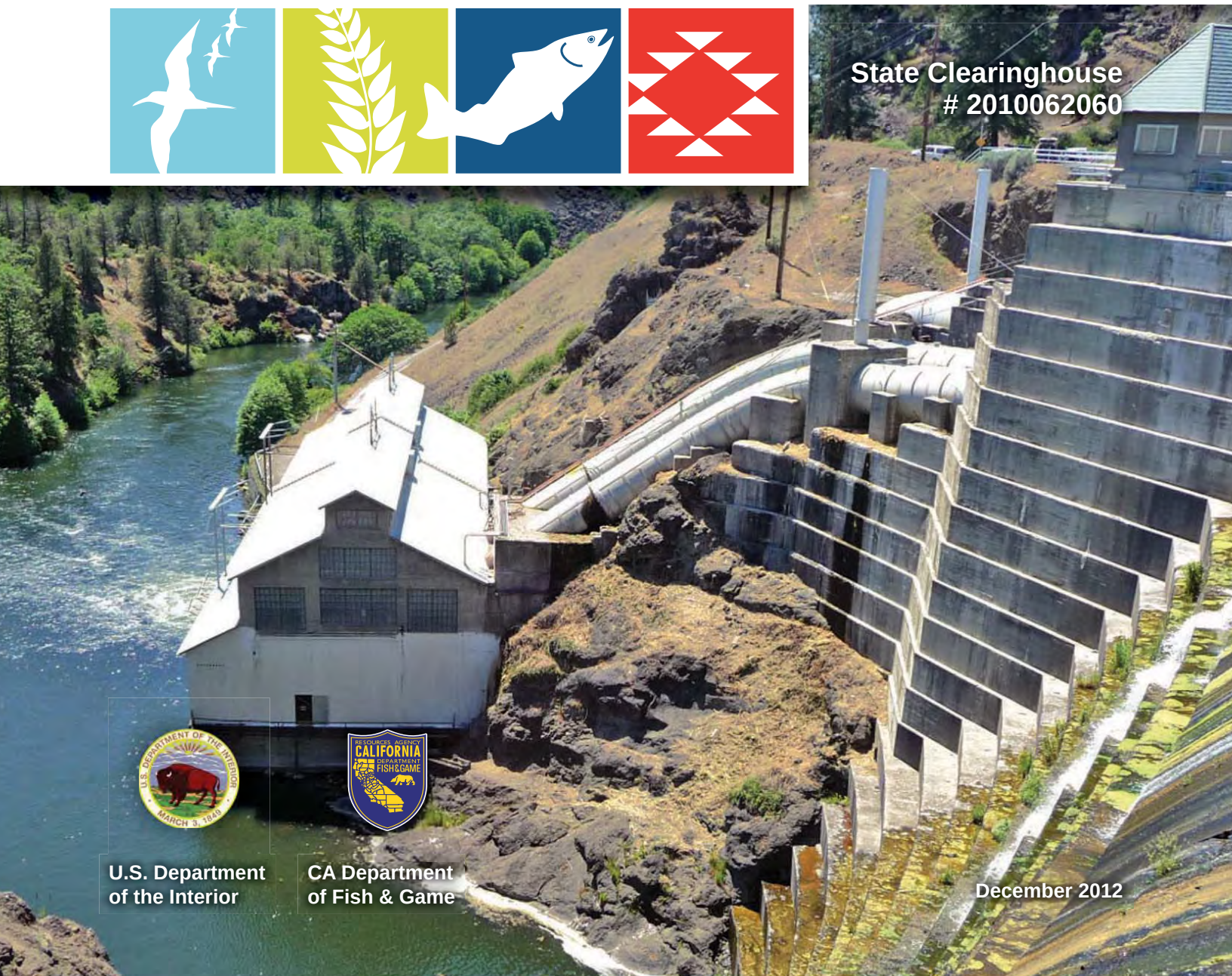
Volume II

Klamath Facilities Removal Final Environmental Impact Statement/ Environmental Impact Report

Appendices



State Clearinghouse
2010062060

U.S. Department of the Interior

CA Department of Fish & Game

December 2012

Volume II
APPENDICES

Klamath Facilities Removal
Final Environmental Impact Statement/ Environmental Impact Report

State Clearinghouse # 2010062060

U.S. Department of the Interior
California Department of Fish & Game

December 2012

Mission Statements

U.S. Department of the Interior

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

California Department of Fish and Game

The mission of the Department of Fish and Game is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public.

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Appendix A

Klamath Settlement Final Alternatives Report

Environmental Impact Statement/Environmental Impact Report on the Klamath Facilities Removal

FINAL
Alternatives Report

Klamath Settlement

Vol. II, Appendix A – December 2012

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Abbreviations and Acronyms

AF	Acre-feet
AIP	Agreement in principle
AWS	Auxiliary water supply
CDFG	California Department of Fish and Game
cfs	Cubic feet per second
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
DOI	United States Department of the Interior
DRE	Dam Removal Entity
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FEMP	Fishway Evaluation and Modification Plan
FERC	Federal Energy Regulatory Commission
FSBC	Floating surface bypass collector
ft	Feet
KBRA	Klamath Basin Restoration Agreement
KHSA	Klamath Hydroelectric Settlement Agreement
mi	Miles
MW	Megawatts
NCRWCQB	North Coast Regional Water Quality Control Board
NEPA	National Environmental Policy Act
NOAA Fisheries Service	National Oceanic and Atmospheric Administration Fisheries Service
NWR	National Wildlife Refuge
ODEQ	Oregon Department of Environmental Quality
OWRD	Oregon Water Resources Department
PCBs	Polychlorinated biphenyls
Reclamation	Bureau of Reclamation
RM	River mile
Secretary	Secretary of the Interior
TMDLs	Total maximum daily loads
USFWS	United States Fish and Wildlife Service
WURP	Water Use Retirement Program
yd^3	Cubic yards

Preface

This Alternatives Formulation Report documents the process used to select alternatives for analysis in the Environmental Impact Statement/Environmental Impact Report (EIS/EIR). The date of this report has been updated to indicate that several minor changes were made after the release of the Public Draft EIS/EIR based on public comments. The details of alternative design presented in Chapter 5, however, may vary in small ways from the description of alternatives in the EIS/EIR. These differences reflect that the alternative descriptions in Chapter 5 preceded the EIS/EIR. The alternative descriptions in the EIS/EIR are those that were used for analysis of environmental impacts.

Chapter 1
Introduction

1.1 Background

The Klamath Basin is in southern Oregon and northern California. Klamath River flow is controlled by six dams: Link River, Keno, J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams (Figure 1-1). The dams, with the exception of Keno Dam, are hydroelectric generating facilities, and make up the Klamath Hydroelectric Project, which is owned and operated by PacifiCorp. The Klamath Hydroelectric Project is regulated by the Federal Energy Regulatory Commission (FERC) as project No. 2082. On February 24, 2004, PacifiCorp filed an application with FERC for a new operating license for the Klamath Hydroelectric Project. The original FERC license pre-dated environmental laws, and most of the Klamath Hydroelectric Project does not include conditions or prescriptions for fish passage upstream of or around the dams; only J.C. Boyle Dam has fish passage facilities. The original license expired on March 1, 2006. Since that time, per FERC regulations, the Klamath Hydroelectric Project has been operating under an annual license with the same conditions as the original license.

This report describes the alternatives to removing four PacifiCorp Dams (J.C. Boyle, Copco 1, Copco 2, and Iron Gate), as described in the Klamath Hydroelectric Settlement Agreement (KHSA). This introduction provides a summary of background information for the Alternatives Report. For more information on the Klamath Basin, the "Layperson's Guide" is available at http://www.klamathrestoration.gov.

1.1.1 History

Upper Klamath Lake and other waterways in the upper watershed provide habitat for the Lost River and shortnose suckers that are listed as endangered under the Federal Endangered Species Act (ESA) and California Endangered Species Act (CESA). Releases from Iron Gate Dam also affect ESA- and CESA-listed coho salmon, Chinook salmon, trout, and other fishes in the Lower Klamath Basin. Without fish passage structures, the hydroelectric facilities block salmon, steelhead, Pacific lamprey, and other species from accessing 350 miles of potential habitat.

In the Klamath Basin, conflicts over water and other natural resources among conservationists, tribes, farmers, fishermen, and state and federal agencies have existed for decades. In particular, several developments affecting the Klamath Basin conflicts have occurred in recent years. These developments include:

- In 2001, water deliveries to irrigation contractors to the Bureau of Reclamation's (Reclamation's) Klamath Project were substantially reduced.
- In 2002, returning adult salmon suffered a major die-off.

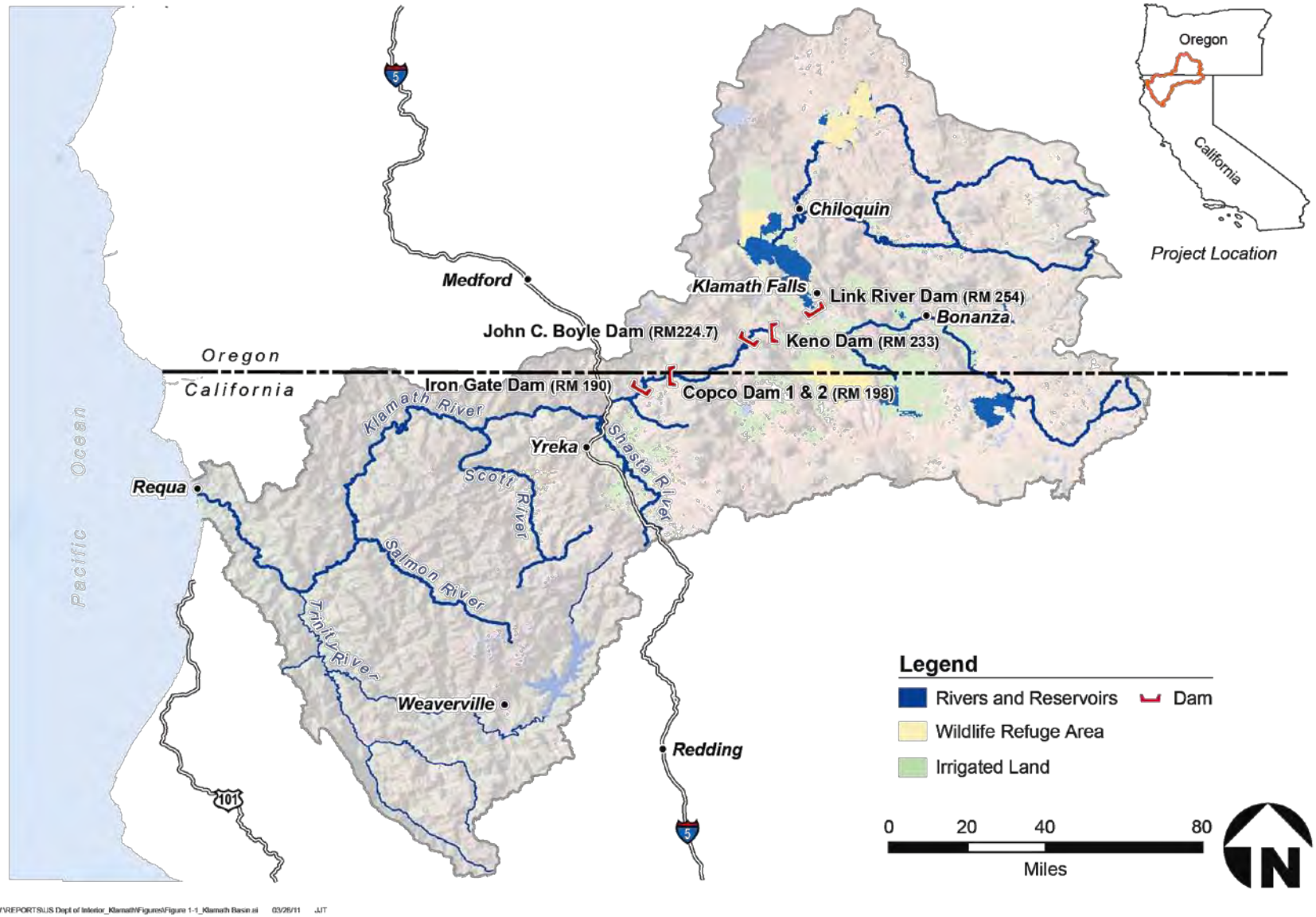

Figure 1-1. Basin Map

- In 2006, the commercial salmon fishing season was closed along 700 miles of the West Coast to protect weak Klamath River stocks.
- In 2010, due to drought conditions, Reclamation's Klamath Project has a reduction in water deliveries resulting in short-term idling of farmland and increased groundwater pumping.
- In 2010, the c'waam (Lost River suckers) fishery for the Klamath Tribes was closed for the 24th year, limiting the Tribes to only a ceremonial harvest.

Since 2003, the United States has spent over $500 million in the Klamath Basin for management actions associated with irrigation, fisheries, and the Klamath Basin National Wildlife Refuge System and resource enhancements.

Fish considerations were a major issue during the FERC relicensing process, which is now in abeyance. The U.S. Department of Commerce and the U.S. Department of the Interior (DOI) submitted fishway prescriptions in 2006 and modified prescriptions in 2007. FERC published a Final Environmental Impact Statement (Final EIS) to comply with the National Environmental Policy Act (NEPA) in November 2007. FERC has not issued a new license for the Project.

As a result of protracted litigation and the Klamath Basin issues surrounding the use of water to support agricultural, tribal, environmental, and commercial fishing needs based upon limited supplies, the United States, the States of California and Oregon, the Klamath, Karuk, and Yurok Tribes, Klamath Project Water Users, and other Klamath Basin stakeholders entered into negotiations to explore possible approaches to resolution of these issues other than through the FERC relicensing process. In November 2008, the four principal parties, the United States, the states of Oregon and California, and PacifiCorp signed an AIP. The AIP contemplated the possibility that, rather than pursue further the FERC relicensing process, the Secretary of the Interior (Secretary) should complete certain studies and make a determination as to whether certain of the facilities (J.C. Boyle, Copco 1, Copco 2 and Iron Gate Dams and appurtenant works, herein referred to as the Four Facilities) in the Klamath Hydroelectric Project should be removed, either all or part of each, to achieve at a minimum a free-flowing condition and volitional fish passage (KHSA 1.4), and by whom, to advance the restoration of salmonid fisheries in the Klamath Basin. The parties recognized that federal legislation would be needed to authorize the Secretary to make such a determination regarding privately owned facilities, and to provide indemnification for PacifiCorp for any liabilities that may accrue to PacifiCorp as a result of facilities removal. As originally contemplated in the AIP, this determination by the Secretary would be whether "the potential benefits for fisheries, water and other resources for removing the facilities would outweigh the potential costs, risks, liabilities or other adverse consequences of such removal." (AIP, at III, p. 5)

1.1.2 Klamath Hydroelectric Settlement Agreement and Klamath Basin Restoration Agreement

As a continuation of the process that led to the AIP, the principal parties negotiated the final agreements with a larger group of stakeholders that included representatives from tribes, the fishing community, irrigators, and environmental groups. On February 18, 2010, the Secretary,

along with the Governors of Oregon and California, more than 30 other parties and the CEO of PacifiCorp, signed the KHSA. At the same time, those same parties, except for the federal parties and PacifiCorp, signed an accompanying agreement, the KBRA. The KBRA was designed to address disagreements over quantities of water; specifically, tensions regarding in-stream flows needed for endangered sucker and salmon species in Upper Klamath Lake and the Klamath River, and water for use in the Reclamation's Klamath Project for irrigation purposes. If fully implemented, the KBRA is intended to result in effective and durable solutions that accomplish the following: (1) restore and sustain natural fish production and provide for full participation in ocean and river harvest of fish species throughout the Klamath Basin; (2) establish reliable water and power supplies that sustain agricultural uses, communities, and National Wildlife Refuges (NWRs); and (3) contribute to the public welfare and the sustainability of all Klamath Basin communities. (KBRA Section 1.3.)

Section 3.3 of the KHSA sets out the terms for the Secretarial Determination and the required conditions that must be met before the Secretary can make a determination regarding removal of the Four Facilities. The KHSA contemplates the Secretary determining whether the four dams should be removed, in whole or in part to achieve at a minimum a free-flowing condition and volitional fish passage (KHSA Section 1.4.). The KHSA also contemplates the Secretary determining who should remove the dams if an affirmative determination is made:

> By March 31, 2012, the Secretary shall use best efforts to (i) determine whether the costs of Facilities Removal as estimated in the Detailed Plan,[1] including the cost of insurance, performance bond, or similar measures, will not exceed the State Cost Cap,[2] and (ii) otherwise complete his determination whether to proceed with Facilities Removal as described in Section 3.3.1, provided that any such determination shall not be made until the following conditions have been satisfied:
>
> A. Federal legislation, which in the judgment of the Secretary is materially consistent with Appendix E, has been enacted;
>
> B. The Secretary and PacifiCorp have authorized funding for Facilities Removal as set forth in Section 4 of this Settlement;
>
> C. The States of Oregon and California have authorized funding for Facilities Removal as set forth in Section 4 of this Settlement;

[1] The Secretary's determination and concurrence from the states will be based, in part, on a "Detailed Plan for Facilities Removal" (Detailed Plan) that describes the following: physical methods to remove the dams and achieve a free-flowing condition; plans for removal of sediment and debris; restoration plans; mitigation measures; plans for obtaining permits; estimated costs; measures to reduce the potential to overrun costs; and identification of a dam removal entity (DRE) to oversee removal efforts.

[2] Defined as the collective maximum monetary contribution from the states of California and Oregon, described in Section 4.1.3 of the KHSA.

D. The Parties have developed a plan to address the excess costs, consistent with Section 4.10 of the Settlement, if the estimate of costs prepared as part of the Detailed Plan (including the cost of insurance, performance bond, or similar measures) shows that there is a reasonable likelihood such costs are likely to exceed the State Cost Cap; and

E. The Secretary has identified a dam removal entity (DRE)-designate, and, if the DRE-designate is a non-federal entity: (i) the Secretary has found that the DRE-designate is qualified; (ii) the States have concurred in such finding; and (iii) the DRE-designate has committed, if so designated, to perform Facilities Removal within the State Cost Cap. (KHSA Section 3.3.4)

An Affirmative Determination in this regard would mean, facilities removal should proceed for all or part of each of the Four Facilities. As noted above, in the event of an Affirmative Determination, the Secretary must also designate who should carry out such removal, whether a federal or private DRE. A Negative Determination means, "a determination by the Secretary under Section 3 of this Settlement that Facilities Removal should not proceed." Under the KHSA, the standard the Secretary shall use to determine whether the dams should be removed is (1) whether it will advance the restoration of the salmonid fishery and (2) whether it is in the public interest, which includes but is not limited to consideration of potential impacts on affected local communities and Tribes. The studies contemplated in the KHSA are intended to inform the Secretarial Determination in light of these standards. If the Secretary makes an Affirmative Determination, the governors of the states of California and Oregon must issue independent concurrences with both the decision on dam removal and selection of a DRE. (KHSA Section 3.3.5.)

The KHSA assumes that environmental analysis supporting the Secretarial Determination will be prepared pursuant to NEPA. The analysis of the environmental consequences of the Proposed Action and its alternatives will be based on information that emerged from the FERC NEPA process, and will be informed, to the extent possible and appropriate, by the results of the specific studies called for in the KHSA, including the information under development for the Detailed Plan (KHSA, 3.3.2).

1.1.3 Facilities Description

The KHSA addresses removal of the Four Facilities: J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams. Table 1-1 contains information about each facility that was used for alternative development.

Table 1-1. Klamath Hydroelectric Dams

Dam	Year Operational	Height (ft)	Length (ft)	Storage Capacity (AF)	Generation Capacity (MW)	Type of Fish Ladder	Dam Type
J.C. Boyle	1958	68	692	2,629 AF at RWS elevation 3793.5	98	Pool and weir ladder	Earthfill and Concrete
Copco 1	1918	135	410	40,000 AF at RWS elevation 2,607.5	20	None	Concrete Gravity Arch
Copco 2	1925	33	335	70 AF at RWS elevation 2,483	27	None	Concrete
Iron Gate	1962	189	740	53,800 AF at RWS elevation 2,328	18	Partial ladder to hatchery	Earthfill

Key:
ft: feet
AF: acre-feet
MW: megawatts
RWS: river water surface
Source: FERC 2007; Reclamation 2012

1.2 Purpose of the Report

In order for the Proposed Action to move forward, the Secretary needs to make a determination that facilities removal should occur, and the governors of California and Oregon need to concur. The DOI and the State of California are completing a joint Environmental Impact Statement/ Environmental Impact Report (EIS/EIR) to comply with NEPA and the California Environmental Quality Act (CEQA). Compliance with NEPA and CEQA will help provide information to decision-makers regarding the potential effects of dam removal.

This Alternatives Report documents the process of identifying alternatives for the EIS/EIR and applying considerations to evaluate them. This process resulted in a full range of reasonable alternatives for detailed evaluation in the Klamath Facilities Removal EIS/EIR. The purpose of this report is to document how alternatives were identified, screened, and selected to carry forward for more detailed analysis in the EIS/EIR. The DOI and California, in conjunction with the Cooperating, Responsible, and Trustee Agencies, are using this structured planning process to ensure that a full range of alternatives is evaluated in compliance with NEPA and CEQA.

Chapter 2
Alternatives Development and Screening Process

Both NEPA and CEQA require EISs and EIRs, respectively, to identify a reasonable range of alternatives. The Klamath Facilities Removal EIS/EIR Lead Agencies (DOI and the California Department of Fish and Game [CDFG]) developed a structured process to identify and screen alternatives. Through internal and public scoping, the Lead Agencies identified a wide range of alternatives representing diverse viewpoints and needs. Figure 2-1 illustrates the process.

Figure 2-1. Alternatives Development and Screening Process

2.1 NEPA Purpose of and Need for Action/CEQA Objectives

The purpose and need statement (under NEPA) and objectives (under CEQA) describe the underlying need for and purpose of a proposed project. This statement is a critical part of the environmental review process because it helps to set the overall direction of an EIS/EIR, identify the range of reasonable alternatives, and focus the scope of analysis. The NEPA and CEQA Lead Agencies developed the following purpose and need/project objectives statement. This statement was published in the Notice of Intent to Prepare an EIS in the Federal Register and the Notice of Preparation of an EIR.

The NEPA purpose and need and each of the six primary CEQA objectives must be met to achieve the program's purpose. Important physical, ecological, and socioeconomic linkages exist between the objectives and possible solutions. Accordingly, a solution to one objective cannot be pursued without addressing problems in the other resource categories. To practically achieve the purpose of the project and program, the solutions will need to concurrently and comprehensively address problems of the Klamath Basin.

2.1.1 Purpose and Need

The stated Purpose and Need statement below has changed since the publication of the Notice of Preparation in order to provide further clarification. These changes are not substantive and do not change any alternatives.

The Proposed Action is to remove the four lower PacifiCorp dams on the Klamath River. The need for the Proposed Action is to advance restoration of the salmonid fisheries in the Klamath Basin consistent with the KHSA and the connected KBRA. The purpose is to achieve a free flowing river condition and full volitional fish passage as well as other goals expressed in the KHSA and KBRA. By the terms of the KHSA, the Secretary will determine whether the Proposed Action is appropriate and should proceed. In making this determination, the Secretary will consider whether removal of the Four Facilities will advance the restoration of the salmonid fisheries of the Klamath Basin, and is in the public interest, which includes but is not limited to consideration of potential impacts on affected local communities and Tribes.

2.1.2 Project Objectives

As required by CEQA, a lead agency must identify the objectives sought by the proposed project. For this project, CDFG as lead agency has identified the following objectives:

1. Advance restoration of the salmonid fisheries in the Klamath Basin.
2. Restore and sustain natural production of fish species throughout the Klamath Basin in part by restoring access to habitat currently upstream of impassable dams.
3. Provide for full participation in harvest opportunities for sport, commercial, and tribal fisheries.
4. Establish reliable water and power supplies, which sustain agricultural uses and communities and NWRs.
5. Improve long-term water quality conditions consistent with designated beneficial uses.
6. Contribute to the public welfare and the sustainability of Klamath Basin communities**.**

2.2 Alternative Identification

The public provided comments on the scope of the EIS/EIR during the public scoping period. Some of these comments included suggestions for alternatives to the Proposed Action. The Lead Agencies then used the purpose and need statement /project objectives to refine and clarify varying perspectives associated with the suggestions. The resulting preliminary list included more than 18 alternatives. Of these preliminary alternatives, some were determined to have limited functionality as a full alternative, as they focused on techniques for improving natural

resource conditions and are already a part of the KBRA. The final result of the alternative identification process was 18 initial alternatives (Table 2-1). Section 3 describes these alternatives.

Table 2-1. Initial Alternatives

Alternative Number	Alternative Name	Description
Alternative 1	No Action/No Project	Implement none of the action alternatives; Klamath Hydroelectric Project would continue current operations.
Alternative 2	Full Facilities Removal of Four Dams (Proposed Action)	Remove four dams and related facilities.
Alternative 3	Partial Facilities Removal of Four Dams	Remove main areas of four dams to allow a free-flowing river; related facilities and/or abutments may remain.
Alternative 4	Fish Passage at Four Dams	Construct fish passage facilities to provide upstream and downstream passage at four dams.
Alternative 5	Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate	Remove Copco 1 and Iron Gate Dams, construct fish passage at J.C. Boyle and Copco 2 Dams.
Alternative 6	Fish Passage at J.C. Boyle, Remove Copco 1, Copco 2, and Iron Gate	Remove Copco 1, Copco 2, and Iron Gate Dams, construct upgraded fish passage at J.C. Boyle Dam.
Alternative 7	Sequenced Removal of Four Dams	Remove four dams and related facilities over a period of three to five years.
Alternative 8	Full Facilities Removal of Four Dams without KBRA	Remove four dams and related facilities but do not implement restoration and other actions in the KBRA.
Alternative 9	Trap and Haul Fish	Capture fish at Iron Gate Dam and transport them upstream of J.C. Boyle Dam.
Alternative 10	Fish Bypass: Bogus Creek Bypass	Create a fish bypass using Bogus Creek, Cold Creek, Little Deer Creek and a constructed canal to connect to Copco 1 Reservoir.
Alternative 11	Fish Bypass: Alternative Tunnel Route	Create a fish bypass using Bogus Creek and a 5-mile tunnel to connect to Copco 1 Reservoir.
Alternative 12	Notching Four Dams	Notch four dams to create a free-flowing river.
Alternative 13	Federal Takeover of Project	Use the authority of the Federal Power Act for government to take over dams and initiate removal.
Alternative 14	Full Removal of Five Dams	Remove Keno Dam in addition to the four downstream dams.
Alternative 15	Full Removal of Six Dams	Remove Keno and Link River Dams in addition to the four downstream dams.
Alternative 16	Dredge Upper Klamath Lake	Remove sediments in Upper Klamath Lake to remove phosphorus and increase storage capacity.
Alternative 17	Predator Control	Control seal, sea lion, and cormorant populations that are salmonid predators.
Alternative 18	Partition Upper Klamath Lake	Create an “inner lake” that will have lower residence time and improved water quality.

2.3 Screening Consideration Definition

The Lead Agencies developed and applied a set of screening considerations to create a screening process that was fair and unbiased. The screening considerations were based on NEPA and CEQA guidance:

- NEPA requires that agencies shall "rigorously explore and objectively evaluate all the reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for their having been eliminated" (40 CFR Part 1502.14(a)). The DOI NEPA procedures (43 CFR Part 46.420(b)) define reasonable alternatives as "alternatives that are technically and economically practical or feasible and meet the purpose and need of the proposed action."
- CEQA Guidelines section §15126.6 (a) states, "An EIR shall describe a range of reasonable alternatives to the project, or to the location of the project, which would feasibly attain most of the basic objectives of the project but would avoid or substantially lessen any of the significant effects of the project." An EIR need not consider every conceivable alternative to a project or alternatives that are infeasible. (CEQA Guidelines, §15126.6 (a).) State CEQA Guidelines section 15364 defines feasible as "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors."

Both NEPA and CEQA include provisions that alternatives meet (or meet most of) the purpose and need/project objectives, and be potentially feasible. Under CEQA, alternatives do not need to meet all of the project objectives; alternatives should be included if they can meet most of the objectives and avoid or substantially lessen significant environmental impacts of the project. The NEPA and CEQA guidance led to the creation of the following screening considerations that are based on the NEPA purpose and need and CEQA objectives in Section 2.1.

Screening Considerations:

- Ability to meet the purpose and need/project objectives:
  - Would the alternative be consistent with the KHSA and KBRA?
  - Would the alternative result in a free-flowing condition on the Klamath River?
  - Would the alternative provide full volitional passage of fish? (Would fish voluntarily pass the facilities?)
  - Would the alternative advance restoration of the salmonid fisheries in the Klamath Basin?
  - Would the alternative provide for full participation in harvest opportunities for sport, commercial and tribal fisheries?
  - Would the alternative establish reliable water supplies that sustain agricultural uses and communities and NWRs?

  - Would the alternative establish reliable power supplies at affordable costs for communities?
  - Would the alternative improve long term water quality conditions consistent with both Oregon and California designated beneficial uses?
  - Would the alternative contribute to the public welfare and the sustainability of Klamath Basin communities?
- Technical feasibility
  - Would the alternative be technically feasible?

Several of the screening considerations above could not be used to narrow the list of alternatives. The purpose and need/project objectives include the overall goals for the agreements, but to apply some of the goals as screening criteria, more information is needed to describe and evaluate how well alternatives would meet these goals if implemented.

- Would the alternative provide for full participation in harvest opportunities? The answer to this question requires more significant analysis of effects of the alternatives on fish populations over time, which will occur during development of the EIS/EIR.
- Would the alternative contribute to the public welfare and the sustainability of Klamath Basin communities? Fully determining the potential effects of the alternatives requires analysis that will be described in the EIS/EIR.

Because these two questions require additional analysis, they were not included as considerations in the alternative screening process.

2.4 Alternative Screening and Selection

Disagreements regarding the use and management of the Klamath Basin have increasingly taken the form of protracted litigation and legislative battles. These disagreements have not yielded solutions to the water-related conflicts surrounding the Basin. The KHSA and KBRA were designed to reduce these conflicts and provide a solution that competing interests could support. Because both of the KHSA and KBRA are essential to the success of the Program, the alternative screening effort focuses on identifying alternatives that would both restore ecological health and improve water management for beneficial uses of the Klamath Basin system. Each alternative (other than the No Action Alternative) considered in this document would achieve these purposes.

The Lead Agencies screened the alternatives by applying the screening considerations based on available information and best professional judgment. The alternatives that will move forward for more detailed analysis in the EIS/EIR are those that best meet the NEPA purpose and need and CEQA objectives, minimize negative effects, are feasible, and represent a range of reasonable alternatives. Section 4 describes this screening process and its results in more detail.

Chapter 3
Alternatives Overview

This section provides a brief overview of the alternatives considered during the development and screening process. Section 5 includes additional technical information on the alternatives that will move forward for more detailed analysis in the EIS/EIR.

The EIS/EIR will analyze the Proposed Action and alternatives. The KBRA and its component elements will be included in the EIS/EIR as connected actions. If a Negative Determination is made and the terms of the KHSA are not satisfied, then the KBRA and its component elements would not be implemented. Section 3.2.2 describes the KBRA.

3.1 Alternative 1 – No Action/No Project Alternative

NEPA requires an EIS to “include the alternative of no action” (40 CFR Part 1502.14(d)). CEQA requires an EIR to include a No Project Alternative. CEQA Guidelines Section 15126.6(e)(2) states that “the "no project" analysis shall discuss the existing conditions at the time the notice of preparation is published, or if no notice of preparation is published, at the time environmental analysis is commenced, as well as what would be reasonably expected to occur in the foreseeable future if the project were not approved, based on current plans and consistent with available infrastructure and community services.” NEPA’s No Action Alternative and CEQA’s No Project Alternative describe the same conditions, and this alternative is referred to as the No Action/No Project Alternative.

The No Action/No Project Alternative represents the state of the environment without the Proposed Action or any of the alternatives. In this instance, the No Action/No Project Alternative would be no change from current management conditions, other than as noted below, with the dams remaining in place. The No Action/No Project Alternative would only include the portions of the KBRA that are ongoing resource management activities. These resource management actions would receive additional funding and could be expanded or accelerated through the KBRA; however, they were started or under consideration before the KBRA was developed and would move forward even without the KBRA. The No Action/No Project Alternative includes the assumption that the hydroelectric project would continue to operate under annual licenses issued by FERC to PacifiCorp.

Under the No Action/No Project Alternative, the Klamath Hydroelectric Project Interim Measures outlined in the KHSA would cease, except turbine venting. PacifiCorp would need to obtain a long-term operating license from FERC to replace the existing annual license. PacifiCorp would resume relicensing proceedings with FERC to obtain the required long-term operating license.

For the purposes of this analysis, the No Action/No Project Alternative would continue current operations with the dams remaining in place and PacifiCorp operating under the current annual license. The existing license has no requirements for additional fish passage or implementation of the prescriptions that are currently before FERC in the relicensing process. PacifiCorp would continue to operate the Iron Gate Hatchery under its current operations.

The USFWS issued a biological opinion to Reclamation on the operation and maintenance of Reclamation's Klamath Project (USFWS 2008). This biological opinion outlines measures to improve the habitat for the Lost River sucker and shortnose sucker affected by Reclamation's Klamath Project operations. Among other measures to protect the suckers, the biological opinion requires that specific surface elevations of Upper Klamath Lake be maintained to meet certain criteria.

NOAA Fisheries Service also issued a biological opinion to Reclamation requiring releases from Reclamation's Klamath Project to produce specified rates of flow for the Klamath River downstream of Iron Gate Dam, based on the habitat needs of coho salmon (NOAA Fisheries Service 2010). Target flow rates in the Klamath River downstream of Iron Gate Dam vary by month, and are dependent in part on the amount of water entering Upper Klamath Lake.

PacifiCorp would continue to coordinate operations with Reclamation and operate the Klamath Hydroelectric Project in compliance with existing NOAA Fisheries Service and USFWS biological opinions issued for Reclamation's Klamath Project. Under the No Action/No Project Alternative, the Four Facilities would continue to be subject to requirements in PacifiCorp's current annual FERC permit:

- Operating the peaking facility at J.C. Boyle such that the river does not rise or fall more quickly than 9 inches per hour and that minimum flows immediately downstream of the dam are maintained at 100 cubic feet per second (cfs).
- Maintaining minimum flows downstream of Iron Gate Dam.
- Limiting the change in the rate of the release of water from Iron Gate Dam to no more than 250 cfs per hour or a three-inch change in river stage. (FERC 2007)

PacifiCorp also currently coordinates with Reclamation to meet ramp rates in the NOAA Fisheries Service biological opinion on Reclamation's Klamath Project:

- When flows at Iron Gate Dam are 3000 cfs or above, Iron Gate Dam ramp down rates will follow the rate of decline to inflows to Upper Klamath Lake combined with accretions between Keno Dam and Iron Gate Dam.
- When flows at Iron Gate Dam are between 1,750 cfs and 3,000 cfs, Iron Gate Dam ramp down rates will be 300 cfs or less per 24 hour period and no more than 125 cfs per 4 hour period.
- When flows at Iron Gate Dam are 1,750 cfs or less, Iron Gate ramp down rates will be 150 cfs or less per 24 hour period and no more than 50 cfs per two hour period. (NOAA Fisheries Service 2010)

The No Action/No Project Alternative would include other regulatory conditions that would affect conditions in the Klamath Basin. To improve water quality, the Oregon Department of Environmental Quality (ODEQ) and California North Coast Regional Water Quality Control Board (NCRWQCB) cooperated to develop total maximum daily loads (TMDLs) for nine impaired water bodies within the basin. TMDLs are pollution control plans that identify the pollutant load reductions that are necessary from point and nonpoint sources to meet water quality standards. The California and Oregon Klamath River TMDLs focus on reducing high water temperatures, increasing dissolved oxygen levels, and reducing nutrient concentrations in the mainstem Klamath River (NCRWQCB 2010a, ODEQ 2010). Major tributaries in the lower Klamath Basin, such as the Scott, Shasta, and Trinity Rivers, are not included in the technical analyses (i.e., modeling efforts) for the California Klamath TMDLs, but the entire Klamath Basin is included in the associated Implementation Plan (NCRWQCB 2010b). The Implementation Plan focuses on four different areas of the Klamath Basin, two of which are relevant to the project:

- Stateline – the area surrounding the Oregon/ California Stateline. This area presents some management issues, as water quality in the Klamath River does not meet California standards when the river enters the state from Oregon. Nutrient loading from Oregon is believed to be primarily responsible for nuisance blue-green algae growth and associated water quality impairments in Copco 1 and Iron Gate Reservoirs as well as aquatic plant growth in the river. ODEQ has developed TMDLs for the upper Klamath and Lost rivers to meet both Oregon and California water quality standards and they were approved by the United States Environmental Protection Agency approval in December 2010 (ODEQ 2010). Parties responsible for TMDL implementation are listed in the staff report for the Klamath TMDLs and include ODEQ, Oregon Department of Agriculture, the U.S. Environmental Protection Agency Regions 9 and 10, the NCRWQCB, and both point and nonpoint sources in Oregon and the Lost River Basin in California (NCRWQCB 2010a).
- Klamath Hydroelectric Project and Iron Gate Hatchery – The Implementation Plan addresses the effects of the facilities in California, which are the Copco 1, Copco 2, and Iron Gate facilities. The TMDLs assign three allocations to the Klamath Hydroelectric Project in California: water temperature, dissolved oxygen, and nutrients (total phosphorus and total nitrogen). To achieve compliance with the TMDLs, multiple targets are also assigned, including nutrients, organic matter, and algae-based targets (chlorophyll-a, *Microcystis aeruginosa* cell density, the algal toxin microcystin). Responsible parties listed in the staff report for the Klamath TMDLs at this location are the NCRWQCB, the State Water Resources Control Board, and PacifiCorp. Once they are adopted, the TMDLs will become part of the Implementation Plan and thus part of the regulatory environment. They are therefore included in the No Action/No Project Alternative. If the Secretary makes a Negative Determination, PacifiCorp must submit a TMDL implementation plan that complies with the FERC relicensing and water quality certification process, and PacifiCorp will be required to implement measures that meet and/or offset TMDL allocations and targets as prescribed in the Implementation Plan (NCRWQCB 2010b).

