facility will be acclimatized to water temperature in the tailrace area. If fish are transported upstream around a dam, the transport water and release site must have similar water temperatures or the fish will be exposed to thermal shock and stress. Surface water temperatures at the release location, risk of fallback, and reservoir passage survival may affect the advisability of releasing adult steelhead into the reservoir forebay or an alternate upstream location.

Downstream Passage – Fish outmigrating downstream from the Piru Creek Basin must successfully navigate through Lake Piru and successfully find and use a pathway past SF Dam. The timing of entry into the reservoir, outmigrant size, migratory readiness, temperature, and inflow and outflow conditions will affect the survival rate of steelhead migrating through the reservoir. In general, smaller migrants (i.e., fry) will be more vulnerable than larger migrants (smolts) in reservoirs, where predation is often size selective. Reservoirs with straight linear shorelines are more conducive to downstream migration than reservoirs with multiple arms and coves which may cause shoreline-oriented outmigrants to delay their downstream progress. Smaller, younger fish may also suffer greater injury or mortality than larger fish when navigating through reservoirs due to swimming speed limitations and predation.

Once outmigrants successfully approach a dam forebay, they must successfully find and enter a pathway past the dam. Potential pathways include turbines or other conduits, spillways, or downstream fish passage facilities. Each of these migratory pathways provides potential passage through the Project, but each pathway exposes migrants to potential injury and mortality.

Depending on pathway availability, size of migrant, time of year, flow condition, and steelhead behavior, the proportion of the outmigrant population using each pathway may change in response to project operations, flow conditions and seasonal timing. Since each pathway exposes migrants to varying risk of injury, the total survival of outmigrants represents the proportion using each pathway and the mortality associated with each pathway.

It may be possible to screen all fish away from hydroelectric turbines (full exclusion screen), and divert them through a safe downstream bypass facility under all but flood flow conditions. This may not be practical where the reservoir pool level exhibits significant fluctuations or where the volume of screened flow would be difficult to operate and maintain safe design standards for juvenile fish. Partial screens have been employed in combination with barrier nets that guide downstream migrants to the entrance of a collection facility. A floating surface collector is an example where outmigrating fish are guided to the entrance of the structure by pumps located behind the fish screens. The success of floating surface collectors typically depends on the use of nets (e.g., Baker Hydroelectric Project, Washington) or large volumes of flow (e.g., 6,000 cfs at Round Butte Dam, Oregon) to guide fish to the entrance. Similar to reservoir passage, larger outmigrants may have greater survival than smaller, younger fish when navigating through dam passage facilities due to swimming speed limitations (Ferguson et al. 2007).

Although several fish passage facilities may be designed to meet biological design criteria, performance of each facility will vary depending on site-specific conditions. As stated in the January 12, 2012 revision to the NMFS Fishway Design Manual (NMFS 2012):

> *"It is important to note that criteria and guidelines in this manual are not rules. Rather, the Fishway Design Manual is intended to allow design teams to begin with criteria and guidelines known to provide safe, timely and effective fish passage at numerous fish passage facilities in the Pacific Northwest. Then, criteria and guidelines can usually be adapted to site specific conditions at new projects."*

Determining which facility design may be best-adapted to site conditions is a continuing challenge for engineers and biologists, as evidenced by the significant post-project monitoring and modifications that occur at some projects.

Fish that do not pass downstream through fish passage facilities may exit through other pathways, including turbines, other conduits, or spillways. The survival of turbine-passed fish depends on the characteristics of the generating equipment (e.g., the type and size of the turbine, head [related to the difference between reservoir pool elevation and elevation of the turbine], and

size and species of entrained fish). Pelton-type turbines (impulse turbines) designed for high-head installations typically cause very high levels of mortality due to their basic design. In a Pelton turbine, water is directed at high pressure onto clamshell buckets attached to the periphery of the impeller wheel to impart a torque on the turbine impeller. High rotating speeds and tight clearances mean almost 100 percent fish mortality. The survival of outmigrating fish encountering Francis turbines[2] depends on the head, runner diameter, rotational speed and other factors, but may be 70 percent or greater. Other factors being equal, smaller fish exhibit higher survival than large fish when passing through a Francis turbine. Although flow discharging from Francis turbines may appear turbulent, much of the flow energy is used to generate electricity and turbine discharge flows can be safely passed downstream.

If flows from a medium to high head dam are not released through turbines, some other type of energy dissipation device is used to safely contain and reduce the flow energy. Flow dissipation devices, such as cone valves redirect pipe flow into a free-discharging conical jet to pass a controlled amount of water downstream with no damage to the immediate surroundings. Fish entrained in the flow must also pass through the energy dissipation device with extremely poor to no survival. Fish passing through turbines may have much higher survival rates than fish passing through energy dissipation devices.

Survival of fish passing through spillways is primarily affected by shear and strike. Damaging shear occurs when the plunging spill flow enters a tailrace, and there is a substantial difference in velocities where the two flows come together (Nietzel et al. 2000). Strike can occur if the spill flow comes in contact at high velocity with projections within the spillway chute, or with rock along the bank or the bottom of the plunge pool. Other areas of concern for spillway passage survival may be the minimum gate opening and the bottom conditions downstream of the concrete discharge chute (stilling basin). If the gates are only open a small amount to pass small spill flows, then characteristics of the high-velocity jet through the thin opening below the gate could injure or kill fish. Additionally, passing small spill flow volumes results in a very thin sheet of high-velocity water as the flow passes down the spillway, exposing fish to an increased likelihood that they will 'scrape' along the concrete rather than simply ride down in the water column. If the bottom surface downstream of the spillway discharge chute is rough and jagged it could result in fish impacting or scraping on portions of the bottom surface as they move

[2] The Francis turbine is a reaction turbine, which means that the working fluid changes pressure as it moves through the turbine, giving up its energy. The turbine is located between the high-pressure water source and the low-pressure water exit, usually at the base of a dam.

downstream at high velocity. Concentrations of predators within a stilling basin can also affect fish survival.

Biological Performance Tool – The biological performance tool will consist of a spreadsheet-based fish passage model that tracks steelhead survival through various migratory pathways through the SF Dam and reservoir. The values developed using the fish passage model will be used to compare and evaluate potential fish passage concepts, but will not represent estimates of the size of the steelhead population. Estimates of the proportion of the potential migrant population using each pathway will be integrated with estimates of survival associated with each pathway under representative average, wet and dry hydrologic conditions. An evaluation of the uncertainty associated with each assumption will provide an indication of the robustness of modeling results and the potential influence on recommendations of fish passage feasibility.

While life cycle models are often used to evaluate opportunities to restore salmonid populations, the feasibility of restoring a self-sustaining steelhead population is a broader ecological question than the feasibility of steelhead passage at the Project. The Panel believes that the biological performance tool will be useful as a framework for evaluating fish passage concepts and fish passage feasibility. The Panel believes that a complete life cycle model could be developed and used to develop actual numerical population targets, evaluate population viability, and quantify the risk of extinction; however, based on discussions following the first draft of the Study Plan, this level of analysis will be reserved only for potential future use as described in Task 8.

The primary tasks in the Task 2 analysis involve:

- Task 2-1: Compile Background Information on Migratory Pathways;
- Task 2-2: Identify and potentially fill Critical Biological Data Gaps; and
- Task 2-3: Develop and Populate Fish Passage Model with Available Information.

4.2.1 Task 2-1 Compile Background Information on Migratory Pathways

Information needed to develop and populate the fish passage model includes physical, hydraulic and biological information on: conditions in Lake Piru, hydropower generation turbines and other conduits for flow releases, spillway gates, and the size, location and operational characteristics of fish passage facilities to be identified in the study. Information needed to develop and populate the fish passage model will be drawn from existing site-specific data, studies conducted in the area of the Southern California DPS, results of studies conducted at other water control projects, conceptual-level drawings of potential fish passage facilities, and where appropriate the professional opinions of the Panel and Group.

Passage conditions will be evaluated using average daily flows and Project operations data for representative average, wet, and dry years. Project operations data will include daily reservoir water surface elevations, average daily flow releases through turbines and other conduits, and average daily flow through the spillways. Due to operational changes at the SF Dam, and changes in flow release guidelines at upstream Pyramid Lake implemented since 2005, historic records of hydrology and reservoir pool levels are not indicative of future conditions. During the FERC relicensing process, a reservoir model was developed by United and then refined in collaboration with the CDFG, and the Regional Water Quality Control Board (McEachron 2011). The model was used to synthesize daily Lake Piru inflow, flow releases, and reservoir pool levels for the period 1943 to 2010 under existing operating rules for Pyramid Lake and SF Dam. Flow releases from SF Dam were modeled in accordance with the FERC Water Release Plan (United 2010b). United revised the 2010 FERC Water Release Plan in 2012 (United 2012). The modeled flow releases from the 2010 FERC Water Release Plan are also contained within the 2012 FERC Water Release Plan and remain representative of current and proposed future conditions. Representative years will be selected in coordination with the Group to evaluate fish passage facilities. Information compiled as part of Task 2-1 will be used to populate the fish passage model and will be presented with a progress report at the end of this task. Additionally, this information will be discussed with the Group during Meeting #G1.

4.2.1.1 Passage Considerations in Lake Piru

Juvenile and adult steelhead passing the Project must pass through SF Dam and Lake Piru. During reservoir passage they may be exposed to predation, poor water quality, thermal gradients, or become disoriented and delay or fail to pass through the reservoir. Fish passage facilities to be considered may include several different locations in the dam forebay; however, some types of fish passage facilities could also be located at the head of the reservoir or in Piru Creek. In order to compare and evaluate the range of potential fish passage facilities, a fish passage model must consider passage through both Lake Piru and SF Dam. Specific passage related factors within Lake Piru include:

- Average daily reservoir inflow under average, wet, and dry water years
- Periodicity of steelhead migration (peak and shoulder periods)
- Monthly reservoir water temperature profiles
- Daily reservoir water surface elevations under representative average, wet, and dry water years
- Relationship of fish migration rate to average daily flow
- Species, abundance and feeding behavior of potential piscivorous predators

4.2.1.2 Turbine and Other Conduit Passage Considerations

Fish passage related factors associated with turbines or other conduits include:

- Elevation and style of turbine intake
- Diameter, material, age, number and angle of conduit bends
- Capacity and style of energy dissipation devices (e.g., cone valves)
- Turbine characteristics (type, capacity, head, operating speed)
- Daily reservoir water surface elevations under representative average, wet, and dry water years
- Record of average daily flow releases under representative average, wet, and dry water years

4.2.1.3 Spillway Passage Considerations

Fish passage related factors associated with spillways include:

- Elevation and style of spillway gates
- Frequency and size of gate openings
- Material, gradient, and roughness of spillway chute
- Stilling basin bathymetry
- Species, abundance and feeding behavior of potential piscivorous predators in stilling basin
- Water quality conditions, such as temperature or total dissolved gas during spill
- Daily reservoir water surface elevations under representative average, wet, and dry water years
- Pattern of spillway operation under representative average, wet, and dry water years

4.2.1.4 Fish Passage Facility Considerations

Successful fish passage facilities must attract and guide migrating fish into the facility where they are captured and passed downstream in a safe, timely, and effective manner. Fish attraction and guidance may be enhanced by the volume of attraction flow, the use of barrier or guidance structure or nets, and siting of the facility in a location to intercept migrating fish. Fish safety through the facility is ensured by designing components following guidelines in fish passage design manuals (CDFG 2009, NMFS 2012). However, fish passage facilities that satisfy design guidelines may still function under a range of fish guidance efficiency and survival depending on

site specific conditions and behavior of the target species. Factors associated with the feasibility of fish passage facilities include:

- Style, size, design and volume of facility
- Effectiveness of fish guidance or barrier structure or nets
- Frequency and effectiveness of screen cleaning
- Behavior of target species in response to facility design
- Frequency and duration of operation under representative average, wet, and dry water years

4.2.2 Task 2-2 Identify Critical Biological Data Gaps

The Panel will discuss the information noted above during planned web calls, and determine its completeness for the fish passage biological evaluation needs. Evaluation of each migratory pathway requires structural and hydrologic information and assumptions regarding steelhead behavior. Where site specific data are not available, survival estimates can be based on data collected in nearby watersheds, literature values, or professional opinions of the researchers. The need for robust site-specific data varies between migratory pathways. Some pathways may be relatively insensitive to parameters involving steelhead behavior, whereas other pathways may be highly sensitive to estimating fish passage facility performance. If additional information is needed, the Panel will work with the Group to take appropriate steps to acquire the necessary material or develop reasonable assumptions. The process to address information gaps will be identified based on the specifics of the information. If data gaps are identified that prove critical to the feasibility evaluations and Panel recommendations, the Panel will identify the most appropriate means to fill those gaps, including influence on ability to complete an meaningful analysis, timing to acquire and evaluate the information and potential outcomes as they could affect the recommendations by the Panel.

The following steps will be utilized in Task 2-2:

- Perform a background review of biological information, and identify information needs.
- Identify any biologically-related critical data gaps.

4.2.3 Task 2-3 Develop and Populate Fish Passage Model with Available Information

Potential fish passage facilities at the Project will be evaluated using the biological performance tool that tracks outmigrant survival through various migratory pathways at SF Dam and reservoir. The biological performance tool will be used to conduct a relative comparison of the biological performance of fish passage facilities, but by itself will not represent estimates of

steelhead productivity. An evaluation of the uncertainty and sensitivity of the assumptions used to develop the mathematical functions will provide an indication of the robustness of modeling results. Evaluation of critical parameters, and background information available to define them, will be evaluated to determine the influence of the values in evaluating the potential feasibility of fish passage facilities.

One goal of the fish passage model is to incorporate a mechanism to easily alter the percentage of fish that move through each potential migratory pathway as a function of river flow and reservoir water surface elevation. A flow response factor will be developed for steelhead outmigrants to identify how migrants respond to flow. An initial response factor may assume that the number of fish entering the project on a given day in the migration period is approximately proportional to the volume of the daily reservoir inflow in relation to the total inflow during the migration period. Using separate calculations for peak and off-peak migration periods, the total volume of inflow will be calculated and the proportion of fish migrating per day will be based on the percent of total flow for each day under average, wet and dry representative water years. An alternate response factor could assume that an equal number of fish passes each day in the migration period, or migration rates are correlated to water temperature. By incorporating an adjustable value, the sensitivity of the response factor to changing conditions will provide an indication of the influence of the response factor in evaluating total Project survival.

While there will be a level of uncertainty associated with various mathematical functions, other factors may affect the feasibility of fish passage facilities. For example, the relationship between reservoir inflow and steelhead reservoir migration rates may have an apparent high level of uncertainty. The results of this parameter may influence the siting of a smolt collection facility in Piru Creek, at the upper end of Lake Piru, or at the dam forebay. However, the technical practicality of maintaining effective outmigrant collection under episodic high flow events may determine the feasibility of siting a fish passage facility independent of smolt reservoir migration rates.

The mathematical functions used to calculate survival between migratory pathways will be developed in an Excel or other spreadsheet formats to ensure transparency and ease of stakeholder review. The results of the biological performance tool will be an estimate of system survival for fish passage through Lake Piru and SF Dam for each passage alternative. In addition, similar flow response functions and pathway apportionment will be used to estimate fish passage survival under existing conditions without fish passage facilities. Although steelhead are currently blocked from migrating upstream past SF Dam, downstream migration can still occur through the spillway. During some high flow conditions, juvenile rainbow

passing downstream through the Project may survive passage through the spillway and recruit to the Southern California DPS of steelhead. Evaluating Existing Conditions and fish passage facilities will provide a comparison of biological performance and the relative benefit of potential fish passage facilities.

Flow will be apportioned among available passage routes following guidelines provided by United in their synthesis of daily flow and reservoir pool levels (McEachron 2011). If the turbines are not available for power generation, flow will be routed through the bypass conduits. The percentage of fish passing through each flow pathway will be exposed to the level of potential mortality associated with each route and the total of all flow pathways will represent Project survival (Figure 1). The estimate of Project survival will include the percent of migrants that do not enter a passage route and remain in the reservoir.

The results of the analysis will also be used to provide feedback and identify potential modifications to improve facility effectiveness. For instance, the volume of attraction flow water is an important design feature of facility components. Attraction flow volumes for both upstream and downstream are a balance between site conditions, competing flow releases, and cost. Alternate attraction flow volumes can be examined in terms of Project fish survival to assess facility sizing options. The feedback mechanism provided by fish passage model results will assist engineering decisions and allow each concept to be refined so that the optimum design of each fish passage alternative can be used in the feasibility evaluation.

Parameter values will be estimated from site specific data, borrowed from other populations, or professional opinion based on steelhead passage behavior. Each assumption will be identified and documented and major parameters will be accompanied by an evaluation of uncertainty.

The following steps will be utilized in Task 2-3:

- Prepare the biological performance tool, which will be a spreadsheet-based passage evaluation model.
- Populate the model with data and perform sensitivity runs to assess the model's output prior to use on the fish passage concepts and alternatives.

The deliverables for this task include:

- a compilation of background information related to the project biology,
- a draft of the spreadsheet based model and data set, and
- a sample of model runs with output and a preliminary sensitivity analysis.

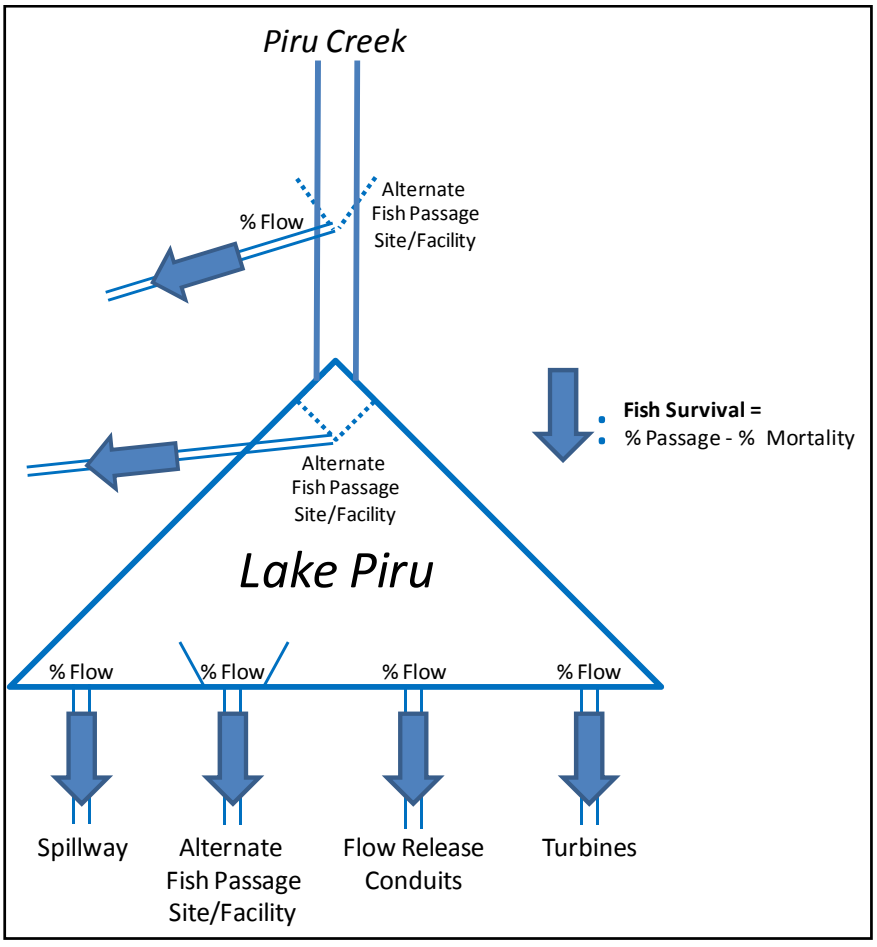

Figure 1. Conceptual schematic of downstream fish passage survival model under alternate fish passage facilities at Santa Felicia Dam and reservoir. Project survival calculated by totaling daily survival over the outmigration period during average, wet, and dry years.

4.3 TASK 3 – IDENTIFY FISH PASSAGE CONCEPTS

4.3.1 Task Overview

This task will utilize a facilitated 2-day brainstorm session (Meeting #P1) to identify fish passage concepts. The workshop environment allows rapid and complete generation of fish passage concepts, based on the Panel and Group technical members' diverse expertise and experience with related facilities. The Panel will develop concepts based on the professional judgment of Panel members as well as studies, experience, and history of other fish passage facilities and specific criteria and guidelines published by NMFS and CDFG. Concepts might be components of fish passage facilities, operational procedures, locations of facilities, or entire facilities.

Following the brainstorm exercise, the concepts will be grouped and organized during the meeting for an initial evaluation, and the Panel will utilize its expertise to perform an initial "fatal flaw analysis" to eliminate any concept that cannon meet the basic criteria. Concepts at this early phase of development that are fatally flawed will be documented but will not be further developed. Fatal flaws might include dam or personnel safety issues, constructability concerns, or poor chance of satisfying fish passage or other objectives of the SF Dam. Concepts without fatal flaws will be considered technically feasible for further analysis and development.

The biological performance tool developed in Task 2 will be reviewed by the Panel and tested at the meeting to assure all necessary parameters and data are provided to address the short list of passage concepts. The goal of this exercise is to obtain feedback and critique of the biological model by all Panel members to assure all parameters and model needs are included prior more formal use of the model in the next task.

The remainder of Task 3 will be to compile a meeting record, and organize the work to develop concepts by small groups or individual Panel members that will continue in Task 4. The sections following this introduction and overview provide additional detail on the task specifics.

4.3.2 Task 3-1 Meeting #P1, Panel Brainstorm Session

4.3.2.1 Meeting Protocols and Preparation

The brainstorm session will be conducted with few limitations. A Panel member will be selected as a facilitator prior to the meeting to assure the workshop is conducted in an efficient manner. A designated note taker will also be selected to record and distribute draft meeting notes for Panel review. Workshop facilities will be suitable for a team meeting, with flip charts, visual aids, and copy machines available. Towards the end of the workshop, roles will be assigned for individual Panel members to further develop alternatives for ongoing discussion.

The initial list of concepts will be refined using the background information developed in Tasks 1 and 2, and physical considerations described below. Existing and expected future conditions at SF Dam will be considered with the concept development. This will include any relevant requirements adopted as a result of RPA Element 1 (geomorphic effects) or RPA Element 2 (flow release schedule), and any operational or physical conditions that might be affected by United. Concepts will be developed based on design considerations described below, NMFS and CDFG fish passage guidelines, and the Panel members' professional experience and opinion regarding fish passage facilities. Feedback during this design development process will be sought from the Group.

The identification and design of concepts will include both physical (including biological and environmental) considerations, and specific evaluation criteria, as defined below.

- Physical considerations are the physical background and setting into which fish passage facilities must be built and operated. They describe aspects of the dam, reservoir, stream channel, hydrology, facility operations, and biology that must be considered in the design of fish passage facilities.
- Evaluation criteria will help to estimate each alternative's expected level of success in achieving fish passage and Project purpose. Evaluation criteria are similar to physical considerations though are specific and quantified. An initial list of evaluation criteria is in Appendix C.

In addition to the evaluation criteria (see draft criteria in Appendix C), the following considerations will guide the Panel:

- Additional dam and reservoir considerations include the size, height, structure, layout of the dam, topography around it, access, any potential entrance or exit locations, and any necessary ancillary structures.
- Additional operational considerations include any effects on dam operation both during normal operations and during fish passage facility construction.
- Hydrologic considerations include inflow timing and magnitude, reservoir pool levels and rate of change, the flow release schedule, and spill timing, rate, and frequency. The outflows from the dam are influenced by the 2012 Water Release Plan, which will be reviewed by the Panel and used as a guiding but not limiting factor in the identification, development and evaluation of fish passage facilities. The Panel recognizes that its assessment of alternatives needs to take into account the fact that water releases contained in the 2012 plan may change over the term of the license because United is required to adaptively manage water releases under RPA 2(c). Nevertheless, in assessing the technical feasibility of passage alternatives, the Panel may consider whether the alternatives can function within the constraints of the required operations of the Project, including allocation of a limited water supply, as described in evaluation criterion C-2.3.
- Biological considerations include species to be passed and species present, migration timing and behavior, swimming abilities and behaviors, reservoir passage, and issues of rearing, predation, or residualization in the reservoir, risk of spillway passage, and water quality.

4.3.2.2 Brainstorm Session Agenda

Panel members will review the compiled information and the draft evaluation criteria and evaluation matrix that will be used prior during the brainstorm workshop. The Panel envisions the two day workshop to be organized as follows:

Brainstorm Meeting #P1 – Day 1

- Review, edit and define meeting rules and protocols, and finalize the agenda.
- Briefly review Project and fish passage feasibility background information.
- Review available biological information, discuss desired information, and discuss how results could impact evaluations. For example, it is currently unknown whether downstream fish passage through the reservoir provides a benefit for fish rearing or a significant risk by predation or residualization. Assumptions will be made initially for such criteria but may have to be modified later when additional information is available.
- Review the biological performance tool developed in Phase 2, so all participants are aware of its structure, use, sensitivity, and value to the concept development process.
- Review and update evaluation and comparison criteria prior to brainstorming, so all meeting attendees are familiar with the criteria that must be met or addressed.
- Begin structured brainstorm activity to develop a list of concepts for both upstream and downstream passage. Concepts will be recorded with limited text and sketches to clearly communicate the concepts.

Brainstorm Meeting #P1 – Day 2

- Finish brainstorming concepts after the evening break, to assure all reasonable concepts are identified.
- Group concepts into like categories and consolidate similar ideas. Consolidate any upstream and downstream concepts into stand-alone passage concepts that are inter-dependent.
- Identify risks and uncertainties associated with each concept, and develop a list of study and information needs that will be required to finalize selection of concepts. This will include and information needed to confirm poor viability of any concept with fatal flaws.
- Review concepts with respect to obvious fatal flaws. Any alternatives that are not constructible, or that have less than a good chance of satisfying all crucial criteria (i.e.; fatally flawed) will be dropped from consideration. If a concept is to be dropped due to high risk or uncertainty, discuss how this uncertainty could be reduced. Descriptions of those alternatives and their fatal flaws will be summarized with a meeting record for the final report.

- Review the biological performance tool with respect to the concept list to assure it can accommodate the list of concepts. Run the spreadsheet model with examples to educate the Panel on expected output and level of sensitivity, and to address any preliminary data and output.
- Conduct further brainstorming and development or refinement of fish passage concepts relative to the evaluation criteria as time allows.
- Assign members to develop conceptual designs for short-listed alternatives and to document those that were not selected
- Adopt a common format for alternative development in Task 4.

4.3.3 Task 3-2 Meeting #P1 Summary

The deliverable for Task 3 will be a meeting summary with the following:

- Updated criteria document and a draft evaluation spreadsheet.
- List of fish passage concepts identified in the brainstorm session.
- List of additional information necessary to reduce uncertainty or risks associated with each concept.
- A discussion of the fatal flaw analysis, and documentation of concepts eliminated from further consideration at this time.
- Status update on the biological performance tool and any further development recommended by the Panel.
- A short list of fish passage concepts for further development.

This summary document will be distributed within two weeks of the meeting date.

4.4 TASK 4 – CONCEPT DEVELOPMENT AND ALTERNATIVE DEFINITION

Task 4 will result in the development of the fish passage concepts identified in Task 3, and the assembly of various concepts into full fish passage "alternatives" (upstream and downstream fish passage systems) applicable at the SF Dam. The fish passage alternatives will be developed to address site-specific constraints, describe the full hydraulic functional design and general layout of each alternative, and will identify any uncertainties associated with each alternative prior to the evaluation process.

Potential volitional fish passage alternatives will be identified and evaluated concurrently with other alternatives. Volitional passage is the concept of giving fish the choice of moving upstream or downstream based on their own motivation. Pure volitional passage would not

include any facilities for trapping or hauling fish. The Panel will use the following definition of volitional passage:

> *"Volitional fish passage is a means of fish passage with appropriate hydraulic conditions such that all individual migrating adult and juvenile fish of the species of interest have the opportunity to move freely and safely upstream and/or downstream past the Project according to their own motivation."*

Under volitional passage, a barrier is modified such that fish arrive at the site under their own power, swimming through or around and past the former blockage. A concrete fish ladder is an example of a volitional facility for adult steelhead. Volitional fish passage facilities are generally preferred because they operate constantly, require little human interference, and may be mechanically less likely to break. They may be less costly to maintain and operate but may represent a larger capital expenditure. However, volitional facilities often provide little flexibility to accommodate uncertainties, or to adjust to changes in fish behavior, environmental or operating conditions.

A trap and transport operation is a type of non-volitional fish passage used where volitional passage is not logistically, technically, or biologically possible, and fish must be actively moved upstream and/or downstream around barriers. Space or engineering constraints may prevent the design of safe and effective, volitional fish passage facilities. Trap and transport allows reintroduction to target specific sites for release. For example, spawning adults could be released into the highest quality habitat or dispersed among several upstream reaches. Particularly for juveniles, impoundments may present challenges that cannot be overcome with volitional passage if currents confuse downstream fish navigation or if an abundance of predators would reduce survival below a level consistent with self-sustaining production. In some situations, non-volitional facilities can be a preferred method of providing fish passage. Non-volitional fish passage facilities can also be implemented on an interim basis, monitored, and then hardened into volitional passage facilities if site conditions are appropriate.

At least one pure volitional passage alternative for upstream and downstream passage will be included in the final set of alternatives throughout the study, regardless of its feasibility. There may also be alternatives that have volitional passage characteristics though are not entirely volitional.

Once alternatives are defined, an initial opinion of probable construction and operating cost will be provided in this task for each alternative based on comparative values to other systems. The

estimated performance of the alternatives will be compared using the biological performance tool developed and updated in Tasks 2 and 3.

Alternatives that are not feasible will be dropped from consideration and reasons for them being dropped, will be described. It may be the case that an alternative scores low due to a specific uncertainty; in this case, the alternative will be retained and a plan to address this uncertainty developed. Based on the evaluation scores, the Panel will update the remaining alternatives for presentation to the Group.

A Group meeting will be held in this Task to present the Panel's work to date, discuss the alternatives and their relative scores, and propose a final list of alternatives for additional development. Based on this input, the Panel members will revise and update the alternative list, and begin additional design efforts to better define alternative characteristics for further evaluation in Task 5. Task 4 will result in alternative descriptions including: brief descriptive text and drawings, estimates of biological performance, uncertainties, and initial opinions of probable construction and operating cost.

4.4.1 Task 4-1 Develop Initial Concepts

Panel members (or small teams of Panel members) will be assigned individual alternatives to develop for further Panel and Group discussion based on the concepts identified in Task 3. The primary goals of this task are:

- Define each concept with respect to its hydraulic and operational characteristics,
- Draw and define the concepts so that the design intent is clearly communicated to all Panel and Group members. A common format for drawings will be developed by the Panel in this task.

Panel members will develop each alternative to provide:

- Plan and sectional drawings to scale, to fully define the concept,
- Hydraulic characteristics and function design features, shown on the sketches, or on separate sheets,
- Brief write-up suitable for panel member review to describe the concept's key characteristics and how the alternative operates,
- List of pros and cons for each alternative relative to operations, biological performance goals, reliability, etc., and
- Probable opinion of construction and operating cost and complexity (high, medium, or low).

With the additional investigation, some concepts may prove to be infeasible or may be modified into two or more concepts. As noted above, at least one upstream and downstream volitional alternative will be retained for the duration of the study. Panel members will use discretion and experience to develop concepts, and will coordinate with other Panel members via web meetings scheduled at two-week intervals, and on an individual basis as needed.

4.4.2 Task 4-2 Prepare for Meeting #P2

Following development of each alternative, a facilitator will compile all of the alternatives into a single discussion document for distribution to all Panel members. The Panel will be given at least 2 weeks following distribution of this document to prepare for Meeting #P2.

4.4.3 Task 4-3 Meeting #P2, Panel Review Concepts and Define Alternatives

A second Panel workshop (Meeting #P2) will be conducted to:

- Discuss and refine the concepts developed to date,
- Select preferred concepts, and combine the concepts into site specific upstream and downstream fish passage alternatives to fit the SF Dam requirements.
- Make recommendations for further action, and prepare for the first Group meeting.

A panel member will be assigned to take and distribute draft meeting notes. Workshop facilities will be suitable for a team meeting, with flip charts, visual aids, and copy machines available.

The two day Panel meeting will be organized as follows:

Meeting #P2 – Day 1

- Discuss and critique/refine the fish passage concepts developed to date.
- Discuss and refine evaluation criteria based on the current state of the concepts.
- Identify any criteria that, if not satisfied to some degree, would constitute a fatal flaw.
- Identify any uncertainties and/or risks associated with each concept, and a means to address these issues.
- Run the biological performance tool, to gain an understanding of the fish passage performance of the various concepts.
- Perform a fatal flaw analysis on the concepts, eliminate any concepts with fatal flaws, and record eliminated concepts for reporting in the meeting notes.
- Combine and consolidate concepts into distinct, stand-alone fish passage alternatives (upstream and downstream alternatives) appropriate for the SF Dam site. This exercise will be the first iteration of defining passage alternatives to be evaluated and further

developed. At least one upstream and downstream volitional fish passage alternative will be identified.

Meeting #P2 – Day 2

- Discuss and refine fish passage alternatives.
- Revisit the evaluation criteria, in light of the passage alternatives, and update the evaluation matrix for use in the next task.
- Identify any criteria related to the alternatives that, if not satisfied to some degree, would constitute a fatal flow.
- Eliminate any alternatives with fatal flaws and describe reasons in meeting notes.

4.4.4 Task 4-4 Meeting #P2 Summary

A meeting summary will be prepared with the following information:

- List of fish passage concepts identified in the brainstorm session.
- A discussion of the fatal flaw analysis and documentation of concepts eliminated from further consideration at this time.
- A list of fish passage alternatives identified for further development.
- Results of the biological performance tool runs conducted to date.
- Updated criteria document and a draft evaluation spreadsheet.
- List of additional information necessary to reduce uncertainty or risks associated with each alternative.

This summary document will be distributed within two weeks of the meeting date.

4.4.5 Task 4-5 Group Meeting #G1 – Alternative Presentation and Review

Meeting #G1 will be the first opportunity for the Panel to discuss the fish passage alternatives, criteria, and the biological performance tool developed to date. The topics for Meeting #G1 will include:

- Panel will present an overview of the work completed to date, and will address any questions from the previously distributed meeting notes.
- Review the biological performance tool developed in Task 2, including input parameters and sensitivity runs.
- Review the status and changes to the criteria document, and present the current evaluation matrix.

- Panel will present the list of upstream and downstream fish passage alternatives, and will discuss the list of concepts/alternatives eliminated to date due to fatal flaws.
- The Group will discuss and provide any critique to the identified alternatives.
- Discuss the next steps based on the future tasks identified in this Study Plan, and confirm the current Study Plan is still applicable or address any concerns at this time.
- Prepare a list of action items.

A meeting record will be prepared by the Panel for Meeting #G1, to be distributed for review within 2 weeks of the meeting.

4.4.6 Task 4-6 Develop Alternatives

Panel members (or small teams) will be assigned lead responsibility to sketch individual alternatives for further Panel discussion and evaluation in Task 5. Similar to the above task with the concept development, the primary goals of this task are:

- Define each alternative with respect to its hydraulic and operational characteristics.
- Draw and define the alternative so that the design intent is clearly communicated to all Panel and Group members. A common format for drawings will be developed by the Panel in this task to advance the alternative conceptual design status.

Panel members will develop each alternative to provide:

- Plan and sectional drawings to scale to fully define the alternative.
- Hydraulic characteristics and function design features, shown on the sketches, or on separate sheets.
- Brief write-up suitable for panel member review to describe the alternative's key characteristics and operation.
- List of pros and cons for each alternative relative to operations, fish passage effectiveness, reliability, etc., and
- Updated initial opinion of probable construction and operating cost and complexity (high, medium, or low).

Panel members will use discretion and experience to develop concepts, and will coordinate with other Panel members via web meetings scheduled at two-week intervals, and on an individual basis as needed.

Once the alternatives are developed, they will be compiled and reviewed by the Panel to prepare for the next meeting. After distribution of this review document, the biological performance tool will be run for each alternative so preliminary results are ready for the next Panel meeting.

Panel members will have one week to prepare for the next Panel meeting.

4.5 TASK 5 – INITIAL EVALUATION

Based on the alternatives developed through Task 4, an evaluation of the alternatives will be performed and documented in Task 5. Much of this task will be conducted with Panel and Group meetings.

The evaluation matrix will be utilized during a Panel meeting to prepare the first evaluation of the alternatives that will challenge the existing state of each alternatives conceptual design for better performance, and will allow a relative comparison of the alternatives. The evaluation will be done by using a grid analysis technique, or Pugh Matrix, which breaks the alternatives down into discrete elements for comparison, evaluation, and optimization. Breaking the alternatives into discrete elements reduces the possibility of alternatives being selected based on general prejudiced opinions. The matrix will result in consolidated scores, which reflect the relative success of achieving criteria, and will thus help rank or prioritize alternatives.

The results of the grid analysis can be used to further refine facility components, identify data gaps, and assess the potential influence of uncertainties. However, the grid analysis is only a decision tool; the results are used to influence but not dictate decisions. As mentioned earlier, the process of developing and using the matrix is explained in Appendix C along with provisional criteria that will be used within it. The characteristics and effectiveness of upstream and downstream fish passage facilities will be evaluated, and the results used to refine and optimize the location, size and timing of each type of passage facility.

Based on the results of this initial evaluation, the Panel will work together to update descriptions and drawings for the fish passage alternatives. The results will be presented to the Group at a meeting, with the goal of reaching consensus on a final list of alternatives for final refinement in Task 6.

4.5.1 Task 5-1 Panel Meeting #P3, Evaluate and Refine Alternatives

A third Panel workshop will be conducted to review the biological performance tool, perform a final scoring of alternatives using the evaluation matrix, and develop the final report outline from the Panel.

Meeting #P3 Topics

- Review output from the biological performance tool provided from Task 4-6, and run the spreadsheet in the Panel meeting to interactively assess performance and sensitivity based on a discussion of the alternatives.
- Perform an evaluation of alternatives relative to evaluation criteria, using the latest evaluation matrix.
- Review Panel's preliminary opinion on cost and technical feasibility of each alternative.
- Critique alternatives, and develop recommendations for future actions regarding each remaining alternative.
- Prepare a final list of alternatives (still maintaining a full volitional passage alternative for both upstream and downstream alternatives), and document any alternatives that can be eliminated to date.
- Prepare a report outline for the Draft Fish Passage Feasibility Report.
- Make assignments to panel members for final report text, drawings, cost estimates, and other tasks required to complete the report.