TMDLs for eight of the nine impaired subbasins in the Klamath Basin have been adopted and are currently in the implementation phase (TMDLs for the California mainstem Klamath River were adopted on December 28, 2010). The Upper Klamath and Lost River TMDLs will be implemented during the Klamath Facilities Removal EIS/EIR period of analysis. These TMDLs are expected to result in improvements to water quality conditions, but the improvements cannot be quantified because of uncertainties regarding the timing and magnitude of mitigation projects necessary to achieve water quality standards.

3.2 Alternative 2 – Full Facilities Removal of Four Dams (Proposed Action)

Implementation of this alternative, the Proposed Action, would result in the removal of the Four Facilities and their appurtenant structures as described in the KHSA. The alternative would include the complete removal of power generation facilities, bypass canals, pipelines, and dam foundations (see Figure 3-1) during a 12-month period. Reservoir drawdown may begin earlier in 2019 to allow preparatory activities; dam removal would be targeted to be complete by December 31, 2020. The Proposed Action would also include riverbank stabilization and replanting within the former reservoir basins after complete drawdown.

Full removal of the Four Facilities in a single year would require specialized construction machinery and equipment and personnel. Work crews would be housed in nearby towns, campgrounds, and on-site housing (where available), and staging of equipment would need to occur in the months leading up to initiation of the removal. The project would require a build-up of equipment and personnel prior to reservoir drawdown and a closing down period after the removal is complete. These activities would take place over a period of months before and after the actual 12-month dam deconstruction period.

Deconstruction would require heavy equipment such as excavators, bulldozers, dump trucks, cranes, and support equipment. Water levels would be drawn down by notching the top of the dam or using low level outlets.

J.C. Boyle, Copco 1, and Iron Gate Dams have a large quantity of sediment deposited within their reservoirs. The volume of sediment within Copco 2 Reservoir is negligible because of its small size and close proximity to Copco 1 Dam. The sediment depth behind the dams varies in each reservoir from 0 feet to greater than 9 feet (Figures 3-2 through 3-4). The variation in sediment depth within and among the reservoirs is caused by differences in flow velocity, depth of the reservoirs, and type of sediment. The downstream portions of the impoundments, where water velocity slows and sediments are able to settle to the bottom, typically contain deeper sediments. Table 3-1 lists the estimated sediment volumes within each reservoir. Copco 2 Reservoir is not included in the table because of the small volume of sediment that it contains.

Figure 3-1. Iron Gate Dam before removal (on top) and a simulation of what the facility could look like after full removal (on the bottom)

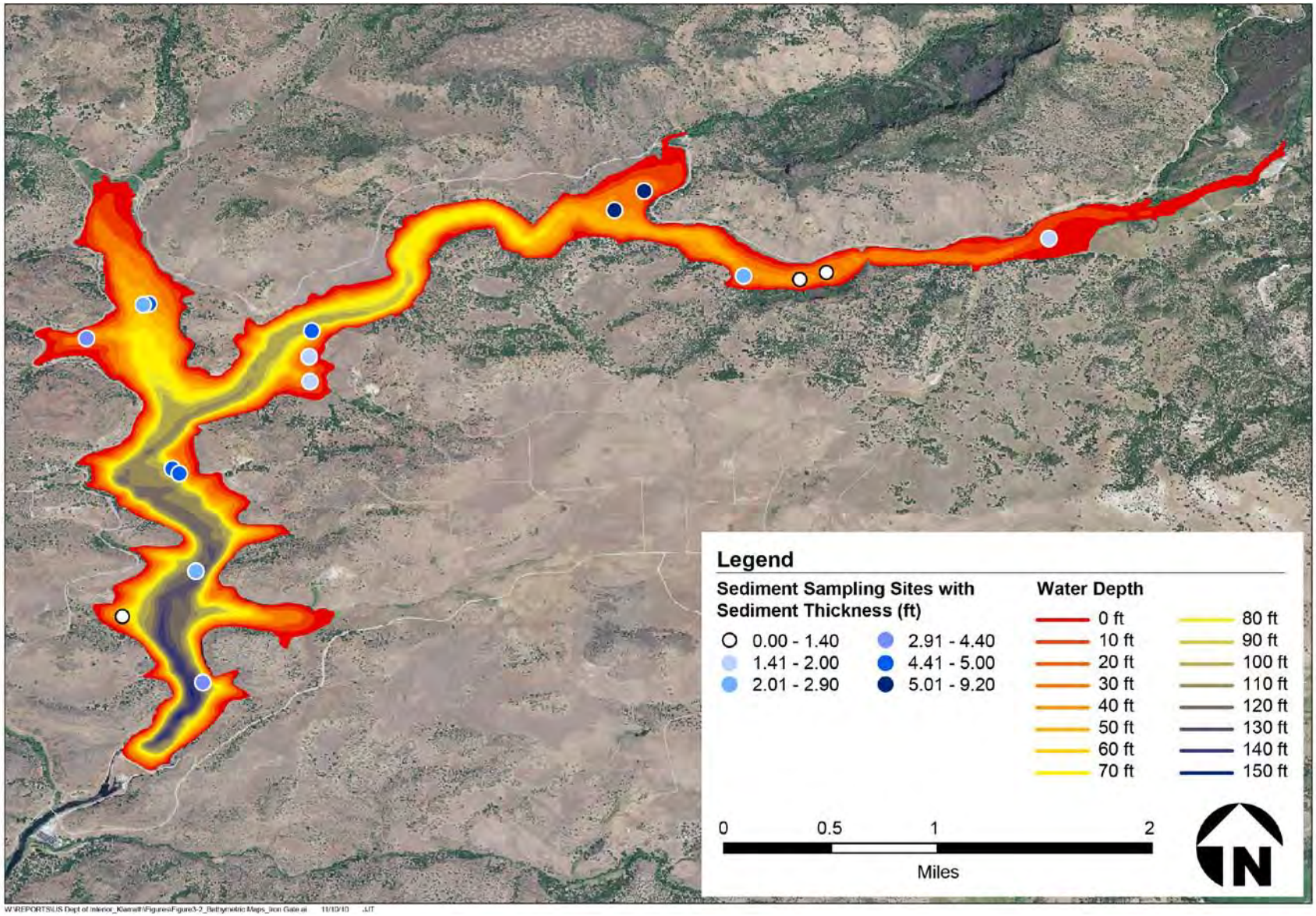

Figure 3-2. Sediment Thickness at Selected Sites in Iron Gate Reservoir

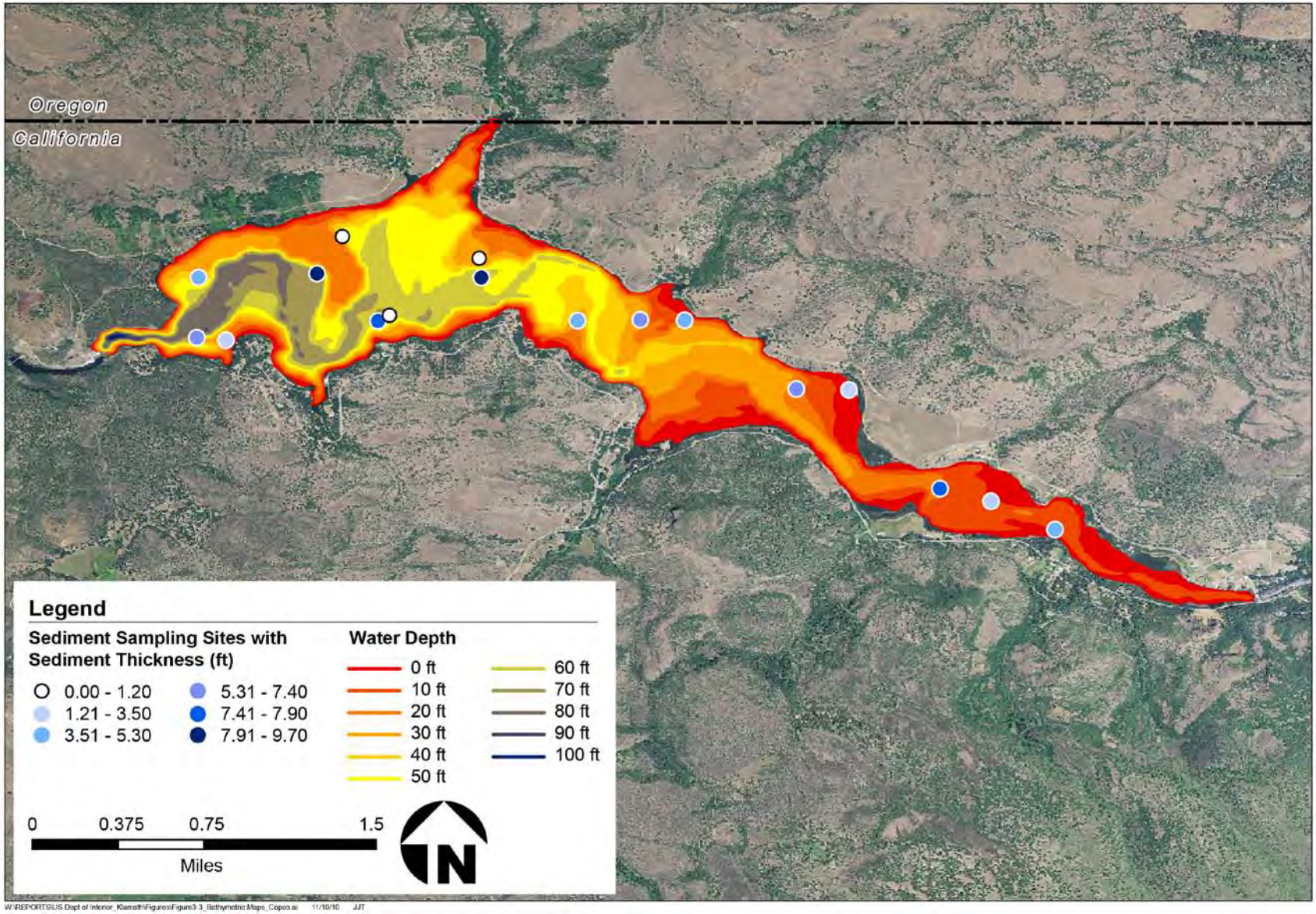

Figure 3-3. Sediment Thickness at Selected Sites in Copco 1 Reservoir

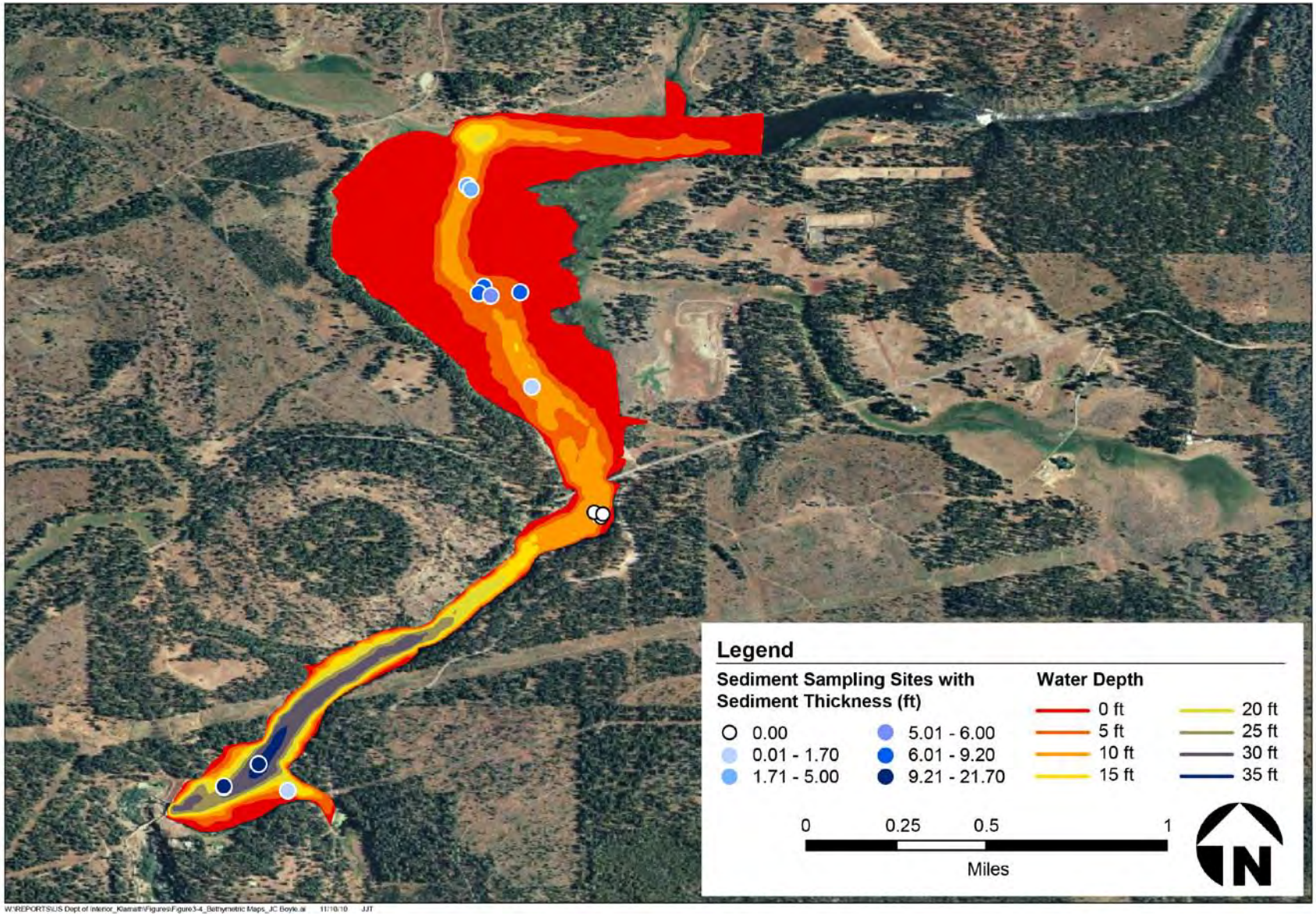

Figure 3-4. Sediment Thickness at Selected Sites in J.C. Boyle Reservoir

Table 3-1. Accumulated Sediment Volumes

Reservoir	Source area[1] (mi^2)	Period of Sediment Accumulation	Sediment Accumulation Volume (yd^3)
Iron Gate	212	40 yr (1962-2002)	4,700,000
Copco 1	273	84 yr (1918–2002)	7,400,000
J.C. Boyle	225	44 yr (1958–2002)	1,000,000
Total			**13,100,000**

Key:
mi^2: square miles
yd^3: cubic yards
yr: Year
Source: Reclamation 2012
Notes:
[1] Source Area refers to the sub basin that drains to the reservoir.

Dam removal would release some of the accumulated sediments downstream. The Proposed Action includes the use of erosion from river flows to flush the sediment behind the dams downstream during facility removal. Reservoir drawdown would focus on the wet season in order to flush the sediment downstream with the natural seasonal high flows. Modeling studies indicate that drawdown would erode and flush 41 to 65 percent of the stored sediment downstream (DOI 2011). The initial drawdown would begin slowly, to minimize riverbank erosion, with the rate increasing as water levels drop to maximize the amount of sediment flushed down stream. Most of the sediment remaining on the riverbank slopes would stabilize and would not erode downstream in subsequent years.

3.2.1 Option: Sediment Removal

If analysis indicates that the release of sediment could result in significant effects, the EIS/EIR may include consideration of dredging sediments out of the reservoirs before removing the dams if this measure is determined to be feasible. Dredging would focus on the area within the new river area; sediment remaining above the new stream level would only require removal if the slopes would not be stable. Surveys to date have shown water content in the sediments behind the reservoir to average 80 percent by volume (Eilers and Gubala 2003). Once dredging began, the spoils would be pumped to a detention area near the reservoir for the sediments to dry.

Dredging and the mechanical removal of sediment from the reservoirs would require equipment in addition to that needed for dam removal. This additional equipment would include barges, dredges, and pumps. Storing the spoils after removal from the reservoirs would require an area of sufficient size to allow the sediment to be spread and dried.

3.2.2 KBRA

The KBRA and its component elements are connected actions to the KHSA, and would be a part of the alternatives that include the KHSA. The Proposed Action includes the KBRA and its component elements. The KBRA has three primary goals:

- Restore and sustain natural production and provide for full participation in harvest opportunities of fish species throughout the Klamath Basin;
- Establish reliable water and power supplies which sustain agricultural uses and communities and NWRs; and
- Contribute to the public welfare and the sustainability of all Klamath Basin Communities.

Two sections of the KBRA, the Fisheries Restoration, Reintroduction, and Monitoring Program and the Water Resources Program, outline restoration actions and management activities that would guide restoration and allocate water to environmental and agricultural uses for the duration of the period from the Secretarial Determination through the initiation of facilities removal and beyond. These two programs provide specific goals and actions that work towards meeting the overarching goals of the KBRA outlined above.

The Fisheries Program of the KBRA is intended to accomplish the following:

- Provide for the reintroduction of anadromous species throughout their historic range upstream of Iron Gate Dam, excluding the Lost River sub-basin, and reestablish and maintain the ecological functionality and connectivity of fish habitat.
- Provide for the natural sustainability and genetic diversity of fish species and the overall ecosystem health of the Klamath Basin.
- Establish conditions that provide for the natural sustainability and genetic diversity of fish species and to assess the status, trends, and factors that influence those trends, and assess the effectiveness of the actions mandated under the KBRA.
- Provide for adaptive management based on the assessments of the effectiveness of the restoration actions.

The Fisheries Program currently consists of two planning and implementation phases. Phase I would identify “Investigations, facilities, actions, monitoring, and decisions necessary to initiate and accomplish the reintroduction of anadromous fish species.” Phase II would address the management of the reintroduced fish populations in areas where anadromous fish are currently not present.

The Water Resources Program contains six "Discrete and consistent elements" intended to provide water to the different interests dependent on the Klamath Basin. The KBRA established funds and guidelines for each of these elements, and describes the relationship between these elements:

- On-Project Water Users Program, including provisions related to Tribes and to NWRs
- Off-Project Water Program
- Power for Water Management Program
- Additional Water Conservation and Storage
- Drought, Climate Change, and Emergency
- Environmental Water

The KBRA provides a variety of agreements and assurances between the various signatories and the United States. These agreements and assurances delineate the timeframe of the agreement, the relationships between the different water rights and parties, and the scope and purpose of the different elements and programs created by and described in the document and listed above.

3.3 Alternative 3 – Partial Facilities Removal of Four Dams

This alternative would include removal of the primary structure of the four dams within the streambank to allow the river to achieve a free-flowing condition. Appurtenant structures would remain in place (see Figure 3-5). These features to remain in place could include buildings, power generation facilities, bypass canals and pipelines, and dam foundations. As it would be for Alternative 2, this alternative would include the use of river flow-driven erosion to flush the sediment behind the dams downstream during facility removal. Dredging sediments may be considered. This alternative would also include KBRA implementation (see Section 3.2.2 for more information) and riverbank stabilization within the former reservoir areas.

Figure 3-5. Iron Gate Dam before deconstruction (on top) and a simulation of what the facility could look like after partial facilities removal (on the bottom)

3.4 Alternative 4 – Fish Passage at Four Dams

Under this alternative, the Four Facilities would remain intact and fish passage facilities would be constructed or upgraded to allow volitional fish passage around each of the dams. Iron Gate and Copco 1 Dams are the largest dams under consideration, and these facilities are larger obstacles to fish passage than J.C. Boyle and Copco 2 Dams. Iron Gate Dam has a fish ladder that takes fish to the hatchery, but the ladder does not provide passage around the dam. Copco 1 and Copco 2 Dams do not have fish passage facilities. J.C. Boyle has a pool and weir type fish ladder that would be upgraded to meet state and federal standards. This alternative would require FERC action for implementation and thus is outside of DOI's jurisdiction to implement; however, NEPA requires an agency to study alternatives it does not necessarily have the authority to implement. Implementation of this alternative would require the Hydropower Licensee to obtain a new FERC license to continue operations.

To allow volitional fish passage at each of the dams, facilities must allow both migrating adults to move upstream around the dams to spawn and juveniles to migrate downstream without being drawn into the power house and turbines of the hydroelectric facilities.

To provide for upstream migration, fish ladders require a consistent, cool, and well-oxygenated water supply, an entrance pool, and the actual fishway. Fishways can be “pool and weir” type ladders, wherein a series of stepped pools are constructed that allow adults to swim and jump from one pool to the next, which is the type of ladder that exists at J.C. Boyle (Figure 3-6). Other upstream fish passage designs include aerial trams, where migrating adults are guided into cars on a tram that then transports them up and over the dam to the reservoir. The tram method does not provide “full volitional fish passage” because fish must wait for a tram to arrive before they can move. Ladders allow fish to migrate upstream at will, provided they can find and use the ladder.

On the upstream side, screens may be required at the powerhouse intake and the spillways to prevent juveniles from being swept over the dam or into the turbines. Facilities must also provide for downstream migration. The Fish Passage at Four Dams Alternative includes bypass systems, in which collectors or screens are placed in the reservoir to guide juveniles to the collector. The collector is attached to a pipe that extends to the downstream side of the dam. Downstream passage facilities would need to be constructed at each facility in the project.

Figure 3-6. Examples of Types of Fishways

3.5 Alternative 5 – Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate

This alternative provides for the staged removal of Iron Gate and Copco 1 Dams with construction of fish passage facilities at Copco 2 and J.C. Boyle Dams. Dam removal would occur within a 12-month period once the deconstruction began. This alternative would eliminate peaking power generation at J.C. Boyle Dam. Currently, peaking power generation at J.C. Boyle Dam requires the Copco 1 Reservoir to reregulate flows downstream of the J.C. Boyle peaking reach, because of the large volumes of water used in generating the power. Without Copco 1 Reservoir, river stages would increase rapidly during power generation at J.C. Boyle Dam. Copco 2 Reservoir would not have adequate capacity to absorb these rapid increases in flows. This alternative is outside the DOI's jurisdiction; however, NEPA requires an agency to study alternatives it does not necessarily have the authority to implement. Implementation of this alternative would require the Hydropower Licensee to obtain a new FERC license to generate power at J.C. Boyle and Copco 2 Dams.

Under this alternative, 100 to 200 cubic yards (yd^3) of spawning gravel would be placed downstream from J.C. Boyle Dam to improve spawning habitat in the J.C. Boyle Bypass Reach. This alternative would improve access to habitat for anadromous fisheries by removing Iron Gate and Copco 1 Dams and improving passage at Copco 2 and J.C. Boyle Dams. J.C. Boyle Dam has an outdated fish ladder and outdated fish screens that do not meet current NOAA Fisheries Service fish passage criteria; Alternative 5 would include an upgrade these facilities.

Removal of Iron Gate and Copco 1 Dams would be completed as described for previous alternatives. Reservoir drawdown would begin slowly and would increase in daily flow as the water level dropped in order to maximize the downriver movement of the trapped sediment while minimizing the erosion of the banks of the reservoir.

3.6 Alternative 6 – Fish Passage at J.C. Boyle, Remove Copco 1, Copco 2, and Iron Gate

This alternative would include removal of Copco 1, Copco 2, and Iron Gate Dams and improvement of fish ladders at J.C. Boyle Dam to provide for full volitional fish passage. This alternative would include full removal of the dams and the appurtenant structures and multiple construction crews to complete the removal within a 12-month period once the deconstruction began. Removal of these three dams would provide free flowing conditions to J.C. Boyle Dam, where improved fish ladders would provide full volitional fish passage upstream and downstream of the facility. This alternative is outside the DOI's jurisdiction; however, NEPA requires an agency to study alternatives it does not necessarily have the authority to implement. Implementation of this alternative would require the Hydropower Licensee to obtain a new FERC license to generate power at J.C. Boyle Dam.

Under this alternative, power generation at J.C. Boyle would continue, although it would not be able to produce peaking power because of the removal of Copco 1 Dam. Currently, Copco 1 Reservoir acts as a regulator for the high flows associated with peaking power generation from J.C. Boyle Dam, in order for the operations to comply with the biological opinions from USFWS and NOAA Fisheries Service. Without Copco 1 Reservoir, the flows from J.C. Boyle would need to conform to the ramping rates and other operational guidelines outlined in the existing biological opinions and agreements, which would preclude peaking power generation without new agreements and guidelines.

3.7 Alternative 7 – Sequenced Removal of Four Dams

The Sequenced Removal of Four Dams Alternative would involve removal of the Four Facilities over a period of three to five years. This alternative would include removal of Iron Gate Dam first, then Copco 1 and 2 Dams at the same time, and finally J.C. Boyle Dam over a period of three years. Copco 2 Dam would be removed at the same time as Copco 1 Dam because of its relatively small size, lack of sediment storage, and proximity to Copco 1 Dam.

Sequencing dam removal could allow small, staged disturbances over several years instead of a single, large disturbance in one year. Construction workers could move from site to site and provide skilled labor. Equipment would also be moved from one site to the next, reducing overall needs. Each dam removal effort would provide an opportunity to adaptively manage the next effort based on lessons learned.

A different removal order was initially considered to allow Iron Gate Reservoir to capture sediment released from upstream dams. However, analysis indicated that the sediment particles were too fine and the retention time within the reservoir too short to allow for settling of a significant amount of sediment (Cui and Orr 2007). Therefore, the focus on determining the order for dam removal became public health and safety. Iron Gate Dam is an earthfill dam that could be the most difficult to remove in a safe manner. It has the highest potential for significant safety issues during dam removal because of the potential for overtopping river flows that could uncontrollably scour the dam material and cause catastrophic failure. In order to minimize this risk to public safety, removing Iron Gate Dam first would provide an opportunity for partial flow regulation and peak flow attenuation upstream at the Copco and J.C. Boyle Developments. Additionally, Section 7.3.7 of the KHSA states "Parties agree that if Decommissioning and Facilities Removal occurs in a staged manner, J.C. Boyle is intended to be the last Facility decommissioned."

3.8 Alternative 8 – Full Facilities Removal of Four Dams without KBRA

The Full Facilities Removal of Four Dams without KBRA would include removal of the Four Facilities within a one-year period. This alternative would return the river to a free-flowing condition and allow volitional fish passage. The details of dam removal would be the same as those described for the Proposed Action. This alternative would not include implementation of the KBRA actions described in Section 3.2.2.

3.9 Alternative 9 – Trap and Haul Fish

This alternative would include modification of the existing hatchery at Iron Gate Dam to include collection, sorting, holding, and loading facilities. This alternative is the same as the FERC staff alternative in the EIS on the Klamath Hydroelectric Project relicensing. The hatchery would still operate, and the Hydropower Licensee would be responsible for all of the operating and maintenance costs of the facility. Migrating adult salmonids would be trapped at Iron Gate Dam and hauled to various release points upstream of J.C. Boyle Dam, including the Williamson and Wood Rivers (upstream of Upper Klamath Lake), to allow salmonids access to potential spawning habitat in the upstream watershed. Adult survival would be monitored using telemetry to monitor the effectiveness of the trap and haul operations. Juvenile salmonids would be trapped at J.C Boyle Dam and hauled to Iron Gate Dam, where they would be marked in a new facility to assess smolt-to-adult survival rates. Monitoring would be employed to find their survival rates from the trapping phase through holding and release. Multiple release points for the juveniles would be used, and survival monitoring would provide data for adaptive management efforts.

In addition to the trap and haul operation, this alternative would include several monitoring and management efforts to improve water quality, reduce fish disease, and improve smolt survival during their outmigration. These efforts would include releasing cooler water from Iron Gate Reservoir to lower downstream water temperature, maintaining flows downstream of J.C. Boyle Dam to increase usable fish habitat, placing spawning gravel upstream of J.C. Boyle and downstream of Iron Gate Dam to improve salmonid habitat, and installing flow gages and water quality monitoring equipment to measure the effectiveness of the efforts.

This alternative would not include fish passage facilities at any of the dams or modifications to the operations of the hydroelectric facilities. As discussed for the No Action/No Project Alternative, the NOAA Fisheries Service biological opinion would govern flows and provide some limits on power operations. Implementation of this alternative would require the Hydropower Licensee to obtain a new FERC license to continue operations.

3.10 Alternative 10 – Fish Bypass: Bogus Creek Bypass

This alternative would include development of an approximately 13-mile route for migrating anadromous fish to bypass three of the four dams on the main stem of the Klamath and access upstream spawning habitat. J.C. Boyle Dam would also need improvements to the fish passage structures to allow upstream and downstream passage. Under this alternative, power production would continue as in the No Action/No Project Alternative, under which the NOAA Fisheries Service biological opinion would govern flows and limit power operations. Implementation of this alternative would require the Hydropower Licensee to obtain a new FERC license to continue operations.

This alternative would include creation of a migratory bypass around the dams using Bogus Creek and a constructed canal to connect the headwaters of Cold Creek with the headwaters of Little Deer Creek (Figure 3-7). The headwaters of Cold Creek, which flows into the headwaters of Bogus Creek, are about three miles from Little Deer Creek, which flows into the Copco 1 Reservoir. This design would allow up-migrating salmonids to swim upstream in Bogus Creek to its confluence with Cold Creek, then upstream in Cold Creek to the constructed canal. The fish would proceed downstream through the canal to Little Deer Creek and into Copco 1 Reservoir (CDFG 2009). Juvenile salmonids migrating downstream would follow the same route in reverse.

The 3.2-mile canal would connect Cold Creek with Little Deer Creek, and be partially supplied with water from Cold Creek. The alternative would require the construction of a 2.3-mile pipeline and the installation of a 1,500 horse power recirculating pump to lift the water approximately 500 feet from Copco 1 Reservoir through the pipeline to the confluence of the canal and Little Deer Creek. The pipeline would take water from Copco 1 Reservoir and use it to feed the lower portion of the canal and increase flows in Little Deer Creek to accommodate the migrating salmonid population.

Bogus Creek is a small stream, with an average width in the lower reaches of 15 feet and pools about four feet deep. It becomes smaller in its upper reaches where it connects with Cold Creek, which has an average width of six to eight feet and an average depth of only eight to twelve inches. Deer Creek is similar in size to Cold Creek, and steeper. Depth and gradient is a limiting factor for salmonids, with both coho and Chinook tending to spawn in streams with gradients less than three percent (CDFG 2009). The gradients in the upper reaches, where the canal is proposed, exceed this slope, and neither coho nor Chinook are typically seen in the upper portions of the watershed.

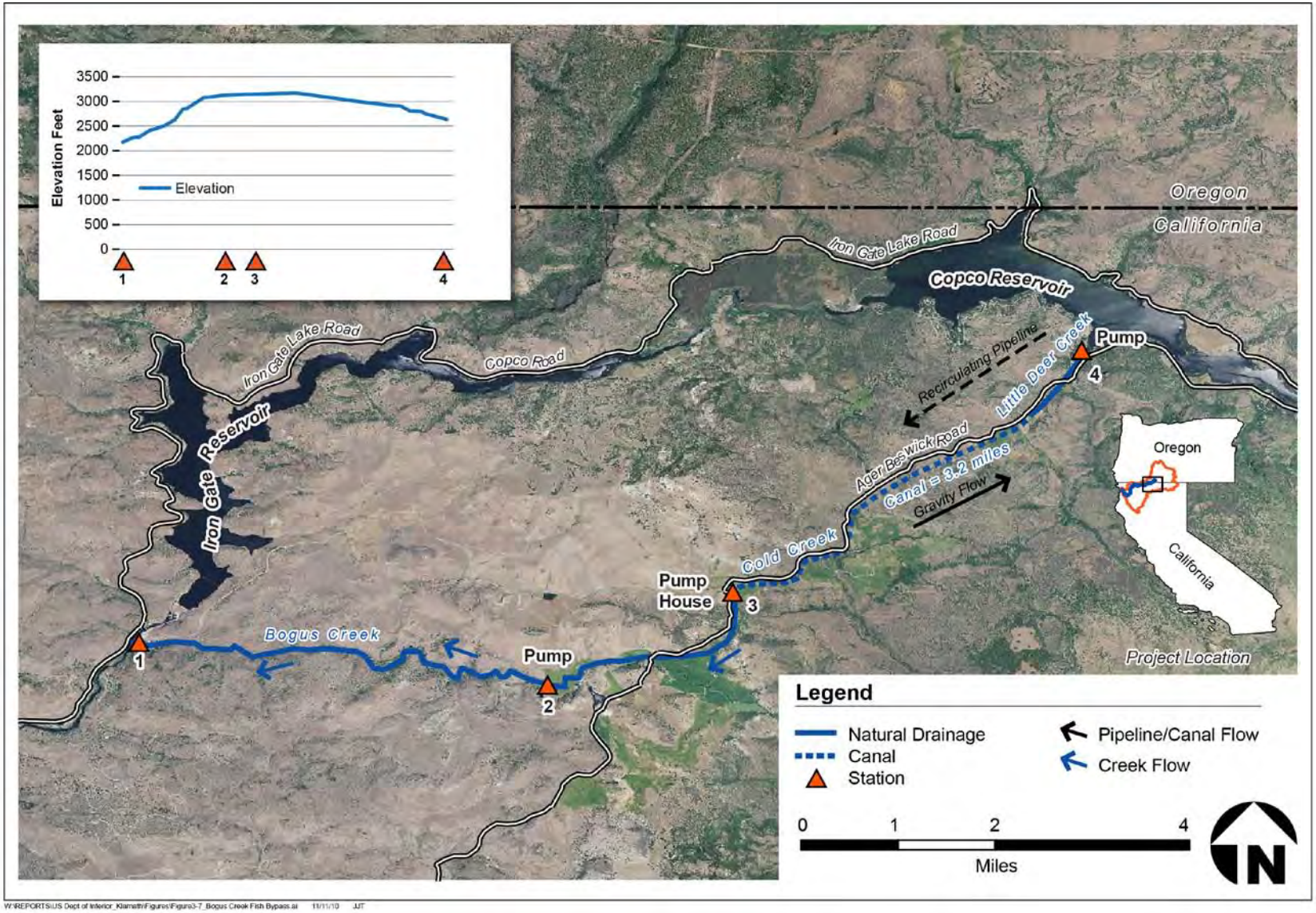

Figure 3-7. Bogus Creek Fish Bypass

Bogus Creek enters the Klamath River just downstream of the Iron Gate Dam, and is used by salmonids as spawning habitat. The Bogus Creek Bypass Alternative includes a variety of habitat improvements in Bogus Creek, Cold Creek, and Little Deer Creek, and constructed habitat in the canal. Habitat in Bogus Creek would be improved by adding spawning gravel and other habitat elements between the confluence of the creek at the Klamath River and the entrance to the proposed canal. This alternative would include construction of refugia in other areas along Cold Creek, the canal, and Little Deer Creek to improve the habitat for migrating salmonids, and to encourage spawning in the Bypass. Refuge areas would be created or augmented where smaller creeks enter the Bypass route as they provide cold water sources, and could provide thermal refugia for migrating adults.

There are two existing fish ladders on the proposed route: one in Bogus Creek at stream mile 3.6 to pass fish around a natural, 22-foot waterfall, and one in Cold Creek at stream mile 0.6 at a naturally occurring 9-foot waterfall (CDFG 2009). These existing ladders are insufficient to pass large numbers of migrating salmonids, and would have to be upgraded to accommodate the potential increase in the size of the fish migration.

3.11 Alternative 11 – Fish Bypass: Alternative Tunnel Route

This alternative would use a combination of natural drainages and a constructed tunnel to provide a migratory passage for anadromous species around Copco 1, Copco 2, and Iron Gate Dams while leaving the dams in place. This alternative also includes improvements to fish passage facilities at J.C. Boyle Dam to allow upstream and downstream passage. This alternative would allow continued power generation at the Four Facilities, but the Hydropower Licensee would need to obtain a new FERC license to continue operations.

This alternative bypass would route upmigrating fish into Bogus Creek into an approximately five-mile tunnel that would connect Bogus Creek to Copco 1 Reservoir. The tunnel would connect to Bogus Creek at stream mile 2.9, well downstream of the existing fish ladder on the creek and the confluence with Cold Creek (Bacigalupi and Lake 2010) (Figure 3-8).

The proposed tunnel would be 16 feet wide by 12 feet high and would contain a 4 foot wide by 2 foot deep fish channel on one side. Larger “rest areas” for the migrating fish would be placed every 250 feet, and vertical shafts would be installed at regular intervals to provide natural light to the channel (Bacigalupi and Lake 2010). The proposed gradient of the channel would be less than one percent, and flow would be above 10 cfs.

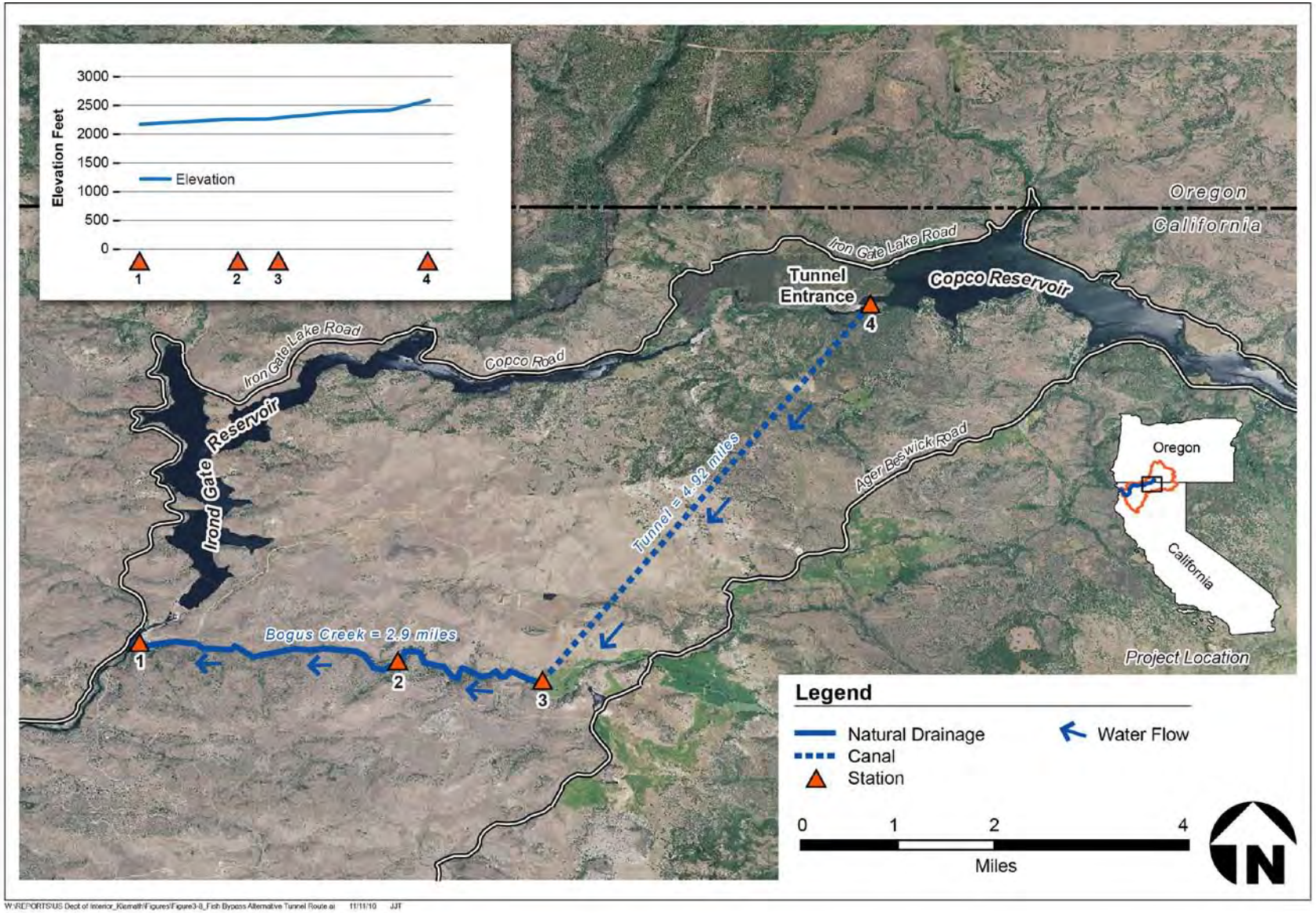

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Figure 3-8. Fish Bypass Alternative Tunnel Route

A floating entrance structure at Copco 1 Reservoir would provide water and fish access to the tunnel. The structure would float with the level of the lake to provide a year round water supply regardless of the level of the reservoir, as well as serve as the access to the tunnel for anadromous species.

The proposal addresses some of the issues associated with Alternative 10, the Bogus Creek Bypass route: the tunnel would allow migrating salmonids to swim in a consistently upstream direction, as the tunnel would be drilled to connect the reservoir with the downstream tributary. In addition, it would not require a new water supply or negotiations, as would the bypass in the fully appropriated Cold Creek (in Alternative 10), because water for Alternative 11 would be supplied from Copco 1 Reservoir. Finally, the tunnel might provide more capacity for the large numbers of migrating salmonids than the smaller drainages of Clear and Deer Creeks.

3.12 Alternative 12 – Notching of Four Dams

This alternative includes notching J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams as an alternative to full or partial removal of the Four Facilities. The work would involve cutting concrete and excavating earthen material from the middle of the dams down to the river bed to create a "free-flowing condition." This process would leave portions of each dam intact on either side of the river, along with many of the appurtenant structures (see Figure 3-9). The appurtenant structures would be retired, but left in place.

Under this alternative, more material would remain in place than with the partial removal alternatives. Powerhouses, diversion canals, and other facilities would also remain in place. The material left in place would either be hardened with large rock or material from the removed portions of the dam, or left to erode downstream.

3.13 Alternative 13 – Federal Takeover of Project

Under this alternative, the federal government takes control of the dams under the authority of the Federal Power Act. The intent of the Federal Takeover Alternative would be to fast track the removal of the Four Facilities. Under this alternative, the federal government would fund the removal costs, rather than dam removal being funding as described in the KHSA.[3]

[3] Under the KHSA, dam removal would not begin until 2020 in order to provide an adequate opportunity to raise funds to pay for the dam deconstruction. The KHSA indicates that the Public Utilities Commissions of both Oregon and California would establish customer surcharges on PacifiCorp's customers with the express purpose of raising funds for dam removal. The Oregon surcharge has been approved and implemented. The California Legislature has agreed to put a general obligation bond before the voters in November 2012 to fund the difference between the customer contribution and the actual cost of dam removal. All funds that are acquired during the period from the Secretarial Determination until the beginning of facilities removal would be managed and dispersed by a trustee.

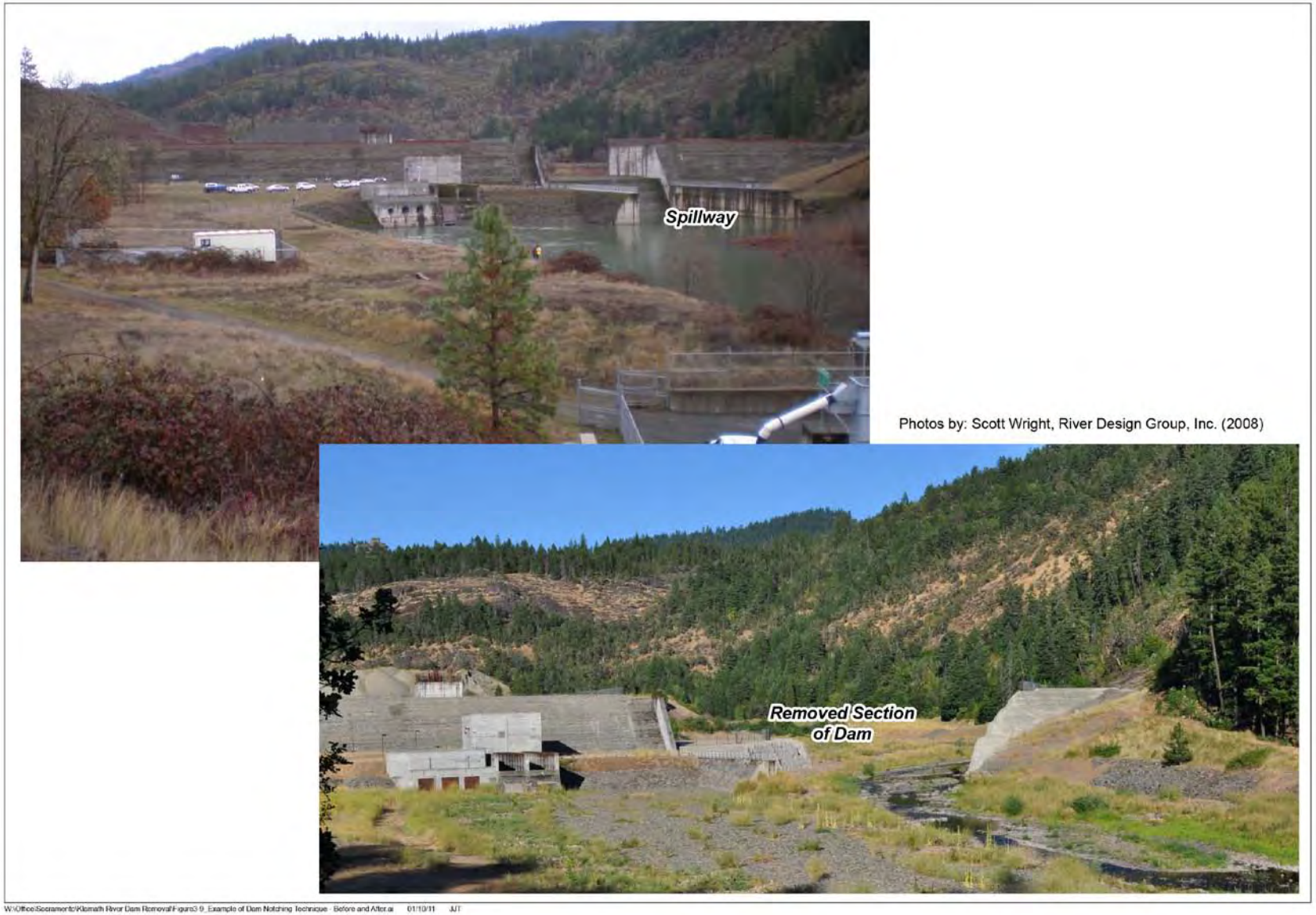

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Figure 3-9. Example of Dam Notching Technique, Before and After

Any Federal takeover would require Congressional approval, development of mitigation plans, and actions to secure permits that would require an in-depth environmental review process by federal and state agencies. The federal government has no plan for a takeover of the facility. Developing and implementing such a plan would involve many of the same design and permitting steps as the KHSA. The timeline would likely not be expedited substantially from the timeframe specified in the KHSA.

The federal takeover would still involve the full removal of the Four Facilities, requiring the same deconstruction activities under this alternative as in Alternative 2. Alternative 13 would differ from Alternative 2 in its lack of implementation of some elements of the KBRA, its source of funding for the project, and its timeline for completion.

3.14 Alternative 14 – Full Removal of Five Dams

This alternative would involve removal of Keno Dam in addition to the Four Facilities. The intent of this alternative would be to further expand the amount of habitat available to anadromous species, and would include the full removal of Keno Dam, the power generation facilities, bypass canals, pipelines, and dam foundations. This alternative would include the use of natural sediment flushing to move deposited sediment downstream, similar to Alternative 2, and would include riverbank restoration and revegetation within the areas of the former reservoirs.

Keno Dam is at River Mile (RM) 233, approximately 20 miles downstream from Link River Dam. There is no power generation at Keno Dam. The Keno facilities include a fish ladder suitable for trout and salmon passage. The Keno Impoundment provides irrigation supplies to the Lost River Diversion Channel, which serves the Ady and North Canals, the Klamath Drainage District, Area K Lease lands, and the Lower Klamath NWR. The removal of Keno Dam and Impoundment would require the construction of new irrigation infrastructure to replace the storage and conveyance facilities currently in place. Facilities to replace supplies would need to either pump from the river in a nearby location, or convey water from Upper Klamath Lake. New infrastructure would include pumps and pipelines to transport the water and modifications to the existing canals to accept water from the new sources.

3.15 Alternative 15 – Full Removal of Six Dams

This alternative would involve removal of Keno and Link River Dams in addition to the Four Facilities. The six dams would be fully removed, with all portions of the dams, hydroelectric facilities, and appurtenant structures being decommissioned. Keno Dam would be removed as described for Alternative 14, but this alternative would also include removal of Link River Dam. Like Alternative 14, this alternative includes natural sediment flushing, bank stabilization, and revegetation efforts within the former reservoir sites.

The Link River Dam is a concrete slab structure with a crest length of 435 feet. The structure stands 22 feet high and is 7 feet wide at the top. Link River Dam's reservoir, Upper Klamath Lake, has a total capacity of 873,000 acre-feet. Upper Klamath Lake provides water for the downstream hydroelectric facilities and irrigation needs, and regulates water levels to comply with the USFWS biological opinion on the shortnose and Lost River suckers. Link River Dam is 253.7 river miles up the Klamath River from its mouth, at the downstream end of Upper Klamath Lake. This facility has a state-of-the-art fish ladder suitable for trout, suckers, and anadromous fish migrations. This alternative would also require the construction of new conveyance and storage facilities for dependent irrigators and NWRs, and could result in a lack of water supplies to meet the requirements of the biological opinion for the suckers.

3.16 Alternative 16 – Dredge Upper Klamath Lake

The intent of this alternative would be to improve water quality in the Klamath Basin by dredging and removing phosphorous-rich sediments from Upper Klamath Lake. Ortho-phosphate, an agricultural fertilizer, helps fuel algae blooms that reduce the amount of oxygen available for other aquatic species. Reducing the supply of phosphorous to Upper Klamath Lake could improve the quality of water discharged downstream, although other naturally-occurring phosphorus sources would remain.

The dredging could also increase the storage capacity of Upper Klamath Lake, offering the potential to increase supplies and reduce the competition for limited water supplies among the irrigators, wildlife refuges, and environmental needs downstream of the lake.

This alternative would not involve removal of any dams, and thus would maintain the hydroelectric generating capacity of the Klamath Hydroelectric Project. It does not provide for fish passage at these facilities; therefore, implementing this alternative would not open any spawning areas or salmonid habitat.

3.17 Alternative 17 – Predator Control

This alternative would include control of seal, sea lion, and cormorant populations at the mouth of the Klamath River as an alternative to dam removal. It has been suggested that predation of anadromous salmonids by these marine species is having a major effect on the salmonid population as they return to the Klamath River to spawn. A number of seal and sea lion haul outs and sea bird colonies exist in the vicinity of the mouth of the Klamath (Figure 3-10).

Since the passage of the Marine Mammal Protection Act in 1972, marine mammal populations have recovered, and are considered "healthy and robust" (NOAA Fisheries Service 2008a). Proponents of predator control claim that the recovered predator population is increasing the

pressure on salmonids because of unbalanced numbers of predators compared to the still depressed salmonid population numbers. Salmon waiting to enter the Klamath for their upstream migration congregate at the mouth of the river, where the marine predators are able to feed easily on the schools of fish.

A study (Wiese, et al. 2008) examined the effects that avian predators, such as gulls, cormorants, and certain species of ducks, have on out-migrating smolts in the Columbia River at reservoirs. Smolts congregate in reservoirs as they attempt to find fish passage infrastructure on their way to the ocean, making them easy targets for resident piscivorous birds. The study concluded that predatory birds in the reservoirs accounted for the mortality of less than one percent of the juvenile salmonid population. Similar percentages may be expected as juvenile salmonids pass down river into the ocean.

3.18 Alternative 18 – Partition Upper Klamath Lake

This alternative was a suggestion intended to increase the amount of active storage in Upper Klamath Lake, which could reduce competition for water by increasing the available supply. The concept behind this alternative is to create an “inner lake” in Upper Klamath Lake by constructing a new levee in the middle of the existing lake (Figure 3-11). The new reservoir would capture excess winter and spring runoff, and be fed throughout the summer by natural springs.

The proposed levee would be approximately 50 feet wide and 40 feet tall, and would enclose a body of water approximately three miles wide by eight miles long, with an expected capacity of 400,000 acre feet (Herald and News 2010). In addition, the new lake would be dredged, further increasing the holding capacity of the new storage facility by deepening the reservoir.

The new supply of water would be used to provide consistent irrigation supplies while still providing adequate water for downstream beneficial uses, which include power generation, recreation, and environmental needs in the Klamath River and the nearby wildlife refuges.

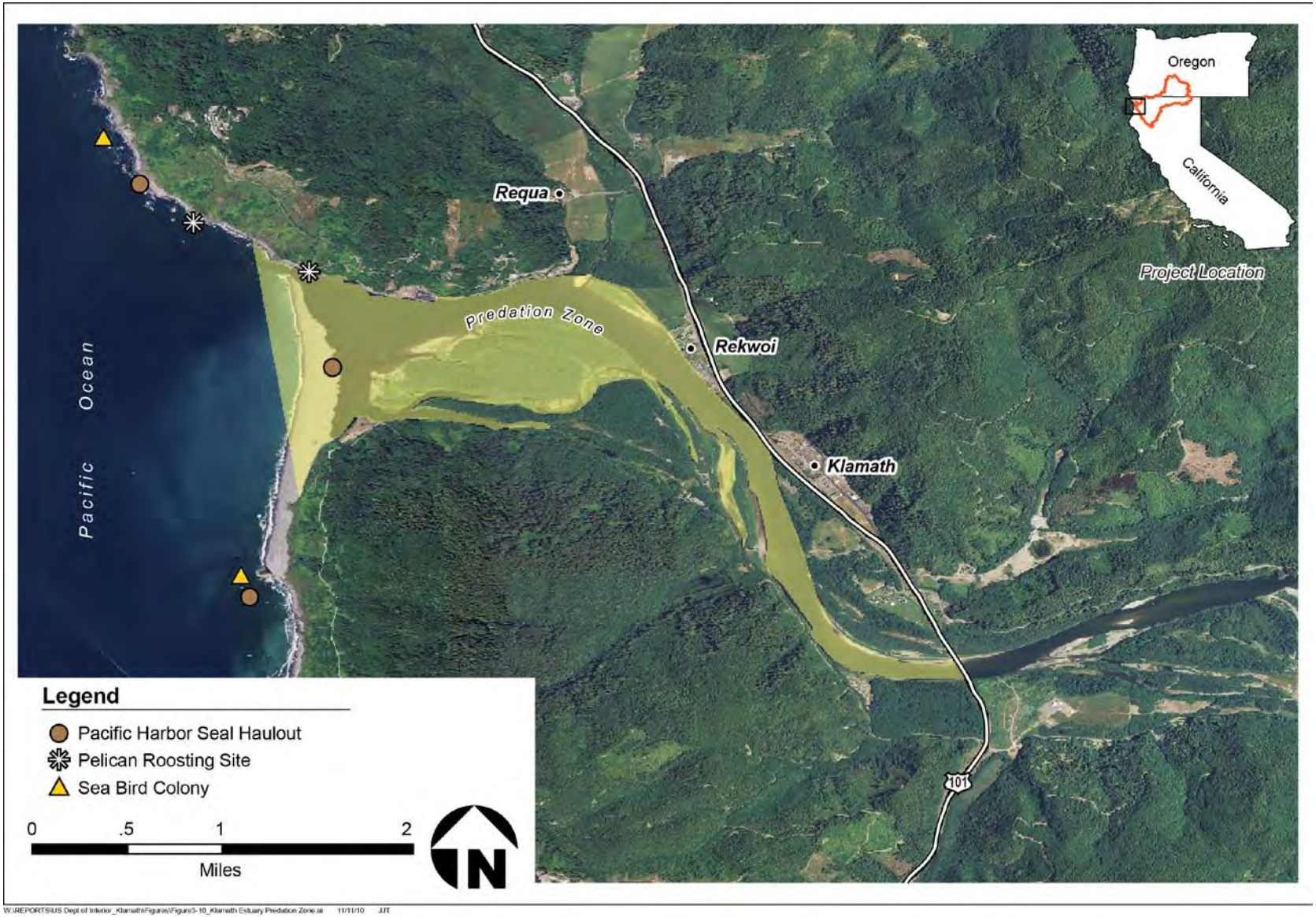

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Figure 3-10. Klamath Estuary Predation Zone

Figure 3-11. Proposed Inner Lake in Upper Klamath Lake

Chapter 4
Alternatives Screening

4.1 Screening Evaluation

The screening considerations described in Section 2.3 were applied to all alternatives and given a rating, described as follows:

1. Green: The alternative meets the screening consideration.
2. Yellow: The alternative does not meet the screening consideration.
3. White: More information is necessary to determine whether the alternative meets the screening consideration.

4.2 Screening

This section presents the screening evaluation for the alternatives. Each alternative discussion includes a table that indicates whether the alternative meets each consideration or requires more information for analysis. The tables list the major influencing factors that affected the rating determination. The influencing factors are based on available data and studies and best professional judgment.

4.2.1 Alternative 1 – No Action/No Project Alternative

NEPA and CEQA require inclusion of the No Action/No Project Alternative; therefore, this alternative will be carried forward for more detailed analysis in the EIS/EIR.

4.2.2 Alternative 2 – Full Facilities Removal of Four Dams (Proposed Action)

Alternative 2 would involve full implementation of the KHSA and the KBRA elements. It would fully meet the purpose and need/project objectives. Table 4-1 summarizes the results of the evaluation of the Proposed Action according to the screening considerations.

Table 4-1. Screening of Alternative 2: Full Facilities Removal of Four Dams Alternative (Proposed Action)

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would meet requirements of both agreements	Meets consideration
Free-flowing condition	Would remove dams to allow the river to flow freely	Meets consideration
Full volitional passage of fish	Would remove dams to provide for full volitional fish passage	Meets consideration
Advance restoration of salmonids	Would provide access to more of the watershed and include restoration actions in KBRA to advance restoration	Meets consideration
Reliable water supplies	Would establish diversion patterns based on year types in the KBRA to improve reliability of water supplies	Meets consideration
Reliable power supplies	Would implement power program to ensure reliable electricity at affordable rates	Meets consideration
Improve long-term water quality	Would create free-flowing river, increase inflow, and implement restoration actions that improve water quality	Meets consideration
Technically feasible	Would be technically feasible	Meets consideration

The Proposed Action meets all of the screening considerations. It is possible to engineer and execute the deconstruction of the Four Facilities. The task of planning and designing the deconstruction project would be complicated by the presence of sensitive aquatic species and the KHSA requirement to remove the dams in one year; however, dam removal is feasible.

With respect to the "Improve long-term water quality" consideration, water quality in the Klamath River downstream of the Klamath Hydroelectric Project might be reduced temporarily by the release of reservoir sediments, which would flow downstream as the dams are removed. The suspension of sediments in the water column, and other associated water quality parameters, could adversely affect aquatic species, including ESA- and CESA-listed fish. If necessary and feasible, mechanically removing a portion of reservoir sediment could reduce the potential adverse water quality impacts of sediment release. Sediment removal could cause impacts. In particular, dredging sediments could damage cultural or historic resources buried under the sediment. The feasibility of conducting mechanical sediment removal is uncertain at this time (for instance, the engineering details, such as equipment access, locations where sediment can drain, and disposal locations would need to be determined and analyzed). Dredging three reservoirs prior to dam removal and in accordance with the KHSA would take additional time, possibly more than the current one-year dam removal schedule.

Alternative 2 meets all the screening considerations and therefore **will be retained for further evaluation in the EIS/EIR**.

4.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

Similar to Alternative 2, Alternative 3 would involve full implementation of the KHSA and KBRA elements. In contrast to Alternative 2, Alternative 3 would include removal of J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams, but would allow for some appurtenant structures to remain on site. Alternative 3 would fully meet the purpose and need/project objectives. Table 4-2 summarizes the evaluation of the Partial Facilities Removal Alternative according to the screening considerations.

Table 4-2. Screening of Alternative 3: Partial Facilities Removal of Four Dams Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would meet requirements of both agreements	Meets consideration
Free-flowing condition	Would remove dams to allow the river to flow freely	Meets consideration
Full volitional passage of fish	Would remove dams to provide for full volitional fish passage	Meets consideration
Advance restoration of salmonids	Would provide access to more of the watershed and include restoration actions in KBRA to advance restoration	Meets consideration
Reliable water supplies	Would establish diversion patterns based on year types in the KBRA to improve reliability of water supplies	Meets consideration
Reliable power supplies	Would implement power program to ensure reliable electricity at affordable rates	Meets consideration
Improve long-term water quality	Would create free-flowing river, increase inflow, and implement restoration actions that improve water quality	Meets consideration
Technically feasible	Would be technically feasible	Meets consideration

The Partial Facilities Removal Alternative addresses all of the screening considerations. Implementation of this alternative would require long-term maintenance of any remaining facilities. As discussed in Section 4.2.2 (Alternative 2), mechanical sediment removal could be included in Alternative 3 to reduce impacts of sediment release, if necessary and feasible. Notwithstanding its potential to lessen the adverse impacts on water quality, dredging sediment might cause adverse impacts on other resources.

Alternative 3 meets all the screening considerations and therefore **will be retained for further evaluation in the EIS/EIR.**

4.2.4 Alternative 4 – Fish Passage at Four Dams

Alternative 4 would not involve the removal of any dam facilities and thus neither the KHSA nor the KBRA would be implemented. Instead, this alternative would involve construction of fishways at each of the four dams. Table 4-3 summarizes the evaluation of the Fish Passage at Four Dams Alternative according to the screening considerations.

Table 4-3. Screening of Alternative 4: Fish Passage at Four Dams Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would not remove any of the four dams	Does not meet consideration
Free-flowing condition	Would not allow a free-flowing river condition	Does not meet consideration
Full volitional passage of fish	Would provide full volitional fish passage	Meets consideration
Advance restoration of salmonids	Would provide access to more of the watershed for salmonid restoration	Meets consideration
Reliable water supplies	Would not implement water supply provisions of the KBRA	Does not meet consideration
Reliable power supplies	Would not implement power supply provisions of the KBRA to provide reliable electricity at affordable rates	Does not meet consideration
Improve long-term water quality	Would not improve water quality	Does not meet consideration
Technically feasible	Would be technically feasible	Meets consideration

The Fish Passage at Four Dams Alternative does not meet most of the screening considerations. The alternative would not result in a free-flowing river, although it would provide for full volitional fish passage and therefore would advance salmonid restoration. The design and construction of fishways for the dams, specifically the very tall dams at the Iron Gate and Copco 1 Developments, would be technically difficult due to the length of facility needed to reach the top of the dam. Fish would need to expend a substantial amount of energy to climb these fishways. The design will focus on providing full volitional fish passage, and this alternative would be technically feasible.

Because the KHSA would not be implemented as the terms and conditions require, the KBRA and its elements would also not be implemented, as they are dependent connected actions. Programs under the KBRA, such as those addressing reliable water supplies or power, would not be implemented. While the hydropower facilities would continue to generate power as part of this alternative, future rates are uncertain and elements of the KBRA intended to provide reliable long-term power at affordable prices would not be implemented. This alternative would not include elements that would improve water quality compared to the No Action/No Project Alternative.

Although Alternative 4 would not meet the purpose and need of the action or most of the objectives, it **will be retained for further evaluation in the EIS/EIR** because it could lessen

potential construction-related environmental and power generation effects of the Proposed Action. Additionally, multiple commenters suggested that it be retained. Alternative 4 provides a comparison of what is most likely to be implemented if the FERC FEIS were implemented. Furthermore, a comparison of effects will be informative.

4.2.5 Alternative 5 – Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate

Alternative 5 includes removal of the dams and appurtenant structures at the Iron Gate and Copco 1 Developments, and construction of (or improvements to) fishways at Copco 2 and J.C. Boyle Dams. Alternative 5 would not involve implementation of the KHSA or the KBRA elements as the terms and conditions require, because only two of the four dams would be removed. Table 4-4 summarizes the evaluation of Alternative 5 according to the screening considerations.

Table 4-4. Screening of Alternative 5: Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would remove only two of the four dams	Does not meet consideration
Free-flowing condition	Would not allow a free-flowing river condition	Does not meet consideration
Full volitional passage of fish	Removes two dams and adds ladders to two dams to provide for full volitional fish passage	Meets consideration
Advance restoration of salmonids	Provides access to more of the watershed	Meets consideration
Reliable water supplies	Would not implement water supply provisions of the KBRA	Does not meet consideration
Reliable power supplies	Would not implement power supply provisions of the KBRA to provide reliable electricity at affordable rates	Does not meet consideration
Improve long-term water quality	Would improve degraded water quality caused by Iron Gate and Copco 1 Dams	Meets consideration
Technically feasible	Would be technically feasible	Meets consideration

Alternative 5 does not meet most of the screening considerations. The alternative would not result in a completely free-flowing river, although it would result in more of the river open for free-flowing conditions. Implementation of Alternative 5 would improve water quality because the reservoirs behind Iron Gate and Copco 1 Dams degrade water quality on the river. Because the KHSA requirements would not be met, the KBRA and its elements would not be implemented as dependent connected actions. Programs under the KBRA, such as those addressing reliable water supplies or power, would not be implemented as part of Alternative 5.

Although Alternative 5 does not meet most of the screening considerations, it **will be retained for further evaluation in the EIS/EIR** because this alternative has the potential to reduce construction-related environmental and power generation effects associated with deconstruction.

Implementation of the alternative would improve water quality and provide for additional fish habitat while still providing some power generation. Additionally, it would lessen water quality effects of the two larger reservoirs. Inclusion of this alternative helps create a reasonable range of alternatives.

4.2.6 Alternative 6 – Fish Passage at J.C. Boyle, Remove Copco 1, Copco 2, and Iron Gate

Alternative 6 would not involve full implementation of the KHSA or the KBRA and its component elements because it would involve removal of three of the four dams under consideration. Table 4-5 summarizes the evaluation of Alternative 6 according to the screening considerations.

Table 4-5. Screening of Alternative 6: Fish Passage at J.C. Boyle, Remove Copco 1, Copco 2, and Iron Gate Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would remove only three of the four dams	Does not meet consideration
Free-flowing condition	Would not allow a free-flowing river condition	Does not meet consideration
Full volitional passage of fish	Removes three dams and upgrades passage facilities at J.C. Boyle Dam to provide for full volitional fish passage	Meets consideration
Advance restoration of salmonids	Provides access to more of the watershed	Meets consideration
Reliable water supplies	Would not implement water supply provisions of the KBRA	Does not meet consideration
Reliable power supplies	Would not implement power supply provisions of the KBRA to provide reliable electricity at affordable rates	Does not meet consideration
Improve long-term water quality	Would improve degraded water quality caused by Iron Gate and Copco 1 Dams	Meets consideration
Technically feasible	Would be technically feasible	Meets consideration

Alternative 6 would not meet all of the screening considerations. Implementation of this alternative would not result in a free-flowing river, but would achieve full volitional fish passage and would therefore advance salmonid restoration. Because the KHSA and KBRA requirements would not be met, several of the programs under the KBRA would not be implemented to provide reliable water or power supplies.

This alternative would be likely to improve water quality. The effects associated with dam removal and fish ladder construction will be addressed for the Full Facilities Removal (Alternative 2), Fish Passage at Four Dams (Alternative 4), and Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate (Alternative 5) Alternatives. The EIS/EIR will include full analyses regarding the effects of removing all dams, laddering all dams, and a combination

of these measures. The environmental effects of Alternative 6 would be fully analyzed through these other alternatives; therefore, it **will not be retained for analysis in the EIS/EIR as a separate alternative**.

4.2.7 Alternative 7 – Sequenced Removal of Four Dams

Alternative 7 would involve sequencing the deconstruction of each dam over a period of three to five years and would include implementation of the KBRA. Table 4-6 provides the evaluation of the Sequenced Removal of Four Dams Alternative according to the screening considerations.

Table 4-6. Screening of Alternative 7: Sequenced Removal of Four Dams

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would meet requirements of both agreements	Meets consideration
Free-flowing condition	Would remove dams to allow the river to flow freely	Meets consideration
Full volitional passage of fish	Would remove dams to provide for full volitional fish passage	Meets consideration
Advance restoration of salmonids	Would release sediment stored in reservoir over a period of multiple years, which would adversely affect multiple years of salmonids	Does not meet consideration
Reliable water supplies	Would establish diversion patterns based on year types in the KBRA to improve reliability of water supplies	Meets consideration
Reliable power supplies	Would implement power program to ensure reliable electricity at affordable rates	Meets consideration
Improve long-term water quality	Would create free-flowing river, increase inflow, and implement restoration actions that improve water quality	Meets consideration
Technically feasible	Would be technically feasible	Meets consideration

While the KHSA specifies a one-year timeframe for deconstruction, it also includes clauses that the agencies could meet and confer on a different schedule. Alternative 7 would be consistent with the KHSA because of this clause.

The Sequenced Removal of Four Dams Alternative would result in a free-flowing river and would include the restoration actions of the KBRA; therefore, it addresses most of the screening considerations. Sequencing removal over three to five years, however, would lengthen the amount of time that high concentrations of suspended sediment would be in the Klamath River. Under the Proposed Action, the sediment release could result in adverse effects to focal fish species, but the focal fish species are predicted to have a strong recovery because they would not have an entire year-class exposed to multiple months of high suspended sediments. Extending the sediment release over multiple years would affect both adults as they migrate upstream and their progeny when they migrate downstream in subsequent years. Impacts to focal fish species would be greater because the sediment would affect multiple life-stages of fish over multiple years (Stillwater Sciences 2011).

Alternative 7 **will not be carried forward for more detailed analysis in the EIS/EIR** because it would not avoid or lessen the significant environmental effects of the Proposed Action and may increase effects to fish associated with sediment release from the reservoirs over multiple years. Removing the facilities over multiple years could increase adverse effects on fishery resources. Alternative 7 is similar to Alternatives 2 and 3, except for the possibility of increased adverse effects on the salmonids, as advancing restoration of salmonids is an essential consideration, and this alternative does not present a reasonable means of doing so, as compared to Alternatives 2 and 3.

4.2.8 Alternative 8 – Full Facilities Removal of Four Dams without KBRA

Alternative 8 would include full removal of the Four Facilities, but it would not include implementation of the actions in the KBRA. Table 4-7 summarizes the evaluation of the Full Facilities removal of Four Dams without KBRA Alternative according to the screening considerations.

Table 4-7. Screening of Alternative 8: Full Facilities Removal of Four Dams without KBRA Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would not implement the KBRA	Does not meet consideration
Free-flowing condition	Would remove dams to allow the river to flow freely	Meets consideration
Full volitional passage of fish	Would remove dams to provide for full volitional fish passage	Meets consideration
Advance restoration of salmonids	Would provide access to more of the watershed	Meets consideration
Reliable water supplies	Would not implement water supply provisions of the KBRA	Does not meet consideration
Reliable power supplies	Would not implement power supply provisions of the KBRA to provide reliable electricity at affordable rates	Does not meet consideration
Improve long-term water quality	Would create a free-flowing river, which would reduce quality concerns within existing reservoirs	Meets consideration
Technically feasible	Would be technically feasible	Meets consideration

Alternative 8 would satisfy several screening considerations through removal of the four dams and returning the river reach to a free-flowing condition. This alternative would not, however, include the KBRA or its associated benefits, such as improvements to reliability of water and power supplies. Removing the four dams would improve water quality because the existing reservoirs would no longer cause impaired water quality; however, this alternative would not include the water quality benefits from the KBRA.

Alternative 8 **will not be carried forward for more detailed analysis in the EIS/EIR** because it does not meet the purpose and need under NEPA or the project objectives under CEQA and

would not avoid or lessen significant environmental effects of the Proposed Action. The impacts from dam removal would be the same as the Proposed Action, but the restoration elements of the KBRA would not provide benefits to help offset these environmental effects.

4.2.9 Alternative 9 –Trap and Haul Fish

Alternative 9 would include construction and management of fish trapping and hauling facilities; it would not include implementation of the KHSA or the KBRA and its component elements. Table 4-8 summarizes the evaluation of the Trap and Haul Fish Alternative according to the screening considerations.

Table 4-8. Screening of Alternative 9: Trap and Haul Fish Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would not remove any of the four dams	Does not meet consideration
Free-flowing condition	Would not allow a free-flowing river condition	Does not meet consideration
Full volitional passage of fish	Would not provide for volitional fish passage	Does not meet consideration
Advance restoration of salmonids	Unknown whether the alternative would be effective to allow salmonids to thrive in the upper watershed	Needs more information
Reliable water supplies	Would not implement water supply provisions of the KBRA	Does not meet consideration
Reliable power supplies	Would not implement power supply provisions of the KBRA to provide reliable electricity at affordable rates	Does not meet consideration
Improve long-term water quality	Would not improve water quality with dams still in place	Does not meet consideration
Technically feasible	Is technically feasible	Meets consideration

The Trap and Haul Fish Alternative would not meet all of the screening considerations. Implementation of this alternative would not result in a free-flowing river or provide for full volitional fish passage. Although it is unknown whether the trapping and the relocation of fish would provide the opportunity for the advancement of salmonids, it has been shown to be an ineffective technique (CDFG 2006). Because the KHSA and KBRA would not be implemented under the alternative, several of the programs under the KBRA would not be implemented to provide reliable water or power supplies.

Alternative 9 **will not be retained for more detailed analysis in the EIS/EIR** because it does not meet the purpose and need under NEPA or most of the program objectives under CEQA. Additionally, much of what is presented in this alternative is already covered by other alternatives.

4.2.10 Alternative 10 – Fish Bypass: Bogus Creek Bypass

Alternative 10 would involve the construction of a fish bypass around the dams in lieu of dam removal. This alternative would not include implementation of the KHSA; therefore, the KBRA

and its component elements would not be implemented because they are dependent connected actions. Table 4-9 summarizes the evaluation of the Fish Bypass: Bogus Creek Bypass Alternative according to the screening considerations.

The Fish Bypass: Bogus Creek Bypass Alternative would not meet any of the screening considerations. Implementation of this alternative would not result in a free-flowing river or provide for the full volitional passage of fish. The alternative would involve the use of mechanical assistance for fish passage because fish would need to be physically moved at the apex of the passage from one downstream section to the other. In addition, successful implementation of this alternative would require the fish to change their migratory behavior as they would need to swim downstream as part of their upstream migration.

Table 4-9. Screening of Alternative 10: Fish Bypass: Bogus Creek Bypass Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would not remove any of the four dams	Does not meet consideration
Free-flowing condition	Would not allow a free-flowing river condition	Does not meet consideration
Full volitional passage of fish	Would not enable fish to pass without external assistance	Does not meet consideration
Advance restoration of salmonids	Would not likely be used by fish as a passage facility	Does not meet consideration
Reliable water supplies	Would not implement water supply provisions of the KBRA	Does not meet consideration
Reliable power supplies	Would not implement power supply provisions of the KBRA to provide reliable electricity at affordable rates	Does not meet consideration
Improve long-term water quality	Would not improve water quality with dams still in place	Does not meet consideration
Technically feasible	Would not be effective	Does not meet consideration

The CDFG studied the effectiveness of a predecessor to this alternative and presented its findings in a technical memorandum in 2009. CDFG found that in order for Chinook salmon to be able to use this alternative for fish passage, the stream depths and flows of Cold Creek would have to be greater than the flows included in this alternative. CDFG also determined that behavioral traits of anadromous fish would prevent them from using the fish bypass rather than the Klamath River due to their lack of familiarity with these creeks. Although Alternative 10 has been updated from the alternative assessed in the 2009 study, these findings remain applicable to Alternative 10.