4.5.2 Task 5-2 Meeting #P3 Summary

A meeting summary will be prepared with the following information:

- A list of the current recommended fish passage alternatives.
- Discussion of the biological performance tool runs and results.
- Discussion of the evaluation scores and Panel recommendations.
- A discussion of the fatal flaw analysis, and documentation of concepts eliminated from further consideration at this time.
- A list of fish passage alternatives identified for further development.
- List of additional information necessary to reduce uncertainty or risks associated with each alternative.

This summary document will be distributed within two weeks of the meeting date.

4.5.3 Task 5-3 Meeting #G2 – Group Alternative Presentation and Evaluation

Meeting #G2 will be conducted at this interim step of the alternative refinement activity. This meeting will allow for Group review and input of the fish passage alternatives and biological performance tool run outputs, in time for the Panel to incorporate any comments into the final alternative development. The draft evaluation criteria and weights will be presented for input from the Group.

The topics for Meeting #G1 will include:

- Panel will present an overview of the work completed to date, and will address any questions from the previously distributed meeting notes.
- Review the biological performance tool runs and sensitivity analysis.
- Review the status and changes to the criteria document, and present the current evaluation matrix.
- Panel will present the list of upstream and downstream fish passage alternatives, and will discuss the list of concepts/alternatives eliminated to date due to fatal flaws.
- The Group will discuss and provide any critique to the identified alternatives.
- Consensus on a final list of fish passage alternatives to be refined in Task 6.
- Discuss the next steps based on the future tasks identified in this Study Plan, and confirm the current Study Plan is still applicable or address any concerns at this time.
- Prepare a list of action items.

4.5.4 Task 5-4 Meeting #G2 Summary

A meeting record will be prepared by the Panel for Meeting #G2, to be distributed for review within 2 weeks of the meeting. A key goal of this meeting record it the agreement on a final list of fish passage alternatives for refinement in Task 6.

4.6 TASK 6 – FISH PASSAGE ALTERNATIVE REFINEMENT

Task 6 will focus on the refinement of the remaining fish passage alternatives that are technically feasible. In addition to further development of the conceptual design drawings, the Panel will prepare an opinion of probable construction and operating cost for each alternative, describe operational protocols and issues, address comments from the Group from Task 5, perform final runs of the biological performance tool, prepare a final Panel's quantitative evaluation of the alternatives using the final Pugh matrix and evaluation criteria, and address constructability issues and any remaining data needs or significant risks. At least one volitional fish passage alternative will be included in the final list of alternatives.

4.6.1 Task 6-1 Refine Fish Passage Alternatives

Based on comments received from Task 5, the Panel will work independently and together in small groups to finalize conceptual design drawings and descriptions of the remaining alternatives. An Engineer's Opinions of Probable Construction Costs (OPCC) will be developed for the remaining alternatives to a Class 5 level as defined by the American Association of Cost

Engineers International (AACE). The cost estimates will be suitable for comparison of the alternatives, but may not reflect an accurate number for capital budgeting as they will be developed based on very limited information.

According to the AACE International Recommended Practices and Standards:

> *"AACE International Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges. Typically, engineering is 0% to 10% complete. They are typically used for any number of business planning purposes, such as but not limited to market studies, assessment of initial viability, evaluation of alternate schemes, project screening, project location studies, evaluation of resource needs and budgeting, or long-range capital planning. Virtually all Class 5 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -20% to -50% on the low side and +30% to +100% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 1 hour or less to perhaps more than 200 hours may have been spent preparing the estimate depending on the project and estimating methodology."*

Any data gaps or significant risks will be identified for discussion prior to Panel Meeting #P4.

4.6.2 Task 6-2 Panel Meeting #P4 – Refine Alternatives

A fourth and final Panel meeting will be conducted to review and critique the alternatives, re-run the biological performance tool based on updated information, and do a final scoring of alternatives. The Panel will also finalize the report outline at this meeting.

Meeting #P4 Topics

- Review and discuss the updated alternatives. Note any remaining information needs or significant risks associated with the alternative conceptual designs or recommended operation.
- Re-run the biological performance tool with the Panel present based on the updated designs.
- Review the Panel's OPCC, constructability issues, and the technical feasibility of each alternative.

- Finalize the criteria, and perform a final evaluation of the alternatives relative to evaluation criteria, using the Pugh evaluation matrix.
- Eliminate any alternatives that have fatal flaws based on their latest design, or that score low relative to others, and record eliminated concepts for reporting in the meeting notes. Note that the Panel will continue to advance at least one upstream and one downstream fish passage alternative for the final report.
- Develop recommendations for future actions regarding each remaining alternative, including opportunities to improve performance or optimize alternatives based on the comparisons in the evaluation matrix.
- List final pros and cons for each alternative.
- Finalize the Fish Passage Feasibility Study report outline (for Task 7)
- Make assignments to panel members for final report text, drawings, cost estimates, and other tasks required to complete the report.

4.6.3 Task 6-3 Meeting #P4 Summary

As a final progress report prior to the Panel's issuance of a draft report, the Panel will prepare and distribute a meeting record for Meeting #P4 with the following information:

- Final list of fish passage alternatives planned for the report, along with brief descriptions and a list of the pros and cons for each alternative.
- A list of any alternatives eliminated due to poor relative ratings in the Evaluation Matrix.
- Outputs of the biological performance tool runs.
- A summary of the OPCC's for the remaining alternatives.
- A copy of the final Evaluation Matrix and scores developed by the Panel.
- A copy of the outline for the Draft Report.

4.7 TASK 7 – REPORTING AND FISH PASSAGE RECOMMENDATIONS

Task 7 is structured to organize and report on the full development of the final fish passage alternatives. A draft and final feasibility report will be developed that will document the process followed, development of feasible fish passage alternatives, evaluation criteria, summary of alternatives eliminated with justification for the eliminations, a final evaluation and the final recommended alternatives. Each alternative will be described with text and conceptual level design drawings, on OPCC, estimate of operating costs, an implementation schedule and description of construction issues, listing of pros and cons, and a summary and details of the final evaluation. Potential indirect costs, such as lost power opportunities or impacts to aquifer

recharge, will be identified but will not be included in the cost estimate. At least one volitional alternative for upstream and downstream passage will be described, regardless of its feasibility.

The final feasibility report will include the Panel's recommendation regarding the technical and biological feasibility of providing volitional steelhead passage at SF Dam. If the Panel cannot recommend a volitional passage facility due to site constraints, uncertainties, or other factors, the Panel will recommend a non-volitional passage facility if deemed feasible. If the Panel cannot identify a feasible fish passage alternative, the Panel will document its rationale and describe potential next steps to respond to RPA Element 3 (see Task 8).

Recommendations for next steps will be developed, which might include: fish passage alternatives to be pursued; further studies, if needed to address uncertainties or risk; or economic assessments and recommendations to explore non-passage alternatives. The draft report will be presented to the Group for input, and then finalized after a Group meeting and consideration of the Group's comments.

4.7.1 Task 7-1 Prepare Draft Fish Passage Feasibility Report

A Draft Fish Passage Feasibility Report will be developed in this task to document the scope of the study, background information used, design criteria, the process utilized to conduct the feasibility Analyses, and the results of the Analyses. A draft table of contents for the report is listed below as a guide for the Panel and Group members.

The draft (and final) report will contain at least the following:

- Introduction
    - Problem statement
    - Purpose, objective
        - Fish passage goal statement
        - Relevance to other RPAs
    - Overview of Fish Passage Panel Process
        - Summary of meetings, coordination, and progress reports
    - Overview of the biological performance tool
        - Overview of the spreadsheet based fish passage model
- Descriptions of alternatives
    - Short descriptions of all initial brainstorm concepts
        - Documentation of concepts that were dropped for fatal flaws or low ranking

  - Preferred Concepts
    - Detailed physical, functional, and operational descriptions
    - Pros and cons
    - Expected performance for upstream and downstream fish passage (based on the biological performance tool)
    - Implementation challenges and uncertainties
    - Constructability considerations
    - Opinions of probable construction and operating costs
    - Two to five scale drawings will be provided for each alternative, with applicable site overviews, site plans, sections, elevations, and hydraulic design parameters clearly defined.

- Evaluation of Alternatives
  - Description of evaluation process
    - Description of evaluation matrix and criteria
      - Weighting and scoring
    - Criteria that could lead to fatal flaws
  - Graphics and summaries of evaluation
    - Ranking of alternatives based on evaluation matrix
    - Ranking of alternatives based just on fish passage criteria
    - Relative fish passage ranking compared to cost and operations criteria
- Conclusions and Recommendations
- References cited

The Draft Report will be distributed at least two weeks prior to Group Meeting #G3.

4.7.2 Task 7-2 Group Meeting #G3, Review Draft Fish Passage Feasibility Report

Group Meeting #G3 is intended as an opportunity for the Panel to present the entire draft report, and for the Group to discuss any concerns based on the draft report. Brief meeting notes will be prepared and distributed within two weeks of this meeting, to assist the Group in preparing formal comments, and to allow the Panel to continue working to address any concerns voiced in the meeting.

Thirty (30) calendar days are identified for the Group to prepare written comments prior to production of the Final Report.

4.7.3 Task 7-3 Prepare Final Report

This task will address comments received following the Group's review of the draft report, and will result in production of the Final Fish Passage Feasibility Report.

4.7.4 Task 7-4 Group Meeting #G4, Present Final Fish Passage Feasibility Report

The Panel will present the Final Fish Passage Feasibility Report at Group Meeting #G4, including: a discussion of any remaining key issues based on comments received on the draft report, how the Panel addressed the comments and those key issues; and will summarize the final recommendations and report contents. The Group will provide the Panel with guidance on any desired agenda items, and any other stakeholders they may wish to attend this meeting.

4.8 TASK 8 – GROUP FISH PASSAGE DECISION

Based on the technical information provided in the final Fish Passage Feasibility Report developed in Task 7, the path of continuing work will proceed in one of two directions. The Group will review the Final Panel Fish Feasibility Study report, and consider its recommendations at a meeting of the Group and Panel. The recommendation will be based upon the technical feasibility of the alternative(s), the expected biological performance, and the cost to construct and operate each alternative. The recommendation will include strong consideration of the risk and uncertainties associated with the performance of the alternatives. The recommendation will *not* include consideration of biological feasibility. Biological feasibility would eventually be conducted to evaluate each fish passage alternative with the biological goals to provide conditions so that the Project avoids jeopardizing the continued existence of the Southern California steelhead DPS or adversely affecting designated critical habitat, and is interrelated with Elements 1 and 2 of the RPA. Conclusion may be based on existing information provided in the BO, and conduct of Task 8 would provide the opportunity to make that determination. Without such a determination, Task 9 would be implemented as proposed, which would require further investigation and consultation to define parameters of biological feasibility, methods for developing and assessing those parameters and the scope of the feasibility assessment. A possible outcome of the meeting is for the Group to agree upon the Panel's recommendation, per Task 7, of a recommended fish passage alternative or further study. If there is a consensus of the Group, the Study terminates, and the implementation process can begin. If there is no consensus, the Study continues with Task 9, an examination of issues raised during the meeting, which could include biological feasibility and/or off-site alternatives including an economic analysis.

4.9 TASK 9 –BIOLOGICAL AND ECONOMIC FEASIBILITY ANALYSES AND OFF-SITE ALTERNATIVES ASSESSMENT

Inherent within this evaluation of technical and especially biological elements of the fish passage alternatives are uncertainties related to both biological performance and to other components not specifically examined per Tasks 1 through 7, such as downstream conditions or habitat in the basin. If the uncertainty levels are sufficiently low, the Group could decide to eliminate the need

for a broader examination of the biological and economic feasibility of fish passage, including off-site alternatives. This could include habitat modification and enhancement in the Piru Creek basin, off-site replacement habitat, population supplementation programs, fish passage at other sites, or other similar means to avoid jeopardizing the continued existence of the Southern California steelhead DPS. The predicted cost of fish passage facilities at Santa Felicia Dam could also influence this decision. Without a decision to accept the recommendations provided in Task 7 and considered further in Task 8, the Study will continue with Task 9.

The approach to be used for a complete feasibility analysis would be a combination of "cost effectiveness analysis" (CEA) and "socioeconomic impact analysis." The biological feasibility will be included as a component of the CEA. This approach will provide a mechanism for choosing among the alternatives that achieve biological goals at minimum cost. It will also provide an opportunity to acknowledge and consider how and where costs are borne.

4.9.1 Off-Site Alternatives

Off-site alternatives could include habitat modification and enhancement in the Piru Creek basin, off-site replacement habitat, population supplementation programs, fish passage at other sites, or other similar means to avoid jeopardizing the continued existence of the Southern California steelhead DPS. Identification, development and analysis of these alternatives would require consultation, per the BO. The process could include

- Acquisition and evaluation of information on habitat conditions in the Santa Clara River basin but outside the Project Area
- Studies that could include at least one year of field investigation,
- Development and implementation of criteria and methods to identify and evaluate off-site alternatives following a process similar to tasks 1-6 in this Study Plan.

4.9.2 Biological Feasibility

The biological feasibility of the various alternatives, beginning with the SF Dam fish passage alternative, is a function of meeting the biological goals. These goals have been characterized in the BO as providing benefits to the Southern California steelhead DPS through reducing fragmentation and increasing habitat availability, to support a viable steelhead population. Consistent with the BO regarding the approach to be followed if SF Dam fish passage is not feasible, biological feasibility would be addressed in consultation. Again, similar to the steps taken in Tasks 1 through 6 of this Study Plan, a biological feasibility evaluation would require acquisition and assessment of information on Santa Clara River habitat, Southern California steelhead DPS population and a process to identify, develop and assess criteria that allow evaluation of the feasibility of meeting the biological goals.

4.9.3 Cost Effectiveness Analysis

CEA is one analytical tool used by economists to compare and evaluate the feasibility of alternatives. Of particular relevance to public entities (both federal and non-federal), CEA is commonly used to evaluate alternatives involving environmental goods. CEA differs from benefit-cost analysis by not specifying, or attempting to quantify in economic terms, the benefits associated with an alternative. A second important concept is that of socioeconomic impact analysis, a tool that helps an entity to measure the extent of impacts in an affected area.

CEA allows two or more alternatives to be compared in order to determine which is preferred. It is typically applied by setting a goal or standard, and then analyzing alternative means for achieving the goal. For example, an environmental goal may be to minimize effects on a species so as to avoid jeopardy, and determine the least cost alternative of meeting the goal.

4.9.3.1 Elements of the Cost Effectiveness Analysis

The first step in the CEA is to confirm biological goals and the measure of biological effectiveness (biological feasibility); these are based on the set of criteria developed in the full Study. It is acknowledged that the overarching goal of the RPA is continued viability of the Southern California DPS of steelhead, and that Santa Felicia Dam project hydropower operations must not jeopardize the species' continued existence. In response to the RPA, and subsequent to the Study of passage alternatives, the Panel will identify non-fish passage alternatives at Santa Felicia Dam and evaluate the contribution of feasible alternatives to the increased viability of the DPS. Biological performance will be examined for the technically feasible alternatives, in order to provide a means of comparison and which reflect an avoidance of contributing to jeopardy. The evaluation process for non-passage alternatives will largely follow a process similar to that established in the Study Plan for passage alternatives.

Once the goal is established, the additional non-passage alternatives that have been identified will be considered. The overall assessment will include the new alternatives plus the recommended and technically feasible configurations of fish passage infrastructure from the Study. Each alternative will likely involve certain capital investments and recurring costs that are the responsibility of the proponent; the alternative configurations should then have their construction estimates and annual costs organized and presented in comparative terms (such as annual average cost equivalents).

Conceivably, there may be impacts to, or costs incurred by, other uses of the stored water behind the Santa Felicia dam. If these impacts are anticipated as a result of fish passage infrastructure, non-passage structures, or change in flow releases or groundwater aquifer replenishment, then

the costs should be quantified on a net basis, and organized in comparative terms as the annualized costs. For example:

1. **Hydroelectric power generation** – potential change in production
2. **Agricultural water diversions** – potential reductions in downstream supply due to reshaping of water releases
3. **Municipal water supply** – potential change in available timing or supply
4. **Recreation in Lake Piru reservoir** – net impacts to current and future uses resulting from change in reservoir levels from reshaped water releases

For the Santa Felicia Dam fish passage alternatives, the additional impacts are anticipated to include only changes in hydroelectric power generation. However, the other three impact categories may be affected as well by any or all of the non-passage alternatives. The alternatives, including all reasonable permeations of component parts, should be arranged on a cost basis relative to the biological benefit they would achieve; a hypothetical example of such an arrangement is shown in plotted form below in Figure 2.

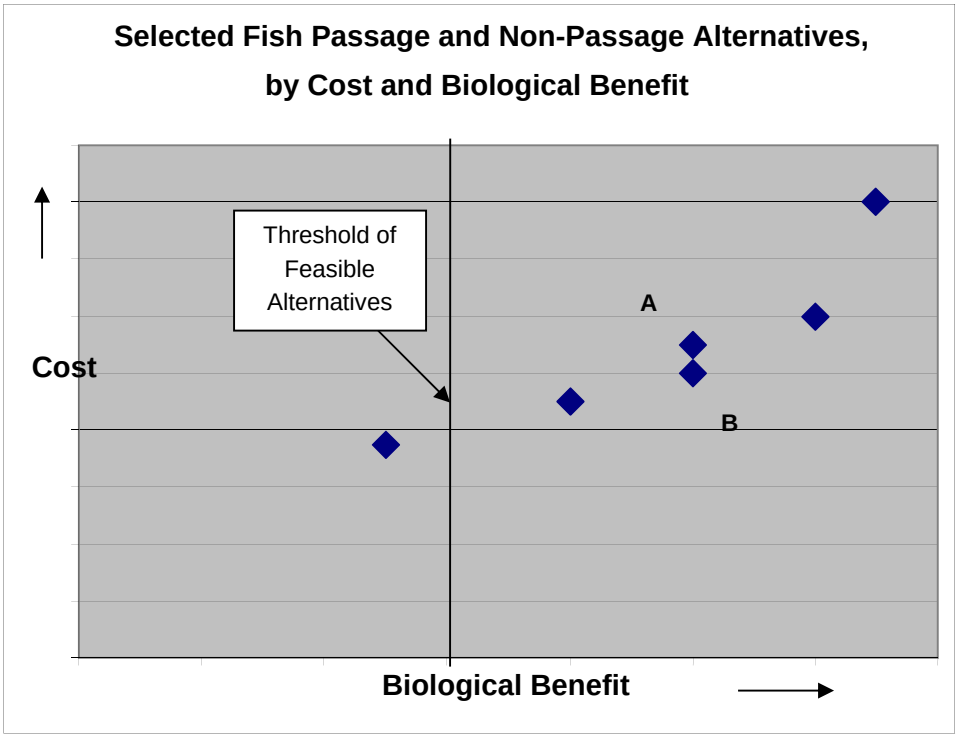

Figure 2. Hypothetical Comparison of Alternatives.

The figure displays the hypothetical relationship between the cost and biological benefit of each alternative, represented as diamonds. The vertical bar represents the threshold whereby the

biological criteria are attained. That is, technically feasible alternatives that are to the left of the bar fail to achieve one or more of the biological criteria, and are not considered "biologically feasible." Those to the right of the bar meet or exceed the set of biological criteria and are all feasible.

Once a goal is specified, CEA is conducted by examining the alternative means by which the goal may be achieved or exceeded. Of course, there is often considerable uncertainty in predicting the level of biological benefit, and the "point estimate" may represent a most-likely or expected value outcome. If two alternatives, such as A and B in the figure, achieve essentially the same biological benefit, the alternative with the lower cost (B) is preferred over the one with higher cost (A). If the biological goal is strictly set (say, avoiding jeopardy), then the set of feasible alternatives includes those which meet or exceed the goal, and the *preferred* alternative is that which meets the goal at *least cost* among them.