Additionally, the Lead Agencies received independent reviews of Alternatives 10 and 11 that confirmed that the two fish bypass methods are unlikely to be used by adult anadromous fish or outgoing smolts. These reviews (Mefford 2011 and White 2011) conclude that Alternative 10 does not comport with known salmonid migratory behavior and does not include provisions for outmigrating juvenile salmonids.

Because the KHSA and KBRA would not move forward, several of the programs under the KBRA would not be implemented to provide reliable water or power supplies.

This alternative **will not be retained for more detailed analysis in the EIS/EIR** because it does not meet any elements of the purpose and need under NEPA or program objectives under CEQA.

4.2.11 Alternative 11 – Fish Bypass: Alternate Tunnel Route

Alternative 11 would be similar to Alternative 10 except that the main fish passage would be a tunnel. The alternative would not include implementation of the KHSA or KBRA. Table 4-10 summarizes the evaluation of the Fish Bypass: Alternate Tunnel Route according to the screening considerations.

Table 4-10. Screening of Alternative 11: Fish Bypass: Alternate Tunnel Route Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would not remove any of the four dams	Does not meet consideration
Free-flowing condition	Would not allow a free-flowing river condition	Does not meet consideration
Full volitional passage of fish	Would not likely be used by fish	Does not meet consideration
Advance restoration of salmonids	Would not enable fish to pass without external assistance	Does not meet consideration
Reliable water supplies	Would not implement water supply provisions of the KBRA	Does not meet consideration
Reliable power supplies	Would not implement power supply provisions of the KBRA to provide reliable electricity at affordable rates	Does not meet consideration
Improve long-term water quality	Would not improve water quality with dams still in place	Does not meet consideration
Technically feasible	Would not be effective	Does not meet consideration

The Fish Bypass: Alternate Tunnel Route Alternative would not meet any of the screening considerations. Implementation of this alternative would not result in a free-flowing river or provide for the full volitional passage of fish. Because the KHSA and KBRA requirements would not be met, the programs under the KBRA would not be implemented to provide reliable water or power supplies.

Although the 2009 CDFG technical memorandum (See Section 4.2.10) did not address this particular alternative, many of the concerns noted therein would be applicable to this alternative as well. Use of the tunnel might address concerns about flows on Cold Creek and the multi-directional migration corridor; however, fish would still be unlikely to choose this new migration route rather than the mainstem of the Klamath River. Additionally, the independent reviews referenced in the analysis of Alternative 10 also analyzed Alternative 11 (Mefford 2011 and White 2011). Mr. Mefford states that Alternative 11 would provide no ecological benefit for the river and, to a degree, would further degrade the ecology of the Klamath River within this reach by diverting water. He goes on to say that, while the tunnel option must be considered very high

risk, dam removal would have a high likelihood of reestablishing the ecological benefits of the river lost by the construction of the dams. Alternative 11 would not provide a simple alternative for passage of salmon and steelhead populations past the lower four dams in the Klamath River.

This alternative **will not be carried forward for more detailed analysis in the EIS/EIR** because it does not meet any elements of the purpose and need under NEPA or program objectives under CEQA.

4.2.12 Alternative 12 – Notching Four Dams

Alternative 12 would involve implementation of the KHSA as described in the agreement, and would include full implementation of the KBRA and its component elements. Because the alternative is consistent with the objectives of these agreements, Alternative 12 would fully meet the elements of the purpose and need/project objectives. Table 4-11 summarizes the evaluation of the Notching Four Dams Alternative according to the screening considerations.

Table 4-11. Screening of Alternative 12: Notching Four Dams Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would meet requirements of both agreements	Meets consideration
Free-flowing condition	Would allow a free-flowing river condition	Meets consideration
Full volitional passage of fish	Would remove portions of dams blocking river to provide for full volitional fish passage	Meets consideration
Advance restoration of salmonids	Would provide access to more of the watershed and include restoration actions in KBRA to advance restoration	Meets consideration
Reliable water supplies	Would establish diversion patterns based on year types in the KBRA to improve reliability of water supplies	Meets consideration
Reliable power supplies	Would implement power program to ensure reliable electricity at affordable rates	Meets consideration
Improve long-term water quality	Would create a free-flowing river, increase inflow, and implement restoration actions that improve water quality	Meets consideration
Technically feasible	Would be technically feasible	Meets consideration

The Notching Four Dams Alternative meets all of the screening considerations. Implementation of this alternative would require long-term maintenance of retained appurtenant structures. Deconstructing the dams would release the sediment stored behind the dams into the river downstream, which could temporarily affect water quality and aquatic species in the river. In order to create a free-flowing river, the four dams would have to be notched in a manner similar to that used for Partial Facilities Removal in Alternative 3. This alternative is very similar to Alternative 3, and would result in the same type of effects as Alternative 3. Therefore, this alternative **will not be carried forward for more detailed analysis in the EIS/EIR as a separate alternative**.

4.2.13 Alternative 13 – Federal Takeover

Alternative 13 would include a federal takeover of the Four Facilities for removal and would not include implementation of the KHSA or the KBRA. Table 4-12 summarizes the evaluation of the Federal Takeover Alternative according to the screening considerations.

The Federal Takeover Alternative would not meet all of the screening considerations. Implementation of this alternative would result in a free-flowing river and provide for the full volitional passage of fish, and would therefore advance salmonid restoration, but because the KHSA and KBRA requirements would not be not met, the programs under the KBRA would not be implemented to provide reliable water or power supplies. The schedule for dam removal would be similar to the current schedule under the KHSA.

This alternative **will not be carried forward for more detailed analysis in the EIS/EIR** because the environmental effects would be generally the same as those under Alternative 2 (and have generally the same timeframe). This alternative would not reduce or lessen significant environmental effects. Moreover, the federal government has not expressed an interest in taking over the facilities.

Table 4-12. Screening of Alternative 13: Federal Takeover Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would not fully implement the KHSA	Does not meet consideration
Free-flowing condition	Would remove dams to allow the river to flow freely	Meets consideration
Full volitional passage of fish	Would remove dams to provide for full volitional fish passage	Meets consideration
Advance restoration of salmonids	Would provide access to more of the watershed	Meets consideration
Reliable water supplies	Would not implement water supply provisions of the KBRA	Does not meet consideration
Reliable power supplies	Would not implement power supply provisions of the KBRA to provide reliable electricity at affordable rates	Does not meet consideration
Improve long-term water quality	Would create a free-flowing river, increase inflow, and implement restoration actions that improve water quality	Meets consideration
Technically feasible	Would be technically feasible	Meets consideration

4.2.14 Alternative 14 – Full Removal of Five Dams

Alternative 14 would involve removal of Keno Dam in addition to the Four Facilities that would be removed under Alternative 2. Table 4-13 summarizes the evaluation of the Full Removal of Five Dams Alternative according to the screening considerations.

Table 4-13. Screening of Alternative 14: Full Removal of Five Dams Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would not meet the KHSA requirements because of the removal of Keno Dam	Does not meet consideration
Free-flowing condition	Would remove dams to allow the river to flow freely	Meets consideration
Full volitional passage of fish	Would remove dams to provide for full volitional fish passage	Meets consideration
Advance restoration of salmonids	Would provide access to more of the watershed and include restoration actions in KBRA to advance restoration	Meets consideration
Reliable water supplies	Would not implement water supply provisions of the KBRA	Does not meet consideration
Reliable power supplies	Would not implement power supply provisions of the KBRA to provide reliable electricity at affordable rates	Does not meet consideration
Improve long-term water quality	Would create a free-flowing river, increase inflow, and implement restoration actions that improve water quality	Meets consideration
Technically feasible	Would be technically feasible	Meets consideration

The Full Removal of Five Dams would not meet all of the screening considerations. Implementation of this alternative would result in a free-flowing river and provide for the full volitional passage of fish, and therefore would advance salmonid restoration. However, the programs under the KBRA would not be implemented to provide reliable water or power supplies because the alternative would not include the KHSA or the connected elements of the KBRA. Implementation of this alternative would require construction to maintain and continue current water diversions. It is unknown whether newly constructed facilities to deliver water would be able to fully provide for legal uses of water associated with Keno Dam.

Alternative 14 **will not be carried forward for more detailed analysis in the EIS/EIR** because it does not fully meet the purpose and need under NEPA or the project objectives under CEQA (because it is not consistent with the KHSA) and it would not avoid or lessen potential significant environmental effects of the Proposed Action. Implementation of this alternative would require substantial construction to continue current water diversions, which would likely create environmental and social effects that would be greater than the effects associated with other alternatives that are being carried forward.

4.2.15 Alternative 15 – Full Removal of Six Dams

Alternative 15 would involve removal of the Keno and Link River Dams in addition to the four dams that would be removed under Alternative 2. Table 4-14 summarizes the evaluation of the Full Removal of Six Dams Alternative according to the screening considerations.

Table 4-14. Screening of Alternative 15: Full Removal of Six Dams Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would not meet the KHSA requirements because of the removal of Keno and Link River Dams	Does not meet consideration
Free-flowing condition	Would remove dams to allow the river to flow freely	Meets consideration
Full volitional passage of fish	Would remove dams to provide for full volitional fish passage	Meets consideration
Advance restoration of salmonids	Would provide access to more of the watershed and include restoration actions in KBRA to advance restoration	Meets consideration
Reliable water supplies	Would not implement water supply provisions of the KBRA	Does not meet consideration
Reliable power supplies	Would not implement power supply provisions of the KBRA to provide reliable electricity at affordable rates	Does not meet consideration
Improve long-term water quality	Unknown whether action would improve long-term water quality	Needs more information
Technically feasible	Would be technically feasible	Meets consideration

The Full Removal of Six Dams would not meet all of the screening considerations. Implementation of this alternative would result in a free-flowing river and would provide for the full volitional passage of fish, and therefore would advance salmonid restoration. Some of the programs under the KBRA would not be implemented to provide reliable water or power supplies because the KHSA and the connected elements of the KBRA would not be part of this alternative. Link River Dam regulates Klamath River flow and Upper Klamath Lake levels, and Link River Dam's effect on water quality in the river and the lake has not been analyzed.

The alternative would not be consistent with the tribal trust water rights associated with Upper Klamath Lake. In addition, the removal of Link River Dam would not meet legal requirements of Reclamation's Klamath Project. Further, Link River Dam is used to regulate water levels for the ESA-listed Lost River and shortnose suckers, and removal of the facility could affect these fish.

Alternative 15 **will not be carried forward for more detailed analysis in the EIS/EIR** because it does not fully meet the purpose and need under NEPA and project objectives under CEQA (because it is not consistent with the KHSA) and it would not avoid or lessen significant environmental effects of the Proposed Action. Implementation of Alternative 15 would also not be likely to meet ESA requirements or tribal trust water rights within Upper Klamath Lake.

4.2.16 Alternative 16 – Dredge Upper Klamath Lake

Alternative 16 would include dredging to improve water quality and storage at Upper Klamath Lake. Table 4-15 summarizes the evaluation of the Dredge Upper Klamath Lake Alternative according to the screening considerations.

Table 4-15. Screening of Alternative 16: Dredge Upper Klamath Lake Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would not meet the KHSA requirements	Does not meet consideration
Free-flowing condition	Would not allow a free-flowing river condition	Does not meet consideration
Full volitional passage of fish	Would not provide for volitional fish passage	Does not meet consideration
Advance restoration of salmonids	Uncertain whether action would advance salmonid restoration	Needs more information
Reliable water supplies	Would provide increased water storage	Meets consideration
Reliable power supplies	Would not implement power supply provisions of the KBRA to provide reliable electricity at affordable rates	Does not meet consideration
Improve long-term water quality	Unknown whether action would improve long-term water quality	Needs more information
Technically feasible	Would be technically feasible	Meets consideration

Dredging Upper Klamath Lake would not meet most of the screening considerations. Implementation of this alternative would not result in a free-flowing river or provide for the full volitional passage of fish. Because the KHSA and the connected elements of the KBRA would not be part of this alternative, many of the programs under the KBRA would not be implemented to provide reliable water or power supplies.

Alternative 16 **will not be carried forward for more detailed analysis in the EIS/EIR** because it would not meet the NEPA purpose and need or most of the CEQA objectives.

4.2.17 Alternative 17 – Predator Control

Alternative 17 would promote fish recovery by reducing predation on salmonids by birds and marine animals. As an alternative to the Proposed Action, Alternative 17 would not include implementation of the KHSA or KBRA and its component elements. Table 4-16 summarizes the evaluation of the Predator Control Alternative according to the screening considerations.

Table 4-16. Screening of Alternative 17: Predator Control Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would not meet the KHSA requirements	Does not meet consideration
Free-flowing condition	Would not allow a free-flowing river condition	Does not meet consideration
Full volitional passage of fish	Would not provide for volitional fish passage	Does not meet consideration
Advance restoration of salmonids	Could decrease predation at mouth of river, allowing more fish to pass	Meets consideration
Reliable water supplies	Would not implement water supply provisions of the KBRA	Does not meet consideration
Reliable power supplies	Would not implement power supply provisions of the KBRA to provide reliable electricity at affordable rates	Does not meet consideration
Improve long-term water quality	Would not improve water quality with dams still in place	Does not meet consideration
Technically feasible	Would be technically feasible	Meets consideration

Predator Control would not meet most of the screening considerations. Implementation of this alternative would not result in a free-flowing river or provide for the full volitional passage of fish. This alternative's actions could advance restoration of salmonids; therefore, it satisfies that screening consideration. However, reducing predation of salmonids at the mouth of the Klamath River would address only one factor that could affect fish and would not improve any of the upstream conditions for anadromous fish. Because the alternative would not include the KHSA or the connected elements of the KBRA, several of the programs under the KBRA would not be implemented to provide reliable water or power supplies.

Alternative 17 **will not be carried forward for more detailed analysis in the EIS/EIR** because it would not meet the purpose and need under NEPA or objectives under CEQA. Moreover, it would be difficult to permit because of biological concerns.

4.2.18 Alternative 18 – Partition Upper Klamath Lake

Alternative 18 would include creation of a partition in Upper Klamath Lake to increase the water storage within the lake. Table 4-17 summarizes the evaluation of the Partition Upper Klamath Lake Alternative according to the screening considerations.

Table 4-17. Screening of Alternative 18: Partition Upper Klamath Lake Alternative

Consideration	Influencing Factors	Rating
Consistent with KBRA and KHSA	Would not remove any of the four dams	Does not meet consideration
Free-flowing condition	Would not allow a free-flowing river condition	Does not meet consideration
Full volitional passage of fish	Would not provide for full volitional fish passage	Does not meet consideration
Advance restoration of salmonids	Would not advance of salmonid recovery	Does not meet consideration
Reliable water supplies	Would not implement water supply provisions of the KBRA	Does not meet consideration
Reliable power supplies	Would not implement power supply provisions of the KBRA to provide reliable electricity at affordable rates	Does not meet consideration
Improve long-term water quality	Would not improve water quality with dams still in place	Does not meet consideration
Technically feasible	Would be technically feasible	Meets consideration

Partitioning Upper Klamath Lake would not meet most of the screening considerations. Implementation of this alternative would not result in a free-flowing river or provide for volitional fish passage and would not advance the restoration of salmonids. Although water storage would be increased by the partition, this increase would not be sufficient to provide for reliable water supplies throughout the basin. Because the alternative would not include the KHSA or the connected elements of the KBRA, several of the programs under the KBRA would not be implemented to provide reliable water or power supplies. One objective of the partition would be to concentrate higher quality water in a smaller area of Upper Klamath Lake, which could improve water quality conditions in downstream reaches of the river. These changes would, however, be small and would be insufficient to ameliorate adverse water quality conditions downstream of Upper Klamath Lake.

Alternative 18 **will not be carried forward for more detailed analysis in the EIS/EIR** because it would not meet the purpose and need under NEPA or objectives under CEQA.

4.3 Screening Results

Figure 4-1 shows the results of the alternatives screening process.

Alt.		Consistent with KBRA and KHSA	Free-flowing condition	Full volitional passage of fish	Advance restoration of salmonids	Reliable water supplies	Reliable power supplies	Improve long-term water quality	Technically feasible
2	Full Facilities Removal of Four Dams	■	■	■	■	■	■	■	■
3	Partial Facilties Removal of Four Dams	■	■	■	■	■	■	■	■
4	Fish Passage at Four Dams	▒	▒	■	■	▒	▒	▒	■
5	Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate	▒	▒	■	■	▒	▒	■	■
6	Fish Passage at J.C. Boyle, Remove Copco 1, Copco 2, and Iron Gate	▒	▒	■	■	▒	▒	■	■
7	Sequenced Removal of Four Dams	■	■	■	▒	■	■	■	■
8	Full Facilities Removal of Four Dams without KBRA	▒	■	■	■	▒	▒	■	■
9	Trap and Haul Fish	▒	▒	▒		▒	▒	▒	■
10	Fish Bypass: Bogus Creek Bypass	▒	▒	▒	▒	▒	▒	▒	▒
11	Fish Bypass: Alternate Tunnel Route	▒	▒	▒	▒	▒	▒	▒	▒
12	Notching Four Dams	■	■	■	■	■	■	■	■
13	Federal Takeover	▒	■	■	■	▒	▒	■	■
14	Full Removal of Five Dams	▒	■	■	■	▒	▒	■	■
15	Full Removal of Six Dams	▒	■	■	■	▒	▒		■
16	Dredge Upper Klamath Lake	▒	▒	▒		■	▒		■
17	Predator Control	▒	▒	▒	■	▒	▒	▒	■
18	Partition Upper Klamath Lake	▒	▒	▒	▒	▒	▒	▒	■

Legend
■ Meets the screening consideration
▒ Does not meet the screening consideration
More information necessary to apply a screening consideration

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Figure 4-1. Screening Consideration Matrix

Chapter 5
Alternatives Retained for Analysis

5.1 Alternative 2 – Proposed Action: Full Facilities Removal of Four Dams

5.1.1 Features of the Proposed Action

The Full Facilities Removal of Four Dams (Proposed Action) alternative is the removal of the Four Facilities (J.C. Boyle, Copco 1, Copco 2, and Iron Gate Dams) during a 12-month period as described in the KHSA. The alternative would include the complete removal of power generation facilities, water intake structures, canals, pipelines, ancillary buildings and dam foundations. These four dams and their appurtenant facilities are referred to herein as the Four Facilities. Preparation for dam removal would begin in May 2019 for Iron Gate Dam and June 2019 for Copco 1 Dam. Deconstruction efforts for the J.C. Boyle and Copco 2 facilities would commence after January 1, 2020 and all four dams would be completely removed by December 31, 2020.

DOI has developed preliminary concepts for how each facility would be removed based on PacifiCorp's detailed engineering drawings and current conditions. Members of the DOI engineering team have inspected each dam site to confirm the specifics of project features that form the basis for alternative design. In general, this alternative would include removal of all facilities and sealing or securing of areas made unsafe by dam removal activities. The KHSA states that a DRE would remove the facilities, and that the implementing agencies would select the DRE as part of KHSA implementation. The following descriptions provide more detail on full facility removal at each dam site.

5.1.1.1 J.C. Boyle Dam and Powerhouse

The J.C. Boyle Development consists of a reservoir, combination embankment and concrete dam, spillway with Tainter gates, diversion water intake structure, water conveyance system, and powerhouse on the Klamath River between RM 228 and RM 220. The dam has a concrete spillway section with flow control gates and an earth embankment section to retain water. The embankment dam is 68 feet high above the original riverbed, 15 feet wide at its crest, and has a length of 413 feet. The reservoir side of the embankment dam has a rise of 1 vertical foot for every 3 horizontal feet, referred to as a 3H:1V slope. A 3-foot-thick layer of riprap protects the upstream slope. The downstream slope is constant at 2.5H:1V with a 16-foot-wide berm for an access road. Below the access road, a 2-foot -thick layer of riprap protects the slope. J.C. Boyle Dam impounds a narrow reservoir (J.C. Boyle Reservoir) with a surface area of 420 acres and a storage capacity of approximately 2,629 acre-feet of at river water surface elevation 3,793.5 feet.

Diverted water is conveyed a total distance of 2.56 miles through a steel pipe, concrete canal (2 miles), tunnel, and penstock pipe to the powerhouse. The powerhouse is on the right bank approximately 4.3 river miles downstream from the dam, as illustrated in Figure 5-1. The powerhouse is an outdoor-type structure with two vertical shafts and Francis generating units, with a total rated capacity of about 98 megawatts (MW).

Figure 5-1. J.C. Boyle Dam, Reservoir, and Powerhouse

Full removal of the J.C. Boyle Dam and Powerhouse would include removal of the entire embankment dam, concrete spillway and Tainter gates, and concrete fish ladder. This alternative would also include removal of ancillary facilities, such as the power water intake structure, left[4] abutment concrete gravity section, steel conveyance pipeline and pipeline support structure that crosses the river, and the concrete conveyance canal. The extensive headcut downstream of the forebay overflow discharge canal would be filled and stabilized with a portion of the material removed from the dam structure.

Under this alternative, the DRE would remove not only the immediate facilities at the dam, but also the powerhouse, powerhouse crane, turbines, concrete structures, and power generation support equipment. The DRE would remove the tunnel entrance structure and seal the tunnel at

[4] River left and right refer to the left and right banks of the river as one faces downstream.

both ends to prevent entry. Further, the DRE would fill the tailrace area of the powerhouse to restore natural river conditions in this area. The DRE would perform a controlled reservoir drawdown to access the dam for deconstruction using the spillway gates, conveyance pipeline and canal, and diversion conduit.

Trapped sediments in the reservoir consist primarily of highly erodible silts and clays. DOI's modeling studies (DOI 2011) indicate that drawdown would erode and flush 41 to 65 percent of the stored sediment downstream. Once eroded from the reservoir, the fine sediment would continue in suspension to the ocean. Large quantities of sediment would remain in place after dam removal, primarily on terraces above the active channel. Restoration of these areas following drawdown would minimize erosion; restoration would include seeding with herbaceous species and planting with woody species in accordance with reservoir restoration plans (DOI 2011).

Figure 5-2. Copco 1 Dam showing gated spillway and penstock pipes

5.1.1.2 Copco 1 Dam and Powerhouse

Copco 1 Dam (Figure 5-2) is in a bedrock canyon on the Klamath River at RM 198.6. The Copco 1 Dam is a concrete, gravity arch dam with a spillway crest approximately 115 feet above the original riverbed, with concrete cutoff walls that extend an additional 100 feet below the existing river bed elevation. The overall dam structure height is 215 feet from the spillway crest to the lowest depth of excavation at the base of the dam foundation. The crest length between the rock abutments is about 410 feet, and the deck is 8 feet wide. The upstream face of the dam is vertical at the top and the downstream face is stepped with risers that are generally 6 feet high. The width of the dam at the historical river level is approximately 94 feet.

Construction records show that the dam includes 465 tons of 30-pound steel rails for reinforcement. Vertical rails are on the upstream side in rows parallel to the face, 4.5 feet apart. Spacing of horizontal mats of rails varied from 5 to 8 feet. Dam construction methods included the placement of small amounts of concrete at a time with the rails projecting out of the sides to

connect the adjacent concrete sections. An ogee-type spillway is on the crest of the gravity arch dam. It has 13 bays controlled by 14 foot by 14 foot Tainter gates. Figure 5-2 shows these Tainter gates, the gated spillway, and penstock pipes.

Copco 1 Powerhouse is on the river right bank of the Klamath River, immediately downstream from the dam. It is a conventional, indoor type structure with two horizontal, double runner, Francis turbines that drive 10 MW generators.

Under the Proposed Action, the DRE would remove the entire concrete gravity arch dam from canyon wall to canyon wall and five feet below the existing streambed (a total of 130 feet from the top of the dam). Removing the entire facility would entail removal of the concrete water intake structure, concrete gate houses, penstock pipes and supports, powerhouse, and power generation support facilities. The water intake facility on the left side of the dam would be removed and the associated tunnel would be plugged to prevent unauthorized entry.

This alternative would also include removal of the switchyard (above the dam on the right abutment) and any unused transmission lines, including fencing, poles, and transformers. Removal of the Copco 1 switchyard would include all transformers, breakers, switches, and take-off structures. Removal would include the steel penstocks: two 10-foot-diameter (reducing to two 8-foot-diameter) pipes and one 14-foot-diameter pipe (reducing to two 8-foot-diameter pipes) from the intake structure to the powerhouse, including three vertical air vent pipes.

Using the spillway gates and modified diversion tunnel, the DRE would perform a controlled reservoir drawdown to access the dam for deconstruction. DOI's modeling indicates that the initial drawdown would flush 46 to 81 percent of the silts and clays behind the dam. Once eroded from the reservoir, the fine sediment would continue in suspension all the way to the ocean. After drawdown, the remaining sediments would consolidate and decrease in thickness. Copco 1 Reservoir sediments would likely experience a substantial amount of consolidation, which would decrease the depth of the remaining sediment. Initial DOI modeling studies show change in sediment depth layers up to 61 percent of original depth due to desiccation (DOI 2011). Similar shrinkage of sediment layers would be expected for J.C. Boyle and Iron Gate Reservoirs. Restoration efforts would minimize future erosion and sedimentation through planting of herbaceous and woody species and eventually, natural flora colonization would occur.

5.1.1.3 Copco 2 Dam and Powerhouse

Copco 2 Dam is in a confined canyon on the Klamath River at RM 198.3. Copco 2 Dam is a concrete, gravity dam with an earthen embankment section, gated spillway with Tainter gates, water conveyance system, and powerhouse. Figure 5-3 shows the existing dam with gated concrete spillway. The dam has a gated intake to a water conveyance tunnel on the left abutment, a central spillway section that is 145 feet long, with five 26 foot by 11 foot radial Tainter gates, and a 132 foot long earthen embankment with cutoff wall on the right abutment. The dam is 33 feet high, with an overall crest length of 335 feet and a crest width of 9 feet. A corrugated metal pipe with a capacity of 5 cfs flows to the Bypass Reach downstream of the dam.

Copco 2 Powerhouse is 1.5 miles downstream of Copco 2 Dam, on the left bank of the river. Water flows from the dam through 2,440 feet of concrete-lined tunnel, 1,313 feet of wood-stave pipeline, an additional 1,110 feet of concrete-lined tunnel, an underground surge tank (including an air vent and overflow spillway), and two steel penstocks. The diameter of the tunnel and wood-stave pipeline sections is 16 feet. The two penstocks, one 405 feet long and one 410 feet long, range from 16 feet in diameter at the upstream ends to 8 feet in diameter at the turbine spiral cases. A 138 inch butterfly valve near the downstream end of each penstock can shut off flow.

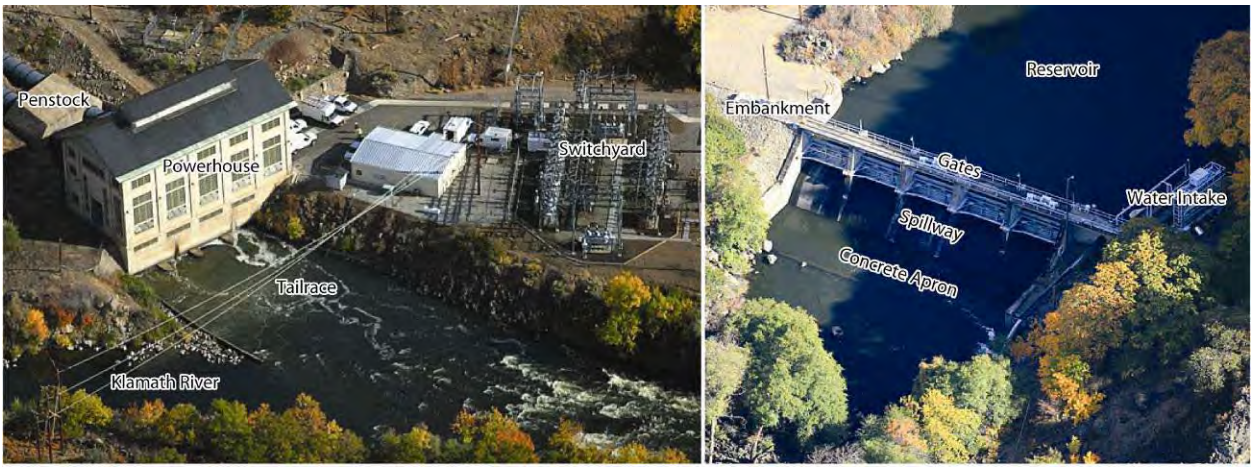

Figure 5-3. View of Copco 2 Powerhouse (left photo) and Dam

The Copco 2 Powerhouse is a reinforced-concrete structure with two vertical, Francis turbines. There are three outdoor, single-phase V transformers for each generator to step up the voltage and also three outdoor, single-phase V step-up transformers for interconnection to the transmission system. A 69 kV transmission line (PacifiCorp Line No. 15) is 1.2 miles long and connects the Copco 2 Powerhouse to the Copco 1 switchyard. A second 69 kV transmission line (also Line No. 15) is 0.14 miles long and connects the Copco 2 Powerhouse to the Copco 2 switchyard.

Full removal of the dam and diversion intake would include removal of the concrete spillway and Tainter gates, spillway apron and sill, concrete sidewalls, water intake structure, and reshaping of the embankment on river right to form a natural channel. Under this alternative, the DRE would remove the creosote treated wood-stave penstock portion between the first and second tunnels, and would haul the removed material to a disposal facility about 120 miles away. This alternative would include removal of the steel penstocks between the second tunnel and the powerhouse and plugging of all remaining open tunnel and shaft portals with concrete to avoid unauthorized entry.

This alternative would also include removal of Copco 2 Powerhouse, along with the power generation equipment (turbines and piping), and unused transmission lines, piles and transformers. Restoration would include backfill of the excavated tailrace channel between the

powerhouse and the river to restore natural river conditions. The Copco 2 substation at the powerhouse, and a 230 kV switchyard on a bluff north of the river, would remain in service following dam removal.

5.1.1.4 Iron Gate Dam and Powerhouse

The Iron Gate Dam and Powerhouse are at RM 190.1 on the Klamath River in a confined bedrock canyon. Iron Gate Dam is a zoned earthfill embankment with a height of approximately 194 feet from the rock foundation at the base of the dam to the dam crest (Figure 5-4). The dam crest width is 20 feet and its length spanning the valley is 740 feet. The dam has a central, vertical, asymmetrical clay core, supported by upstream and downstream shells of pervious rockfill with a maximum rock size of 12 inches. The upstream embankment slope is 3H:1V at the base, increasing to 2.5H:1V in the upper portion of the slope. In 2003, installation of a cantilevered sheet pile raised the water-retaining height in the reservoir but did not raise the overall dam elevation, resulting in a sheet pile parapet wall that is 5 feet high, shown in Figure 5-4. A 10-foot layer of riprap protects the upstream slope, and a 5-foot layer of riprap protects the downstream slope.

Figure 5-4. Iron Gate Dam (left photo) power generating facilities (left photo) and dam crest and parapet sheet pile wall (right photo)

The earthfill embankment has a drainage system with a near-vertical chimney drain and clean, free-draining material between the core and the downstream shell, which connects to a horizontal blanket drain laid over the foundation. The blanket drain contains a 30 inch diameter concrete pipe drain and outlet at a manhole at the toe of the dam. Two graded filter zones are between the

core and the chimney drain to prevent the migration of fine material from the core into the downstream shell or blanket drain. A filter over the top of the horizontal blanket drain protects it from the migration of fine material into the overlying downstream shell. Another filter is between the core and the upstream shell. The dam sits on sound basalt bedrock. The powerhouse is immediately downstream of the dam on the left bank of the river.

Full removal of the dam and powerhouse would include removal of the earthen embankment dam, diversion tunnel gate structure, concrete water intake structure, powerhouse generation facility, penstock and its concrete supports, unused transmission lines, and the switchyard. The DRE would bury the concrete spillway side-channel inlet structure, chute, and terminal structure (requiring up to 300,000 yd^3 of backfill) to restore the pre-dam appearance of the right abutment bedrock canyon. The diversion tunnel portals would be plugged with concrete to avoid unauthorized entry. Restoration would include backfill of the excavated tailrace channel between the powerhouse and the river.

This alternative would include removal of the fish handling facilities at the base of the dam, but the Iron Gate Fish Hatchery would remain in place. PacifiCorp would need to secure an alternate water source for the hatchery. The existing 30 inch diameter, cold water supply pipe from the penstock intake structure to the fish hatchery would be removed with the embankment dam. PacifiCorp would fund eight years of hatchery operations after decommissioning of Iron Gate Dam, after which the parties will be responsible for identifying funding for continued operations.

The DRE would draw down the reservoir to access the dam for deconstruction and facilities removal using the penstock bypass and modified diversion tunnel. DOI modeling indicates that this drawdown would flush 25 to 38 percent of the trapped sediments in the reservoir (primarily silts and clays). Once eroded from the reservoir, the fine sediment would continue in suspension all the way to the ocean. The remaining sediments would consolidate after drawdown, and restoration efforts would stabilize the remaining sediment.

5.1.2 Schedule for the Proposed Action

The DRE and PacifiCorp would need to agree on a final schedule for halting power generation and starting reservoir drawdown as described in the KHSA. The DRE would begin preparatory work in May 2019. The initial schedule for this alternative shows power generation at the Iron Gate and J.C. Boyle projects stopping on December 31, 2019. Power generation would stop at Copco 2 Powerhouse in April 2020 and Copco 1 would cease in October 2019. The following sections describe the proposed operations and drawdown plans for each reservoir. Figure 5-5 provides a schedule for the Proposed Action based on construction requirements for removal.

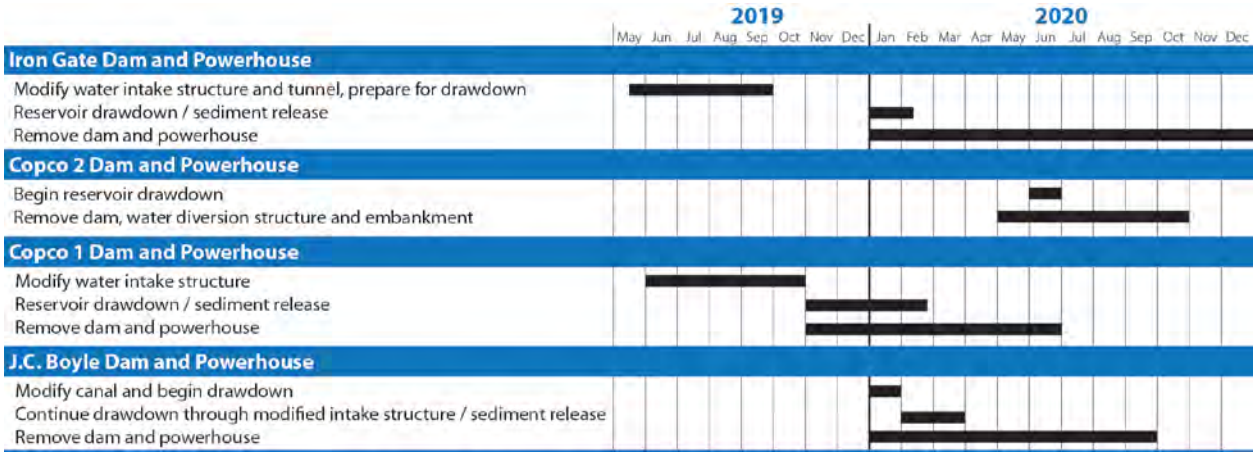

Figure 5-5. Anticipated Schedule for Full Facilities Removal of Four Dams

For removal of J.C. Boyle Dam, only sediment stored in the J.C. Boyle Reservoir would pass through because the alternative does not involve alterations of reservoirs upstream from the project site. The Boyle Reservoir does not have structures around the reservoir rim that could be damaged by slope failures, so embankment slope stability and associated safety issues would control the drawdown rate. A drawdown rate of 1 foot per day would not cause a rapid drawdown failure, because the embankment shells are a mixture of sand and gravel that should have a high strength. A drawdown rate of more than 1 foot per day would most likely be acceptable for the lower portion of the reservoir—during the later part of the drawdown period, when there may be limited control of reservoir releases. The streamflow diversion plan could result in rapid drawdown of approximately 10 feet (between elevations 3,780 and 3,770) and 8 feet (between elevations 3,770 and 3,762) in less than 24 hours, but each of these rapid drawdowns would be followed by a sustained hold period of more than one week before any further drawdown. J.C. Boyle Dam removal would happen primarily in May, June, and July 2020.

The schedule for the Proposed Action Copco 1 plan assumes that power generation at Copco 1 Powerhouse would cease on October 31, 2019. Reservoir drawdown would start at that time at an average drawdown rate of 6 feet per week. The drawdown rate is limited to 1 foot per day for the upper 50 feet of the reservoir and 3 feet per day below that resulting from notching the dam. January through June 2020 would be the primary dam removal period.

The Proposed Action would include power generation at Copco 2 Powerhouse for up to five months after the January 1, 2020 date in the KHSA. Reservoir drawdown at Copco 2 Dam would not commence until June 2020. Because there is no sediment stored at Copco 2 Dam and the Copco 2 Reservoir slopes are stable, no drawdown rate limitations would apply to the removal of Copco 2 Dam. Sediment from upstream dam removals would flow through this area and would not be stored in the Copco 2 Reservoir. The DRE could maintain minimum releases of 5 to 10 cfs to the downstream Bypass Reach if necessary without significant impacts on the demolition activities. The upstream reservoirs at J.C. Boyle and Copco 1 Dams would have

already been mostly drained by the time removal work would begin at Copco 2 Dam, and should not affect the streamflow at the Copco 2 Dam site. May through September 2020 would be the primary dam removal period.

Under the Proposed action, power generation at Iron Gate Dam would end on December 31, 2019. Reservoir drawdown would start on January 1, 2020. An average drawdown rate of 1.7 feet per day, with a maximum rate of 10 feet per day, would ensure stability of Iron Gate Dam because the dam has a wide, pervious outer zone that has high strength and should drain relatively quickly as the reservoir is drawn down. The DRE would perform primary dam removal throughout 2020.