Although the relationship of biological benefits to costs of alternatives are important in selecting a preferred alternative, United may find useful additional information about the distribution of costs and impacts on different socioeconomic groups and sectors of the economy. A "socioeconomic impact analysis" may be initiated independently by United; details are provided in Appendix D of this Study Plan.

4.10 IMPLEMENTATION PROCESS

4.10.1 Overview of the Path to Implementation

Among the requirements in the BO pertaining to the Study Plan is *"a clear description of the specific methods that will be used to perform the various tasks related to the assessment of the steelhead-passage feasibility, including objective decision criteria for judging feasibility in accordance with the information obtained through reasonable and prudent alternative 3(a)(3)(B)"* (NMFS 2008, p. 102). In Task 7, the Panel will recommend that the decision criteria for determining feasibility include a combination of technical and biological elements, the combination of which will provide support indicating effectiveness of alternatives in providing fish passage. Economic feasibility will be addressed only in terms of infrastructure and operating cost, and will only have a bearing on the identification of the Panel's recommended fish passage alternatives, which are by definition intended to be the most "effective" passage alternatives.

Tasks 1 through 6, followed by reporting in Task 7, reflect the selection, design, refinement, and evaluation of fish passage alternatives toward development of one or more preferred alternative. They also include biological performance and technical effectiveness criteria and assigned

weights for determining the feasibility. The path of continuing work to Task 9 will depend on the Group's consideration in Task 8 of the Panel's report, and whether the preferred fish passage alternative that results from the completion of those tasks can adequately meet the objective with sufficient certainty of providing successful fish passage around the Santa Felicia Dam. The determination of "adequacy" and "sufficient certainty" is subject to a test of technical and biological feasibility, and an assessment of certainty of success or risk of failure.

4.10.2 Decision Process and Implementation

Figure 3 presents a simplified schematic showing how results of the evaluation (Tasks 1-7) could lead to different outcomes of implementation. As shown, the Panel can either recommend a technically feasible satisfactorily performing fish passage alternative (or alternatives), or recommend additional studies. The Group will have the opportunity to respond to the Panel's fish passage feasibility report. If the Panel recommends an alternative, the Group may accept the recommendation, and if United is willing to proceed with implementation, then Task 9 will not be conducted and implementation would begin.

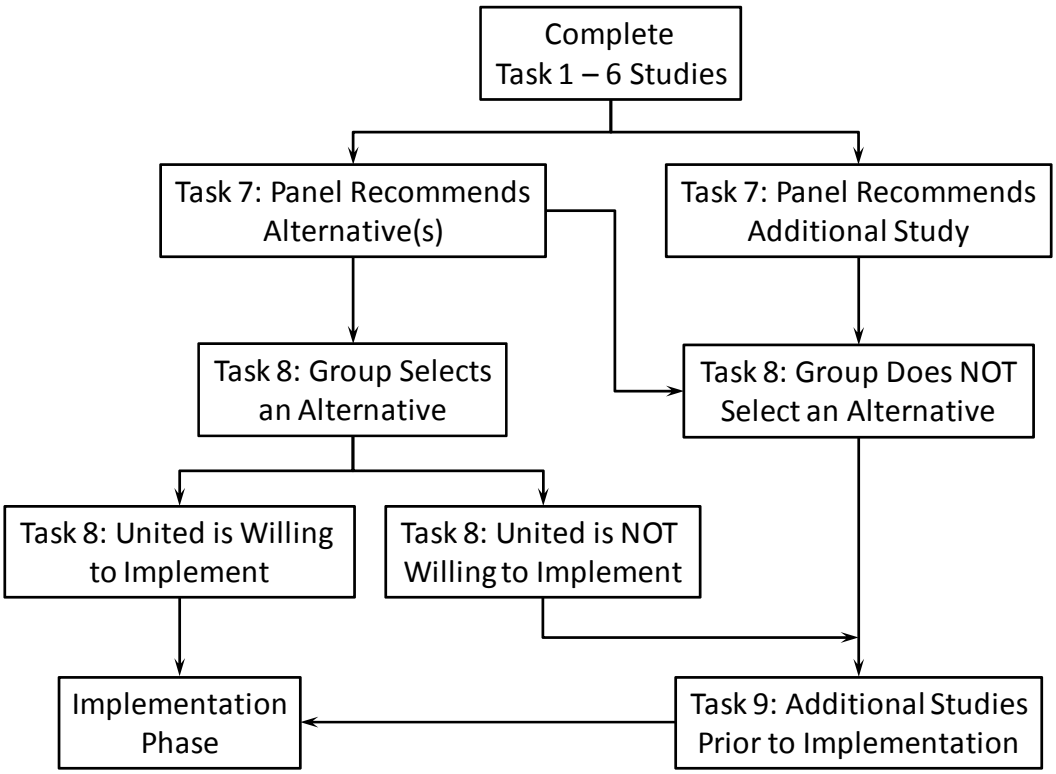

Figure 3. Conceptual schematic of the decision path to implementation or the continuation of additional studies prior to implementation.

Several other scenarios could play out depending upon the criteria, evaluation results, and biological risk and uncertainty. The Panel may recommend one or more studies to address unknowns, the Group may not agree to the Panel's recommended alternatives, or United may not find the selected or preferred alternative to be financially acceptable. From this point, the path could lead in a number of directions.

To add clarity to the Implementation Process, the Panel discussed at least three possible outcome examples that the Group may be presented with at the completion of Task 7 (or Task 9), and a recommended process to address these outcomes. It is possible that a combination of the examples may be present at the end. In this case, the process framework identified in the examples would be combined to address uncertainties, risk, potential data needs, and any financial feasibility concerns. The Group, possibly by way of the Panel, would prepare a more formal plan if this scenario results, which will guide ongoing consultation to address the BO needs.

Example 1 Outcome: Technical Solution Recommended, Group Agrees, Implement Recommended Alternative

The Panel recommends a specific fish passage alternative (or alternatives) to be implemented. The Group agrees with the Panel's recommendation, implementation schedule, funding requirements, and identified risks based on any remaining unknowns. In this example, the Group (and United) could decide to proceed immediately to implementation of the recommended fish passage alternative. This outcome would define the next steps to likely include the following:

- The Panel has completed their assignment, and may either be dissolved or retained to advise on implementation of the project.
- United begins the implementation of the recommended alternative(s), and works to identify and secure funding for the project.
- United works to retain a final design and permitting team to prepare final construction plans and technical specifications in consultation with the appropriate agencies, address permitting needs, and provides an updated opinion of probable construction and operating cost.
- United assembles a biological implementation team to address monitoring and evaluation needs of the preferred alternative.
- United secures a general contractor to construct the project, and the construction is completed.
- United oversees the monitoring and evaluation of the completed project, with appropriate Group consultation.

Example 2 Outcome: Significant Uncertainties Exist, Panel Recommends Additional Study Prior to Implementation

In this scenario, two or more fish passage alternatives are considered to be technically feasible and can meet the BO needs; however, there are significant uncertainties and resulting risk associated with one or more of the alternatives. As an example, the following recommendations could be presented at the end of Task 7:

- Alternative 1 is presented to have a potential 70 percent Fish Passage Efficiency at SF Dam, and there are few uncertainties associated with the concept.
- Alternative 2 is presented to have a potential a range of Fish Passage Efficiencies from 60 percent to over 90 percent, but this range cannot be better quantified due to a known information need. In this case, the Panel might recommend that additional studies be pursued to narrow the gap of uncertainties and would be responsible for identifying the needed information, studies required, and schedule in Task 7. For example, assume a reservoir survival study conducted over two years could provide the missing information narrow the uncertainty gap. The incentive to pursue this alternative is the potential to construct a better performing facility.

With this scenario, the Group must use the Panel's recommendation and the available information to decide how to proceed: either implement the Panel's recommendation of further study or implement either alternative in the same manner as Example 1. If the study route is identified, the next steps might be recommended by the Panel for consideration:

- The Panel has completed the fish passage assessment assignment, and may either be disbanded or retained to develop or assist with the new Study Plan, and work with the Group to make a final decision between Alternatives 1 and 2.
- United implements the recommended study and retains a study team to finalize and implement the recommended studies.
- The Panel (if retained) and Group use this data to refine the original Fish Passage Study outcome, to present the new performance estimate and quantify any remaining uncertainties.
- Ideally, a decision can then be made to implement the preferred alternative as listed in Example 1.

Example 3 Outcome: The Recommended Alternative is Not Considered Financially Feasible, or there is Significant Biological Risk (Biological Feasibility) Unrelated to Fish Passage Capability

In this example, the alternatives that satisfy the technical aspects of the fish passage feasibility may be so costly as to outweigh the expected revenue from the project's continued existence.

Another example may be the Panel's (or Group's) conclusion that there remain significant biological risks unrelated to fish passage in the entire watershed. In this case, the situation could trigger the examination of non-passage alternatives and a recommended economic analysis. The approach recommended for the economic feasibility analysis will be a combination of "cost effectiveness analysis" and "socioeconomic impact analysis." This approach will provide a mechanism for choosing among the alternatives that achieve the biological objectives of avoiding jeopardy for the species at least cost. It will also provide an opportunity to acknowledge and consider how and where costs are borne.

With Example 3, the Group will embark on a path through Task 9 that will diverge from a study focused solely on providing fish passage at SF Dam. Additional consultation to review the approach identified above and in Appendix D will be required.

The analysis of non-passage alternatives will include specifically three components:

- Identify alternatives to fish passage facilities at SF Dam
- Evaluate biological benefits of alternatives, and compare to fish passage at SF Dam
- Conduct cost effectiveness analysis of all alternatives, including fish passage at SF Dam

Details on the substance and completion of these components are included in Appendix D of this Study Plan.

4.10.3 Fish Passage Feasibility Study Completion

Given any of the above example scenarios that would be addressed with the beginning of Task 8, the Panel suggests that the Fish Passage Feasibility Study be complete once a clear path is established. A new process, with potentially different implementation or study team members could be established to guide the ongoing phases as described above.

4.11 SCHEDULE

A work plan was developed that corresponds with the above tasks, to communicate the Panel's opinion of time necessary to conduct the technical activities described above, and the logistical component of meeting coordination, progress reports, etc. Table 1 provides a summary of proposed study milestone dates, along with an estimate of the sequential number of calendar days from the start of the study. A Notice to Proceed (NTP) date of September 10, 2012 was assumed as a starting point to build the implementation schedule, and will need to be confirmed or revised based on the actual implementation date. This date was intended to allow review and approval of this Study Plan document by the Group and FERC, and time for United and other Panel and Group members to address contracting and administrative needs prior to beginning the

study tasks. The schedule is linked to this estimated date, and the milestone dates identified can be adjusted and revised if necessary based on an actual NTP date.

Table 1. Fish Passage Feasibility Study Schedule Milestones.

Activity	Milestone Date	Cal Day from Start
Panel Notice to Proceed Issued for the Study (assumed date, confirm)	6/24/13	0
Panel Distribute Data Assessment Memo to Group	8/23/13	60
Panel Meeting #P1 – Concept Identification	1/25/13	123
Distribute Progress Report, Meeting #P1 Summary	11/8/13	137
Panel Meeting #P2 – Concept Development	2/14/14	235
Distribute Progress Report, Meeting #P2 Summary	2/28/14	249
Group Meeting #G1 – Review Initial Concepts (Concepts, Evaluation Criteria, Life Cycle Model Output, and Evaluation).	3/21/14	270
Distribute Progress Report, Meeting #G1 Summary	4/4/14	294
Panel Meeting #P3 – Evaluate Concepts and Define Alternatives	7/11/14	382
Distribute Progress Report, Meeting #P3 Summary	7/25/14	396
Group Meeting #G2 – Review Initial Alternatives	8/15/14	417
Distribute Meeting #G2 Summary	8/29/14	431
Group Provide Comments on Meeting G2 Summary to Panel	9/28/14	461
Panel Meeting #P4 – Review Alternatives	11/7/14	501
Distribute Progress Report, Meeting #P4 Summary	11/28/14	522
Distribute Draft Fish Passage Feasibility Report to Group	1/9/15	564
Group Meeting #G3 – Draft Fish Passage Feasibility Report Review	2/16/15	592
Group Comments Due on Draft Report	3/8/15	622
Distribute Final Fish Passage Feasibility Report	4/17/15	662
Group Meeting #G4 – Present Final Report	5/1/15	676
Group Meeting #G5 – Discuss Next Steps	6/12/15	718
Decision on Fish Passage Implementation	6/26/15	732
Complete Biological and Economic Assessment	11/11/16	1236
Fish Passage Study Complete	11/11/16	1236

A detailed Gantt chart schedule was developed to estimate the above milestones (see Figure 3). This schedule shows all tasks, their critical path and interaction, and the proposed meetings

included with the study, and corresponds directly to the work plan in Section 4. This schedule was developed using Microsoft Project software. Units shown are based on working days, unless otherwise noted such as "edays," which are uses for some review periods. An "eday" is calculated time as "elapsed days," which are simply calendar days. For example, 30 edays are defined as 30-consecutive days, with no regard to weekends, holidays, etc.

The schedule currently assumes no additional studies will be needed, in order to communicate the Panel's opinion on the minimum duration for this study. During the study, there may be critical information needs developed that could cause a delay in this schedule, to assist with the fish passage alternative development and evaluation. This type of information need would be communicated to the Group at the Panel's earliest opportunity. If this were to occur, additional consultation with Group members would be necessary to develop and agree on a plan to address the information needs, and develop a revised schedule.

The schedule items for Task 8 are intended as a starting point for ongoing discussion, and to communicate the Panel's vision for the implementation phase based on possible outcomes of this study. These Task 8 activities and durations will need to be revisited near the completion of the fish passage feasibility study.

Santa Felicia Dam, Fish Passage Feasibility Study Schedule

ID	Task Name	Duration	Start	Finish
1	Study NTP (assumed date, to be confirmed)	0 days	6/24/13	6/24/13
2	Task 1 - Feasibility Study Preparation	175 days	6/24/13	2/21/14
3	T1-1 Compile Background Information	8 wks	6/24/13	8/16/13
4	T1-2 Prepare Evaluation Matrix and Update Criteria	6 wks	7/8/13	8/16/13
5	T1-3 Identify Critical Data Gaps (if applicable)	1 wk	8/19/13	8/23/13
6	Panel Distribute Data Assessment Memo to Group	0 days	8/23/13	8/23/13
7	Work with Group to Fill Data Gaps (Allowance)	26 ewks	8/23/13	2/21/14
8	T1-4 Meeting Preparation (prepare dwgs, criteria, etc.)	6 wks	8/26/13	10/4/13
9	Task 2 - Prepare Biological Performance Tool	175 days	6/24/13	2/21/14
10	T2-1 Compile Background Info on Migratory Pathways	8 wks	6/24/13	8/16/13
11	T2-2 Identify Critical Biological Data Gaps (if applicable)	1 wk	8/19/13	8/23/13
12	Work with Group to Fill Data Gaps (Allowance)	26 ewks	8/23/13	2/21/14
13	T2-3 Develop and Populate Fish Passage Model	45 days	7/29/13	9/27/13
14	Prepare input parameters	4 wks	7/29/13	8/23/13
15	Populate Model with Available Data	3 wks	8/19/13	9/6/13
16	Test Runs and Preliminary Sensitivity Analysis	2 wks	9/9/13	9/20/13
17	Prepare & Distribute Progress Report to Group	5 days	9/23/13	9/27/13
18	Distribute Biological Performance Tool Review Doc to Panel	0 days	9/27/13	9/27/13
19	Task 3 - Identify Fish Passage Concepts	25 days	10/7/13	11/8/13
20	T3-1 Mtg #P1 - Panel Brainstorm Session (2 Day Mtg)	15 days	10/7/13	10/25/13
21	Review Evaluation Criteria and Spreadsheet	3 wks	10/7/13	10/25/13
22	Brainstorm to Identify Concepts	3 wks	10/7/13	10/25/13
23	Organize and refine List of Concepts	3 wks	10/7/13	10/25/13
24	Perform Initial Fatal Flaw Analysis	3 wks	10/7/13	10/25/13
25	Document Eliminated Concepts	3 wks	10/7/13	10/25/13
26	Produce Short List of Concepts for Further Development	3 wks	10/7/13	10/25/13
27	T3-2 Meeting #P1 Summary	10 days	10/28/13	11/8/13
28	Prepare Mtg #P1 Summary	10 days	10/28/13	11/8/13
29	Panel Distribute Mtg #P1 Summary to Group	0 days	11/8/13	11/8/13
30	Task 4 - Concept Development and Alternative Definition	170 days	11/4/13	6/27/14
31	T4-1 Develop Initial Concepts (break into teams)	50 days	11/4/13	1/10/14
32	Drawings	10 wks	11/4/13	1/10/14
33	Brief Explanatory Text	2 wks	12/30/13	1/10/14
34	Other Characteristics	2 wks	12/30/13	1/10/14
35	T4-2 Prepare for Meeting #P2	15 days	1/13/14	1/31/14
36	Compile Initial Concept Document (from teams)	1 wk	1/13/14	1/17/14
37	Distribute Concept Document to Panel	0 days	1/17/14	1/17/14
38	Panel Prepare for Mtg #P2	2 wks	1/20/14	1/31/14
39	T4-3 Mtg #P2 - Panel Review Concepts & Define Alts (2-day)	10 days	2/3/14	2/14/14
40	Review & Critique Concepts	2 wks	2/3/14	2/14/14
41	Test for Fatal Flaws	2 wks	2/3/14	2/14/14
42	Perform Runs with Biological Performance Tool on Concepts	2 wks	2/3/14	2/14/14
43	Finalize Concept List	2 wks	2/3/14	2/14/14
44	Assemble Concepts into Fish Passage Alternatives	2 wks	2/3/14	2/14/14
45	Update evaluation criteria	2 wks	2/3/14	2/14/14
46	Identify information needs	2 wks	2/3/14	2/14/14
47	Prepare Short List of Alternatives and Document Dropped Items	2 wks	2/3/14	2/14/14
48	T4-4 Meeting #P2 Summary	10 days	2/17/14	2/28/14
49	Prepare Mtg #P2 Summary	2 wks	2/17/14	2/28/14
50	Panel Distribute Mtg #P2 Summary to Group	0 days	2/28/14	2/28/14
51	T4-5 Group Mtg #G1 - Alternative Presentation and Review	20 days	3/10/14	4/4/14
52	Review Alternatives	2 wks	3/10/14	3/21/14
53	Review Updated Criteria	2 wks	3/10/14	3/21/14
54	Review Info Needs	2 wks	3/10/14	3/21/14

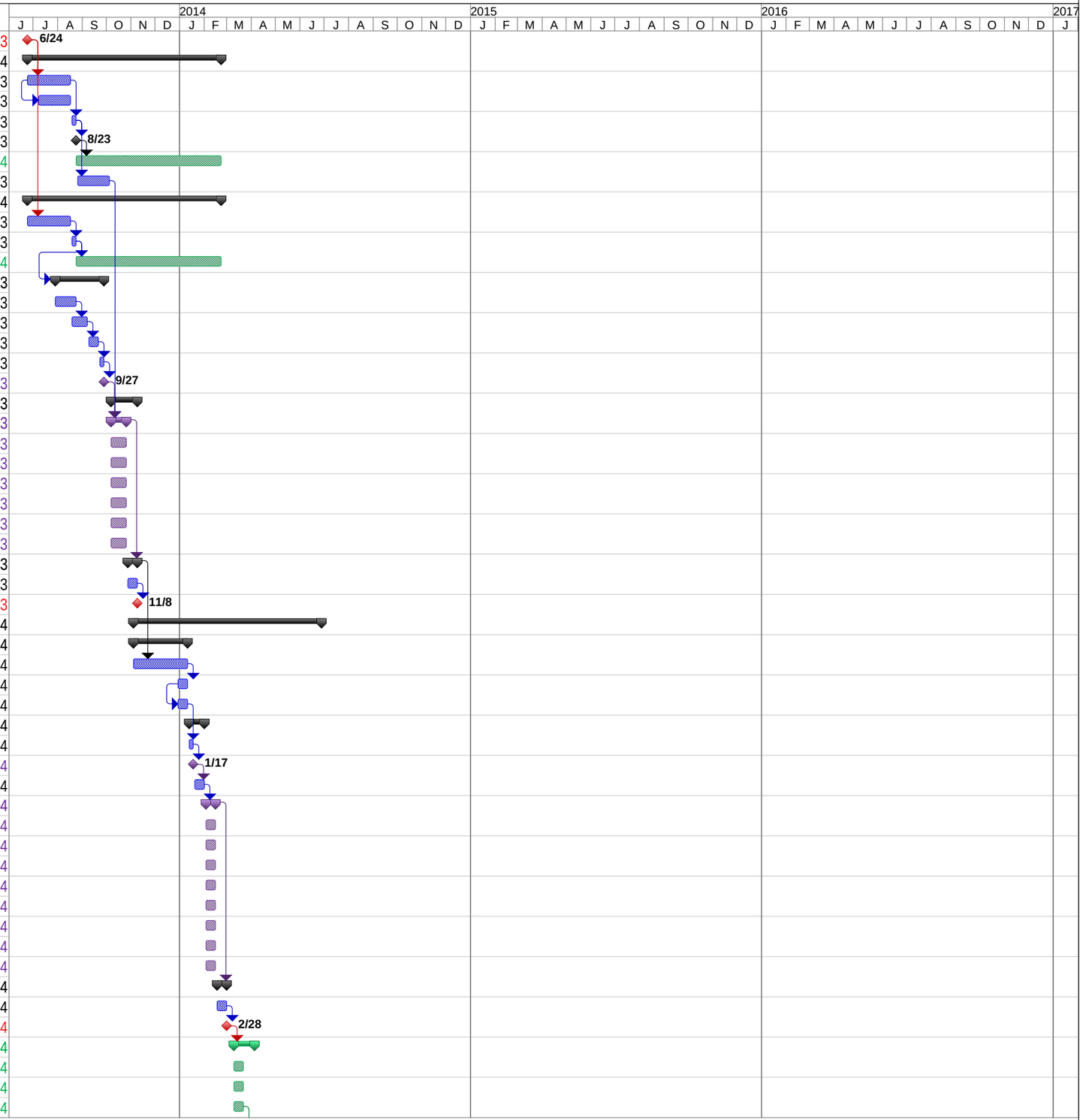

Figure 4. Detailed Study Plan Gantt Chart Schedule

Filename: SF Study Plan Sched V11.mpp

5. CONTINGENCY

Unforeseen circumstances that could affect the conduct of studies or reduce the ability to meet schedules or budgets will be addressed immediately once recognized. The basic approach to remedying unforeseen issues will be for the Panel to immediately identify the issue to the Group along with a proposed solution and then work with the Group to confirm and implement the solution. For example, if a Panel member or a Group member who has been intimately involved in the details and conduct of the analyses were to leave the feasibility team, a decision would need to be made on how to replace that member's contributions. The Panel would meet immediately and identify the consequences of the loss and propose a solution that would be considered by the Group. The Group will identify and adopt a solution for implementation, as appropriate.

6. REFERENCES

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APPENDIX A

History of Group Coordination

Date	Attendees	Purpose
May 14-15, 2011	Catherine McCalvin – UW Linda Purpus – UW Steve Howard – UW John Dickenson – UW Anthony Spina – NMFS Mary Larson – CDFG	On site tour of facilities and surrounding area; discuss purpose of study plan, expectations, interpretations of RPA and SOW and prepare draft objective statement.
June 22, 2011	Catherine McCalvin – UW Linda Purpus – UW Steve Howard – UW John Dickenson – UW Anthony Spina – NMFS Mary Larson – CDFG	Conference Call to discuss study plan elements
August 12, 2011		Letter describing changes to SOW regarding order of development of the study plan
Oct 31, 2011	Catherine McCalvin – UW Linda Purpus – UW Steve Howard – UW John Dickenson – UW Anthony Spina – NMFS Kristin Mull – NMFS Mary Larson – CDFG	In person meeting. Review and discuss draft Study Plan
January 6, 2012	Catherine McCalvin – UW Mike Solomon – UW Linda Purpus – UW Steve Howard – UW John Dickenson – UW Murray McEachron – UW Mike Booth – UW Chris Yates – NMFS Penny Ruvelas – NMFS Anthony Spina – NMFS Darren Brumback – NMFS Mary Larson – CDFG	In person meeting and conference call. Continue to discuss draft Study Plan for specific comments and determine how it is to be finalized.

APPENDIX B

Responses to Comments Provided by the Group to the November 11, 2011 Draft Study Plan

Comment By	Number	Doc pg.par#	Context	Comment	Panel Response
UWCD-1027	1	General	feasibility	1) Study plan focuses more on comparing technically feasible alternatives than assessing overall feasibility for creating passage. The panel needs to revise the study plan to correct this.	The study plan addresses feasibility in two general steps. The first step is to determine whether there is a fatal flaw using the definition as described in the initial steps of the plan. The second step compares feasible alternatives (i.e., those passing the first step) using evaluation criteria defined in the initial steps of the plan. The comparison involves engineering. biological and other attributes in subsequent parts of the plan.See Section 3.1.
UWCD-1027	2	General	decision criteria	2) “objective decision criteria for judging feasibility.” The draft study plan does not contain these. It does contain “evaluation criteria” which seem to serve a different purpose (i.e., compare alternatives that have been deemed technically feasible).	The Panel believes that the objective decision criteria for judging feasibility is the definition of a fatal flaw. A fatal flaw is a condition that would likely prevent an alternative being constructed, or operated effectively or safely, or has a low potential of satisfying fish passage objectives.
UWCD-1027	3	General	decision criteria	Study plan should also include parameters to guide the development of the decision criteria including that they need to be specific enough that they identify what conditions would have to be met for a given alternative to be deemed infeasible.	The definition of a fatal flaw includes the development and application of objective decision criteria for feasibility. Opportunities to develop and refine the decision criteria are provided by participation of the Group during review cycles and workshops.
UWCD-1027	4	General	fatal flaws	Decision criteria also need to be established for what the plan refers to (but provides no details for) as fatal flaws.	A definition has been provided. See responses above (comments # 1, 2, 3)
UWCD-1027	5	General	ESA	3) These conditions (4 conditions of ESA; can be implemented in a manner … etc.) should form the framework around which the feasibility assessment is conducted, including being the basis for the decision criteria for assessing feasibility.	The decision criteria for judging feasibility will ensure any Panel recommendation can be implemented in a manner consistent with the intended purpose of the Project, and can be implemented consistent with the scope of the action agency’s legal authority and jurisdiction. Economic and technical feasibility are addressed through the Study Plan's eight-step evaluation process. Following these steps, the Panel will either recommend implementation of a feasible fish passage alternative, which, per the Biological Opinion - jeopardy or adverse modification will be avoided if feasible passage is provided., or, the Panel will identify the need for further studies and/or consideration of a non-passage alternative that would invoke consultation with NMFS.
UWCD-1027	6	General	volitional	4) In all sections of the study plan, the panel needs to distinguish between evaluations of volitional passage and non-volitional passage	Volitional passage will be considered concurrently with other alternatives. At least one volitional alternative will be carried through the study regardless of feasibility.
UWCD-1027	7	General	feasibility	Biological opinion states that non-volitional passage will be evaluated if volitional passage is deemed infeasible. The study plan should explain how this evaluation would be done.	See response to comment #6.
UWCD-1027	8	General	volitional	Biological opinion also states that alternatives to passage will be considered if non-volitional passage is also deemed infeasible. Again, the study plan should address this in some manner	The study plan will yield a report that will discuss feasibility of fish passage. Per RPA#3, if fish passage is determined to be infeasible as a result of the evaluation, non-passage alternatives would be developed in consultation with NMFS. Feasibility will be judged, first on fatal flaw screening, followed by identifying the most feasible alternative(s) by improivng on conditions of technical and economic feasibility as defined by how well the alternative meets the evaluation criteria, then deciding if the most feasilbe alternative(s) meets a level of certainty regarding its ability to efficiently and effectively pass fish. If the uncertainty or risk is too high, additional information may be required and/or consultation may be initiated with NMFS to consider non-passage alternatives..
UWCD-1027	9	General	preferred alternative	5) The study plan should be revised such that it results in a final feasibility report with a preferred alternative	The Panel will evaluate upstream and downstream passage alternatives and include at least one volitional option for each. This process will provide necessary information for the Panel to evaluate the relative attributes of the alternatives and to develop a recommendation. The recommendation could inlcude the need for evaluation of a non-passage alternative.
UWCD-1027	10	General	Level 3	6) Study plan needs to include Level 3 as a required step in the assessment of feasibility. Level 3 should not be optional based on whether the Group can come to consensus on an alternative.	The study plan includes non-optional cost assessments and considerations for alternatives as well as a subsequent assessment (cost effective analysis) that could take place based on the results of the technical feasibility evaluation.

Comment By	Number	Doc pg.par#	Context	Comment	Panel Response
UWCD-1027	11	General		7) We encourage the panel to reconsider its assumption that no additional studies are needed. If the panel feels strongly, after that reconsideration, that no additional studies are needed, the panel should revise the study plan to state that it is unlikely that additional studies would be needed and identify contingencies in section 6 of the plan for how unexpected data gaps would be addressed. If, after that reconsideration, the panel decides that there are critical data gaps that need to be filled before the Level 2 analysis can be completed, the panel should revise the plan to include the needed studies.	The Panel will review and discuss available information and determine its completeness for the fish passage assessment needs. If information is missing or additional information is desired, the Panel will work with the Group to take appropriate steps to acquire the necessary material. This process to address any information gaps will be identified based on the specifics of the necessary information, and a plan to address this information need will be formulated with Group input including the potential for studies. The evaluation matrix, including the results of the biological performance tool, will be developed using available information. Data gaps will be identified and the potential influence of such gaps identified and considered in the matrix scoring. If critical data gaps are identified that affect the overall feasibility and likelihood of fish passage success, the Panel's recommendation will address the need for additional study.
UWCD-1027	12	General		8) Define "project." and use it consistently. “Project” seems to be referring to different things (e.g., SFD project, feasibility assessment, passage alternative)	The project as we are defining it is the Santa Felicia Dam and Reservoir project and its purpose is to provide aquifer recharge and hydropower.
UWCD-1027	13	General		9) Clearly define the purpose of the Santa Felicia Project	Pursuant to 40 CFR sec. 402.02, the purpose is to yield waters for aquifer recharge and for hydropower generation. This is accomplished through annual lowering of reservoir by as much as 75 feet or more.
UWCD-1027	14	General		10) For the life-cycle model, the panel needs to address the fact that the conditions for steelhead in the Santa Clara River watershed will change over time. Conditions could improve as more recovery actions are implemented or they could become worse. Ideally this variation over time could be worked into the model. This will affect the results of the model	Instead of a complete life-cycle model, the evaluation of feasibility will include a biological performance tool designed to assess fish passage through migratory pathways at the Project available under each fish passage alternative. The evaluation will consider variable hydrologic conditions to provide an indication of future performance.
UWCD-1027	15	1	background	11) United recommends that the study plan contain a separate chapter providing more details on the panel that will implement the study plan. At a minimum, this should include a description of how the panel will function (e.g., independence, facilitator, responsibilities) and its composition (e.g., organizational chart and list of expertise and skills needed). It should also explain how the panel will engage the other G10members of the Group	Comment noted, the study plan has been modified to provide additional description of Panel functions.
UWCD-1027	16	1	background	12) Add the Federal Energy Regulatory Commission (FERC) to the list.	FERC added.
UWCD-1027	17	1 (b)	background	For (b), explain that United needs this plan to comply with its FERC license.	Comment noted, study plan includes the requested explanation.
UWCD-1027	18	1 ©	background	For (c), explain that NMFS and CDFG will use the plan to monitor how the feasibility assessment is conducted	Comment noted, study plan includes the requested explanation.
UWCD-1027	19	3.2	life cycle model	13) The possible need for a more sophisticated life-cycle model beyond what is called for in the study plan … explain what criteria would be used to determine if such a model is needed	A complete life-cycle model will not be used in development of a Panel recommendation. A passage-specific model (Biological Performance Tool) will be used to evaluate fish passage effectiveness of selected options. Fish passage effectiveness will be one element of a grid analysis technique (Pugh matrix) used to compare, evaluate and optimize fish passage alternatives.
UWCD-1027	20	3.3	ESA	14) “RPA Element 3 goals.” The panel needs to clarify what these goals are	The Panel revised the study plan to be consistent to be consistent with RPA #3. The Panel will select a final list of alternatives it considers viable for meeting stated objectives of RPA Element 3. The term goals was inappropriately used in the draft plan.
UWCD-1027	21	3.3	background	15) FERC should be added to the list of entities involved with making the final determination on passage.	The recommended changes have been made.
UWCD-1027	22	4		16) Discuss the potential need for engagement with technical experts from United, NMFS, and CDFG during the workshops and at other times to ensure that they are able to get information and questions answered in a timely manner.	The recommended changes have been made.
UWCD-1027	23	4.1		17) Clarify the second sentence in section 4.1 (Level 1 – Develop and Evaluate Fish Passage Alternatives and Cost).	The recommended changes have been made.
UWCD-1027	24	4.1.1.1		18) Bullet 1 – Add operations for Pyramid Dam (including bypass flows and operational uncertainties), add spill events	The recommended changes have been made.
UWCD-1027	25	4.1.1.1		Bullet 2 - Add fish passage opportunities during various hydrologic conditions (dry, normal, wet and including antecedent conditions).	The recommended changes have been made.
	26	4.1.1.1		Bullet 5 – Acknowledge that some of this information is protected for security purposes and so its distribution and use will be carefully controlled.	The recommended changes have been made.

Comment By	Number	Doc pg.par#	Context	Comment	Panel Response
UWCD-1027	27	4.2	biological feasibility	19) More accurately reflect what the goal of providing passage is and what the threshold of feasibility is. The goal is not to “increase the viability of the endangered Southern California DPS of steelhead trout” as is stated in the first sentence of this section. It is also not to establish “self-sustaining steelhead populations upstream of SF Dam” as is suggested in the second paragraph	The study plan has been modified in response to the comment. In their 2008 BiOp, NMFS stated that all three elements of the RPA must be implemented to avoid jeopardizing the continued existence of the Southern California steelhead DPS or resulting in the destruction or adverse modification of critical habitat. The purpose of element 3 is to prepare a study plan that will guide the evaluation of the feasibility of providing steelhead passage around SFD, or other suitable alternative to passage. The Panel's interpretation of the goal of providing fish passage around SFD is to reduce or eliminate effects of fragmentation and habitat loss associated with the Project.
UWCD-1027	28	4.3.1		20) Table described in section 4.3.1 (Task 3-1) should include challenges associated with implementation, uncertainties associated with implementation, and feasibility ranking based on decision criteria).	The recommended changes have been made.
UWCD-1027	29	4.5	schedule	21) The start date is not realistic given the need for United to obtain written agreement by NMFS on the study plan and then approval by FERC before implementing the plan	The start date has been estimated to be September 2012, to allow flexibility based upon considerations of time to review and finalize the study plan. The Panel considers this date a placeholder for the NTP; the time to complete the evaluation steps identified in the schedule are firm with the actual date of completion being a function of the date of the NTP.
UWCD-1027	30	4.5	schedule	The schedule needs to allow for more review time for the Group	The recommended changes have been made.
UWCD-1027	31	4.5	schedule	The schedule should clarify when review by the group will be required and if written comments are expected.	The recommended changes have been made.
UWCD-1027	32	5.1.1	biological feasibility	22) Comment 19 above similarly applies to the first paragraph of section 5.1.1	Comment noted, study plan includes the requested explanation.
UWCD-1027	33	5.3	preferred alternative	23) Given comment 3 above, section 5.3 (Decision Criteria) needs to be revised to clarify what would happen if a preferred alternative for passage cannot be identified and agreed to (see comment 6 above regarding the process for selecting a preferred alternative).	Comment noted, the study plan has been modified to clarify the decision and implementation process.
UWCD-1027	34	5.3	feasibility	24) The first paragraph of section 5.3 (Decision Criteria) should be revised to reflect the that it is possible that no passage alternatives will be deemed feasible.	Comment noted, study plan includes the requested modification.
UWCD-1027	35	App A	criteria attraction	25) The first bullet discussed ratios of facility flow. The ratio of passage attraction and spill should also be evaluated.	The recommended changes have been made.
UWCD-1027	36	App A	volitional	3rd bullet - clearly describe how volitional passage will be evaluated.	The recommended changes have been made.
UWCD-1027	37	App A	preferred alternative	3rd bullet - Reference to a preferred alternative should be deleted.	The recommended changes have been made.
UWCD-1027	38	App A		3rd bullet - The second and third sentences should also be deleted as they seem out of place.	The recommended changes have been made.
UWCD-1027	39	App A		5th bullet should also describe the fact that volitional passage at Santa Felicia will create a pathway for reservoir fish to move downstream including largemouth bass, black and white crappie, green sunfish and other sunfish, and potentially striped bass.	The study plan has been modified to consider the additional criterion regarding introduction of non-native fish.
UWCD-1027	40	App A	volitional	26) Appendix A contains several references to collection of smolts. The panel should clarify what is meant by collection including distinguishing between volitional and non-volitional.	The recommended changes have been made.
UWCD-1027	41	App A	criteria O&M	27) For Operation and Maintenance Criteria contained in Appendix A, the panel should address the issue raised in comment 3 above regarding modifications to the project	Fish passage alternatives that would require modifications that change the Project purpose would be considered fatally flawed, thus infeasible.
UWCD-1116	1	Nov 3 memo from Panel	process	With respect to the Panel’s November 3, 2011, letter to the group, the process described for moving from a draft to final study plan is consistent with the scope of work, which was developed collaboratively by United, NMFS, and CDFG. Further rounds of review by the Group and revisions by the Panel would deviate from the scope of work and could compromise the Panel’s independence.	No additional review/comment/revision cycles associated with this study plan are proposed. This study plan will be submitted to FERC, via United Water, and will reflect comments provided through the prior review process.
UWCD-1116	2	10/31 mtg	schedule	NMFS raised concern at the October 31, 2011, meeting that the schedule contained in the draft study plan for implementation should be shortened from 18 months to 12 months. Given that the study plan process was originally scheduled to take less than 7 months and is now anticipated to take almost 9 months, United recommends that the implementation schedule remain at 18 months, at a minimum, and perhaps be extended to allow for longer review times by the Group..	The time to complete the evaluation remains at 18 months.