5.1.3 Operations and Adaptive Management of the Proposed Action

PacifiCorp would continue to operate the facilities for the benefit of customers and retain all rights to the power from the facilities until each of the facilities are decommissioned in accordance with the KHSA.

In order to effectively manage the drawdown phase of the Proposed Action, the DRE would develop a monitoring plan prior to implementation. Monitoring suspended sediment and downstream water quality conditions would allow for adaptive management opportunities during dam removal. Adaptive management would allow the DRE to address any unanticipated differences between predictive studies of sediment transport and the actual water quality during the dam removal period.

5.1.4 Construction Details of the Proposed Action

The following sections describe construction techniques and equipment for dam removal at each of the project sites.

5.1.4.1 J.C. Boyle Dam and Powerhouse

The DRE would take the following actions at J.C. Boyle Dam:

- Remove the spillway gates and traveling hoists using a large crane, with the reservoir drawn down below the spillway crest.
- Remove the reinforced concrete spillway bridge deck and piers in pieces using hydraulic excavators, or in sections using diamond-wire sawcutting.
- Remove the upstream concrete bulkheads for the diversion culvert one at a time with a crane or by blasting for additional reservoir drawdown.
- Remove the lower portion of the concrete spillway section in segments by hoe-ramming or by drilling and blasting, working behind a temporary cofferdam if necessary (left side first, with flows through a diversion culvert).

- Remove the reinforced concrete in deck, wall, and floor slabs in remaining features (including fish ladder, intake structure, power canal, forebay structures, powerhouse) using mechanical methods (e.g., hydraulic shears or hoe-ramming), or possibly in sections by diamond-wire sawcutting.
- Stockpile some rockfill for later use protecting slopes for the upstream cofferdam.
- Haul concrete rubble, mechanical and electrical equipment, and miscellaneous items in trucks to designated disposal sites as described below. All material that can be reused or recycled would be transported to an appropriate recycling location or transfer facility.

Dam removal would begin by drawing down the reservoir below the concrete spillway crest by using the penstock and diversion culvert at the bottom of the spillway. With the reservoir drawn down, the DRE would excavate the embankment dam by removing the earth fill from the top of the embankment and working downward with standard excavation equipment. The DRE would place portions of the excavated rockfill on the face of the isolation cofferdam upstream of the embankment. After embankment removal, the DRE would perform a controlled breach of the cofferdam. Natural erosion of the armored cofferdam would complete final reservoir drawdown. The DRE would fully isolate and remove the concrete spillway and fish ladder in dry conditions except the base of the spillway.

Estimated waste quantities for Full Facilities Removal at J.C. Boyle Dam and Powerhouse include 40,000 yd^3 of concrete, 140,000 yd^3 of earthfill, and 3,000 tons of mechanical and electrical items at the dam.

The DRE would use the original borrow pits on the right abutment of J.C. Boyle Dam for waste areas. The DRE would haul materials on existing unpaved roads to the disposal sites along the cleared transmission line corridor, and place some material within ravines below the transmission lines. The existing haul roads would require some initial clearing and minor improvements. The work below the high voltage transmission lines would require special precautions to maintain a safe work site. These precautions could include coordination with PacifiCorp and fencing off areas to ensure that structural features are avoided. The DRE would grade and slope disposal sites for drainage upon completion.

The DRE would place surplus waste concrete and earth materials into the eroded scour hole on the hillside below the forebay overflow spillway structure, to restore the area to near pre-dam conditions. The DRE would separate reinforcing steel from the concrete and haul the steel to a recycling facility in Klamath Falls, Oregon. The DRE would also haul mechanical and electrical equipment to Klamath Falls to be transferred to a suitable recycling facility outside the project boundaries. Potential hazardous materials, which would need specialized abatement and disposal requirements, include asbestos, batteries, bearing and hydraulic control system oils, polychlorinated biphenyls (PCBs), and coatings containing heavy metals in the powerhouse and on the exterior surfaces of the steel penstock pipes, surge tank, bulkhead gate, and generator gantry crane.

Construction activities at J.C. Boyle Dam and Powerhouse would require an estimated average workforce of 25 to 30 people for approximately 10 months. Attachment A includes equipment

needed for the removal of J.C. Boyle Dam and Powerhouse and for restoration of the reservoir area.

5.1.4.2 Copco 1 Dam and Powerhouse

The DRE would take the following actions at Copco 1 Dam:

- Remove the spillway gates and traveling hoists using a large crane, with the reservoir drawn down below the spillway crest.
- Remove the reinforced concrete spillway bridge deck and piers in pieces using hydraulic excavators, or in sections using diamond-wire sawcutting.
- Remove the concrete gravity arch dam in 8-foot horizontal lifts using conventional drilling and blasting techniques. Dam removal would be challenging because the dam has large (cyclopean) boulders in the concrete matrix, and is reinforced with steel rails.
- Remove debris after blasting (concrete rubble and reinforcing steel) using a large tower crane on the right abutment.

The concrete dam crest could safely accommodate overtopping flows during dam removal without concern for frequency floods and freeboard. The DRE would notch the dam by creating 20 foot wide alternating openings that are a minimum of 16 feet deep. Drawdown of the upper 50 feet of the reservoir would be at a rate of 1 foot per day and the remaining drawdown would be at a rate of 3 feet per day.

Once the DRE removed the concrete dam structure down to the water level, it would isolate one side of the dam with a gravel cofferdam. The DRE would remove the isolated portion of the dam to 5 feet below the existing riverbed and then divert the river into the removed portion. The DRE would then isolate the other side of the dam and remove it. The DRE would use mechanical means (e.g., hydraulic shears and hoe-ramming) to excavate the reinforced concrete in deck, wall, and floor slabs for remaining features (including powerhouse and diversion intake structure).

The estimated waste quantity for Full Facilities Removal at Copco 1 Dam is 62,000 yd^3 of concrete and 1,200 tons of mechanical and electrical items at the dam and powerhouse.

The DRE would bury concrete rubble on the right abutment within an on-site disposal area. The DRE would separate reinforcing steel from the concrete and haul it to a local recycling facility in Weed, California. The DRE would then grade and slope the disposal areas for drainage.

The DRE would haul mechanical and electrical equipment to Yreka, California for transfer to a salvage company or disposal outside the project boundaries. Potential hazardous materials, which would need specialized abatement and disposal requirements, include asbestos, batteries, bearing and hydraulic control system oils, PCBs, and coatings containing heavy metals in the powerhouse and on the exterior surfaces of the steel penstock and air vent pipes.

The concrete dam and powerhouse are in a steep, narrow canyon. The existing access roads would require significant upgrades to handle the hauling of excavated concrete and provide access for a large crawler-mounted crane. Crane access may also be available from the left abutment, using existing unpaved roads. All work at the Copco 1 development could be performed within the existing FERC project boundaries.

Construction activities would require an estimated average workforce of 30 to 35 people for approximately 12 months. Attachment A includes equipment needed for the removal of Copco 1 Dam and Powerhouse and for restoration of the reservoir area.

5.1.4.3 Copco 2 Dam and Powerhouse

The DRE would take the following actions at Copco 2 Dam:

- Remove the spillway gates and traveling hoists using a large crane, with the reservoir drawn down as much as possible.
- Remove the reinforced concrete spillway bridge deck in pieces using hydraulic excavators, or in sections using diamond-wire sawcutting.
- Remove the remainder of the spillway structure using conventional drilling and blasting methods as each portion is dewatered.
- Excavate the reinforced concrete in deck, wall, and floor slabs for remaining features (including intake structure, gravity structure, sidewalls, apron, and powerhouse) using mechanical methods (e.g., hydraulic shears or hoe-ramming).

Copco 2 Dam is a concrete dam in a confined canyon with poor access. The existing access roads would require significant upgrades to handle the hauling of the excavated concrete and provide access for a large crawler-mounted crane. The access bridge across the Klamath River downstream of the powerhouse could require improvements to handle the construction equipment loads.

Estimated waste quantities for Full Facilities Removal at Copco 2 Dam and Powerhouse include more than 12,000 yd^3 of concrete, 1,500 yd^3 of earthfill, and more than 2,000 tons of mechanical and electrical items at the dam.

The DRE would bury concrete rubble on the right abutment within an on-site disposal area. The DRE would handle and dispose of reinforcing steel, concrete, and mechanical and electrical equipment in the same manner as for the Copco 1 Dam removal. The list of potential hazardous materials, which would have specialized abatement and disposal requirements, is the same for the Copco 2 development as it is for the Copco 1 Development.

Construction activities would require an estimated average workforce of 25 to 30 people for approximately 7 months. Attachment A includes equipment needed for the removal of Copco 2 Dam and Powerhouse.

5.1.4.4 Iron Gate Dam and Powerhouse

The DRE would take the following actions at Iron Gate Dam:

- Remove the embankment on the narrow crest section using conventional earthmoving equipment.
- Remove riprap with conventional earthmoving equipment.
- Excavate reinforced concrete in the deck, wall, and floor slabs for remaining structures (including intake structures, fish handling facilities, and powerhouse) using mechanical methods (e.g., hydraulic shears or hoe-ramming).
- Remove any mass concrete using conventional drilling and blasting methods.
- Install prefabricated steel pipe bridge for Yreka water supply line at upper end of reservoir area and realign pipe for long term stability after dam removal.

At Iron Gate Dam, the DRE would begin excavation of the embankment on the very narrow crest section, which would affect initial production rates because of the confined work area. As the excavation worked from the top of the dam crest in a downward direction, the width of the excavation footprint would become wider and additional equipment could be added to the excavation equipment fleet. The DRE would remove the riprap as the embankment is excavated down. Existing haul roads would require improvements to handle two-way traffic of large construction equipment between the dam and the disposal site. The access bridge across the Klamath River downstream of the dam could also require improvements to handle the construction equipment loads.

Estimated waste quantities for full removal of Iron Gate Dam and powerhouse include 12,000 yd^3 of concrete, 1.1 million yd^3 of earthfill, and 1,000 tons of mechanical and electrical items at the dam and powerhouse. Removal would also generate waste from four buildings with a combined area of 2,300 square feet.

An original borrow site approximately 0.75 miles upstream from the dam on the left abutment would serve as a disposal site for excavated embankment materials. Another disposal site would be the existing concrete-lined side-channel spillway, chute, and flip-bucket terminal structure, which could accept up to 300,000 yd^3 of excavated embankment material. As the excavation descended, the DRE would need to construct ramps out of the canyon. The DRE would stockpile some rockfill for later use as slope protection for the upstream cofferdam.

The DRE would bury concrete rubble within an on-site disposal area. The DRE would handle and dispose of reinforcing steel, concrete, and mechanical and electrical equipment in the same manner as for the Copco 1 and Copco 2 sites. The list of potentially hazardous materials, which would have specialized abatement and disposal requirements, is the same for the Iron Gate development as it is for the Copco 1 and Copco 2 sites.

The City of Yreka's water supply pipeline passes under the upstream end of the Iron Gate Reservoir and would become exposed to high-velocity river flows after dam removal. Anticipated scour depths are on the order of 10 feet around the pipe so it is not practical to bury the pipe deeper since the likelihood of encountering bedrock is high. Therefore, the DRE would construct a new, elevated pipeline and steel pipeline bridge to support the pipe above the river.

The prefabricated steel pipe bridge would be wide enough to accommodate the pipeline and walkway on the deck. The pipeline bridge would likely be composed of three spans: a center span of 200 feet and two end spans of 100 feet. The spans would be supported on concrete piers. The new pipeline would be connected to the existing buried pipeline at each end of the bridge. In order to avoid a disruption to the city's water supply, the permissible outage period would be limited by the available storage tank capacity.

Construction activities would require an estimated average workforce of 35 to 40 people for approximately 18 months. Meeting the daily production rates would require multiple shifts of workers. Attachment A includes equipment needed for the removal of Iron Gate Dam and Powerhouse and for restoration of the reservoir area. Table 5-1 provides a workforce summary for deconstruction at the four dam sites. In addition to the average construction workforce, there would be 5 to 10 on-site construction management staff (e.g., inspectors, field engineers) at each site for the duration of the project.

Table 5-1. Estimated Construction Workforce for Proposed Action

Facility	Estimated Average Construction Workforce	Duration	Estimated Peak Workforce	Peak Period
J.C. Boyle	25 to 30 people	10 months	40–45	Jul 2020–Sep 2020
Copco 1	30 to 35 people	12 months	50–55	Nov 2019–Apr 2020
Copco 2	25 to 30 people	7 months	35–40	May 2020–Aug 2020
Iron Gate	35 to 40 people	18 months	75–80	Jun 2020–Sep 2020

5.1.4.5 Work Area Isolation for Dam Removal

The DRE would need to control water and isolate the work area from flowing water and aquatic organisms throughout the duration of construction. Control mechanisms would be installed prior to starting work for each dam removal. The DRE could control water in most areas using gravity diversions; however, pumps would be required to dewater isolated ponding. Dewatering would require electric, gasoline, or diesel powered pumps, along with flexible hosing to convey water. Pumps would discharge water away from the river into upland areas to prevent discharge of fine sediments to waterways. Pumps would be screened to prevent entrainment of fish. Screens would be 1/8-inch mesh, placed at sufficient distance from the pump intake to prevent fish from impinging against (colliding into) the screens. Prior to pumping, the DRE would conduct a fish rescue, as described below, within the screened area isolating the pump.

The DRE would work in wet conditions in areas that cannot be dried. For in-water work, physical barriers would isolate the work area. Barriers would consist of bulk bags, which are fabric bags filled with sand or gravel that can be stacked as "bricks" to temporarily isolate work areas. Alternately, the DRE could use steel sheets or piles, concrete blocks, gravel berms, inflatable berms or plastic sheeting as physical barriers to isolate work areas. All barriers would be temporary, and would be removed after completing work.

A fish rescue would be conducted in all areas that cannot be drained in a manner that allows fish to volitionally depart the area. Prior to the beginning of construction, the DRE would contact USFWS, NOAA Fisheries Service, CDFG, and the Oregon Department of Fish and Wildlife to identify specific methods for the rescue and obtain permits. It is anticipated that fish rescue efforts would target only native species and that these species would be relocated to suitable habitat within the basin. After a work area has been isolated so organisms cannot enter, and prior to initiating construction work, the area would be drained to a workable depth (3 to 4 feet maximum depth). A fish rescue crew lead by a qualified biologist would then enter the area and collect all fish. The fish rescue would likely use seines and/or backpack mounted electrofishing equipment. Rescued fish would be handled carefully and kept in aerated coolers at an appropriate temperature until they are released. Once the fish rescue has been completed, construction activities would begin.

5.1.5 KBRA

The Full Facilities Removal of Four Dams Alternative includes implementation of the KBRA. The KBRA is composed of multiple elements including actions, plans and programs to restore and sustain natural fish production, establish reliable water and power supplies, support regional economies, and provide for the support and protection of Indian Trust Assets. The KBRA also includes provisions for local governments and tribes to address economic development needs; provide regulatory assurances that adverse impacts on communities would be minimized; and support tribal participation in fisheries programs. Programs under the KBRA are grouped under the Fisheries Program, the Water and Power Program, the County and Tribal Programs.

5.1.5.1 Fisheries Program

The Fisheries Program of the KBRA has three main goals:

A. Restore and maintain ecological functionality and connectivity to historic habitat.

B. Re-establish and maintain naturally sustainable and viable populations of fish to the full capacity of the restored habitats.

C. Provide for full participation in harvest opportunities.

The key elements of the KBRA related to fisheries include the following:

- An extensive habitat restoration program throughout the basin
- Fisheries reintroduction plans and programs
- Fisheries monitoring plans and programs
- Actions intended to increase flows and reliability of instream water in the main stem of the Klamath River and its tributaries (with the exception of the Trinity River basin)

Fisheries Restoration Plans

The Phase I Fisheries Restoration Plan is intended to establish restoration priorities and criteria for restoration project selection for the immediate future through 2020. The Phase I Plan is scheduled to be finalized by March 2012. Implementation of the plan may include actions for restoration of existing fisheries as well as actions in anticipation of reintroduction of anadromous fish upstream of Iron Gate Dam. Specific elements could include restoration and protection of riparian vegetation, water quality improvements, restoration of stream channel functions, measures to prevent excessive sediment inputs, remediation of fish passage blockages, and prevention of entrainment into diversions. Many of these activities are already on-going throughout the basin. However, the Phase I Fisheries Restoration Plan would prioritize activities and, with additional funding, would allow the realization of greater improvements.

Under Phase I implementation, the effectiveness of the restoration activities would be monitored under the Fisheries Monitoring Plan. Monitoring results would be used in the development of the Phase II Plan to adjust the recommended mix of restoration activities, priorities, and/or project locations to more effectively restore aquatic habitats. The Phase II Fisheries Restoration Plan would establish long-term restoration priorities and an adaptive management process to maintain fish restoration through 2060. The draft Phase II Plan is to be prepared 7 years after the Phase I Plan is finalized, and a final plan is to be completed by March 31, 2022.

Fisheries Reintroduction Plans

The States of California and Oregon would each prepare separate Fisheries Reintroduction plans if each state concurs with an affirmative Secretarial Determination. The Fisheries Reintroduction plans are intended to identify the facilities and actions that would be necessary to start reintroduction of anadromous fish upstream of Iron Gate Dam. Each state would monitor fish populations and might take actions, such as managing the fish harvest, to protect populations during implementation of their Phase I Fisheries Reintroduction Plan.

Reintroduction downstream of Upper Klamath Lake is to be a passive process and would be allowed to occur naturally with the restoration of a free-flowing condition following dam removal. Reintroduction activities outlined in the KBRA specifically exclude the Trinity River watershed upstream of its confluence with the Klamath River; Lost River and its tributaries; and Tule Lake basin. Reintroduction upstream of Upper Klamath Lake may be accomplished by more active means if necessary. Once self-sustaining populations are established, Phase II Fisheries Reintroduction plans would be developed that integrate anadromous fisheries into each state's harvest management plans.

Fisheries Monitoring Plan

The Fisheries Monitoring Plan is intended to direct a cohesive effort to monitor the status and population trends of Chinook and coho salmon, steelhead trout, resident rainbow trout, lamprey, suckers, bull trout, sturgeon, and eulachon. In addition to monitoring fish populations, the monitoring plan calls for collection of data on environmental water, effectiveness of restoration activities, and factors that may limit recovery and restoration of fish populations. The

Monitoring Plan is to be completed by March 2012. Implementation would start in the event of an affirmative determination by the Secretary. The results of the monitoring program are to be reviewed in 2020 and 2030 at a minimum.

Additional Water for Fish

There are many components of the KBRA that are intended to result in additional instream flows and to retain water in Upper Klamath Lake in order to support fisheries restoration. Most of these actions are intended to benefit both anadromous and sucker fish populations regardless of the effects of dam removal. Several programs to provide additional water for fish are identified in the KBRA:

- Diversion limitations to Reclamation's Klamath Project
- Interim program of water lease and purchase to reduce diversions upstream of Upper Klamath Lake
- Voluntary Water Use Retirement Program (WURP) in the Upper Basin to add up to 30,000 acre-feet of instream water per year to the Upper Klamath basin including Wood River, Sprague River, Sycan River (except Sycan Marsh), and Williamson River
- Increased water storage and conservation through specific projects:
  - Reconnect Barnes and Agency Lake Ranches to Agency Lake (project under study) – would add 63,700 acre-feet of potential storage capacity
  - Reconnect Wood River wetlands to Agency Lake (under study) – would add 16,000 acre-feet of potential storage capacity;
- Monitor groundwater use to ensure that river flows and springs are not adversely affected by diversions
- Assess the effects of climate change on basin water budget
- Acquisition of an additional 10,000 acre-feet of storage in the Upper Basin to allow increased diversions in some years, to mitigate effects of drought, and/or to further fish restoration goals.

Most of the programs that provide additional water for fish are described under the Water and Power Program section of the KBRA.

5.1.5.2 Water and Power Program

The Water and Power Program in the KBRA is intended to address water supply reliability and ensure affordable power for on- and off-Project agricultural users, and for moving water through Reclamation's Klamath Project.

The KBRA includes a number of planning efforts that, combined with the diversion limits and the WURP, are intended to meet these goals. Plans and programs to be developed and implemented under the Water and Power Program of the KBRA include these:

- Limitations on water diversions to Reclamation's Klamath Project users including the Klamath Basin National Wildlife Refuge System (KBRA Section 15)
- A WURP to allow for more instream water for fisheries (KBRA Section 16.2.2)
- Interim Flow and Lake Level Protection Plan (KBRA Section 20.4)
- On-Project Plan (KBRA Section 15.2)
- Winter Shortage Plan (KBRA Section 15.1.2.F)
- Off-Project Water Settlement (KBRA Section 16)
- Off-Project Reliance Program Plan (KBRA Section 19.5)
- Power for Water Management Plan (KBRA Section 17)
- Drought Plan (KBRA Section 19.2)
- Emergency Response Plan (KBRA Section 19.3)
- Climate Change Evaluation (KBRA Section 19.4)
- Environmental Water Program (KBRA Section 20)

The major plans to be developed include the On-Project Plan, the Off-Project Water Settlement, and the development of a Power for Water Management Plan. Plans including the Winter Shortage Plan, Drought Plan, Emergency Response Plan, Climate Change Evaluation, and Off-Project Reliance Program Plan are intended to help water users be better prepared for both reasonably foreseeable conditions and unexpected conditions. Winter shortage, drought, and climate change are reasonably foreseeable circumstances that could affect the amount of water available to users on Reclamation's Klamath Project. The Emergency Response Plan is intended to address necessary actions and coordination that may be required in the event of a failure of water diversion facilities or dikes.

To achieve environmental water goals during the interim period, the Interim Flow and Lake Level Protection Program would involve purchase or lease of water rights from willing sellers to increase the amount of water in the Klamath River and Upper Klamath Lake until permanent instream water supply enhancements could be put into effect.

The Off-Project Reliance Program is intended to provide a method for responding to unexpected circumstances affecting water availability downstream of Upper Klamath Lake that could affect the amount of water available for irrigation in the Off-Project Area. Due to the way water rights are prioritized, circumstances that affect water availability downstream of Upper Klamath Lake could affect on-Project users which in turn could affect off-Project users.

The purpose of the Power for Water Management Program is to provide affordable electricity to on- and off-Project power users who have enrolled in the program. This program is only broadly defined in the KBRA and includes an Interim Power Program, a Federal Power Program to supply low cost federal preference power, and a Renewable Power Program to increase efficiency and develop renewable energy sources.

The Environmental Water Program includes a set of projects to improve the real time management of water in the Upper Basin through such measures as the installation of water flow monitoring and snowpack gauges.

5.1.5.3 Diversion Limitations on Reclamation's Klamath Project

A cornerstone of the KBRA is the agreement to limit the amount of water that would be diverted for Reclamation's Klamath Project (KBRA Section 15 and Appendix E-1). These limitations would reduce the availability of irrigation water to approximately 100,000 acre-feet less than current demands in the driest years. Implementation of the diversion limitations would include assurances of increased reliability of diversions.

Under the proposed limitations, the amount of water that would be diverted to on-Project users, including the Klamath Basin National Wildlife Refuge System, varies by season and by water year forecast (whether a year is forecast to be wet or dry) (Table 5-2). The Natural Resources Conservation Service 50 percent exceedance forecast for net inflow to Upper Klamath Lake is used to set diversion limits. The 50 percent exceedance forecast is a prediction that there is a 50 percent chance that the actual stream flow will exceed the forecast value (and a 50 percent chance that flows will be less than the forecast value). Although Reclamation's Klamath Project diverts water from a variety of sources, the Upper Klamath Lake forecast would be used to set the diversion limits each spring and would generally characterize whether a particular year is expected to be wet or dry.

During the interim period (between the effective date and full implementation of the limits on water diversions to Reclamation's Klamath Project), the water diversion to Reclamation's Klamath Project users would conform to these limits as closely as possible. The On-Project Plan would identify what measures might be needed to fully implement the diversion limitations. Full implementation of the On-Project Plan is defined as completion of any measures necessary to allow full implementation of the diversion limitations.

The diversion limitations would not be binding on the parties to the KBRA until Appendix E-1 is filed in an appropriate forum. Appendix E-1 is currently formatted as a filing in the Oregon Water Resources Department (OWRD) water rights adjudication process; however, it is anticipated that that process will be completed before the Appendix is filed. In that case, the appendix would be reformatted for filing with the most appropriate forum and context, which likely would include a filing with OWRD as it concerns matters of water rights. Prior to filing, the appendix would be signed by the USFWS and irrigation districts within Reclamation's Klamath Project.

Table 5-2. Diversion Limitations on Reclamation's Klamath Project per KBRA Appendix E-1

Season	Forecast[2]	Diversion Limit
Phase I [1]		
March–October	287,000 AF or less	378,000 AF (which includes 48,000 AF for the refuges)
	287,000AF to 569,000 AF	378,000 AF to 420,640 AF (which includes from 48,000 AF to 55,640 AF for refuges) [3]
	More than 569,000 AF	445,000 AF (which includes 60,000 AF for refuges)
November–February	N/A	80,000 AF (which includes 35,000 AF for the refuges)
Phase II [1]		
March–October	287,000 AF or less	388,000 AF (which includes 48,000 AF for the refuges)
	287,000AF to 569,000 AF	388,000 AF to 430,640 AF (which includes from 48,000 AF to 55,640 AF for refuges) [4]
	More than 569,000 AF	445,000 AF (which includes 60,000 AF for refuges)
November–February	N/A	80,000 AF (which includes 35,000 AF for the refuges)

Key:

AF: acre-feet

Notes:

[1] Phase I of the diversion limitations represent the baseline agreement. Phase II allows additional diversions up to 10,000 AF under certain circumstances and would apply after i) the physical removal of the dams and a free-flowing condition and volitional fish passage has been restored; or ii) 10,000 AF of new storage has been developed in the upper basin; or iii) the Klamath Basin Coordinating Council on or after February 1, 2020 determines that the increase is appropriate based on the recommendations of the Technical Advisory Team.

[2] "Forecast" means the March 1 Natural Resources Conservation Service 50% exceedance forecast for net inflow to Upper Klamath Lake during the period of April 1 to September 30.

[3] The Phase I allowable diversion in thousands of acre-feet is calculated by the formula 378 + {42.64 x [(Forecast – 287) / 282]} and the refuge allocation is calculated by the formula 48 + {7.64 x [(Forecast – 287) / 282]}.

[4] The Phase II allowable diversion in thousands of acre-feet is calculated by the formula 388 + {42.64 x [(Forecast – 287) / 282]} and the refuge allocation is calculated by the formula 48 + {7.64 x [(Forecast – 287) / 282]}.

Appendix E-1 cannot be filed until the following actions are completed:

1. Notice and publication by the Secretary making assurances with respect to tribal water and fishing rights final and permanent. The Secretarial Notice would be published once the following conditions have been met:

    i. On-Project Plan is drafted and fully implemented

    ii. Wood River Restoration Project NEPA analysis and ESA consultation completed and funding secured

    iii. Agency Lake/ Barnes Ranches Project NEPA analysis and ESA consultation completed and funding secured

    iv. WURP funded

    v. Iron Gate, Copco 1, Copco 2, and J.C. Boyle Dams removed and a free flowing condition restored

2. Tribal water rights assurances are finalized which requires completion of conditions 1.iv and 1.v from above and the following conditions:

    i. Federal authorizing legislation enacted that authorizes federal agencies to become parties to the KBRA and to implement its provisions

    ii. Funding secured for plan development and implementation of Phase I and II Fish Restoration plans, Phase I Fish Reintroduction plans, Fish Monitoring Plan, and Interim Flow and Lake Level Program

    iii. Funding secured for tribal resource management programs and economic development programs

    iv. Funding secured for Klamath Tribes acquisition of Mazama Forest

    v. Petition for an interim fishing site granted to Klamath Tribes

3. Either a General Conservation Plan or a Habitat Conservation Plan has been completed by non-federal irrigators within Reclamation's Klamath Project, USFWS, and NOAA Fisheries Service, and a Section 10 Incidental Take Statement under the ESA issued

4. Final judgment by state courts that the KBRA is a valid agreement

On-Project Plan

The On-Project Plan is intended to align supply and demand for water users within Reclamation's Klamath Project and set the framework for implementation of the diversion limits (KBRA Section 15.2). The plan is to include techniques to monitor and prevent groundwater pumping from having an adverse effect on springs within the basin. An adverse effect is defined as a 6 percent reduction in flow.

The On-Project Plan would include details on management of the Refuge Allocation which would be the amount of water that the Lower Klamath NWR and Tule Lake NWR would receive from water diversions and appropriate responses in the event of summer or winter shortages. The KBRA specifies how and under what circumstances a deficit would be shared among the on-Project users and the NWRs in the event of a summer shortage of water available for diversion. A plan for management of winter shortages is to be developed. The On-Project Plan would reference the Winter Shortage Plan, the Drought Plan, the Emergency Response Plan, and other plans to be developed as appropriate.

Implementation of the On-Project Plan is expected to take up to 5 years and the deadline for full implementation is no later than 2022. To implement the On-Project Plan, managers might need to take a variety of actions including acquisition or negotiation of easements or forbearance agreements, land acquisitions, implementation of efficiency or conservation measures, development of groundwater sources, or creation of additional storage.

5.1.5.4 Off-Project Water Settlement

The Off-Project Water Settlement is intended to provide a forum for resolving long-standing water disputes between the Upper Klamath Water Users Association, Klamath Tribes, and the Bureau of Indian Affairs (KBRA Section 16) in the Off-Project Area. The Off-Project Area includes the Wood River, Sprague River, Sycan River, and Williamson River sub-basins. The intent is to negotiate a settlement that resolves the off-Project irrigators' contests to claims in Tribal Cases under the Klamath Basin water rights adjudication process. In the event that not all such contests are resolved through this process, then the intent is to provide reciprocal assurances for maintenance of instream flows and reliable irrigation water deliveries to the Off-Project Area. The anticipated schedule for development and implementation of the Off-Project Plan is between 2012 and 2021 (KBRA Appendix C-2).

5.1.5.5 Water Use Retirement Program

The voluntary WURP is intended to permanently increase the flow of water into Upper Klamath Lake by 30,000 acre-feet per year to support restoration of fish populations (KBRA Section 16.2.2). In exchange for this benefit to the Upper Klamath Lake fisheries, the Klamath Tribes would be willing to settle certain water rights claims with water users in the Upper Basin.

The WURP is intended to be part of the Off-Project Water Settlement, but may also be implemented independently by the Upper Basin Team. The WURP could take up to 10 years to be fully implemented and the KBRA intends for implementation to start with the completion of the Off-Project Water Settlement in 2012. The WURP may be implemented through a variety of measures including retirement of water rights, forbearance agreements, short-term water leasing, split season irrigation, upland management techniques, water efficiency measures, dry land cropping, and natural storage improvements such as wetlands or improved riparian areas. OWRD would determine when the required 30,000 acre-feet of water would be permanently assigned to Upper Klamath Lake.

5.1.5.6 County and Tribal Programs

County and Tribal programs under the KBRA include the following:

- Regulatory assurances that adverse impacts on communities would be minimized
- Economic development programs for local governments and Tribes
- Tribal fisheries and natural resource conservation management programs

Regulatory Assurances

The KBRA provides for reintroduction of salmon and other aquatic species in the Upper Basin, which could have potential regulatory or other legal consequences for land or water users upstream of the current site of Iron Gate Dam. While the KBRA does not modify existing laws or create exemptions, it identifies several actions that would help to avoid additional regulatory burdens in the event that listed fish species are reintroduced to the Upper Basin. These actions include a commitment from Reclamation to construct entrainment reduction facilities such as

fish screens to prevent fish from entering the diversion facilities on Reclamation's Klamath Project. The parties to the KBRA have also agreed to coordinate with each other and communicate openly on a wide variety of issues in an effort to avoid surprises so that solutions can be sought without acrimony.

The development of either a General Conservation Plan or a Habitat Conservation Plan is identified as a means to secure an incidental take permit under Section 10(a)(1)(B) of the ESA and as one means to avoid or minimize regulatory or other obligations arising from the reintroduction of fish species to the Upper Basin. In that light, NOAA Fisheries Service and USFWS will lead the development of a General Conservation Plan or Plans for use by KBRA parties or others to apply for incidental take permits under the Endangered Species Act.

County Programs

The County Programs under the KBRA were structured with the recognition that there may be impacts and opportunities for each of the counties within the Klamath Basin. Klamath County has agreed to develop a plan for economic development if funding is available (KBRA Section 27). Funding would potentially come from KBRA funding and from state business development funds. The California Water Bond funding legislation, scheduled for a vote in 2012, proposes funding for economic development within Siskiyou County. Humboldt and Del Norte Counties are not included in this economic development fund. Funds remaining in the Water Bond fund after covering dam facility removal, CEQA mitigation, and actions to secure the City of Yreka's water supply, may be used for fish restoration projects within Siskiyou, Humboldt, and Del Norte Counties.

Similarly there may be property tax revenue losses and gains from the various effects of the KBRA. Property tax revenue changes could occur due to reduced agricultural land values from a) a reduction in water deliveries and b) the surrender of significant water rights. The Klamath County Program within the KBRA includes a provision to compensate Klamath County for these potential revenue changes upon the availability of funding. The anticipated schedule for identification of potential property tax impacts and compensation payments is 2016 (KBRA Appendix C-2). County programs for Siskiyou, Humboldt, and Del Norte Counties do not include a provision for compensation for changes in property tax revenues that may result from the removal of the hydroelectric facilities.

Tribal Programs

The KBRA includes provisions for each of the affected tribes (the Klamath Tribes, Karuk Tribe, and Yurok Tribe) to receive assistance in developing their capacity to participate in both fisheries management and conservation management activities within the basin (KBRA Sections 31 and 32). In addition, each tribe would prepare an economic development plan and work towards implementing that program (KBRA Sections 31 and 33). Preparation of economic development plans is anticipated to occur in 2013.

The Klamath Tribes have been working with the Trust for Public Lands and have acquired an option to purchase the Mazama Forest in the upper basin, once a part of the Tribes' reservation

lands. The parties to the KBRA agree to support the Tribes' efforts to secure funding and complete the purchase of this forest land (KBRA Section 33.2). Final acquisition of Mazama Forest is anticipated to occur in 2012 or 2013. Completion of the purchase of Mazama Forest is one of the key milestones towards the filing of KBRA Appendix E-1 and the full implementation of the diversion limits to Reclamation's Klamath Project.

Under Section 34 of the KBRA, the Klamath Tribes have petitioned the California Fish and Game Commission to establish an interim fishing site in the reach of the Klamath River between Iron Gate Dam and the Interstate 5 Bridge. Petitions are reviewed on an annual basis. The CDFG staff must first make a recommendation on a pending petition to the Commission before the Commission may act. Recommendations must be received by the Commission in January for a decision in that year. It is possible that the Pacific Fishery Management Council may be involved in reviewing and approving this interim fishing site as well, in which case the approval process could take longer than a year. The grant of this petition is one of the key milestones toward implementation of the KBRA.

5.1.6 Option: Mechanical Sediment Removal

Mechanical sediment removal may be an option to reduce adverse water quality effects related to sediment erosion generated during drawdown of J.C. Boyle, Copco 1, and Iron Gate Reservoirs. This option includes dredging sediment before and during reservoir drawdown to reduce the quantity of sediment released downstream. This option is under analysis to determine if it could be a feasible and effective way to reduce effects.

Based on engineering analysis of reservoir sediments, reservoir depth, and downstream aquatic species sensitivities, hydraulic dredging with designated disposal sites in close proximity (within 2 miles) to the reservoirs would be the best option for managing reservoir sediments. Hydraulic dredging would occur simultaneously at the three reservoirs, in two stages. The first stage would be before reservoir drawdown. The hydraulic dredges would remove sediment in the reservoirs up to the optimal depth of the dredge (estimated at 25 feet). During the second stage, dredging in each reservoir would progress with reservoir drawdown removing the greatest quantity of sediment possible in the time available. Dredging would leave at least one foot of sediment at the bottom of each reservoir to protect any buried cultural or archeological sites.

The DRE would use flexible piping to hydraulically pump the dredged slurry to a potential disposal site. Disposal sites would either retain the total quantity of sediment and water (ratio of 15 percent sediment to 85 percent water) or a percentage of the water could be decanted and returned to the river or applied to land. Decanting the sediment slurry would ultimately reduce the land requirement for sediment disposal. There are potential locations for disposal facilities around the reservoirs on land belonging to the federal government, PacifiCorp, or a state agency. Most of the potential disposal facilities sites have land slopes exceeding 10 percent. Disposal site containment embankments would be engineered structures estimated at a height of 20 feet, similar to levees, and would likely require dam safety inspection and permitting.

5.1.6.1 J.C. Boyle Reservoir

J.C. Boyle Reservoir has an estimated 940,000 yd^3 of erodible sediment. The sediment thickness is relatively thin in the upper portions of the reservoirs and increasingly thickens to 20 feet near J.C. Boyle Dam. Water depths range from two feet up to 40 feet. The largest hydraulic dredge that the DRE could use effectively for sediment removal has a maximum effective dredge depth of 25 feet. This dredge could access a fairly large amount of the reservoir sediments prior to drawdown.

To remove the sediment, the DRE would use one dredge with a 16-inch-diameter cutterhead and discharge pipeline. This dredge would operate for two shifts (16 hours per day), 6 days a week, at a maximum production capacity of 700 yd^3 per hour. The production efficiency, based on dredge length, depth, dredge swing angle, thickness of the sediment, and depth of the cut, would be about 75 percent (Johnson Undated). This results in an approximate production rate of 7,200 yd^3 per calendar day.

The DRE would put the dredge in the water on the west shore of the reservoir on Highway 66, near the Topsy Recreation Site at the Route 66 Bridge (see Figure 5-6). The DRE would most likely access this site using the Highway 66 Bridge crossing the reservoir. Currently the bridge is a one-lane bridge with an unknown weight capacity, although the maximum limit on Highway 66 is 40 tons of gross weight. The access site would provide an area for equipment staging.