Comment By	Number	Doc pg.par#	Context	Comment	Panel Response
UWCD-1116	3	10/31 mtg	feasibility	how this process for SFD compares to the process that was undertaken for United's Freeman Diversion ... While the two efforts share some similarities, they are fundamentally different in that this effort for the Santa Felicia Dam is a feasibility assessment. The end result may be a finding that providing passage is not feasible. The biological opinion and license allow for this possible outcome. The effort for the Freeman Diversion was not an assessment of the feasibility of passage. Passage is feasible as the Diversion has an existing passage facility. That effort was an evaluation of that existing facility and the development of alternative passage structures that would more effectively pass fish. This is an important point as the assessment for the Santa Felicia Dam must address elements that were not a part of the Freeman effort. This includes developing and using objective decision criteria for judging feasibility, taking into account technical, biological, and economic factors.	The Panel agrees that the evaluation of fish passage feasibility at the Project has significant differences to the prior evaluation of passage alternatives at Vern Freeman. The study plan has been modified to reflect the differences.
UWCD-1116	4	10/31 mtg	ESA	United wants to reiterate a point we made in our previous comment letter regarding the purpose of the feasibility assessment. The purpose is to reduce the effects of the Santa Felicia Project such that it no longer is resulting in jeopardy and adverse modification to critical habitat for steelhead.	The study plan has been modified in response to the comment. In their 2008 BiOp, NMFS stated that all three elements of the RPA must be implemented to avoid jeopardizing the continued existence of the Southern California steelhead DPS or resulting in the destruction or adverse modification of critical habitat. The purpose of element 3 is to prepare a study plan that will guide the evaluation of the feasibility of providing steelhead passage around SFD, or other suitable alternative to passage. The Panel's interpretation of the goal of providing fish passage around SFD is to reduce or eliminate effects of fragmentation and habitat loss associated with the Project.
UWCD-1116	5	10/31 mtg	feasibility	study plan needs to contain a process for evaluating technical feasibility.	The recommended changes have been made. Also, see response to UW 1.
UWCD-1116	6	10/31 mtg	process	suggested adding tasks to the study plan calling for the panel to develop draft criteria and to hold a facilitated workshop for the Group to refine and finalize the criteria. We encourage the Panel to add this or something similar to the study plan. Again, these criteria should address technical, biological, operational, and economic factors	The recommended changes have been made.
UWCD-1116	7	10/31 mtg	Level 3	United wants to reiterate that the study plan needs to include Level 3	The study plan includes non-optional cost assessments and considerations for alternatives as well as a subsequent assessment (cost effective analysis) that would take place based on the results of the technical feasibility evaluation.
UWCD-1116	8	10/31 mtg	Level 2	biological opinion and the scope of work for the study plan require that the study plan include "a clear description of science-based investigations of steelhead behavior, ecology, and habitat requirements." United believes the Level 2 Analysis, including the life-cycle model, meets this plan requirement	A complete life-cycle analysis has been replaced with the biological performance tool that addresses fish passage at the Project. Within the parameters of the biological performance tool, the evaluation of fish passage will consider available information on steelhead behavior, ecology and habitat. The Study Plan includes opportunity to identify and discuss addional data needs.
NMFS-1212	1	1.2	Process	Based on the Panel's November 3, 2011 letter, NMFS understands the Panel is of the opinion that (1) the draft Plan will be considered a final Plan after the Panel undertakes a single revision of the draft Plan in response to comments received from United, the California Department of Fish and Game (DFG), and NMFS1, (2) one or more additional reviews of the draft Plan are unnecessary for finalizing the draft Plan, and (3) the final Plan prepared by the Panel will be subject to review and approval as part of the "ongoing FERC process" and, during the review, the Plan could be subject to change. United concurred with this process in its November 16, 2011 letter. For reasons described in greater detail below, NMFS advises that the draft Plan cannot be viewed as a final Plan under RPA 3(a) until United receives written agreement from NMFS.	No additional review/comment/revision cycles associated with this study plan are proposed. This study plan will be submitted to FERC, via United Water, and will reflect comments provided through the prior review process.
NMFS-1212	2	1.3	Process	RPA 3(a) requires that United must receive written NMFS agreement prior to implementing the final Plan. For reasons that are described in greater detail in NMFS' comments below, NMFS is not in agreement with the draft Plan. Accordingly, NMFS' comments below contain recommendations for revision and comments for the Panel to consider as they further develop the Plan. Following the revision of the draft Plan, the revised draft Plan should be submitted to NMFS for additional review in order for NMFS to determine whether it can provide written agreement with the Plan as required under RPA 3(a).	See response to NMFS-1212 Comment 1.

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NMFS-1212	3	1.4 thru 2.1	Process	From a practical perspective, NMFS' experience indicates that one or possibly more additional reviews of the draft Plan would be necessary for producing an agreeable final Plan. For instance, to ensure that the draft Plan is revised in a manner that meaningfully and substantively responds to NMFS' comments requires that NMFS undertake at least one additional review of the revised draft Plan. Aspects of the draft Plan are presented as preliminary, and because NMFS has identified other elements of the draft Plan that require further development, the draft Plan is expected to be revised. As a result, NMFS must review the revised draft Plan to develop an understanding of the revisions, including any substantively new information, and determine if further revision to the draft Plan is necessary to produce a reliable feasibility assessment in accordance with the tenets and requirements of the RPA.	See response to NMFS-1212 Comment 1.
NMFS-1212	4	2.1	Process	NMFS is aware that the Panel members are under contract with United to undertake an already agreed-upon scope of work to develop a study plan consistent with RPA 3(a). Regardless of what that scope of work includes2, NMFS cannot provide written agreement with the Plan until NMFS has determined that its comments on the Plan have been adequately addressed. As a matter of clarification, undertaking the process set forth in the RPA for finalizing the draft Plan is ultimately the responsibility of United and the Commission. Nonetheless, NMFS fully expects to review the draft Plan upon revision and the draft Plan will not be considered a final Plan until NMFS has provided written agreement.	See response to NMFS-1212 Comment 1.
NMFS-1212	5	2.2	Goal	NMFS asks that readers be mindful of two key themes concerning the assessment of steelhead-passage feasibility. First, the goal of finding the least expensive option that fully meets all biological goals should drive the feasibility assessment, not the best solution for a given cost even though it does not meet passage goals. Second, the feasibility assessment should not focus on addressing the need for fish passage, but instead should focus solely on developing a feasible engineering solution that provides fish passage and evaluating which conceptual design alternative provides the most reliable, safest, and most timely fish passage over the widest range of discharges possible such that the likelihood of avoiding jeopardy to the species is maximized.	Cost estimates are included in the development of the technically feasible fish passage alternatives. Biological performance would be maximized to the extent possible. Second portion of comment the Panel agrees to.
NMFS-1212	6	2.3	Level 1	The Panel proposes to develop and evaluate fish passage alternatives and cost under the Level-1 investigations. Although the conceptual framework for the subject investigation appears reasonable, the narrative is general and not sufficiently developed such that NMFS could understand how the investigation would be undertaken. The draft Plan should clearly describe the specific methods, and decision criteria, that would be used to meet the requirements described in RPA 3 and to make determinations about the following list of factors contained in the draft Plan: 1) The benefits of each alternative; 2) The best fish passage performance; 3) The fish-passage effectiveness of the alternatives; and, 4) Which alternatives would best meet the RPA.	Level 1 had been replaced by an expanded, more detailed description of the evaluatoin process, including development and application of criteria to asses: 1) The benefits of each alternative; 2) The best fish passage performance; 3) The fish-passage effectiveness of the alternatives; and, 4) Which alternatives would best meet the RPA. The Study Plan calls for application of criteria that are included in Appendix A, and development and scoring of criteria when the Panel determines the need - to be conducted with Group participation. Much of the defintion of the metrics and rating/weighting of criteria is not possible until the evaluation is underway and is likely to be based on professional judgement in the absence of emprical information on the Project site or similar fish passage projects.
NMFS-1212	7	3.1	Level 1	That the evaluation and decision criteria are a work in progress and additional development and refinement of the criteria are anticipated underscores the preliminary nature of the draft Plan. However, NMFS must know and understand the criteria prior to implementation and, in this regard, all of the decision or evaluation criteria should be identified and disclosed in a revised draft Plan, rather than deferring complete development of the criteria for the various workshops that are planned. Likewise, the weights that the Panel has in mind to apply to the various criteria should be disclosed in a revised draft Plan for consideration by the Group as a whole.	Study must include development of criteria because they will likely be affected by alternatives considered. - All parties will have a chance to review and comment on weights or provide their own weights. - Change Workshop#1 description to "update draft criteria" rather than "finalize evaluation criteria" - Include criteria in the workshop progress report - Include "review and discussion of criteria and weights" in mtg

Comment By	Number	Doc pg.par#	Context	Comment	Panel Response
NMFS-1212	8	3.1	Level 1	The draft Plan should clearly state that alternative and conceptual analyses, preliminary hydraulic computations and supporting documentation will be assessed to determine whether each alternative will meet NMFS and DFG fish-passage guidelines over the range of fish-passage design flows.	Clarified that alternatives will satisfy criteria and guidelines.
NMFS-1212	9	3.2	Level 1	Although the Panel proposes to apply professional judgment for various purposes, such judgment increases the potential for subjectivity to influence the investigations and retrospective rationalizations. Therefore, the revised draft Plan should adopt and rely upon specific criteria to inform the Panel's decisions regarding the technical feasibility assessment.	Clarified that evaluation criteria are general and are not design criteria.
NMFS-1212	10	3.3	Level 1	With regard to the stated assumptions for designing fish-passage facilities (e.g., those related to physical or operational aspects), NMFS recommends the Panel avoid adopting assumptions that have the functional effect of foreclosing the Panel's ability to identify an alternative with the best fish-passage performance. To this end, NMFS recommends the Panel revise or omit the stated assumptions in the draft Plan that have the potential for this functional effect.	The process proposed in the Study Plan requires the presentation and subsequent assessment of alternatives, including assumptions where empricial evidence is lacking. The expertise of the Panel is part of the process of evaluation where such evidence is lacking and only pertinent experience and expertise can be used to initiate and potentially complete an assessment. The Panel expects such determinations to be made openly and to be presented to and discussed with the Group to assure all pertinent information is provided in the application of assumption-related evaluations
NMFS-1212	11	3.4	Level 1	Although the draft Plan includes criteria to evaluate and compare alternatives, a clear fish-passage performance objective is conspicuously absent, but is needed. Because many members of the existing Panel were part of the Panel that was assembled to evaluate the performance of fish passage at the Vern Freeman Diversion Dam, it may be instructive to consider the fish-passage performance objective involved in the diversion dam assessment.	A quantitative fish passage performance objective would be hyopothetical and require some form of evaluation to be meaningful. An assessment of the relative capability of alternatives to meet general objectives, such as volitional passage, design criteria, etc., can be applied, but the ultimate capability of the alternative to perform will not be known specifically, only relatively. Ultimately, performance measurese will be defined based on other, similar facilities, professional judgement, level of uncertainty and level or risk. The basic objective will be to provide efficient, safe, effective passage, that approaches unimpeded passage.
NMFS-1212	12	3.5	Level 1	The fish-passage performance objective involved promoting or approximating unimpeded passage conditions for endangered steelhead at the diversion dam in the lower Santa Clara River. The bases for this objective generally involved the migratory behavior and ecology of steelhead, the flashiness of the Santa Clara River, and the tenets and requirements of the U.S. Endangered Species Act. A similar fish-passage performance objective should be adopted to guide the evaluation of alternatives for providing passage of endangered steelhead at Santa Felicia Dam. In this regard, elements of a fish-passage performance objective to guide the current proceedings should include providing reliable, safe and timely passage for immigrating and emigrating juvenile and adult steelhead.	The passage performance goal is to provide passage that is unimpeded in terms of delay, access, accessibility, etc. Each component of this objective is to be evaluated compartively among alternatives and against a numeric metric, if available. True passage performance will vary with conditions, so frequency of performance as well as duration, level, etc., are all variable and may likely only be meaningful in comparing relative performance versus actual performance. The risk and uncertainties surrounding actual performance will likely dictate how well the alternative may meet the objective.
NMFS-1212	13	3.6	Level 1	With regard to the proposal to develop cost of the fish-passage alternatives, the topic of cost versus economic feasibility for providing passage of endangered steelhead past Santa Felicia Dam was raised during the October 31, 2011, meeting among United, the DFG, the Panel, and NMFS. Consistent with NMFS' statements at the meeting and requirements of RPA 3(a), NMFS expects that the final Plan would include the requirement to estimate the construction cost for each alternative to achieve passage of steelhead. NMFS is pleased to read that the draft Plan appears to capture this basic approach. NMFS' views on elements of the draft Plan that pertain to economic feasibility are presented in the section of this enclosure entitled "Level 3 – Possible Future Action."	No response needed.
NMFS-1212	14	4.1	Level 1	Although the draft Plan leads NMFS to conclude that the Panel will provide the Group with recommendations on how to select a preferred alternative, RPA Element 3(c) clearly states that the steelhead-passage feasibility report shall "…identify the preferred long-term solution to restore steelhead access to and from historical steelhead spawning and rearing habitats upstream of Santa Felicia Dam…" Therefore, the draft Plan should require the Panel to identify the preferred long-term solution for restoring steelhead access in accordance with RPA Element 3(c).	The Panel has committed to provide a suite of alternatives, including at least one volitional alternative, The possiblity that a preferred alternative cannot be determined on technical feasiblity or biological performance alone, could prevent the Panel from identifying a preferred alternative.The plan will include development and application of criteria to help guide development of alternatives to accommodate site specific conditions as efficiently as possible, and potentially identify the realtive liklihood of the alternative in meeting the criteria.

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NMFS-1212	15	4.2	volitional	With regard to volitional and non-volitional passage options, consistent with RPA Element 3 of NMFS' May 5, 2008, biological opinion, the RPA requires the Panel to first determine the feasibility of volitional passage options. If volitional steelhead passage is determined to be infeasible, then the Panel is to consider non-volitional steelhead passage, though NMFS recognizes that the preferred or selected alternative may represent a combination of volitional and non-volitional passage options.	Comments noted. See response to UW 6, 7, 8. Clarified that at 1/06/12 meeting we agreed to consider volitional alternatives concurrently with others.
NMFS-1212	16	4.3	volitional	At the October 31, 2011, meeting among United, the DFG, the Panel, and NMFS, the Panel requested that NMFS provide a definition of "volitional passage." Although NMFS has not officially defined this phrase, the following provisional view is offered for the purpose of informing the proceedings related to developing a final Plan in accordance with RPA Element 3(a). For these purposes, NMFS views volitional passage as a form(s) of fish passage whereby all individual migrating adult and juvenile endangered steelhead have the opportunity to move freely past the dam according to their own will in a safe, timely, and effective manner, including aquatic conditions that are within the swimming ability of all individual migrating adult and juvenile endangered steelhead as necessary to move freely past the dam according to their own will in a safe, timely, and effective manner.	Panel has modified this definition for the study.
NMFS-1212	17	4.4	Level 2	*Level 2 – Biological Benefits* The Panel proposes to estimate the number of steelhead that could be recruited to the entire southern California population of steelhead under each fish-passage alternative identified through the Level-1 investigations. Having carefully considered the conceptual framework and specific content of the proposed Level 2 investigation, NMFS questions the need for the investigation and recommends it be omitted from the revised draft Plan for two principal reasons. First, there is an extensive body of information that has already been developed, and is available, that highlights the intrinsic value of the Piru Creek sub-basin to endangered steelhead and restoring passage of steelhead to the Piru Creek sub-basin. Second, the application of the life-cycle model as currently proposed is not expected to produce reliable findings. These reasons are described in greater detail as follows.	The Panel originally proposed to estimate the "relative": number of fish that could successfully pass SF Dam as a relative measure of comparison among alternatives with varying performance under varying conditions. The revised Study Plan uses a biolgical performance tool to evaluate relative abilities of alternatives to successfully pass SF Dam. The life-cycle model employed this concept and related the relative performance, in terms of probability of successful passage to the migrating population to estimate a number of fish passing the fcility. The estimation of numbers passing SF Dam is no longer part of this tool.
NMFS-1212	18	4.5 thru 7.5	Level 2	*Existing information regarding the Piru Creek population of endangered steelhead…*	~~Comments noted.~~ Revision made.
NMFS-1212	19	7.6-7	Life-cycle model	Given the following limitations of the life-cycle model, the reliability of steelhead production simulations obtained from application of the model, as well as predicating the evaluation and comparison of alternatives on the model output, are questionable: 1) The model does not influence the actual feasibility of implementing fish passage at the Project. The feasibility of implementing fish passage is primarily an engineering question;	The revised study plan no longer includes a life cycle model as an evaluation tool
NMFS-1212	20	7.8	Life-cycle model	2) The required input data are unavailable. The findings from application of the life-cycle model are not expected to reliably inform science-based decisions concerning the development and selection of alternatives for providing passage of endangered steelhead at Santa Felicia Dam. As discussed during the October 31, 2011, meeting with the Panel, the complement of population demographic, life history, and habitat requirement data that are necessary to populate the life-cycle model simply do not exist for southern California steelhead. Data representing northern conspecifics are not an appropriate surrogate for the life history and habitat requirements of southern California steelhead owing to climatic and related differences in species life history, behavior and ecology;	The revised study plan no longer includes a life cycle model as an evaluation tool.

Comment By	Number	Doc pg.par#	Context	Comment	Panel Response
NMFS-1212	21	8.1	Life-cycle model	3) The resolution of the findings is too coarse. Even if reliable empirical data specific to southern California steelhead were available to properly populate the life-cycle model, the coarse resolution in which the model is proposed for application is not expected to provide the sort of power that is necessary to distinguish innate nuances between or among the alternatives and therefore ecological benefits specific to each of the alternatives;	The revised study plan no longer includes a life cycle model as an evaluation tool.
NMFS-1212	22	8.2	Life-cycle model	4) The model scope is excessively broad and considers factors that are largely inconsequential. Because the currently proposed model would consider environmental and biological factors that are not directly related to assessing the feasibility of steelhead passage at Santa Felicia Dam (e.g., ocean survival rates), the analysis has the potential to artificially mask the value of one or more alternatives for promoting passage of steelhead at the dam;	The revised study plan no longer includes a life cycle model as an evaluation tool.
NMFS-1212	23	8.3	Life-cycle model	5) Certain model assumptions appear inappropriate. Although the model assumptions are not entirely clear, because they have not been stated in the draft Plan, NMFS' review suggests the model is based on a few assumptions that appear invalid. Three examples are warranted. First, one model assumption is that survival rates and numbers of steelhead passing the dam would vary depending on the alternative. However, because NMFS fish-passage guidelines will require all viable fish passage alternatives to have extremely high survival rates and provide successful fish passage over the same fish passage window, survival rates and numbers of fish passing the dam are not expected to vary substantially among the alternatives, particularly in light of the coarse resolution. Second, another assumption is that population spatial structure will vary depending on the alternative; how exactly would population spatial structure vary among the alternatives considered if all of the alternatives provide passage of at least one adult steelhead? Third, application of the model appears to assume that the production potential of upstream habitats, predation and competition, instream migration, and ocean survival will differ between the fish passage alternatives identified in Level 1. However, these factors are not expected to differ among the alternatives; the only difference between alternatives would be the varying degree to which they facilitate passage;	The revised study plan no longer includes a life cycle model as an evaluation tool.
NMFS-1212	24	8.4	Life-cycle model	6) The findings are expected to lack ecological meaningfulness. Given the foregoing conditions and characteristics of the model, the findings are not expected to provide a true representation of the ecological benefits that may result from each of the alternatives.	The revised study plan no longer includes a life cycle model as an evaluation tool.
NMFS-1212	25	8.5	Life-cycle model	Overall, assessing the contribution of the subpopulation to the DPS is largely irrelevant to the task of assessing the feasibility of passage, and the findings from the Level-2 investigation, specifically application of the life-cycle model, are not expected to reliably inform science-based decisions concerning the development and selection of alternatives for providing passage of endangered steelhead at Santa Felicia Dam. Therefore, the Level-2 investigation should be omitted from the draft Plan.	The revised study plan no longer includes a life cycle model as an evaluation tool.
NMFS-1212	26	9.1	Life-cycle model	At this point, the Panel may wonder what NMFS meant under RPA 3(a) by requiring the plan to include a clear description of science based investigations of steelhead behavior, ecology, and habitat requirements (to inform the assessment of steelhead passage feasibility), and how these investigations are to be included in the Plan. NMFS envisioned the Panel would undertake one or more field-based assessments to inform development of the alternatives. For instance, and briefly, the Panel members may wish to collect and then analyze data pertaining to the migratory ecology and behavior of juvenile and adult migrants at the confluence of Piru Creek and Lake Piru for the purpose of informing the design of a particular fish-guidance technology for this specific location.	The revised study plan no longer includes a life cycle model as an evaluation tool.

Comment By	Number	Doc pg.par#	Context	Comment	Panel Response
NMFS-1212	27	9.2-4	Level 3	*Level 3 – Possible Future Action* With regard to the "economic feasibility" of implementing an alternative, NMFS envisions that the process for informing such a determination would be undertaken largely by United, separate and apart from the Panel's effort to develop and implement a final Plan. As a result, NMFS requests that the Level-3 investigation be omitted from the draft Plan, even as a potential future option.	The Panel has considered NMFS comment and United's position, and has revised the Study Plan to enable United to conduct a financial (cost) feasibility analysis. If a passage alternative is not selected by the Group, an economic analysis will be considered with off-site alternatives.
NMFS-1212	28	10.1	RPA Elements	1) Page 1-2, last paragraph states "This Study Plan has been prepared to meet the requirements of RPA Element 3, to assess the feasibility of providing passage of adult and juvenile steelhead at or around SF DAM. The Panel has also taken care to address the RPA Element 3 within the context of Elements 1 and 2 as described above." It is not clear how the Panel did this and/or what was considered needed or relevant to make sure the study plan fit within the context of Elements 1 and 2.	See Response to NMFS 41.
NMFS-1212	29	10.2	RPA Elements	2) Page 3-3. It is stated that existing and expected future conditions will be the basis of the feasibility study. With respects to hydrologic and hydraulic conditions and when fish should be able to pass, such an assumption may not be appropriate. If steelhead, historically, were able to pass at wider discharge windows than those that currently exist, then, for example, avoiding jeopardy of the species (avoid reducing appreciably the likelihood of both the survival and recovery of the listed species in the wild by reducing the reproduction, numbers, or distribution of that species) would greatly depend upon recreating passage windows similar to those that existed historically (or at least having key elements of the historic hydrologic regime).	Clarified that conditons are at the dam.
NMFS-1212	30	10.3	Level 1	3) Page 3-3. The terms "analysis considerations" and "evaluation criteria" are somewhat vague and confusing. Terms such as "physical, biological and environmental considerations" and "project performance criteria" might be more appropriate.	Revised plan clarifies the terms.
NMFS-1212	31	10.4	Goal	4) Page 3-4. In addition to the concerns NMFS raised regarding the Level-2 investigation, the stated intent of this investigation is not consistent with the substantive issues that are the basis of the RPA, including RPA 3(a). The substantive issues primarily involve whether passage of steelhead at Santa Felicia Dam is feasible, the means (i.e., alternatives) for promoting passage, and an understanding of the functionality of identified alternatives for promoting passage (i.e., attainment of the fish-passage performance objective). To this end, the Level-2 analysis should propose a method (qualitative or quantitative) to assess whether passage alternatives will lead to attainment of the fish-passage performance objective.	Panel has revised the study plan to include a Biological Performance Tool. The tool will be enhanced during the implementation of the plan to include identification of performance criteria and objectives, as appropriate.
NMFS-1212	32	10.5	process	5) Page 4-1. One task that should be listed is to distribute the project background information to the Group for review and comment prior to the panel's first Workshop. The Group members should also be provided an opportunity to visit the site after having read the background information. This provides Group members time to familiarize themselves with the project and constraints prior to having to quickly provide comments to the Panel based upon the results of the alternative selection workshop (workshop #1).	The revised study plan includes scheduling of workshops, review cycles, and sharing information to accompany implementation of each task.
NMFS-1212	33	10.6	Level 1	6) Page 4-3. With regard to compiling background information, consider addressing historical data on streamflows and comparison of streamflows between pre-dam and post-dam construction (sensu Richter et al. 1996). Hydrologic record extension methods may be used when pre-impact records do not exist. This analysis can inform fish passage design flows.	The Panel expects that the hydrology to be assessed for potential fish passage conditions will primarily include that to be the result of operation of SFD (to be confirmed as part of the RPA element 2) and hydrology resulting from Pyramid Lake operations and unaltered flow between Pyramid Lake and SFD. These data will be further defined and applied as appropriate during initial phases of plan implementation.
NMFS-1212	34	10.7	Level 1	7) Page 4-5, Task 1-2. Why would the panel use the Washington Department of Fish and Wildlife's criteria? Do WDFW criteria meet or exceed NMFS and CDFG criteria?	The Panel uses NMFS and CDFG design criteria and guidelines as appropriate. Study Plan has been revised.
NMFS-1212	35	10.8	Level 1	8) Page 4-6, first sentence. This sentence does not make sense. Is it being suggested that the evaluation matrix will be fully developed and fixed before the alternatives are selected? If yes, this may not be desirable and the Group should be able to weigh in on the matrix prior to Workshop #1.	This is a preliminary draft list. Group has already reviewed the criteria.

Comment By	Number	Doc pg.par#	Context	Comment	Panel Response
NMFS-1212	36	11.1	Level 3	9) Page 4-6. Consistent with the goals of achieving the best passage, cost should not be considered a fatal flaw in identifying initial and conceptual solutions because under the proposed Level-3 analyses cost is only supposed to be considered relative to the various conceptual designs that fully achieve the biological goals (e.g. the goal of finding the least expensive option that fully meets all biological goals versus finding the best solution for a given cost even though it does not meet passage goals).	The goal of achieving the "best" passage is not clear, nor defined succinctly in the BO or related correspondences with NMFS. Nonetheless, the process presented in the study plan includes a screening to determine fatal flaws at several levels, including an initial screening prior to development of cost. An alternative will be evaluated for cost only if it passes the initial fatal flaw screen, and would not be eliminated from further consideration based on cost alone, but cost iwill be a consideration in development and assessment of the alternatives. For example, cost reduction may be a condition of an alternative that is defined in the evaluation as a condition that would affect feasibility.
NMFS-1212	37	11.2	Level 2	10) Page 4-10, first paragraph under 4.2. It is stated that "The Panel has determined that assessing these parameters in context of a life cycle model will support the evaluation of the feasibility of fish passage at SF dam." It is not clear how a life-cycle model will determine whether establishing fish passage at SF dam is feasible, as the feasibility of establishing fish passage at SF dam is almost entirely an engineering question. This statement implies that at least one of the purposes of the Level-2 analyses may be to determine whether it is worth establishing fish passage at SF dam, based upon life cycle model results. NMFS' biological opinion (which provides the basis for the RPA) has already well established that fish passage is needed at SF dam. Thus, this study should not focus on addressing the need for fish passage, but instead should be focusing solely on developing a feasible engineering solution that provides fish passage and evaluating which **conceptual design** alternative provides the **most reliable, safest, and most timely fish passage over the widest range of discharges possible** such that the likelihood of avoiding jeopardy to the species is maximized.	The Life Cycle Model has been removed from the study plan and a biological performance model has been added to provide a tool for assessing, among other conditions, reliability in terms of efficiency and effectiveness of the alternative providing passage around SFD. The Panel does not agree that the fish passage feasiblity evaluation is almost entirely an engineering question. Biological performance, included conditions other than hydraulics and as the evaluation moves from development of conceptual alternatives to evaluating feasiblity, the relative influence of biological performance could distinguish feasiblity among technically similar alternatives.
NMFS-1212	38	11.3	Level 2	11) The study should incorporate plans to calibrate and validate any models that are utilized in its analyses.	The Plan includes a step where data gaps are adressed. It is anticipated that the biological performance model will help identify those gaps as well as studies to validate/calibrate the model, as needed.
NMFS-1212	39	11.4	Criteria	12) The Group should be allowed to carefully review and provide input on the weight of various parameters in any decision matrices used in selecting alternatives and or model simulations.	The Study Plan is purposefully designed to include input from the Group at strategic points in plan implementation, including development and application of criteria.
NMFS-1212	40	11.5	Level 1	13) The Gantt Chart is confusing in that the text on page 4-20 states days are meant to include all calendar days (including weekends, holidays, etc.). However, the Level 1 Feasibility Analysis is stated to take 300 days in the chart but simultaneously shows that task will take more than a year (1/16/12 to 3/8/13).	The Study Plan has been revised to clarify and simplify the description of the progression, integration, and scheduling of the various tasks.
NMFS-1212	41	11.6	RPA Elements	14) It is unclear how well one can isolate and evaluate fish passage alternatives independently of the other two RPA elements (geomorphic effects and flow releases). To what extent can and will information from these two aspects need to be coordinated in order to achieve optimal operational and biological goals?	The statement regarding achieving optimal operational and biological goals is confusing and unexpected in that NMFS has limited the extent that cost and biological measures can be used to evaluate the feasiblity of fish passage. NMFS has stated that the study is essentially an engineering study (NMFS 37), that costs are not to be considered as potential cause for elimination of an alternative (NMFS 27,36) and that the biological need for the fish passage has already been established in the BO and is not a consideration in the feasiblity evaluation (NMFS 23, 25). In discussions with NMFS staff, the Panel was told that conditions to be implemented per RPA Elements 1 and 2, specifically the efficacy of the flow conditions to provide required access to and from SFD, are to be considered as met. The focus of the feasiblity study is to be passage around SFD, not between the dam and the ocean. As such, the Panel does not propose to consider the potential outcomes of implementing RPA elements 1 and 2 other than that they will fully accommodate NMFS expectations to provide fish passage to and from SFD and the ocean and provide the necessary increse in habitat function and availablity to the extent that implementation of a feasible fish passage alternative around SFD or a non-passage alternative if passage is infeasible, will suffice in meeting the requirements of RPA Element 3.

Comment By	Number	Doc pg.par#	Context	Comment	Panel Response
NMFS-1212	42	11.7	Goal	15) Section 4.2.1.3 (page 4-14). Consideration of connectivity is irrelevant for developing a feasible engineering solution to restore passage of endangered steelhead at Santa Felicia Dam, and therefore should be omitted from the draft Plan. The feasibility of steelhead passage at the dam is largely an engineering question. Additionally, NMFS responded to numerous comments during the formal consultation with the Commission on the Project that pertained to the issue of connectivity downstream of Santa Felicia Dam, specifically groundwater percolation in an area referred to as the Piru groundwater basin. Some of the more pertinent responses are as follows:	The Panel acknowledges NMFS expectation that the conditions downstream of SFD as they influence the frequency and potential success fish can migrate to and from SFD and the Ocean are not part of the fish passage feasiblity evaluation, although NMFS comment 41 can be interpreted to require such consideration.
NMFS-1212	43	12.1	Goal	15.a) While the final biological opinion does not dismiss the existence of the Piru groundwater basin, United's model and related results are inappropriate for estimating the frequency that steelhead may have migrated into Piru Creek. Setting aside problems related to the underlying model assumptions and methodology, the model lacks any biological realism that would allow one to reasonably translate the findings from the flow-duration analyses into meaningful estimates regarding the migratory behavior of steelhead. When the modeling results are taken for what they truly represent, we are simply left with an understanding of how often river discharge exceeds a flow-threshold criterion. Such information is woefully inadequate for beginning to reliably predict the frequency of steelhead emigration or immigration events because it alone says nothing directly about the species' response, if any, to the percolative behavior of the groundwater basin;	See Response to NMFS 42.
NMFS-1212	44	12.2	Goal	15.b) Any attempt to diminish or dismiss the functional value of coastal basins in Southern California in general, and Piru Creek in particular, based on naturally variable climatic (including hydrological) conditions is inappropriate. Climatic conditions at the southern extent of the geographic range of steelhead fluctuate widely. For instance, interannual regional precipitation can be quite variable. As a result, migratory conditions for steelhead can be extremely limited or non-existent one year, then suitable the next. During extended periods of below normal precipitation, steelhead are likely precluded from accessing natal spawning areas within coastal basins, but such is characteristic of the species' habitat in the southern landscape, not simply one sub-basin within a broader basin. The variable environmental conditions (including interannual variation in migratory conditions) is probably one reason why the species' life history is exceedingly complex;	See Response to NMFS 42.
NMFS-1212	45	12.3	Goal	15.c) While the percolative behavior of the Piru groundwater basin has been documented, its actual or true influence on steelhead migration, if any, has not. As discussed in the final biological opinion, what is known is that the genetic and ecological evidence indicate steelhead migrated into Piru Creek prior to the construction of Santa Felicia Dam, and descendants of native Southern California steelhead (which are not currently listed under the ESA) exist and dominate reproducing populations of O. mykiss in the Piru Creek drainage upstream of Pyramid Dam and Santa Felicia Dam; and,	See Response to NMFS 42.

Comment By	Number	Doc pg.par#	Context	Comment	Panel Response
NMFS-1212	46	12.4	Goal	15.d) One key aspect of the hydrology of the Santa Clara River is that while evidence indicates surface flows can percolate entirely into the channel bed during the dry season and periods of low flow, there is no reliable information indicating the percolation can render the Santa Clara River mainstem impassible during those periods when steelhead would be migrating. Steelhead have evolved to exploit rain-induced pulses of river discharge, and both adult and juvenile lifestages have been found to migrate during periods of elevated winter and spring discharge. Prior to the construction of Santa Felicia Dam, river discharge is expected to have been elevated and continuous throughout the Santa Clara River during periods when steelhead were migrating. Even today after the construction of dams in the upper watershed (e.g., Santa Felicia Dam, Pyramid Dam, Castaic Dam), elevated continuous wet-season discharge in the Santa Clara River in the vicinity and downstream of the confluence with Piru Creek is not uncommon, and the mainstem Santa Clara River is known to flood during rainfall events.	See Response to NMFS 42.
NMFS-1212	47	13.1	Level 3	16) Page 5-1. The cost-effectiveness analysis requires the quantification of benefits (effectiveness) but does so in a non-monetary metric.	The text, now in Task 9, has been clarified to indicate that the biological metric is based on decision criteria developed in the Study Plan.
NMFS-1212	48	13.2	Level 3	17) Page 5-1. This approach does not seem appropriate in this case – what does "closest to the goal subject to a budget constraint" mean?	The text has been revised to address only alternatives that are feasible.
NMFS-1212	49	13.3	Level 3	18) Page 5-1. The manner in which CE analysis will be used for Level 3 analysis is not the standard approach. See comments below regarding Figure 5-2.	Comment noted, no response necessary.
NMFS-1212	50	13.4	Level 3	19) Page 5-4. This is where this approach is somewhat problematic, at least from a theoretical perspective. In Figure 5-2, suppose the biological goal falls just to the left of points A and B, so that the points to the right of A and B exceed the biological goal but come at a higher cost. A standard CE analysis draw no conclusion about the preferred alternative because a CE analysis cannot say whether the extra biological benefit of the rightward points is worth the extra cost. The suggested decision criteria in this document, however, essentially assumes there is no economic or social value in biological benefits above the biological goal, or at least above the benefits achieved by the least cost alternative that meets or exceeds the biological goal. That assumption is fine, but it distinguishes this use of CE analysis from standard practice.	First, the figure has been revised to show that the biological benefit continuum has a threshold level, whereby points to the right meet or exceed "biological feasibility," and to the left are considered infeasible. Second, with respect to the social value of small increases in benefits, while we acknowlege that they exist, it is a private decision by United as to whether they are willing to pay a higher cost to gain those additional benefits. This process distinguishes those made by private versus government entities.
NMFS-1212	51	13.5	Level 3	20) Page 5-4. With regard to the socioeconomic impact analysis, it is unclear what will be gained from including this type of analysis, as it simply adds uncertainty to the selection criteria in the previous section. Is the goal here to be "equitable"? If so, what are the quantifiable criteria by which to judge "equity"? Would the preference for alternative B over A in Figure 5-2 be potentially reversed if alternative A was "more equitable"? Although "equity" has not been identified as an explicit criterion for this analysis, it is an obvious candidate when the analysis focuses on distribution. From a NMFS perspective, there is no need or the desirability for this type of analysis. Such an analysis may play a role in development of an EIS, but not for the actual decision making about fish passage.	This analysis may be carried out by United independently from the Study, as the information it provides will largely benefit them in terms of selecting among otherwise feasible plans. We have removed it explicitly from the Study Plan.
NMFS-1212	52	13.6	Level 3	21) Page 5-5, first paragraph. This looks like it contradicts statements in the previous paragraph: "For the fish passage alternatives, the additional impacts are likely to include only changes in hydroelectric power generation. The other three impact categories would not be affected by fish passage, and are not considered further."	The text has been revised, since the application of socioeconomic analysis applies more generally to passage and non-passage alternatives.
NMFS-1212	53	13.7	Level 3	22) Page 5-5, second paragraph. Relevant in what way and to whom? This level of analysis is supposedly triggered to assess economic feasibility in terms of cost-effectiveness. Conducting a regional economic impact analysis is irrelevant to that task.	See response to 51.
NMFS-1212	54	13.8	Level 3	23) Section 5.3 (page 5-5). The stated criteria are too fuzzy. They introduce too much potential for ad hoc or ex post rationalizations for rejecting "cost-effective" alternatives.	The text has been revised. The information generated by the analysis may largely benefit United rather than the Group as a whole, but reflects decisions among otherwise feasible alternatives.

Comment By	Number	Doc pg.par#	Context	Comment	Panel Response
NMFS-1212	55	13.9	Level 3	24) Page 5-5. Under the Level-3 analysis, it is stated that "The preferred alternative is the least cost alternative that is able to meet or exceed the biological goal." Who or what process actually quantifies and sets the biological goal/benefit in this process-the Group, the panel, the biological opinion, guidelines and criteria? Specifically, how do you quantify "biological benefit" on the x-axis of Figure 5-2?	The biological performance tool will be used to guide evaluation of biological benefit. The tool adresses performance in terms of the efficiency and ffectiveness of an alternative to pass fish and can be used to quantify benefits. The metrics and their application will be further refined during implementation of the plan.
NMFS-1212	56	14.1	Level 3	25) Appendix A. The total time, duration, and discharge ranges over which fish passage will be available must be documented and included in the evaluation parameters.	The Study Plan proposes to evaluate the alternatives relative to accomodating specific flow ranges (per Table A1). The frequeny and duration of these flows will be consistent across all evaluations, the ability of the alternative to provide passage under the entire flow range will define relative performance and considered in the evaluation. For example, two alternatives that can provide passage under all design flows will be considered to provide equal passage in terms of frequency and duration...
NMFS-1212	57	14.2	Level 1	26) Page A-1, second paragraph. It is stated that "Specific quantitative **threshold design criteria** (e.g.; maximum velocity, minimum water depth) **will likely be applied** in the final detailed design of any selected alternative." Valid fish passage solutions **must consider and meet NMFS and CDFG "threshold" guidelines/criteria** such as maximum velocity, minimum water depth, maximum jump height, etc. *[NMFS bold emphasis]*	The Study Plan was revised to clarify that the final design is beyond the scope of the feasibility study

APPENDIX C

Evaluation Process and Draft Evaluation Criteria

This is a description of the process the Panel will use to evaluate alternatives developed in Task 4. These alternatives will be evaluated for potential feasibility and effectiveness. A grid analysis technique (Pugh Matrix) will be used, which breaks the alternatives down into discrete elements for comparison, evaluation, and optimization.