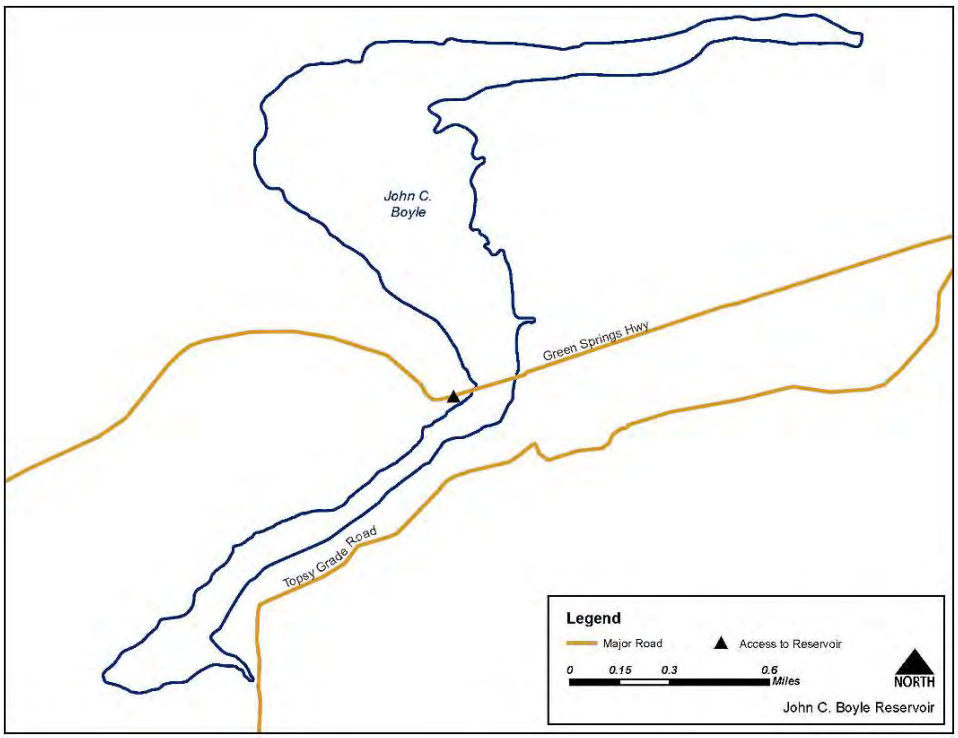

Figure 5-6. J.C. Boyle Reservoir Access

Hydraulic dredging operations would start before reservoir drawdown. During this time, the DRE would remove the accessible sediment in water less than 25 feet in depth. The DRE could remove approximately 335,600 yd^3 of sediment before drawdown in approximately 47 days, based on the 7,200 yd^3 per calendar day production rate.

Dredging operations would continue simultaneously with reservoir drawdown, removing the sediment as reservoir areas became available in water shallower than 25 feet. Assuming a starting reservoir elevation of 3,793.0 feet and ending at elevation 3,762.0 feet, complete drawdown would take about 31 days in a normal water year. Drawdown would take less time in a dry water year and more time in a wet year.

The DRE could remove approximately 219,800 yd^3 of additional reservoir sediment during the drawdown period (about 31 days). Table 5-3 summarizes the maximum amount of sediment that could be removed before and during reservoir drawdown. This approach would strand the dredge in the reservoir near the J.C. Boyle Dam. The DRE would remove the dredge at Topsy Grade Road with cranes and other means during dam removal.

Table 5-3. J.C. Boyle Reservoir Maximum Sediment Removal

Assumptions	
Drawdown rate	Average of 1 foot/day
Total amount of eroded sediment	940,000 yd^3
Reservoir elevation prior to drawdown	3,793.0 feet
Calculated Quantities	
Pre-drawdown duration	47 days
Number of dredges for pre-drawdown dredging	1
Pre-drawdown sediment removal	335,600 yd^3
Drawdown duration	31 days
Number of dredges during drawdown	1
Sediment removal during drawdown	219,800 yd^3
Total sediment removal	**555,400** yd^3
Percentage of erodible sediment removed	**59.1**

Key:
yd^3: cubic yards

The DRE could remove an estimated 555,400 yd^3, or 59.1 percent of erodible sediment, using hydraulic dredging. The slurry would contain about 15 percent solids (by weight). The total volume of slurry requiring management and disposal would be approximately 3,702,667 yd^3.

The DRE would construct a diked containment area to hold the sediment slurry, allowing the sediment to settle out and the water to either decant or evaporate. Assuming that the DRE would decant the slurry prior to sending it to the containment area, the containment area would need a parcel of land of approximately 57 acres, using 20 foot high containment dikes. Land directly around J.C. Boyle might accommodate this size of sediment management and disposal site. As shown in Figure 5-7, several areas of relatively flat land (slopes less than 10 percent) surround the reservoir that are privately-owned or owned by PacifiCorp. The Sportsman's Park recreation area, owned by PacifiCorp, would be a good location but cannot be used because the land will stay a recreational park. The DRE would likely construct several sediment disposal areas to create enough volume to hold the decanted slurry. After dredging was complete, the water would slowly drain or evaporate out of the containment area. The DRE would revegetate the sediment-covered land to stabilize the sediment after water removal.

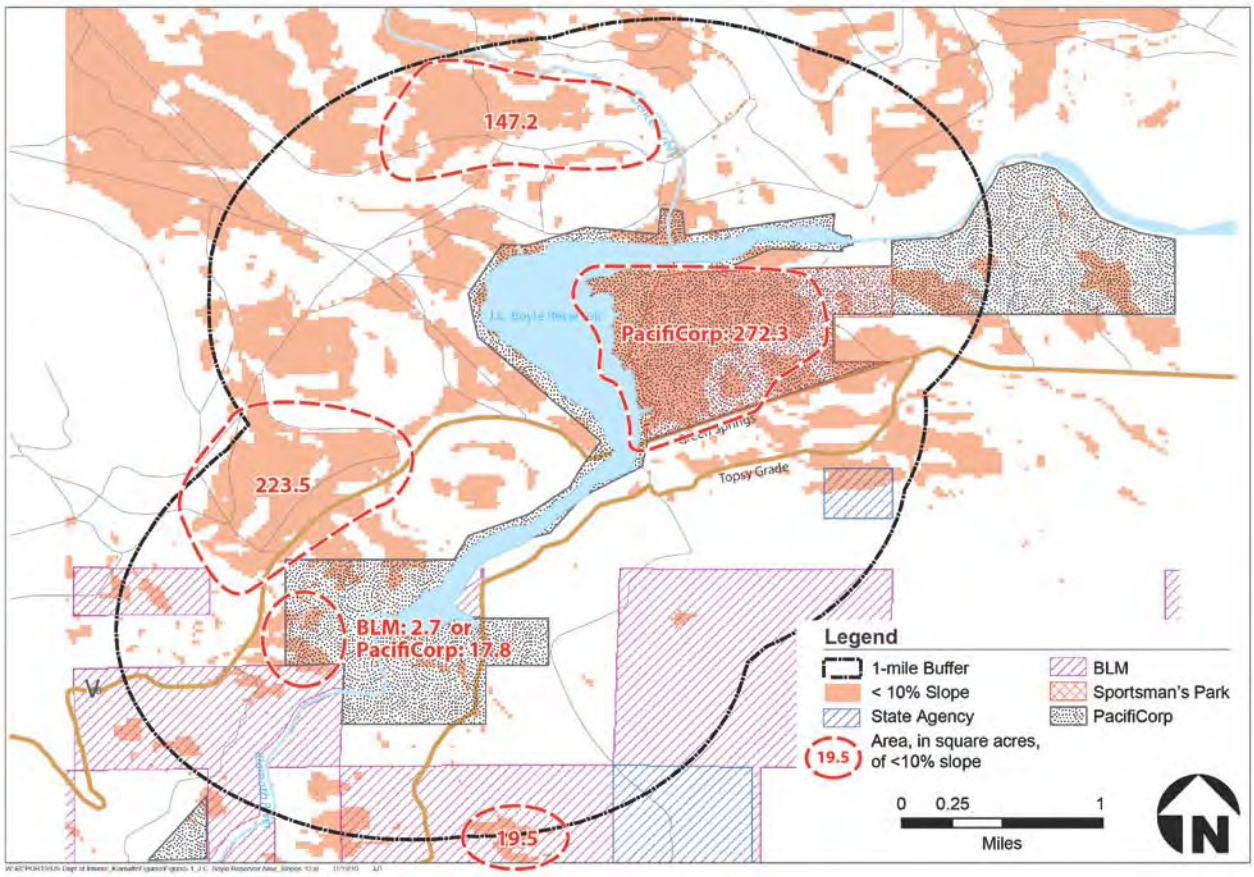

Figure 5-7. J.C. Boyle Reservoir Area (Slopes <10%)

5.1.6.2 Copco 1 Reservoir

Copco 1 Reservoir has an estimated 2,700,000 yd^3 of erodible sediment. The sediment thickness is relatively uniform throughout the reservoir, ranging from 0.2 to 10.4 feet. Water depths in

Copco 1 Reservoir range from 5 feet to 110 feet. The largest hydraulic dredge that the DRE could use effectively has a maximum effective depth of 25 feet. The dredge could access only a relatively small area of the reservoir sediments before drawdown.

The DRE would use up to three dredges on the reservoir, each with a 16-inch-diameter cutterhead and pipeline and an approximate production rate of 7,200 yd^3 per calendar day. The DRE would put the dredges in the water on the north shore of the reservoir on Copco Road (Figure 5-8). The site would provide an area for equipment staging.

Hydraulic dredging operations would start before reservoir drawdown. During this time, the DRE would use two dredges to remove accessible sediment in water less than 25 feet in depth. The start of hydraulic dredging operations would occur prior to the start of reservoir drawdown using two dredges. The DRE could remove approximately 176,700 yd^3 of sediment before drawdown in approximately 12 days, based upon the 7,200 yd^3 per day production rate for two dredges.

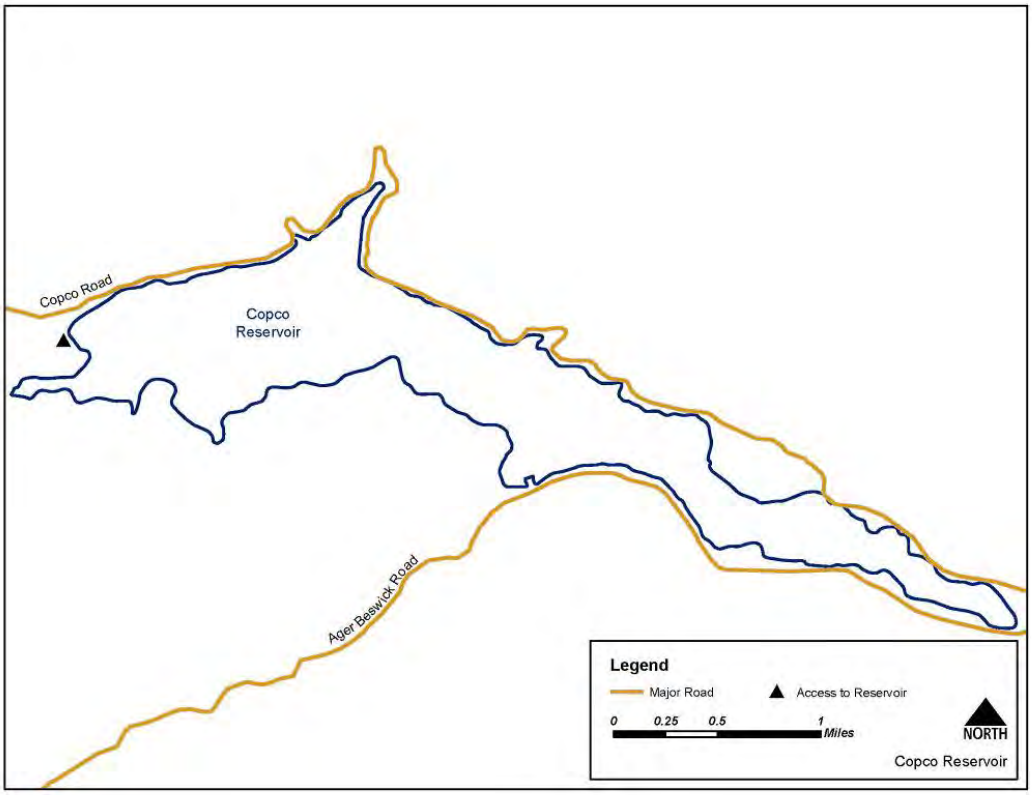

Figure 5-8. Copco 1 Reservoir Access

Dredging operations would continue simultaneously with reservoir drawdown, removing the sediment as areas became available in water shallower than 25 feet. The DRE would use two dredges for the entire duration of drawdown, and a third for a portion of the drawdown period.

The drawdown scenario assumes a starting reservoir elevation of 2,606.0 feet and ending at 2,484.0 feet, with drawdown taking approximately 108 days under a normal water year. This approach would strand the dredges in the reservoir near the Copco 1 Dam. The DRE would remove the dredge along Copco Road with cranes and other means during dam removal.

The DRE could remove approximately 1,277,100 yd^3 of additional reservoir sediment during the drawdown period. Table 5-4 summarizes the maximum amount of sediment that could be removed before and during drawdown from Copco 1 Reservoir.

Table 5-4. Copco 1 Reservoir Maximum Sediment Removal

Assumptions	
Drawdown rate	Average of 1 foot/day to elevation 2,590.0 feet, then an average of 1.75 feet/day to elevation 2,529.0, then an average of 2.25 feet/day to elevation 2,484.0
Total amount of eroded sediment	2,700,000 yd^3
Reservoir elevation prior to drawdown	2,606.0 feet
Calculated Quantities	
Pre-drawdown dredging duration	12 days
Number of dredges for pre-drawdown dredging	2
Pre-drawdown sediment removal	176,700 yd^3
Drawdown duration	108 days
Number of dredges during drawdown	2 to 3
Sediment removal during drawdown	1,277,100 yd^3
Total sediment removal	**1,453,800 yd^3**
Percentage of eroded sediment removed	**53.8**

Key:
yd^3: cubic yards

The DRE could remove approximately 1,453,800 yd^3 of sediment as slurry with the hydraulic dredge. The slurry would contain approximately 15 percent solids (by weight). The total volume of slurry requiring management and disposal would be approximately 9,692,000 yd^3. Assuming that the DRE would decant the slurry prior to sending it to the containment area, the containment area would need a parcel of land of approximately 150 acres, using 20 foot high containment dikes.

As shown in Figure 5-9, the lands around Copco 1 Reservoir have relatively steep slopes, and few areas have less than a 20 percent slope. The largest area with less than a 20 percent slope is approximately 519.4 acres of PacifiCorp-owned land, approximately a mile and a half northeast from the reservoir. This parcel of land would hold the decanted slurry. After dredging is complete, the water would slowly drain out of the containment area. The DRE would revegetate the sediment-covered land to stabilize the sediment after water removal.

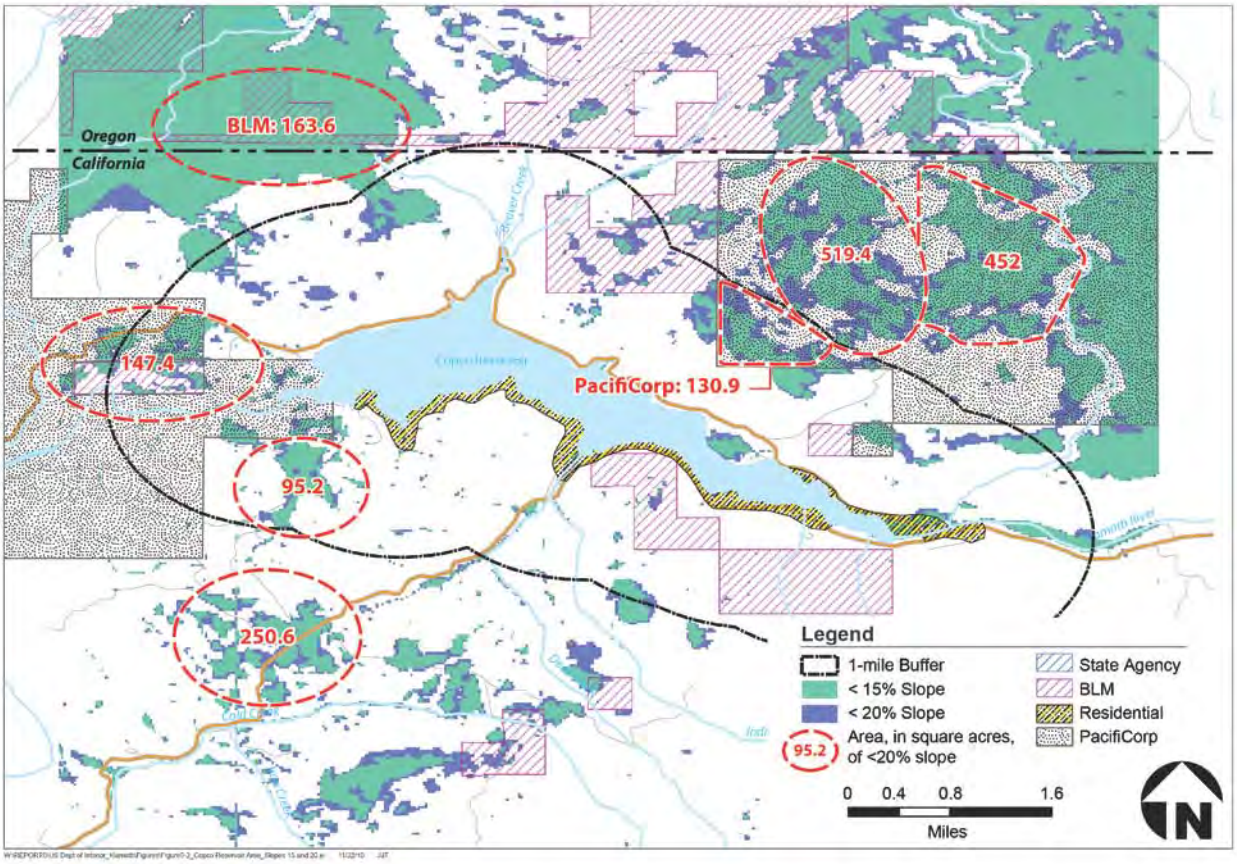

Figure 5-9. Copco 1 Reservoir Area (Slopes <15% and <20%)

5.1.6.3 Iron Gate Reservoir

Iron Gate Reservoir has an estimated 2,830,000 yd^3 of erodible sediment. The sediment thickness is relatively uniform throughout the reservoir, ranging from 1 to 6 feet in water depths up to 160 feet. The largest hydraulic dredge that the DRE could use effectively for sediment removal has a maximum effective depth of 25 feet. As with Copco 1 Reservoir, the dredge has an ability to access only a relatively small area of the reservoir sediment without drawdown.

To remove the sediment, the DRE would use up to three dredges with 16-inch-diameter pipelines and an approximate production rate of 7,200 yd^3 per calendar day per dredge. The DRE would put the dredge in the water on the south shore of the reservoir by an access road off of Lake View Road (Figure 5-10). The site would provide an area for equipment staging.

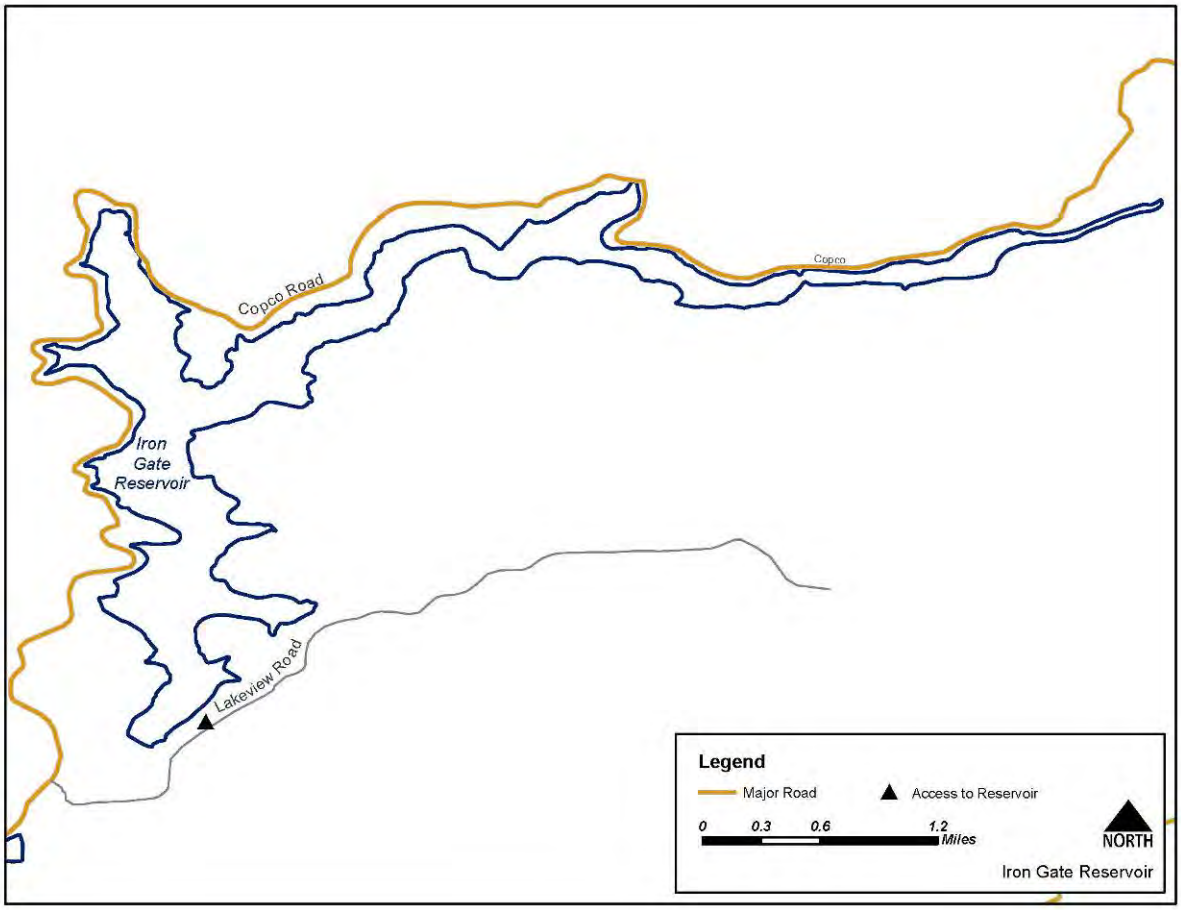

Figure 5-10. Iron Gate Reservoir Access

Hydraulic dredging operations would start before reservoir drawdown. During this time, the DRE would use two dredges to remove the accessible sediment in water depths less than 25 feet. The DRE could remove approximately 106,000 yd^3 before drawdown in approximately 7 days, based on the 7,200 cubic yards per day production rate for each dredge.

Dredging operations would continue simultaneously with reservoir drawdown, removing the sediment as areas became available. The DRE would use three dredges during drawdown to remove sediment. Assuming a starting elevation of 2,328.0 feet and an ending elevation of 2,202.0 feet, complete drawdown would take about 42 days in a normal water year. The DRE could remove approximately 733,100 yd^3 of additional reservoir sediment during the drawdown period. This approach would strand the dredges in the reservoir near the Iron Gate dam. The DRE would remove the dredge with cranes and other means at the dam site during dam removal. Table 5-5 summarizes the maximum amount of sediment that could be removed before and during drawdown.

Table 5-5. Iron Gate Reservoir Maximum Sediment Removal

Assumptions	
Drawdown rate	Average of 3 feet/day
Total amount of eroded sediment	2,830,000 yd^3
Reservoir elevation prior to drawdown	2,328.0 feet
Calculated Quantities	
Pre-drawdown duration	7 days
Pre-drawdown sediment removal	106,000 yd^3
Number of dredges for pre-drawdown dredging	2
Drawdown duration	42 days
Number of dredges during drawdown	3
Sediment removal during drawdown	733,100 yd^3
Total sediment removal	**839,100 yd^3**
Percentage of eroded sediment removed	**29.7**

Key:
yd^3: cubic yards

The DRE could remove an estimated 839,100 yd^3, or approximately 29.7 percent of erodible sediment, using hydraulic dredging. The slurry would contain approximately 15 percent solids (by weight). The volume of the sediment slurry requiring management and disposal would be approximately 5,594,000 yd^3.

As shown in Figure 5-11, the lands around Iron Gate Reservoir have relatively steep slopes, with few areas that have less than a 20 percent slope. The federal government and PacifiCorp own several small parcels of land around the reservoir. Assuming that the DRE would decant water prior to sending the slurry to the containment area, the containment area would need, a parcel of land that is approximately 87 acres. Figure 5-11 shows a 147.4-acre parcel that could hold the decanted slurry. After dredging was complete, the water would slowly drain out of the containment area. The DRE would revegetate the sediment-covered land to stabilize the sediment after water removal.

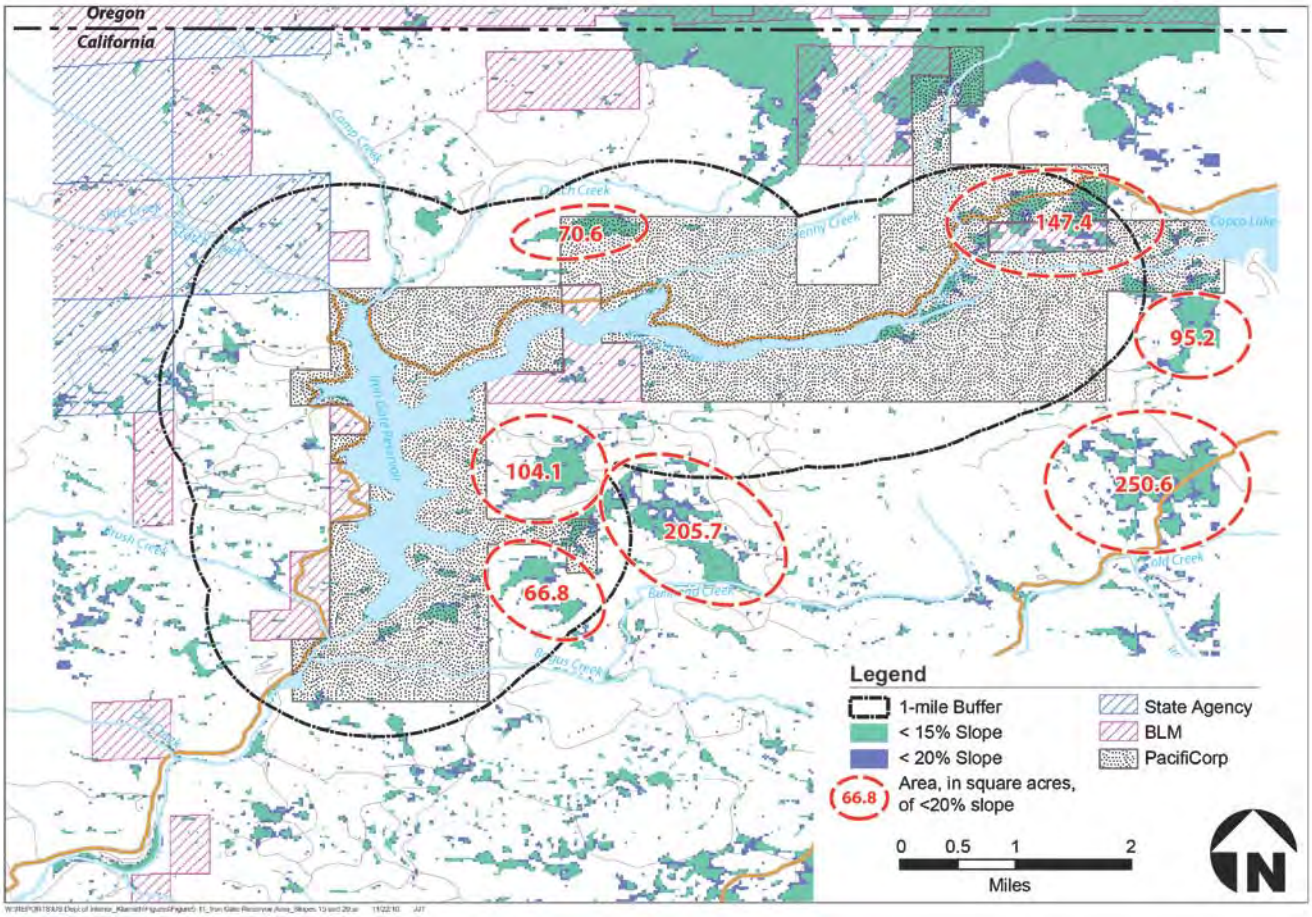

Figure 5-11. Iron Gate Reservoir Area (Slopes <15% and <20%)

5.2 Alternative 3 – Partial Facilities Removal of Four Dams

5.2.1 Features of the Partial Facilities Removal of Four Dams Alternative

Two of the primary goals of dam removal on the Klamath River are to restore volitional fish passage and a free-flowing river conditions at each dam site in order to advance restoration of anadromous fish populations. This goal would be achieved through full dam removal, but could also be achieved through partial dam removal where practical. The schedule for Partial Facilities Removal of Four Dams would be the same as for Full Facilities Removal.

Partial Facilities Removal of Four Dams would remove enough of each dam to allow free-flowing river conditions and volitional fish passage at all times. Under the partial removal alternative, portions of each dam would remain in place along with ancillary buildings and structures such as powerhouses, foundations, tunnels, and pipes. Some of these remaining features would likely require perpetual maintenance and security measures to prevent unauthorized entry. All tunnel openings would be sealed with reinforced concrete to eliminate

trespass concerns. All oils, hydraulic fluids, and other potential contaminants found in powerhouses and machinery would be removed prior to final decommissioning and securing of buildings. Table 5-6 provides a summary of facilities that would be removed or retained under the Partial Facilities Removal of Four Dams Alternative. All facilities that would be retained in the Partial Facilities Removal of Four Dams Alternative would be removed in the Full Facilities Removal of Four Dams Alternative. The Partial Facilities Removal of Four Dams Alternative also includes implementation of the KBRA (see Section 5.1.5).

Table 5-6. Summary of Features to be Removed or Retained with the Partial Facilities Removal of Four Dams Alternative

Feature	J.C. Boyle	Copco 1	Copco 2	Iron Gate
Embankment/earth fill dam	Remove	N/A	Retain	Remove
Concrete dam structure	Remove	Remove	Remove	N/A
Concrete wingwalls	N/A	N/A	Retain Right Wall	N/A
Reservoir power intake structure	Retain	Retain	Retain	Remove
Spillway	Remove	Remove	Remove	Retain
Spillway control gates	Remove	Remove	Remove	N/A
Concrete fish ladder	Remove	N/A	N/A	Remove
Concrete flume headgate structure	Retain	N/A	N/A	N/A
Concrete canal intake screen	Retain	N/A	N/A	N/A
Concrete flume	Remove Walls	N/A	N/A	N/A
Concrete canal spillway	Remove	N/A	N/A	N/A
Tunnel intake structure	Remove	Retain	Retain	Remove
Tunnel portals	Plug	Plug	Plug	Plug
Steel pipeline & supports	Retain	N/A	N/A	N/A
Steel surge tank	Remove	N/A	N/A	N/A
Wood-stave penstock	N/A	N/A	Remove	N/A
Penstocks, supports, anchors	Remove	Retain	Retain	Remove
Powerhouse building	N/A	Retain	Retain	Retain
Powerhouse gantry crane	Remove	N/A	N/A	N/A
Powerhouse concrete slab/structure	Retain	Retain	Retain	Retain
Powerhouse hazardous materials	Remove	Remove	Remove	Remove
Tailrace flume walls	Retain	N/A	N/A	N/A
Tailrace channel	Fill	Fill	Fill	Fill
Switchyard	Remove	Remove	Retain	Remove
Warehouse & support buildings	Remove	N/A	Retain	N/A
Fish Hatchery	N/A	N/A	N/A	Retain

The following sections describe the work limits and features for partial removal of each dam under this alternative. Section 5.2.4 describes the construction details for this alternative.

5.2.1.1 J.C. Boyle

See Section 5.1.1 for a description of J.C. Boyle Dam. Partial Facilities Removal would require the complete removal of the embankment section, gated concrete spillway section, and concrete cutoff wall to the bedrock foundation. The DRE would undertake the following actions:

- Remove the lower portion of the fish ladder to prevent potential fish stranding during peak flow events.
- Remove the spillway gates, deck, and piers to facilitate reservoir drawdown and to ensure sufficient discharge capacity during dam removal to prevent an overtopping failure of the embankment.
- Remove the abutment wall and upper portion of the fish ladder, because they could become unstable after the removal of the embankment and spillway sections.
- Recoat the 14-foot-diameter steel pipeline and supports to encapsulate potential heavy metals.
- Remove concrete walls for the water conveyance canal to allow drainage and animal migration, and prevent collapse due to rockfall.
- Remove the 78-foot-tall steel surge tank and the 150-ton gantry crane to prevent a potential future stability problem during a large seismic event.
- Remove the penstocks to avoid long-term maintenance issues related to the steel, which likely has coatings containing heavy metals.
- Plug the downstream tunnel portal with concrete to avoid unauthorized entry.
- Remove the switchyard and warehouse building.
- Fence and seal the powerhouse

Under the Partial Facilities Removal of Four Dams Alternative, the DRE would not remove the water intake structure, left abutment concrete gravity section, concrete headgate structure, intake screen, steel pipeline and supports, tailrace walls, and powerhouse concrete slab and structure, as shown in Figure 5-12. The DRE would not fill and stabilize the headcut downstream of the forebay overflow discharge canal (as in the Proposed Action) because it would require a large quantity of material that would not be available; partial removal would not produce as much concrete rubble as full removal would.

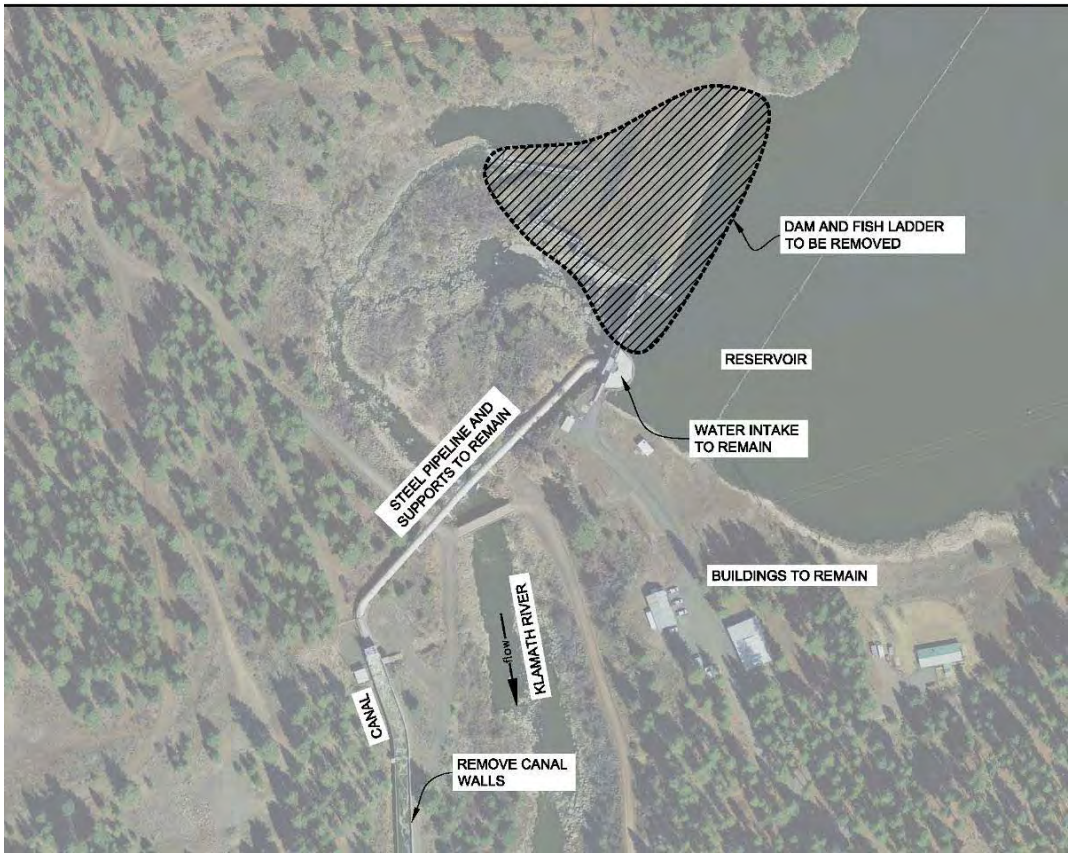

Figure 5-12. View of J.C. Boyle Dam Showing Portion of Dam and Fish Ladder for the Partial Facilities Removal of Four Dams Alternative

The DRE would leave the mechanical and electrical equipment in place with all power connections to the outside removed; however, the DRE would remove any oil in the turbine governor and hydraulic control systems, transformers, oil storage tanks, or other equipment. The DRE would also remove other mechanical and electrical equipment containing potentially hazardous materials.

5.2.1.2 Copco 1 Dam and Powerhouse

To create a free-flowing condition and volitional fish passage through the Copco 1 site, the DRE would take the following actions:

- Remove the concrete gravity arch dam and associated facilities (spillway gates, bridge deck, and piers) between the left abutment rock and the concrete intake structure on the right abutment, to 5 feet below the existing streambed level at the dam.
- Remove the two concrete gate houses on the right abutment intake structure if necessary to provide workspace for a large crane.

- Seal the downstream end of the intake tunnel portal with concrete to avoid unauthorized entry.
- Remove unused transmission lines, poles, and the switchyard.
- Seal and fence the powerhouse.

Under the Partial Facilities Removal of Four Dams Alternative, the DRE would not remove the power generation water intake structure, penstocks, and powerhouse. Retention of these structures would require long-term maintenance, including the preservation of any items with coatings containing heavy metals.

The DRE would handle mechanical and electrical equipment and equipment containing potentially hazardous materials in the same manner as for the J.C. Boyle Dam removal under this alternative.

5.2.1.3 Copco 2 Dam and Powerhouse

To create a free-flowing condition and volitional fish passage through the Copco 2 site, the DRE would take the following actions:

- Remove the concrete gated spillway structure and concrete end sill between the existing sidewalls (see Figure 5-13) as well as associated facilities (spillway gates, bridge deck, and piers).
- Remove wood-stave penstock.
- Remove equipment on the right abutment embankment section to facilitate construction access to the gated spillway.
- Seal and fence powerhouse.

Under the Partial Facilities Removal of Four Dams Alternative, the embankment section on river right, intake structure on river left, conveyance system to the powerhouse, and powerhouse would remain in place. Figure 5-14 shows an example of a partial dam removal project that retained portions of the dam while maintaining free-flow conditions and volitional fish passage.

A small portion of the downstream basin apron slab would remain intact for structural stability of the right sidewall, provided that a potential fish barrier would not result in the future.

The DRE would handle mechanical and electrical equipment and equipment containing potentially hazardous materials in the same manner as for the J.C. Boyle and Copco 1 Dam removals under this alternative.

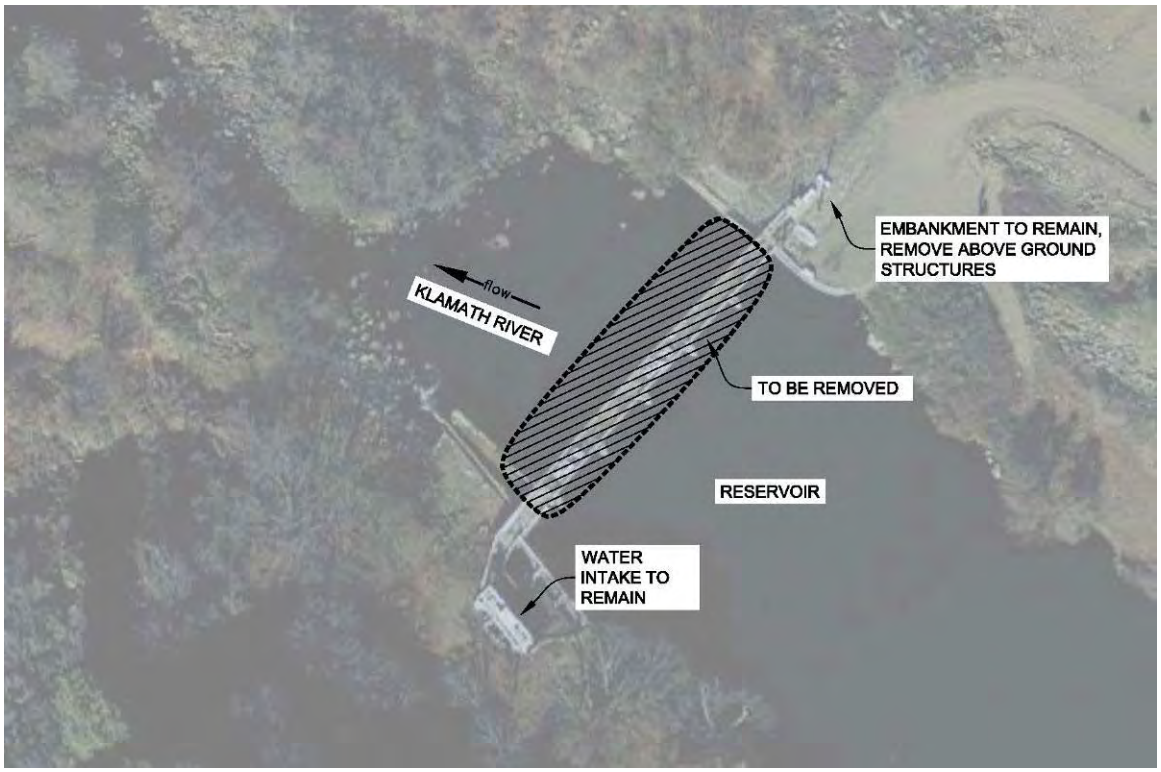

Figure 5-13. Copco 2 dam Showing Portion of Dam that would be removed for the Partial Facilities Removal Alternative

Figure 5-14. Example of Partial Dam removal showing Savage Rapids Dam on the Rogue River (2010)

5.2.1.4 Iron Gate Dam and Powerhouse

Prior to construction of Iron Gate Dam, the Klamath River had an average channel width of at least 70 feet during baseflow conditions in the area of the existing dam based on historical topographic surveys and cross-sections. During yearly high flow events, the channel expanded out onto a floodplain that consists primarily of bedrock material out to the toe of steep, bedrock walls. The bedrock canyon width is 200 to 250 feet at the base of the dam. Based on the historical channel width, the minimum width of the channel at the base of the dam should be approximately 100 feet or more to ensure the area is not a fish passage barrier at high flows. One check for this width is the bridge that is just downstream of the existing dam and has a span of 175 feet, based on structural drawings.

With a minimum notch of 100 feet at the base of the dam, the slopes of the remaining embankment material would need a maximum slope of 1.5H:1V for stability, and more likely, a slope of 2H:1V or flatter. In addition, the inner core of the earthfill dam would need a filter layer similar to the upstream and downstream sides of the dam for stability. A stable riprap blanket would cover the filter material to protect the remaining portion of the dam.

Figure 5-15 shows Iron Gate Dam with a 100-foot-wide notch at the base of the dam with 1.5H:1V side slopes or 2H:1V side slopes to the top of the dam. This figure illustrates that notching the dam would remove nearly the entire dam and would create the need to protect the newly exposed inner core of the dam for stability. The amount of effort required to notch the dam is comparable to simply removing the entire earthfill embankment. Likewise, the stabilization costs of the remaining structure would be comparable to the costs to remove the minor amount of remaining material. Therefore, under this alternative, the DRE would remove the entire embankment dam, concrete water intakes, water supply pipes, and fish facilities at the base of the dam, with methods and equipment requirements as described for the Proposed Action.

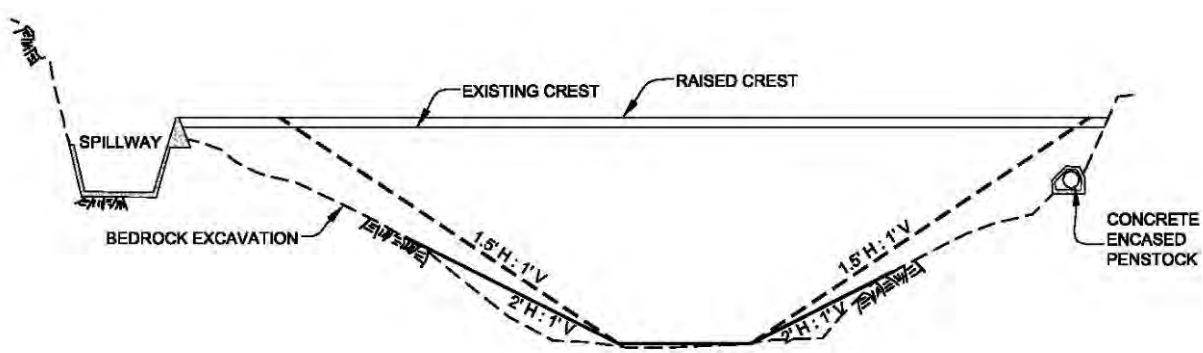

Figure 5-15. Section View of Iron Gate Dam showing 100-foot-wide Bottom Notch with Different Potential Side Slopes

Development features that would remain include the existing concrete spillway and powerhouse. The DRE would fill the spillway and chute with material removed from the dam embankment. The DRE would seal all tunnels at the upstream and downstream openings using reinforced concrete plugs to prevent unauthorized entry.

The Iron Gate fish hatchery facility downstream of the dam would remain in place. PacifiCorp would need to secure an alternate water source to replace the existing water supply pipe from Iron Gate Dam.

Retention of the Iron Gate powerhouse would require the structure to be sealed and fenced. The DRE would handle mechanical and electrical equipment and equipment containing potentially hazardous materials in the same manner as for the other dam removals under this alternative.

5.2.2 Schedule for the Partial Facilities Removal of Four Dams Alternative

The Partial Facilities Removal of Four Dams Alternative would follow a schedule similar to that of the Proposed Action. Figure 5-16 provides a schedule that is consistent with the schedule in Section 5.1.2 for Full Facilities Removal. The staging and methods would remain the same; however, the DRE would only remove portions of the dam and facilities. This alternative's schedule includes time to secure retained facilities by removing hazardous materials and installing fences and similar security features to prevent unwanted entry. Therefore, it is not likely that this alternative would result in a significantly shorter project schedule than the Proposed Action.

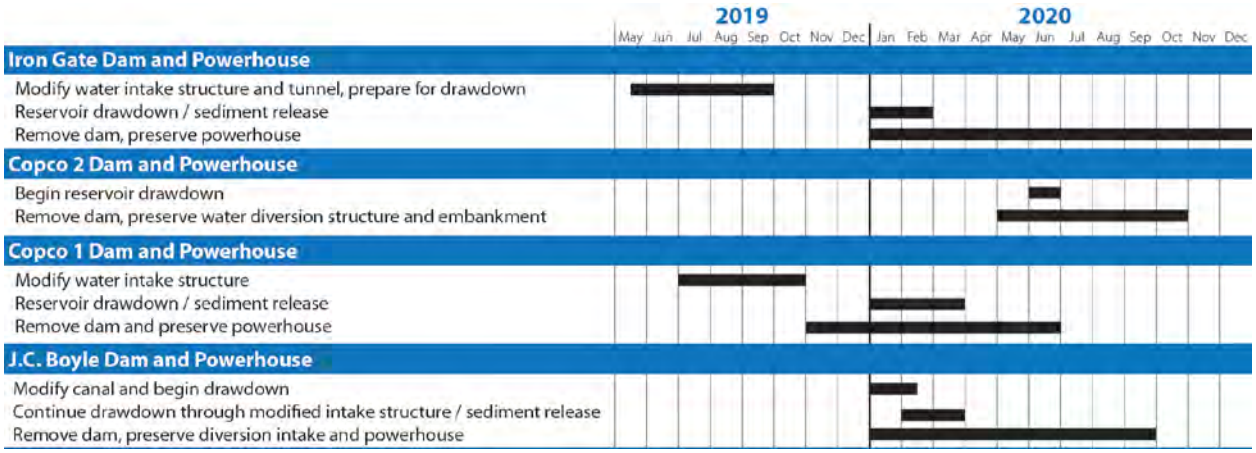

Figure 5-16. Anticipated Schedule for Partial Facilities Removal

5.2.3 Operations and Adaptive Management Actions of the Partial Facilities Removal of Four Dams Alternative

Facility operations and timing of the Partial Facilities Removal Alternative would be similar to that for the Proposed Action. Power production would decrease or cease on January 1, 2020 at J.C. Boyle and Iron Gate Powerhouses. The DRE would prepare for partial dam removal

beginning in the summer and fall of 2019 with modifications to intake structures for water control during dam removal. Embankment dam removal would begin immediately after spring runoff in June or July when conditions are safe at the Iron Gate and J.C. Boyle Dams. The winter flows would flush stored sediment in the reservoirs downstream during reservoir drawdown primarily in January and February. The DRE would stabilize remaining reservoir deposits as part of the restoration plan for each site.

As with the Proposed Action, the Partial Facilities Removal at Four Dams Alternative would require adaptive management and a monitoring plan.

5.2.4 Construction Details of the Partial Facilities Removal of Four Dams Alternative

Partial dam removal, with the objective of restoring volitional fish passage and free-flowing river conditions, is a technique that has been used with excellent success on several recent projects. Examples include the Savage Rapids Dam on the Rogue River (Oregon) and Elk Creek Dam on Elk Creek (Oregon). These dams were partially removed to restore free-flowing river conditions and fish passage at all times while leaving substantial portions of the dam and secondary structures in place. Construction techniques and overall constructability of these projects is the same as for the Proposed Action, with no specialized means or methods necessary. Because Partial Facilities Removal would be done during a one-year period, dam removal at each site would use the same equipment as the Proposed Action.

Table 5-7 shows the estimated workforce necessary for deconstruction at each facility. The crews for Copco 1 and 2 Dam removals could move between the projects as necessary to perform critical path work to reduce overall workforce numbers depending on how the contract is released for the projects. In addition to the average construction workforce, there would be 5 to 10 on-site construction management staff (e.g., inspectors, field engineers) at each site for the duration of the project.

Table 5-7. Estimated Construction Workforce for Partial Removal at each Facility

Facility	Estimated Average Construction Workforce	Duration	Estimated Peak Workforce	Peak Period
J.C. Boyle	20 to 30 people	10 months	40–45	Jul 2020–Sep 2020
Copco 1	25 to 35 people	12 months	50–55	Nov 2019–Apr 2020
Copco 2	20 to 30 people	7 months	35–40	May 2020–Aug 2020
Iron Gate	30 to 40 people	18 months	75–80	Jun 2020–Sep 2020

The Partial Removal of Four Dams Alternative would generate different quantities of material than the Proposed Action. Table 5-8 summarizes the quantities for Partial Facilities Removal of Four Dams Alternative.

Table 5-8. Estimated Waste Quantities for the Partial Facilities Removal Alternative

Dam	Waste Material/Qty	Disposal Site	Transportation Route
J.C. Boyle	Earth - 140,000 yd^3	Right abutment site or D/S scour hole	Existing unpaved haul road - 0.5 mile
	Concrete - 8,000 yd^3	D/S scour hole	Existing unpaved canal road - up to 2.5 miles
	Metal - 700 tons	Approved landfill (Klamath Falls, OR)	Topsy Grade county road to OR Hwy 66 to US 97 - 22 miles
Copco 1	Concrete - 46,500 yd^3	Right abutment site	Improve unpaved access road - 1 mile
	Metal - 600 tons	Approved transfer station (Yreka, CA)	Copco county road to Interstate 5 - 28 miles
Copco 2	Earth - 15,000 yd^3	Right abutment site	Improve unpaved access road - 1 mile
	Concrete at dam - 4,000 yd^3	Right abutment site	Improve unpaved access road - 1 mile
	Metal - 880 tons	Approved transfer station (Yreka, CA)	Copco county road to Interstate 5 - 28 miles
	Wood-stave planks - 725 tons	Approved hazmat site	Copco county road to Interstate 5 - 120 mile
Iron Gate	Earth - 1,100,000 yd^3	Spillway and Left abutment borrow sites	Existing unpaved access roads - 1 mile
	Concrete - 10,000 yd^3	Left abutment site	Existing unpaved access roads - 1 mile
	Metal - 800 tons	Approved transfer station (Yreka, CA)	Copco county road to Interstate 5 - 24 miles

Key:
yd^3: cubic yards

5.3 Alternative 4 – Fish Passage at Four Dams

Starting in fall 2001 and continuing through 2003, PacifiCorp studied fisheries resources for the Four Facilities. The efforts served as the foundation for PacifiCorp's FERC relicensing application with regards to fisheries. The description of Alternative 4 uses information from the *United States Department of the Interior and National Marine Fisheries Service Modified Prescriptions for Fishways and Alternatives Analysis Pursuant to Section 18 and Section 33 of the Federal Power Act for the Klamath Hydroelectric Project (FERC Project No. 2082)* (DOI and NOAA Fisheries Service 2007) and from Interior's Modified Terms and Conditions and Fishways filed pursuant to Sections 4(e) and 18 of the Federal Power Action (DOI/BLM 2007). These fishway prescriptions and mandatory conditions were developed during the FERC relicensing process. Issues of Material Fact associated with the prescriptions and mandatory conditions were challenged; the resulting Administrative Law Judge decision found that the Agencies met their burden of proof on most factual issues in dispute. Attachment B includes the full set of prescriptions. The Hydropower Licensee would implement this alternative.

The prescriptions include a key condition that requires at least 40 percent of J.C. Boyle inflow to be released into the Bypass Reach. Under this alternative, the J.C. Boyle Powerhouse would produce peaking power only one day a week to coincide with recreation releases. This

alternative would generate less power than current production because of the change in peaking operations and the flow requirements for the J.C. Boyle Bypass Reach. Several of the prescriptions include studies to determine if features are necessary (such as spillway and tailrace modification). For the purposes of analysis in this EIS/EIR, Alternative 4 includes some specific fishway facility design and construction details beyond what are specifically required in the prescriptions and are based on designs of similar fishway facilities used at other hydroelectric facilities.

5.3.1 General Fish Passage Facilities

Based on the prescriptions, typical upstream fish passage facilities at each dam would consist of pool and weir type fish ladders to provide the safe, timely, and effective upstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. This type of fish ladder is generally constructed from reinforced concrete and occasionally uses metal or wood hardware for adjustable components. In order to meet the prescribed fish passage criteria (DOI and NOAA Fisheries Service 2007), the fish ladders would use 6-inch steps between each weir that would result in an overall structure slope of 4 to 6 percent. At a minimum, each ladder bay would measure 8 feet long by 6 feet wide by 5 feet deep to meet the minimum pool requirements (NOAA Fisheries Service 2008b) and thus driving the structure slope to 4 to 6 percent. Figure 5-17 shows an example of a cast-in-place pool and weir fish ladder that is similar to that proposed for upstream fish passage at the Four Facilities under this alternative. Final design of these structures would likely exceed this minimum pool dimension by 50 to 100 percent in order to meet all regulatory criteria and minimize turbulence in the ladder bays. Table 5-9 provides a minimum footprint for each upstream fish ladder.

Figure 5-17. Example of Cast-in-Place Pool and Weir Fish Ladder

Table 5-9. Minimum Structure Footprint and Dimensions for Fish Ladders at Each Dam

Dam	Vertical Drop[1] (ft)	Min. Number of Pools	Min. Structure Length (ft)	Min. Structure Footprint (ft^2)
J.C. Boyle	61	122	1,089	8,712
Copco 1	124	249	2,241	17,928
Copco 2	22	44	396	3,168
Iron Gate	157	314	2,826	22,608

Key:
ft: feet
ft^2: square feet
[1] Source: CH2M Hill 2003.

The J.C. Boyle and Copco 2 fish ladders would be well within the range of typical pool and weir fish ladders being designed today to meet fish passage criteria for the vertical drop. For instance, PacifiCorp is currently installing a pool and weir fish ladder at Soda Springs (Oregon) that has an elevation differential of approximately 57 feet with 59 pools and meets current regulatory requirements. The Copco 1 and Iron Gate fish ladders would be significantly longer and have a bigger elevation differential; however, there are two successful examples in Oregon where bigger elevation differentials have been overcome with pool and weir fish ladders for upstream fish passage. The two examples are the Faraday/North Fork ladder on the Clackamas River (196 feet tall, 1.9 miles long) and the Pelton ladder on the Deschutes River (230 feet tall, 2.8 miles long) (Ratliff et.al. 1999). The Pelton ladder was shut down in 1968 primarily due to downstream juvenile passage and not upstream passage.

Fish ladders would be designed to allow passage 90 percent of the time that migratory fish would be present in the project area. For the extreme high and low flows, or 10 percent of the time, hydraulic conditions might prevent the ladders from meeting fish passage criteria. All fish ladders would require an auxiliary water supply (AWS) to ensure adequate attraction flows at the downstream end of the ladders to draw fish into the fish ladder and to moderate water temperatures. Fishway prescriptions require two downstream entrances and associated entrance pools for each fish ladder (DOI and NOAA Fisheries Service 2007).

The AWS would consist of a pipeline or intake that draws water from the reservoir and releases it in the fish ladder and near the fishway entrance pools. General components of the AWS include a screened intake designed to NOAA Fisheries Service screening standards to prevent fish entrapment in the AWS pipeline, an automated system to control flow rates in the AWS, selective withdrawal for water temperature, and provisions to remove excess energy from the AWS prior to discharge into the fishway. The energy dissipation structures would likely be concrete structures such as stilling basins or turbines, placed close to the fishway. A series of diffusers would remove energy at the point where AWS water enters the fishway. The AWS outlet would discharge water to fishway bays upstream from the fishway entrance to provide attraction flow over a range of tailwater conditions. To accommodate increased flows, the downstream bays of the fish ladder would be larger than upstream bays in the fish ladder.

Downstream fish passage facilities at each dam would consist of V-screens with terminal fish bypass pipes. Screens would be fitted with baffle systems to help facilitate consistent velocities across the screens and provide fine-tuning and flexibility based on monitoring results. The screens would be installed on the existing hydropower water intake structures. The fish bypass system would include a feature to detect and record data for PIT-tagged downstream migrating fish. Likewise, spillways would be modified to allow safe passage of downstream migrants. Copco 1 Dam would require a surface bypass collector rather than spillway modifications due to the size of the spillway and stair-stepped spillway surface. NOAA Fisheries Service and USFWS recommended that downstream facilities be installed prior to upstream passage facilities (DOI and NOAA Fisheries Service 2007).

Table 5-10 summarizes the fish passage facilities that would be required at each dam under this alternative.

Table 5-10. Fish Passage Improvements under the Fish Passage at Four Dams Alternative

Dam	Upstream Fish Passage	Spillway Modifications[1]	Tailrace Barrier[1]	Screens & Bypass
J.C. Boyle	New fish ladder over dam with auxiliary water supply (AWS) for attraction	Spillway modification to provide smooth transition	Extend river bank and install cutoff screen	New V-screen with fish bypass
Copco 1	New fish ladder over dam with AWS	Surface bypass collector		New V-screen with fish bypass
Copco 2	New fish ladder over dam with AWS		Extend river bank and install cutoff screen	New V-screen with fish bypass
Iron Gate	New fish ladder over dam with AWS, observation and sorting station in fish ladder	Spillway modification to provide smooth transition		New V-screen with fish bypass

Notes:

1. The prescriptions require studies to determine the need for and design of spillway modifications and tailrace barriers. For the purposes of analysis in this EIS/EIR, Alternative 4 includes some specific fishway facility design and construction details that are beyond those required in the prescriptions.

The following sections provide a detailed description of necessary fish passage facilities for each dam under the Fish Passage at Four Dams Alternative.

5.3.1.1 J.C. Boyle Fish Passage Facilities

Upstream Passage

J.C. Boyle Dam has fish passage facilities, but the existing pool and weir concrete fish ladder, on the north side of the spillway, do not meet current design criteria and must be replaced because of its configuration and poor structural condition. The Fish Passage at Four Dams Alternative would include removal of the existing fish ladder structure and construction of a new pool and weir, reinforced concrete fish ladder on the north side of the dam spillway, at or near the same location as the existing fish ladder (see Figure 5-18). The overall head differential from the downstream river to the J.C. Boyle Reservoir ranges from 55 to 61 feet, depending on reservoir

pool elevation. The new fish passage facilities must be designed to accommodate the reservoir pool fluctuation while maintaining continual upstream passage. The new ladder would have two entrances, to accommodate low flow and high flow conditions, at the downstream end of the ladder. The weir walls would be rounded on the edges to enhance lamprey passage.

An AWS would be necessary for temperature and attraction flow mitigation. The AWS would draw water from the reservoir through a screened inlet and variable height intake structure to provide water temperature control. The AWS would pipe water into the fish ladder at two locations and would include an energy dissipation pool to reduce turbulence.

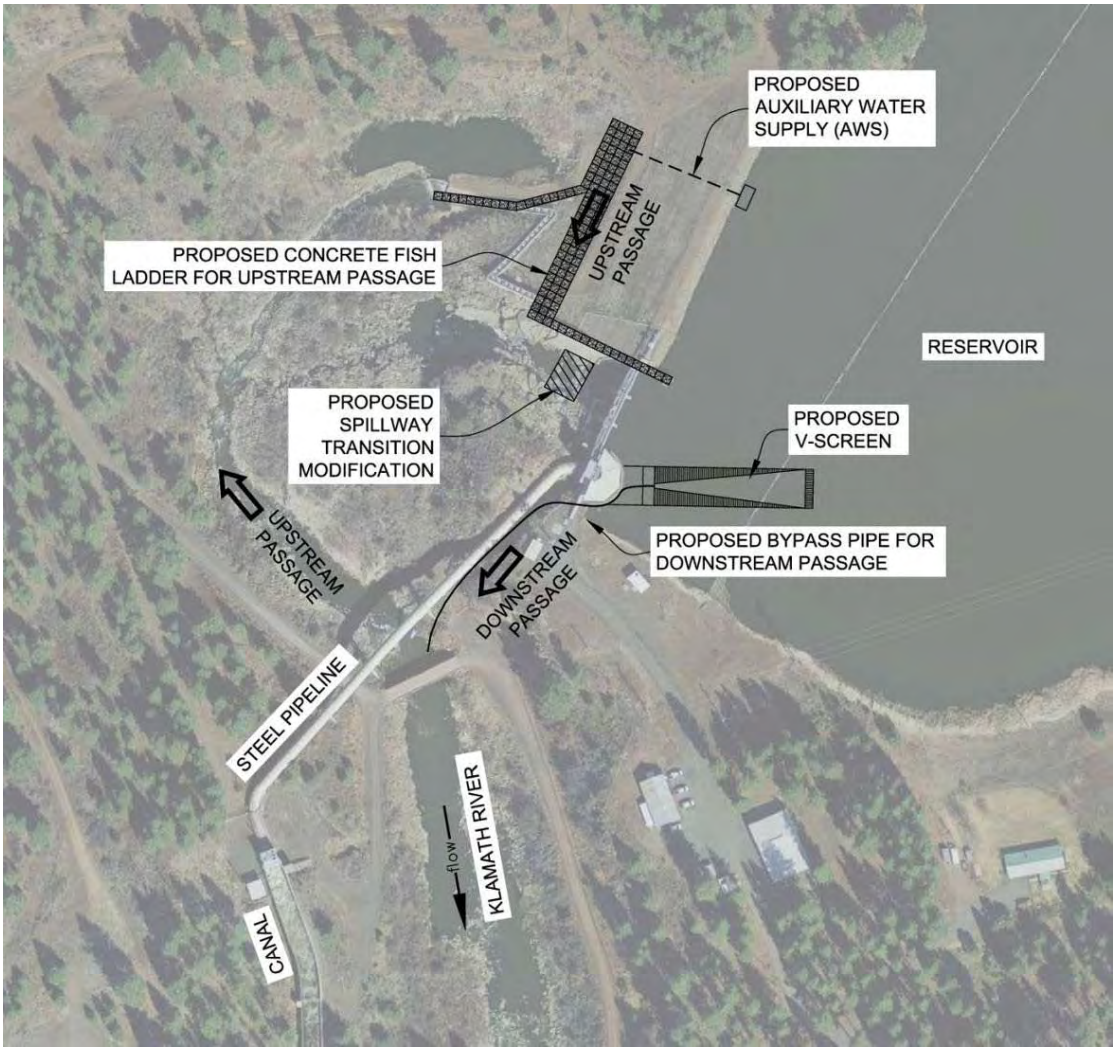

Figure 5-18. Conceptual Layout of J.C. Boyle Fish Passage Facilities

Downstream Fish Passage - Water Intake

The existing water intake has a design flow of 3,000 cfs that requires a minimum fish screen of 7,500 square feet based on an approach velocity of 0.4 feet per second. The Fish Passage at Four Dams Alternative would include a conventional V-screen at the water intake. The V-screen

would terminate in a 36" diameter fish bypass pipe (approximately 40 cfs) that would run from the water intake to a bypass facility for recording downstream migrating fish and then continuing on to a controlled outfall in the river downstream of the dam. The V-screen would be stainless steel and the fish return pipe would be standard steel with concrete and steel support structures along the length of the pipe. The V-screen would have louver baffles to control the flows and ensure even velocity distribution across the screen.

Downstream Fish Passage- Spillway

Radial Tainter gates regulate discharge over the J.C. Boyle Dam's concrete spillway section which terminates in an abrupt drop onto bedrock. Modifications to the spillway would likely include building a smoother transition at the downstream end using cast-in-place concrete to form an ogee-type drop structure and minor channel modifications. This design would likely reduce fish mortality on the rock outcrop below the spillway and provide a smooth transition for downstream passage.

Tailrace Barrier

The power generation turbines for J.C. Boyle are several miles downstream from the dam with a large tailrace area that flows into the Klamath River. This tailrace has the potential for false attraction waters and needs a barrier. The Fish Passage at Four Dams Alternative would include extension of the bank of the Klamath River and installation of a stainless steel, wedge-wire cutoff screen (see Figure 5-19).

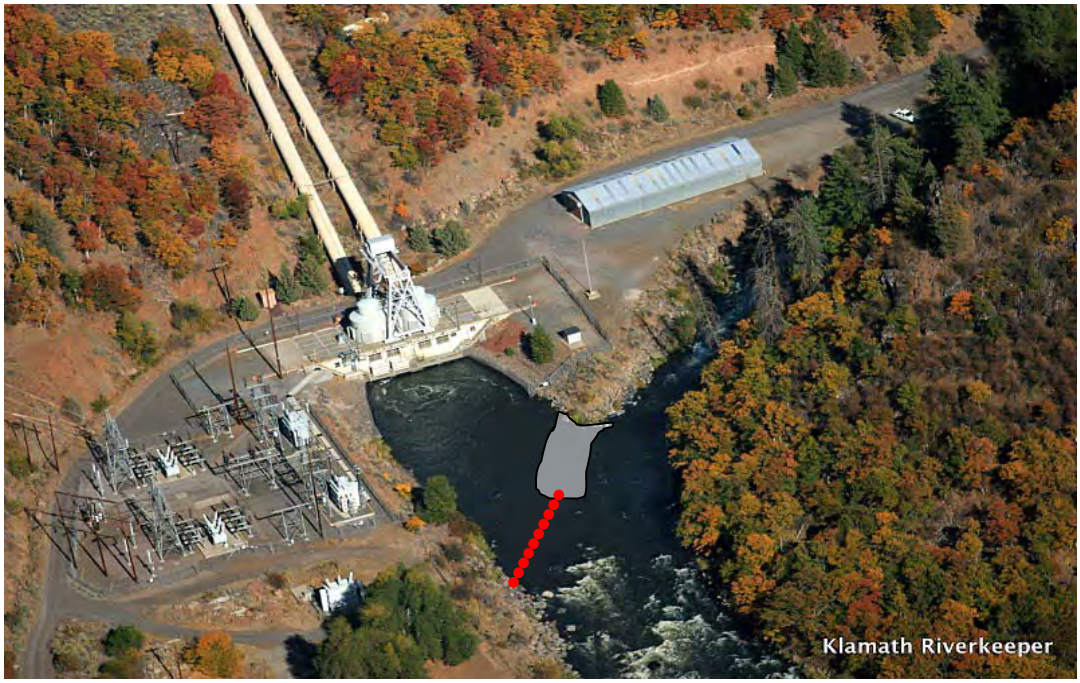

Figure 5-19. Modifications at the Tailrace of J.C. Boyle Power Generation Plant Would Extend the Bank and Install a Tailrace Barrier Screen (red dots) (photo from Klamath Riverkeeper)

5.3.1.2 Copco 1 Fish Passage Facilities

Upstream Passage

The Fish Passage at Four Dams Alternative would include a new pool and weir fish ladder on the right side of the dam for upstream fish passage. The fish ladder would have an AWS plumbed into it at two locations to moderate water temperatures, flow in the fishway, and attraction flows at the downstream end of the fishway. The downstream entrance of the fish ladder would have two entrances for low water and high water conditions, as shown in Figure 5-20.

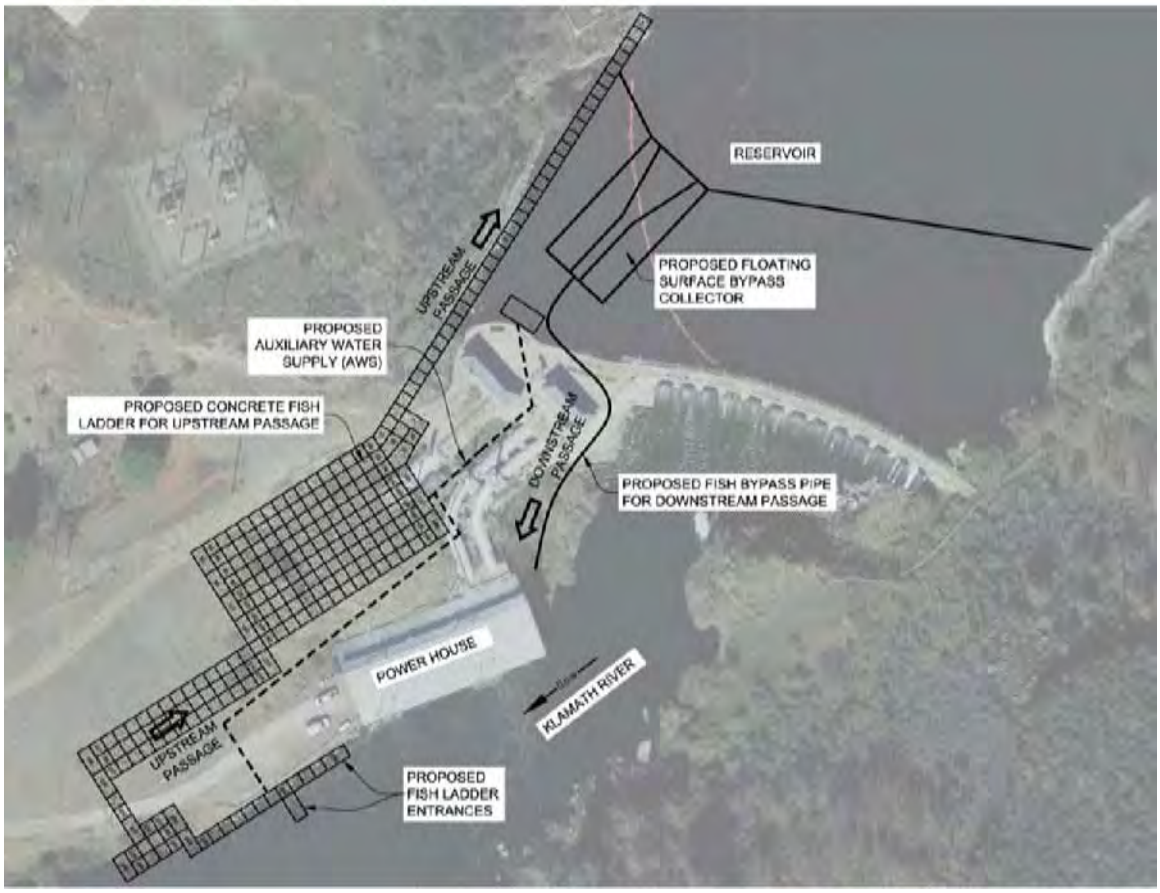

Figure 5-20. Copco 1 Fish Ladder Configuration and Floating Surface Bypass Collector

Figure 5-21 shows a recently built fish ladder at Thompson Falls Dam, Montana that is an example of what the Copco 1 fish ladder could look like when completed. The fish ladder has several shared walls built into an existing bedrock canyon wall. This example ladder also has an AWS to augment flows inside the ladder.

Figure 5-21. Example of Fish Ladder Built into Steep Bedrock Similar to Copco 1 Option (photo courtesy of GEI Consultants)

Downstream Fish Passage and Spillway Passage

The existing facilities at Copco 1 Dam are not conducive to downstream fish passage because the juvenile salmonids travelling downstream would flow through the intake to the power generation facility or over the dam spillway during high flows. Section 5.2.1 of the prescriptions (DOI and NOAA Fisheries Service 2007) states the Hydropower Licensee shall construct, operate, maintain, and evaluate a fish screen and bypass facility. To meet this requirement, the Fish Passage at Four Dams Alternative would include construction of a floating surface bypass collector (FSBC) with full depth nets to prevent fish from moving into both the water intake and the spillway. The FSBC has an integrated V-screen with a fish bypass that would screen fish away from the water intake. Several dams in the northwest have similar structures, including the Upper Baker Dam on the Baker River, Round Butte Dam on the Deschutes River, and Swift Reservoir on the Lewis River. Results from these projects have been positive and provide support for a similar system on the Copco 1 Dam.

The FSBC would be a steel structure using a typical V-screen configuration similar to Upper Baker Dam in Washington (see Figure 5-22). The existing power generation water intake has a design flow of 3,200 cfs, which requires a minimum fish screen of 8,000 square feet based on an

approach velocity of 0.4 feet per second. The main FSBC would be at the intake structure on the right side of the dam. The FSBC would be anchored to the existing rock and concrete dam structure to ensure stability.

Figure 5-22. Example of Floating Surface Bypass Collector in Upper Baker Dam, Washington (photo courtesy of NOAA Fisheries Service)

Tailrace Barrier

The Copco 1 powerhouse configuration is similar to the Iron Gate facility which does not require a tailrace barrier based on observed conditions and past performance. Modified Specific Conditions (DOI and NOAA Fisheries Service 2007) Section 5.4.2 states that the Copco 1 tailrace area should be studied and a final determination should be made regarding the requirements for a tailrace barrier. Due to the similarities with Iron Gate, it is likely that a tailrace barrier will not be required and one is not included in this analysis.

5.3.1.3 Copco 2 Fish Passage Facilities

Upstream Fish Passage

The Fish Passage at Four Dams Alternative includes a concrete pool and weir fish ladder with 6-inch drops to provide volitional fish passage at Copco 2 Dam. The overall head differential from the downstream river to Copco 2 Reservoir is about 20 to 25 feet, depending on reservoir pool elevations. The new fish passage facilities would accommodate the reservoir pool fluctuation while maintaining continual upstream passage.

The pool and weir fish ladder would be on the right side of the concrete spillway structure in the earth embankment. The weir walls would be rounded concrete to enhance lamprey passage. An AWS would be necessary for temperature and attraction flow mitigation. The AWS would draw water from the reservoir through a screened inlet. Figure 5-23 shows a conceptual layout for a fish ladder at Copco 2 Dam.