C-1. EVALUATION PROCESS

The Grid analysis is used to help develop consensus of design solutions that could be pursued. It is essential to developing a mutual understanding of each alternative, understanding each other's values and points of view, and optimizing alternatives. It is not just about selecting a winner. This basic process is commonly used to assist engineering decisions; we emphasize specific parts of the process and use some statistics to help.

The following chart is a schematic example of the grid analysis. This is greatly simplified for the sake of explanation, The SF Dam evaluation will consist of at least two matrices, one for upstream and a second for downstream passage.

Schematic Example of Pugh Matrix grid analysis

	Criteria Weights	Alternative 1		Alternative 2	
Evaluation Criteria (Objectives)		**Score**	**Weighted Score**	**Score**	**Weighted Score**
Criteria 1	6	5	30	5	30
Criteria 2	10	2	20	8	80
Criteria 3	1	9	9	4	4
Criteria 4	3	3	9	8	24
Weighted totals			68		138

Some benefits of using this method are:

- Quantitative technique to rank multi-dimensional options.
- Helps remove personal judgments from decisions.
- Develops a clear common understanding of options being considered
- Helps diverse stakeholders understand each other's values and issues
- Can test sensitivity of objectives and project features
- Rational and consistent. Engineers and managers love numbers and rational decisions.
- Most importantly, a framework for discussion, understanding, consensus-building.

The process of the analysis is as follows. Each component of the grid is explained further below.

- Define evaluation criteria
- Weight criteria
- Describe alternatives
- Score alternatives for each criterion
- Multiply each score by the criteria weight
- Sum the score-weight products for each alternative

C-1.1 DEFINE EVALUATION CRITERIA

Each criterion is a positive attribute and can be considered an objective of the project by which the alternatives will be evaluated. The criteria are not all thresholds that must be entirely satisfied. Most criteria will be satisfied to different degrees by various alternatives, though failure of alternatives to satisfy (meet a threshold score) certain specific, essential criteria might result in fatal flaws. The criteria have different levels of importance and will be weighed appropriately as part of the alternatives comparison. Initial provisional criteria have been developed and will be refined with input from the Group.

The evaluation criteria will be entered as a column in spreadsheets with the alternatives listed in a row across the top of the spreadsheet.

C-1.2 WEIGHT CRITERIA

The criteria have different levels of importance and are weighted appropriately. The weighting uses a scale of zero to ten. If a criterion scores "zero" it has no influence on the design but it can be left on the list because it might be important to other parties. To challenge users to differentiate among the criteria by not allowing all criteria to be weighed "ten," it will be stipulated that the average weight has to be five. So, for example, if there are 20 criteria, the sum of the weights has to be 100. In the schematic example above, the weights varies from 1 to 10 and averaged 5.

It is helpful for different stakeholders to do their own weighting at some point in the process to reflect their perception of values for this project. The differences in weights among the Panel and various stakeholders highlight differences in values and subsequent differences in final scores highlights where discussion is needed to achieve consensus.

C-1.3 SCORE ALTERNATIVES

The next step is to score how well each alternative satisfies each criterion. Put the score into the appropriate cell in the matrix. We use a ten-point (zero to ten) scoring system. A 3-point or semantic 7-point scoring system is often used for this but we use the wider range to create room for an alternative to be incrementally improved by modifying it.

Specific criteria that are considered essential will be highlighted. If they are not satisfied by any alternative to a high degree, the alternative might be fatally flawed. For example, alternatives that do not score a value of ten for dam safety would be fatally flawed.

The Panel will do the scoring based on their collective judgment. Large differences among the products of individual scores and weights highlight differences among the Panel that most affect the final results and that therefore merit discussion. Large differences might be due to different information available or the experience of individual team members or differences in understanding of the alternative. Regardless, those differences will be addressed. The description of each alternative will be modified as necessary until there was a common understanding of it. The point is to achieve a true common understanding of each score, not just to agree on a number.

C-1.4 SIMPLE MATH

Each final score will be multiplied by the weight for that criterion to get the weighted score. In the schematic example above, Alternative 2 scored much higher than Alternative 1 for Criteria 2. The importance of the criteria, weighted 10, overwhelmed the fact that Alternative 1 scored much higher than Alternative 2 for Criteria 3, because it was only weighted a value of three.

Then the weighted scores were summed for each alternative and the totals will be compared. We emphasize that the entire process should be used as a means for communication, mutual understanding, and optimization of alternatives. To optimize alternatives, the lower-ranking alternatives should be "challenged" by addressing the specific criteria that cause them to score low. Focus on the criteria for which the weighted scores differ the most. This uses the highest scoring alternatives to optimize the low-scoring ones and is an important part of this process.

The spreadsheets can be provided to other parties to do their own weighting independently. Differences of final results among parties are valid when they are differences in values reflected in the criteria weights. They are also welcome to challenge scores applied to alternatives. Again, emphasize a mutual understanding of the alternatives and any information available that affects scores. Compare the sums of the client and stakeholders. Where are the differences? If there is a significant difference among highest ranking alternatives, ask why. Look at the differences in weighted scores between matrices scored by different parties. The greatest

differences highlight the criteria that are sources of differences. Ask what can be done to the alternative with a lower score to raise it closer to the higher score.

The matrices and charts showing the comparison of ranking of the alternatives will be included in the text of the report. Charts can be show relative ranking of alternatives considering only fish passage, operations and maintenance, or other categories of interest.

C-2. DRAFT EVALUATION CRITERIA FOR PREFERRED FISH PASSAGE ALTERNATIVES

The following criteria will be used to compare and evaluate the alternatives for upstream and downstream passage were identified and deemed to be technically feasible. Knowing that they will be used to evaluate alternatives, the Panel will have them in mind during the initial brainstorm as well. The Panel expects the criteria to be refined and even changed as information on conditions specific to the Santa Felicia Project is gathered and the Panel's understanding of these conditions improves.

Specific quantitative threshold design criteria (e.g.; maximum velocity, minimum water depth) will likely be applied in the final detailed design of any selected alternative, which is beyond the scope of the feasibility study.

This section of the document describes the criteria and considerations made in weighting them. It also includes some general description of how various types of alternatives score for each criterion. The descriptions may be further developed within the study. More specific descriptions of the scores will be reflected in the pros and cons listed for each alternative in the final report.

C-2.1 CRITERIA OF UPSTREAM FISH PASSAGE FACILITIES

- ***Attraction of Adult Fish to Fish passage facility – Normal, Mid-high, and High Flows***

  Attraction is the guidance of fish to find the migration pathway over the dam. It includes attraction to the vicinity of and passage into the passage facility entrance. Attraction into the facility is evaluated with respect to ranges of river flows applied to each alternative. Several ranges of flows might be evaluated. The following table shows examples of ranges that might be used as well as other relevant flows for comparison. Note that the flows listed here are just placeholders as examples at this time; specific flow ranges will be identified in the assessment and will presumably include considerations of the instream flow schedule, Project operations, and hydrology.

Table C-1. Ranges of flows that may be evaluated.

Flow Range Descriptions	Flows
Normal flow	200 cfs from hydro or energy dissipater
Mid-high flow range	800 cfs including 200 cfs from hydro
High flow range	2,000 cfs including 1,000 cfs spill

Attraction is the key component to minimizing migration delay. Attraction depends on the facility entrance flow, entrance location, and shape of the entrance flow jet. Characteristics of the tailwater that affect attraction are bathymetry, attraction to the area or distraction or competition from other flows.

The facility entrance flow is crucial, especially in relation to other discharges. It is made up of the flow in the facility plus any additional auxiliary flow that is added for attraction. When a facility entrance has greater flow, it is generally more attractive. Exceptions to this are when the extra flow creates excess drops and/or velocity. In those cases, fish might be attracted to the facility but may not be able to enter it.

The ratio of facility entrance flow to the high fish passage flow (river flow) is often used as a design guide. Ratios of facility flow of five to ten percent of the high fish passage flow are often applied. The ratio of momentum (equivalent to the product of flow rate and velocity) has also been used. Simple ratios alone do not account for the other attraction considerations listed above.

The evaluation of attraction of upstream migrants will be based on the professional judgment of the Panel as well as the characteristics described above.

- ***Passage of Target Species through Upstream Fish Passage Facility***

  Passage of target species through the passage facility pertains to the expected success and efficiency (energy, stress, and time expended to pass) of fish passage.

  The physical safety of adult fish passing through the facility is included in this characteristic. Safety is possibly diminished when fish are expected to leap over weirs or are unintentionally induced to leap at other locations. Safety is diminished if fish might become stranded in the facility when it is dewatered.

- ***Volitional Upstream Fish Passage***

  Volitional passage is the concept of giving fish the choice of moving upstream or downstream (i.e., entrance, movement through the facility, and release or exit) based on their own motivation. Pure volitional passage would not include any facilities that trap or haul fish. See Section xxx for a definition of volitional passage. There may also be alternatives that have volitional passage characteristics though are not entirely volitional. Scoring for volitional passage will reflect the degree of volitional passage; pure volitional alternatives will be scored the highest possible score.

- ***Fish Access Out of Fish Passage Facility to Upper Piru Creek***

  This characteristic describes physical access for fish from the facility through any flow control section and any device for accommodating range of reservoir elevations. Head differential, depth of flow at the exit, certainty of adequate flow passing into the facility, and safety of exit conditions (such as discharge to a low reservoir level and fallback considerations) are the primary considerations.

- ***Attraction and Passage of Non-target Species***

  The target species for fish passage is adult steelhead. There might be added ecological value or risk in providing for or blocking passage of other species and life stages. Risks could include the passage of non-native species. No other non-target species have been specifically identified for passage but the Panel assumed if there are any, they would be weaker swimmers than steelhead.

- ***Potential for Fish Passage Evaluation or Biological Monitoring***

  This characteristic is the ability to add facilities for trapping and counting fish passage through the facility to either assess performance of the facility or to monitor populations. The primary objective of the feasibility assessment is to provide fish passage alternatives; there is no stated intent of doing population monitoring at this time. Other technologies (cameras, radio tracking) are available for facility evaluation. If continuing monitoring of fish passage is considered a priority, the best means of achieving that goal can be determined in the design process.

- ***Safety of Juvenile Fish***

  The upstream passage facilities are not anticipated to be a preferred passage route for downstream migrants at Santa Felicia Dam; however, should juvenile fish enter the facility some alternatives may be more fish friendly than others.

- ***Certainty of Collection and Passage***

  This is a measure of how certain the Panel is regarding success of collection and passage. It is based on our combined knowledge of characteristics of the site, hydrology, this steelhead population, and precedents of other similar projects.

  The aspect of certainty would normally be a heavily weighted criterion but, since the Panel has the opportunity in this case to make a final recommendation that includes additional studies to reduce uncertainty, low certainty should not diminish the evaluation score of any alternative unless the uncertainty cannot be mitigated.

- ***Relationship to Dam Operations and Downstream Passage Facilities***

  There might be opportunities to optimize the design of upstream and downstream facilities by combining certain aspects of them and with dam operations to manage costs, operations, and/or conserve water. This characteristic is a function of combinations of upstream and downstream alternatives and will not be used in the initial design and comparison.

- ***Adaptability of Collection and Passage***

  Certainty is increased with adaptability in design and/or operation. For example, an upstream passage alternative might score higher if the attraction flow can be modified in the future or if fish can be released at various locations.

C-2.2 CRITERIA OF DOWNSTREAM FISH PASSAGE FACILITIES

- ***Safety and Viability of Smolts from Upper Piru to a Collector***

  Depending on the design, efficiency, and location of a collector, fish might pass through the reservoir, which might have a beneficial or detrimental effect. Effects might include predation, water quality effects, residualization, and beneficial rearing. This characteristic will include effects of fish protection screening at the outlet if it is included in any alternatives.

- ***Smolt collection at low, medium, and high flow ranges***

  Smolt collection is the efficiency of collection of smolts for each flow range. Specific flow ranges will be developed during the assessment based on expected operations, hydrology and smolt migration timing. Smolt collection might depend on season, streamflow, reservoir circulation patterns, reservoir temperature and water quality, spill, and location and characteristics of the collector.

- ***Smolt collection at low, medium, full, and high pool water surface elevations***

  To successfully collect smolts, the collector will have to be effective at various reservoir elevations as the reservoir is filled and drained. This characteristic is related to the smolt collection and safety through spill criteria and might be combined with them.

- ***Safety of smolts and other fish through facility***

  This includes safety of smolts from where they are collected to immediately after they are released.

- ***Safety of smolts through spillway***

  This includes likelihood of passage through spillway.

- ***Kelt collection, safety, and passage***

- ***Potential for biological monitoring***

- ***Certainty of collection***

  This is a measure of how certain the Panel is regarding success of collection and passage. It is based on our combined knowledge of characteristics of the site, hydrology, this steelhead population, and precedents of other similar projects.

- ***Relationship to Dam Operation and Upstream Passage and Facilities***

  There might be opportunities to optimize the design of upstream and downstream facilities by combining certain aspects of them and with dam operations to manage costs, operations, and/or conserve water. This characteristic is a function of combinations of upstream and downstream alternatives and will not be used in the initial design and comparison.

- ***Adaptability of collection***

  Certainty is increased with adaptability in design and/or operation. For example, a smolt collection alternative might score higher if the attraction flow can be modified in the future or if fish can be released at various locations.

C-2.3 OPERATION AND MAINTENANCE CRITERIA

- ***Simplicity of Fish Passage Operations***

  More complex and frequent operational demands result in greater uncertainty and risk due to improper operations or possible failure of equipment. Additional entrance gates, auxiliary water systems, and mechanical flow control weirs add to complexity but

operations are still simple when these can be automated. Complexity is also increased by remoteness of sites and hauling fish.

- ***Debris Management***

  Fish ladders and fish protection screens are vulnerable to debris. Debris can impair operations and performance if allowed to accumulate, thus compromising its passage effectiveness. Facility or auxiliary water that is pumped must be screened to exclude debris. This characteristic describes the likelihood and the consequence of debris accumulation at the exit of or within the facility and at screened intakes and the ease of dealing with it.

- ***Durability of Structure***

  This is risk of damage of the fish passage structure due to high flows, debris and sediment, or changes in the channel.

- ***Effect on Project Operations***

  Various alternatives may have differing impacts on the Project's ability to meet its water supply and generation goals. Facilities that can meet fish passage needs with no impacts to the Project operations should score highest in this category.

C-2.4 OTHER CRITERIA

Other evaluation criteria that may be considered and evaluated include public safety, aesthetics, education, and permitting. Construction, operation and maintenance costs and certainty of cost factors will be assessed but not used as part of an evaluation.

APPENDIX D

Economic Feasibility and Cost Effectiveness Analysis

The economic feasibility analysis articulated in the BO (NMFS 2008) should apply to the combination of all three RPA Elements: 1) geomorphic effects, 2) flow releases, and 3) fish passage. However, consistent with the outcome of the Study Plan Review Meeting on January 6, 2012, the focus in Tasks 1 through 6 of the Study Plan is on Element 3 of the RPA, fish passage, and the economic analysis is limited to a financial analysis of the costs (implementation and operating) of the alternatives.

Inherent within the evaluation of technical and biological elements of the fish passage alternatives in the Study Plan, is uncertainty related to other components not specifically examined, such as downstream conditions or habitat in the basin. If the uncertainty levels are sufficiently high, they may "trigger" the need for a broader examination of non-passage alternatives. Conceivably, there may be alternative approaches to *each* of the RPA Elements, not just fish passage, which could achieve the same objective. This could include habitat modification and enhancement in the Piru Creek basin, off-site replacement habitat, population supplementation programs, or other similar non-passage means to avoid jeopardizing the continued existence of the Southern California steelhead DPS. If non-passage alternatives are considered, then a complete economic feasibility study would be appropriate.

The approach to be used for a complete economic feasibility analysis would be a combination of "cost effectiveness analysis" and "socioeconomic impact analysis." This approach will provide a mechanism for choosing among the alternatives that achieve biological goals at minimum cost. It will also provide an opportunity to acknowledge and consider how and where costs are borne. Details of a CEA are presented within Task 9 of the Study Plan. The approach for conducting a socioeconomic impact analysis is presented below.

D.1 SOCIOECONOMIC IMPACT ANALYSIS

While the total benefits and costs of alternatives are important in selecting among alternatives, so too may be information about the distribution of costs and the impact of alternatives on socioeconomic groups and sectors of the economy. A "socioeconomic impact analysis" is useful in characterizing the population groups that benefit from improved biological conditions, and which entities or populations bear the costs of an alternative. The extent of the costs (and possibly of the benefits) on specific populations, and whether those impacts are inconsequential or "significant," can potentially influence the selection of a preferred alternative.

The first step in a socioeconomic impact analysis is identifying affected populations. In the case of fish passage alternatives, the benefactors may be widespread and disparate – essentially, the general public who benefits from the avoidance of jeopardy of the species. The costs of passage facilities and operation are more concentrated, to the proponent and its ratepayers. If hydroelectric power generation is affected, the lost power revenues can also have an effect on

ratepayers, and possibly the purchasers of power if the measurable change is sufficiently large. In general, though not with fish passage alone, other groups may be affected: recreation participants, agricultural irrigators, and municipal or industrial water clients of the proponent.

Secondary or regional economic impacts may also provide relevant information. Investment in fish passage facilities or other infrastructure can lead to direct sales and purchases of materials, and design and construction contractors. These purchases can then lead to additional economic activity in support industries, input suppliers, and other services that will ripple through and provide quantifiable impacts in the region. Several well established and widely available modeling platforms are available to generate estimates of sales ("total industry output"), personal income, and employment changes by business sector categories that are likely to result from the initial investment.

D.2 DECISION CRITERIA

As noted in the discussion in Task 9, the cost-effectiveness analysis will determine economic feasibility of technically feasible alternatives and yield a determination of feasibility and identify a set of alternatives, provided that the biological benefit is sufficient to meet the established goal of avoiding a jeopardy call. The *preferred* alternative is the least cost alternative that is able to meet or exceed the biological goal. The selection of the preferred alternative may be influenced by the outcome of the socioeconomic analysis: one or more alternatives could lead to "unacceptable" level of impact or distribution of costs from the perspective of the project proponent. It is anticipated that they may gravitate towards selecting a feasible alternative that meets or exceeds both technical and biological criteria, but that also results in "minimal" impact.

Within the Study Plan, the Group must decide (Task 8) if they can agree on a Panel-recommended fish passage alternative, assuming one exists. If the Group cannot arrive at a consensus decision, an optional next step could be to conduct a full economic analysis of the complete RPA. This would prompt an investigation into a range of alternative approaches to avoiding jeopardy, and could include a re-evaluation of the water release schedule and consideration of suitable alternatives to fish passage.

The full economic analysis would be conducted in a manner similar to that outlined above, but is likely to contain a broader set of potential impacts, affected parties (e.g., recreationists, irrigators, water and power customers, and ratepayers), and cost estimates. Depending upon the approaches considered, it is conceivable that some affected parties may have net benefits. It is also possible that the definition of what is meant by "biological benefit" may become more difficult, and add complexity to the cost-effectiveness analysis. Finally, the socioeconomic impact analysis may involve a similar increase in complexity if additional affected parties are identified, or if the region of analysis for secondary impacts expands to include other locations.