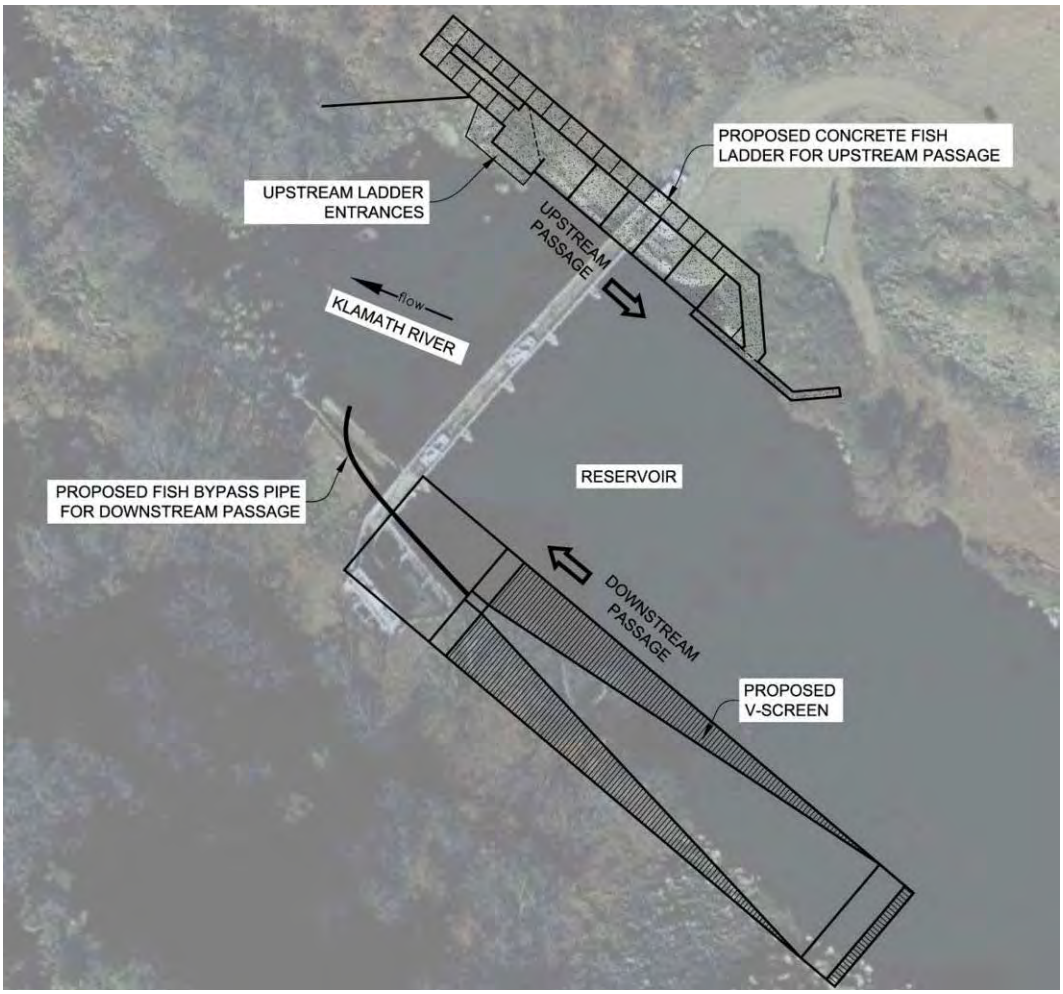

Figure 5-23. Copco 2 Fish Ladder and V-screen, along the left side of the river, for power water diversion (primarily from CH2MHill concept, 2003)

In addition to the fish ladder, a transverse bedrock sill approximately 0.5 miles upstream of the Copco 2 Powerhouse in the Bypass Reach could create a fish passage barrier. A new FERC license would likely increase flows in the Bypass Reach and this barrier would not likely exist. As part of the license renewal process, a study would determine whether corrective measures would be needed at this barrier to provide fish passage.

Downstream Fish Passage

The existing power generation water intake at Copco 2 Dam is on the left side of the concrete spillway structure. The water diversion capacity is 3,200 cfs, which would require a minimum 8,000 square feet of screen. A conventional V-screen for the water intake would minimize the length of the screen. The V-screen would terminate in a fish bypass pipe that would flow over the dam and into the downstream river area.

Tailrace Barrier

The power generation turbines for Copco 2 are several miles downstream from the dam with a large tailrace area that flows back into the Klamath River. This tailrace has the potential for false attraction waters and section 4.4.1 of the prescriptions (DOI and NOAA Fisheries Service 2007) requires a tailrace barrier unless studies prove otherwise. Due to the orientation and nature of the tailrace area, it is likely that a tailrace barrier will be required. The Fish Passage at Four Dams Alternative includes extending the bank line of the Klamath River and installing a cutoff screen to prevent fish from straying into the tailrace area (see Figure 5-24).

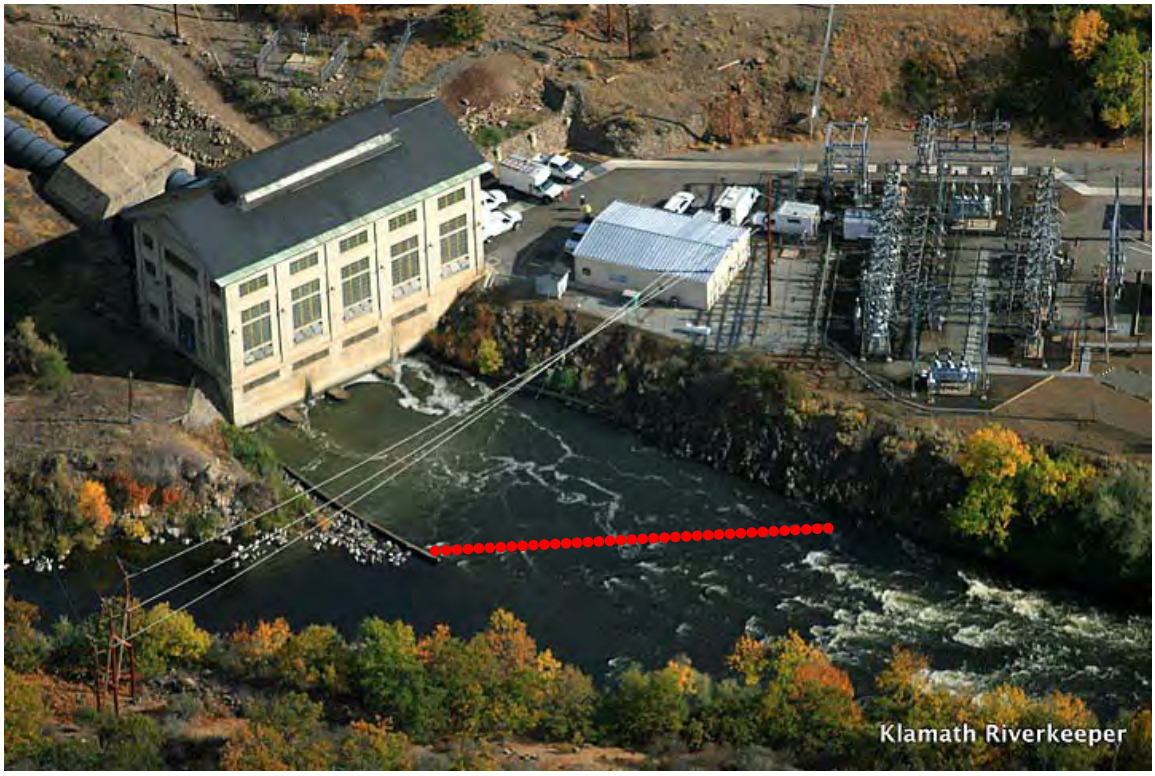

Figure 5-24. Modifications at the Tailrace of the Copco 2 Powerplant would extend the bank and install a tailrace barrier screen (red dots) (photo from Klamath Riverkeeper)

5.3.1.4 Iron Gate Dam Fish Passage Facilities

Upstream Fish Passage

The Fish Passage at Four Dams Alternative would include installation of a reinforced concrete fish ladder on the left side of the existing dam near the existing penstock pipe as shown in Figure 5-25. The fish ladder would have two entrances with entrance pools at the downstream end of the fish ladder. An AWS would feed water into the fish ladder at two locations to help with attraction flows and water temperatures.

Figure 5-25. Conceptual Fish Passage Facilities Layout for Iron Gate Dam showing fish ladder, water intake screen, and spillway transition modifications

Downstream Fish Passage

The existing power generation water intake structure at Iron Gate Dam is on the left side of the embankment dam. The water intake design flow is 1,735 cfs and would require a minimum fish screen of 4,340 square feet based on an approach velocity of 0.4 feet per second. A conventional V-screen would be the best option for screening the water intake to address the substantial size of the screen. The V-screen would terminate in a 36 inch diameter fish bypass pipe (≈40 cfs) that would run from the water intake to a fish bypass facility for identification of downstream migrating juveniles and then continue downstream to the river below the dam. The V-screen would be stainless steel and the fish return pipe would be standard steel with concrete and steel support structures along the length of the pipe. The V-screen would have louver baffles to control the flows and ensure even velocity distribution across the screen.

Spillway Downstream Passage

The Iron Gate spillway is an unregulated, free overflow from the reservoir area. Likely modifications to the spillway would include building a smoother transition at the downstream end using cast-in-place concrete to form an ogee-type drop structure that would connect the downstream river levels to the free flowing spill conditions. This modification would reduce fish mortality on the rock outcrop below the spillway. In addition, the Hydropower Licensee would use concrete to fill the area just upstream of the free outfall at the downstream end of the spillway to make a consistent hydraulic transition and reduce potential harm during downstream fish passage of primarily juvenile fish.

5.3.2 Schedule for the Fish Passage at Four Dams Alternative

The schedule would likely follow the schedule prescribed in the FERC relicensing process. The prescriptions include a schedule for implementation and recommend that downstream facilities be installed prior to upstream passage facilities (DOI and NOAA Fisheries 2007). Table 5-11 shows the schedule for construction of the fish passage facilities at each dam, based on these constraints.

Table 5-11. Length of Time to Complete Fish Passage Improvements from Date of FERC License Renewal

Dam	Upstream Fish Passage	Spillway Modifications	Tailrace Barrier	Screens & Bypass
J.C. Boyle	4 years	4 years	4 years	4 years
Copco 1	6 years	6 years	N/A	6 years
Copco 2	6 years	6 years	8 years	6 years
Iron Gate	5 years	5 years	N/A	5 years

Key:
N/A: Not Applicable

5.3.3 Operations and Adaptive Management Actions of Fish Passage at Four Dams Alternative

Achieving optimal fish passage at new ladders, screens, and bypasses often requires adjustments. Fish ladders are designed to work in typical river flow ranges (i.e., between 5 and 95 percent exceedance flows) and not necessarily during extremely high and low flow conditions. At design fish passage flows, fish passage would be accessible for Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. As part of the prescriptions (DOI and NOAA Fisheries Service 2007), the Hydropower Licensee would develop a Fishway Evaluation and Modification Plan (FEMP) for review and approval by the regulatory agencies. The FEMP for fish passage facilities would describe actions to monitor and modify facilities to ensure volitional fish passage at each dam.

The FEMPs would require an annual work plan describing prospective actions the Hydropower Licensee will take to implement and monitor fish passage. Implementation of this annual work plan would ensure adequate and timely coordination between the Licensee and regulatory agencies. The annual plans also would provide insight in determining whether program goals are achieved and whether the appropriate techniques are applied for fish passage.

5.3.4 Construction Details of the Fish Passage at Four Dams Alternative

5.3.4.1 Site Access, Preparation, and Mobilization

Construction of fish ladders represents the bulk of the work under this alternative. The Hydropower Licensee would construct the ladders from reinforced concrete using construction methods typical for civil infrastructure work. Prior to beginning work, the Hydropower Licensee would make provisions to access the site, and to stage, store, and stockpile equipment and materials. Site access would require construction of temporary gravel access roads and storage pads. The Hydropower Licensee would construct access roads and storage pads with a bulldozer to clear vegetation, create level ground, and spread gravel using dump trucks to deliver crushed gravel. Preparatory work would also consist of establishing temporary power supply and offices, establishing security fencing, developing sanitary facilities for workers, creating fueling stations, mobilizing equipment, and stockpiling materials that would be incorporated into the work. The Hydropower Licensee would also install temporary sediment control provisions, with the incorporation of best management practices to minimize sediment discharge from the work site.

The J.C. Boyle site has the best access for construction equipment and staging for construction. Equipment and materials could be brought into the site on existing gravel access roads and temporary access roads where necessary. The Copco 2 site has difficult access due to the narrow canyon and relatively steep road access into the site. The existing access road would require upgrades such as gravel surfacing and grading. Like Copco 2 Dam, Iron Gate and Copco 1 Dams have difficult site access because of steep canyon terrain, and would also require special provisions, in addition to temporary roads for site access, such as a tower crane or aerial tramway for construction.

Preparatory work would also include selective demolition of existing structures to accommodate future structures or to provide work access. For concrete work, this would likely involve concrete sawing, grinding, or cutting, and/or concrete demolition. The Hydropower Licensee would remove demolished materials (rock, concrete, and steel) from the project area and dispose of them at authorized disposal sites.

The Hydropower Licensee would need to control water and isolate the work area from flowing water and aquatic organisms throughout the duration of construction. Control mechanisms would be installed prior to starting work for each dam removal. The Hydropower Licensee could control water in most areas using gravity diversions; however, pumps would be required to dewater isolated ponding. Dewatering would require electric, gasoline, or diesel powered pumps, along with flexible hosing to convey water. Pumps would discharge water away from the river into upland areas to prevent discharge of fine sediments to waterways.

The Hydropower Licensee would work in wet conditions in areas that cannot be dried. For in-water work, the Hydropower Licensee would use physical barriers of a type and in a manner similar to that used under the dam removal alternatives.

The Hydropower Licensee would need to salvage fish from work areas and prevent them from re-entering the area. The Hydropower Licensee would use specialized labor and equipment in a manner similar to that used under the dam removal alternatives.

Access and mobilization would likely require 2 weeks to 1 month for each site, depending upon the scale of the project, with the larger fish ladders at Copco 1 and Iron Gate Dams requiring additional time for access and mobilization. Grading and site preparation would scale with project size, and could be performed concurrently with access development and work area isolation. Work area isolation and de-fishing would likely take between days and two weeks depending on contractor approach, with some activities remaining concurrent on a piecemeal basis throughout construction.

5.3.4.2 Concrete Placement

The majority of work to construct the proposed fishways would consist of cast in place, reinforced concrete construction. Table 5-12 shows estimated quantities of concrete for each facility. Following grading and site preparation, the Hydropower Licensee would assemble temporary formwork and install reinforcement steel within the formwork, secured using standard ties in preparation for placing concrete. The Hydropower Licensee would construct formwork from plywood, dimensional lumber, timber, and metal formwork ties. Formwork would be removed after

Table 5-12. Estimated Minimum Amount of Reinforced Concrete Necessary For Fish Ladder at Each Dam

Dam	Reinforced Concrete (yd^3)
J.C. Boyle	2,800
Copco 1	5,800
Copco 2	1,000
Iron Gate	7,000

Key:
yd^3: cubic yards

concrete placement. A small crew of skilled workers would complete the formwork and steelwork using light equipment similar to that used for the Thompson Falls Dam fish ladder in Montana (Figure 5-26).

Figure 5-26. Typical Construction Techniques for Building Reinforced, Cast-in-Place Concrete Fish Ladder Using Lattice Crane and Temporary Access Platform at Thompson Falls Dam (photo courtesy of GEI Consultants)

Concrete placement would involve importing concrete via truck along temporary access routes, and placing concrete using pumps, booms, and hydraulic hoses for the typical access sites at J.C. Boyle and Copco 2 Dams. Concrete would be trucked from Yreka, California or Klamath Falls, Oregon. For the difficult access sites at Copco 1 and Iron Gate Dams, concrete placement would likely require a tower crane and concrete bucket or an aerial tramway and concrete bucket. The Hydropower Licensee would remove the formwork one week after concrete placement and re-use it for other work areas. The Hydropower Licensee would apply water (or concrete curing solutions) to each area for one month after concrete placement to allow the concrete to cure.

Production rates for concrete placement would likely involve placing between 40 to 80 yd^3 of concrete per day (RS Means 2008). The crew would include skilled workers for steel and formwork erection and light equipment operators for grading and material handling. Attachment A lists the typical equipment that would likely be required under this alternative.

5.3.4.3 V-Screen Installation, Tailrace Barriers and Floating Surface Bypass Collector

The V-screens intended for downstream passage and screening of power water intakes would be fabricated offsite and installed by a crew of skilled workers using light equipment. Because of the locations of the V-screens within the reservoirs, this phase of construction would require an intensive dewatering and work area isolation effort in order to provide a dry or partially isolated work area. Dewatering could require water level manipulation within the reservoir and construction of coffer barriers with pumps to dewater the work area around the water intakes.

Tailrace barriers would be constructed with cast-in-place reinforced concrete with metal screens. The area would be isolated from moving water using temporary cofferdams and dewatered with gas powered pumps. Concrete trucks would access the site and place concrete using a concrete pumping system. After construction of the tailrace barriers, the cofferdams would be removed.

The FSBC would be fabricated off-site and shipped to the site using standard flatbed trucks. The Hydropower Licensee would assemble the pieces on-site to create the larger body of the FSBC. Once the structure was assembled, the Hydropower Licensee would float it into place near the water intake area and secure it. Reservoir guide nets would facilitate fish passage through the bypass collector.

5.3.4.4 Demobilization, Clean-up, and Re-Vegetation

Following the work, the Hydropower Licensee would remove temporary facilities from the worksite, demobilize equipment, remove construction-related debris, install erosion control best management practices, and re-establish vegetation. The Hydropower Licensee would remove temporary access roads, equipment, and material staging areas. The Hydropower Licensee would loosen compacted soils in portions of the project site with soils compacted by equipment travel, grade disturbed areas, and would redistribute any stockpiled topsoil onto mineral soils. Work would likely begin at the farthest point away from improved roads and progress towards the nearest improved road.

The Hydropower Licensee would seed and mulch using a truck-mounted or aerial seed and mulch sprayer to establish grass vegetation on disturbed areas. The Hydropower Licensee would implement this erosion control practice following construction and at the end of seasonal work, should any work span seasonal work windows. The Hydropower Licensee would revegetate the site during the winter dormancy period immediately following the completion of construction. A labor crew would install plantings using hand tools and light equipment, and the intensity of the effort would scale with project size. The estimated workforce required for this alternative is summarized in Table 5-13. Each facility would also have 5 to 10 on-site construction administrative personnel (e.g., inspectors, field engineers) for the duration of the project.

Table 5-13. Estimated Average Construction Workforce for Fish Passage at Four Dams

Facility	Estimated Construction Workforce	Duration
J.C. Boyle	10 to 20 people	4 to 6 months
Copco 1	15 to 25 people	9 months
Copco 2	10 to 20 people	4 to 6 months
Iron Gate	15 to 30 people	12 months

5.4 Alternative 5 – Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate

5.4.1 Features of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

This alternative consists of the full removal of Iron Gate and Copco 1 facilities and installation of upstream and downstream fish passage facilities at both the J.C. Boyle and Copco 2 Dams. On Copco 2 and J.C. Boyle Dams, ladders would be less complex to construct and provide volitional fish passage because of dam height and reservoir length. Iron Gate and Copco 1 Dams also provide less power; therefore, removal would have less effect on power generation. Removing Iron Gate and Copco 1 Reservoirs, the two largest impoundments in the Hydroelectric Reach, would also address water quality problems driven by reservoir size, such as increased water temperature, low dissolved oxygen, and toxic algal blooms in the summer and fall.

In order to meet current criteria for volitional fish passage, J.C. Boyle and Copco 2 Dams would require new upstream and downstream fish passage facilities. The fish passage facilities at J.C. Boyle and Copco 2 Dams would be the same as in the Fish Passage at Four Dams Alternative; Section 2.3.4 describes these facilities in detail. Similar to the Fish Passage at Four Dams Alternative, the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative would incorporate most of the prescriptions from the FERC relicensing process related to fish passage at J.C. Boyle and Copco 2 Dams (see Attachment B of Appendix A for a list of prescriptions). Alternative 5 would not incorporate the prescriptions related to peaking power at J.C. Boyle and recreation releases. In Alternative 5, Copco 2 Dam would be the only dam remaining downstream from J.C. Boyle Dam. Copco 2 Reservoir is very small, and does not have adequate capacity to reregulate flows associated with peaking operations so that they are suitable for fish downstream. Therefore, Alternative 5 would not include peaking operations or recreation releases on any days at J.C. Boyle Dam.

5.4.2 Schedule for the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

This alternative would follow a schedule similar to that of the Proposed Action, because two of the dams are being removed and fish passage would be necessary as soon as possible after dam removal. Likewise, the prescriptions require that "downstream fishways at each development should be completed prior to completion of upstream fishways at any given development."

Figure 5-27 shows the schedule for construction of the fish passage facilities at two dams and for removal of the remaining two dams, based on these constraints.

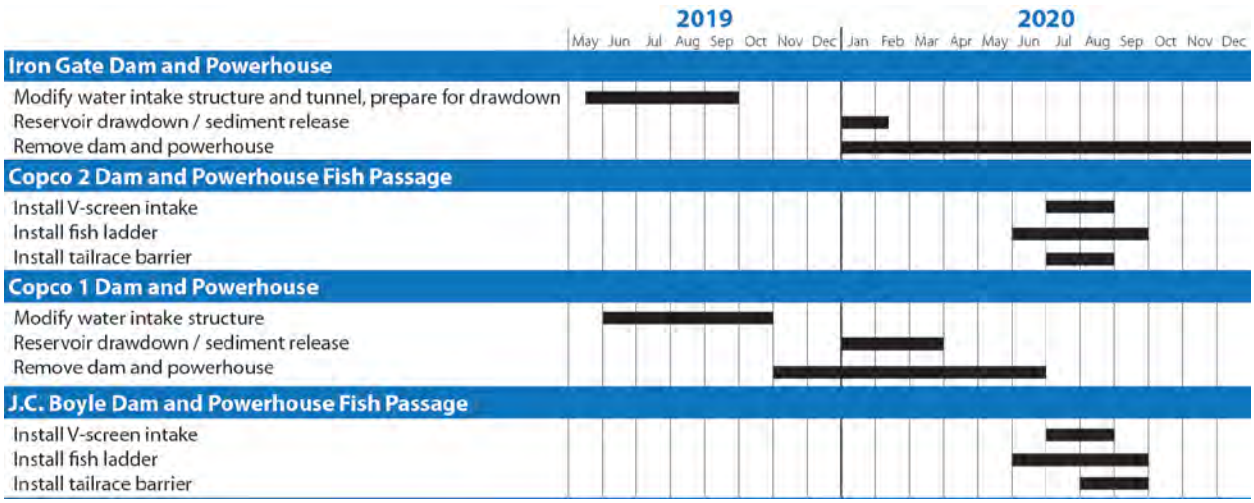

Figure 5-27. Anticipated Schedule for Full Removal of Iron Gate and Copco 1 Dams with Fish Passage at Copco 2 and J.C. Boyle Dams

5.4.3 Operations and Adaptive Management Actions of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

Adjustments are often required to achieve optimal fish passage conditions at newly installed fish ladders, screens, and bypasses. Planning, monitoring, and adaptive management actions to make the adjustments under this alternative would be as described for the Fish Passage at Four Dams Alternative (See Section 5.3.3).

Facility operations and timing of dam removal would be similar to that for the Proposed Action. The power-producing capabilities at the Iron Gate and Copco 1 Developments would be reduced or cease on January 1, 2020. Preparation for dam removal would begin in the fall of 2019 with modifications to intake structures for water control during dam removal. Section 5.1.3 describes the operations for dam removal in more detail as well as the monitoring and adaptive management requirements.

5.4.4 Construction Details of the Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate Alternative

Table 5-14 shows the estimated workforce necessary for each facility under this alternative. In addition to the average construction workforce, there would be 5 to 10 on-site construction management staff (e.g., inspectors, field engineers) at each site for the duration of the project. The fish ladders would represent a small amount of the work under this alternative and would be constructed of reinforced, cast-in-place concrete using construction methods typical for civil infrastructure work. Section 5.3.4 presents construction details for the fish passage facilities at

J.C. Boyle and Copco 2 Dams. The deconstruction efforts at Copco 1 and Iron Gate Dams would constitute the bulk of the construction efforts in this alternative. Section 5.1.4 describes construction details for dam removal at Copco 1 and Iron Gate Dams.

Table 5-14. Estimated Construction Workforce for Full Removal of Iron Gate and Copco 1 Dams with Fish Passage at Copco 2 and J.C. Boyle Dams

Facility	Estimated Average Construction Workforce	Duration	Estimated Peak Workforce	Peak Period
J.C. Boyle	10 to 15 people	4 to 6 months	15–20	Jul 2020–Sep 2020
Copco 1	30 to 35 people	12 months	50–55	Nov 2019–Apr 2020
Copco 2	10 to 15 people	4 to 6 months	15–20	Jul 2020–Sep 2020
Iron Gate	35 to 40 people	18 months	75–80	Jun 2020–Sep 2020

Chapter 6
Summary and Conclusions

6.1 Alternatives Evaluation

This Alternatives Report documented the process to identify initial alternatives and develop a reasonable range of alternatives for further review in the EIS/EIR. The Lead Agencies used alternatives suggested by the public and the purpose and need/project objectives statement in their initial effort to develop conceptual alternatives to achieve the desired outcome. The Lead Agencies then developed and applied a set of screening considerations to verify that the screening process was fair and unbiased when determining which alternatives should move forward for more detailed analysis. Table 6-1 shows the results of this screening process.

Table 6-1. Initial Alternatives

Alternative Number	Alternative Name	Description	Screening Result
Alternative 1	No Action/ No Project	Implement none of the action alternatives; Klamath Hydroelectric Project would continue current operations.	Alternative 1 moved forward to the EIS/EIR for further review.
Alternative 2	Full Facilities Removal of Four Dams (Proposed Action)	Remove four dams and related facilities.	Alternative 2 moved forward to the EIS/EIR for further review.
Alternative 3	Partial Facilities Removal of Four Dams	Remove main areas of four dams to allow a free-flowing river; related facilities and/or abutments may remain.	Alternative 3 moved forward to the EIS/EIR for further review.
Alternative 4	Fish Passage at Four Dams	Construct fish passage facilities to provide upstream and downstream passage at four dams.	Alternative 4 moved forward to the EIS/EIR for further review.
Alternative 5	Fish Passage at J.C. Boyle and Copco 2, Remove Copco 1 and Iron Gate	Remove Copco 1 and Iron Gate Dams, construct fish passage at J.C. Boyle and Copco 2 Dams.	Alternative 5 moved forward to the EIS/EIR for further review.
Alternative 6	Fish Passage at J.C. Boyle, Remove Copco 1, Copco 2, and Iron Gate	Remove Copco 1, Copco 2, and Iron Gate Dams, construct upgraded fish passage at J.C. Boyle.	The EIS/EIR will fully analyze effects of removing all dams, laddering all dams, and a combination of these measures as a part of Alternatives 2, 4, and 5. The potential effects of Alternative 6 will be fully analyzed through these other alternatives. Alternative will not move forward for further analysis.

Table 6-1. Initial Alternatives

Alternative Number	Alternative Name	Description	Screening Result
Alternative 7	Sequenced Removal of Four Dams	Sequence dam removal over three to five years.	Alternative 7 will not be carried forward for more detailed analysis in the EIS/EIR because it would not avoid or lessen environmental effects of the Proposed Action.
Alternative 8	Full Facilities removal of Four Dams without KBRA	Remove four dams and related facilities but do not implement KBRA elements.	Alternative 8 will not be carried forward for more detailed analysis in the EIS/EIR because it would not avoid or lessen environmental effects of the Proposed Action.
Alternative 9	Trap and Haul Fish	Capture fish at Iron Gate Dam and transport them upstream of J.C. Boyle Dam.	Alternative 9 will not move forward for further analysis because it does not meet the purpose and need under NEPA or most of the program objectives under CEQA.
Alternative 10	Fish Bypass: Bogus Creek Bypass	Create fish bypass using Bogus Creek, Cold Creek, Little Deer Creek, and a constructed canal to connect to Copco 1 Reservoir.	Alternative 10 will not move forward for more detailed analysis in the EIS/EIR because it does not meet any elements of the purpose and need under NEPA or program objectives under CEQA.
Alternative 11	Fish Bypass: Alternative Tunnel Route	Create fish bypass using Bogus Creek and a 5-mile tunnel to connect to Copco Reservoir.	Alternative 11 will not move forward for more detailed analysis in the EIS/EIR because it does not meet any elements of the purpose and need under NEPA or program objectives under CEQA.
Alternative 12	Notching Four Dams	Notch four dams to create a free-flowing river.	Alternative 12 is very similar to Alternative 3, and would result in the same type of impacts. Therefore, this alternative will not move forward for more detailed analysis in the EIS/EIR as a separate alternative.
Alternative 13	Federal Takeover of Project	Use authority of the Federal Power Act for government to take over dams and initiate removal.	This alternative will not move forward for more detailed analysis in the EIS/EIR because the environmental impacts would be generally the same as those under Alternative 2. This alternative would not reduce or lessen environmental effects. Moreover, the federal government has not expressed an interest in taking over the facilities.
Alternative 14	Full Removal of Five Dams	Remove Keno Dam in addition to four downstream dams.	Alternative 14 will not be carried forward for more detailed analysis in the EIS/EIR because it would not avoid or lessen environmental effects of the Proposed Action.
Alternative 15	Full Removal of Six Dams	Remove Keno and Link River Dams in addition to four downstream dams.	Alternative 15 will not be carried forward for more detailed analysis in the EIS/EIR because it would not avoid or lessen environmental effects of the Proposed Action. Implementation of Alternative 15 would also not be likely to meet Endangered Species Act requirements or tribal trust water rights within Upper Klamath Lake.
Alternative 16	Dredge Upper Klamath Lake	Remove sediments in Upper Klamath Lake to remove phosphorus and increase storage capacity.	Alternative 16 will not move forward for more detailed analysis in the EIS/EIR because it does not meet the purpose and need under NEPA or most of the program objectives under CEQA.
Alternative 17	Predator Control	Control seal, sea lion, and cormorant populations that are salmonid predators.	Alternative 17 will not move forward for more detailed analysis in the EIS/EIR because it does not meet the purpose and need under NEPA or program objectives under CEQA. Moreover, it would be difficult to permit because of biological concerns.

Table 6-1. Initial Alternatives

Alternative Number	Alternative Name	Description	Screening Result
Alternative 18	Partition Upper Klamath Lake	Create an "inner lake" that will have lower residence time and improved water quality.	Alternative 18 will not move forward for more detailed analysis in the EIS/EIR because it does not meet the purpose and need under NEPA or program objectives under CEQA.

6.2 Next Steps

Five alternatives, including the No Action/No Project Alternative, were retained for further evaluation in the EIS/EIR. These alternatives represent the Proposed Action as well as other alternatives that could meet most of the purpose and need/program objectives. Several alternatives are carried forward because they represent the potential to reduce environmental effects in a resource area that could be affected by the Proposed Action. These alternatives present a range of potential actions; the Lead Agencies may decide to select (or not select) elements of these alternatives or mix elements, as long as the EIS/EIR fully analyzes these elements. The EIS/EIR will include more detailed environmental review of these alternatives.

Chapter 7
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Attachment A. Equipment Summary

Alternative 2 - Proposed Action: Full Facilities Removal of Four Dams
Summary Estimate of Equipment Required

Equipment	J.C. Boyle	Copco No. 1	Copco No. 2	Iron Gate	Total
Lattice boom crane, 160’	1	1	1	1	**4**
Hydraulic yard crane, 40'-60'	2	2	2	2	**8**
Hydraulic excavator w/ hoe ram attachment	2	2	2	1	**7**
Hydraulic excavator, CAT 244-321 hp	2	2	2	2	**8**
Hydraulic excavator, CAT 513 hp	1	0	0	1	**2**
Wheel-loader, CAT 966, 5 yd^3	2	2	2	5	**11**
Wheel-loader, CAT 988, 8 yd^3	0	1	1	0	**2**
Dump truck, CAT 740, 20 yd^3	5	3	2	12	**22**
Crawler dozer, CAT 238	1	1	1	2	**5**
Truck-mounted seed sprayer	1	1	0	1	**3**
Pickup trucks	2	4	3	3	**12**
Flatbed truck with boom crane	1	1	0	1	**3**
Highway tractor trailer	3	1	4	1	**9**
Water tank truck, off-highway	1	1	1	1	**4**
Water tank truck, on-highway	0	1	0	0	**1**
Concrete pump truck w/ boom and hosing	1	1	1	1	**4**
Concrete trucks	2	2	2	2	**8**
Wheel-mounted asphalt paver	0	1	0	0	**1**
Vibratory compactor	0	1	0	0	**1**
Engine generator, 6.5 KW	1	1	3	1	**6**
Engine generator, 10 KW	1	1	2	1	**5**
Air compressor, 100 psi	3	2	3	2	**10**
Air compressor, 150 psi	0	1	0	0	**1**
Air-track drill, 4” hole	0	1	1	1	**3**
Pavement breaker	3	2	3	2	**10**
Acetylene torch	3	2	3	2	**10**
Submersible pump, 4-inch	3	2	5	4	**14**
Highway dump truck	0	0	0	1	**1**

Alternative 3 - Partial Facilities Removal of Four Dams
Summary Estimate of Equipment Required

Equipment	J.C. Boyle	Copco No. 1	Copco No. 2	Iron Gate	Total
Lattice boom crane, 160'	1	1	1	1	**4**
Hydraulic yard crane, 40'-60'	2	2	2	2	**8**
Hydraulic excavator w/ Hoe Ram attachment	1	2	2	1	**6**
Hydraulic excavator, CAT 244-321 hp	2	2	2	2	**8**
Hydraulic excavator, CAT 513 hp	1	0	0	1	**2**
Wheel-loader, CAT 966, 5 yd^3	2	2	2	5	**11**
Wheel-loader, CAT 988, 8 yd^3	0	1	1	0	**2**
Dump truck, CAT 740, 20 yd^3	5	3	2	12	**22**
Crawler dozer, CAT 238	1	1	1	2	**5**
Truck-mounted seed sprayer	1	1	0	1	**3**
Pickup trucks	2	4	3	3	**12**
Flatbed truck with boom crane	1	1	0	1	**3**
Highway tractor trailer	2	1	4	1	**8**
Water tank truck, off-highway	1	1	1	1	**4**
Water tank truck, on-highway	0	1	0	0	**1**
Concrete pump truck w/ boom and hosing	1	1	1	1	**4**
Concrete trucks	2	2	2	2	**8**
Wheel-mounted asphalt paver	0	1	0	0	**1**
Vibratory compactor	0	1	0	0	**1**
Engine generator, 6.5 KW	1	1	3	1	**6**
Engine generator, 10 KW	1	1	2	1	**5**
Air compressor, 100 psi	2	2	3	2	**9**
Air compressor, 150 psi	0	1	0	0	**1**
Air-track drill, 4" hole	0	1	1	1	**3**
Pavement breaker	2	2	2	2	**8**
Acetylene torch	2	2	2	2	**8**
Submersible pump, 4-inch	3	2	5	4	**14**
Highway dump truck	0	0	0	1	**1**

Alternative 4 - Fish Passage at Four Dams
Summary Estimate of Equipment Required

Equipment	J.C. Boyle	Copco No. 1	Copco No. 2	Iron Gate	Total
Lattice boom crane, 160’	1	1	1	1	**4**
Tower crane & bucket	0	1	0	1	**2**
Hydraulic yard crane, 40'-60'	2	2	2	2	**8**
Hydraulic excavator w/ hoe ram attachment	1	1	1	1	**4**
Hydraulic excavator, CAT 244-321 hp	1	1	1	1	**4**
Wheel-loader, CAT 966, 5 yd^3	1	1	1	1	**4**
Dump truck, CAT 740, 20 yd^3	2	1	2	2	**7**
Crawler dozer, CAT 238	1	1	1	1	**4**
Pickup trucks	2	3	2	3	**10**
Highway tractor trailer	1	1	1	1	**4**
Water tank truck, off-highway	1	1	1	1	**4**
Concrete pump truck w/ boom and hosing	1	1	1	1	**4**
Concrete trucks	3	6	3	4	**16**
Vibratory compactor	1	1	1	1	**4**
Engine generator, 6.5 KW	1	1	1	1	**4**
Portable generator, 1 KW	2	2	2	2	**8**
Air compressor, 100 psi	2	2	2	2	**8**
Pavement breaker	1	1	1	1	**4**
Acetylene torch	1	1	1	1	**4**
Submersible pump, 4-inch	2	2	2	2	**8**
Highway dump truck	1	1	1	1	**4**

Alternative 5 - Full Removal of Iron Gate and Copco 1 Dams with Fish Passage at Copco 2 and JC Boyle Dams
Summary Estimate of Equipment Required

Equipment	J.C. Boyle	Copco No. 1	Copco No. 2	Iron Gate	Total
Lattice boom crane, 160’	1	1	1	1	**4**
Hydraulic yard crane, 40'-60'	2	2	2	2	**8**
Hydraulic excavator w/ Hoe Ram attachment	1	2	1	1	**5**
Hydraulic excavator, CAT 244-321 hp	1	2	1	2	**6**
Hydraulic excavator, CAT 513 hp	0	0	0	1	**1**
Wheel-loader, CAT 966, 5 yd^3	1	2	1	5	**9**
Wheel-loader, CAT 988, 8 yd^3	0	1	0	0	**1**
Dump truck, CAT 740, 20 yd^3	2	3	2	12	**19**
Crawler dozer, CAT 238	1	1	1	2	**5**
Truck-mounted seed sprayer	0	1	0	1	**2**
Pickup trucks	2	4	2	3	**11**
Flatbed truck with boom crane	0	1	0	1	**2**
Highway tractor trailer	1	1	1	1	**4**
Water tank truck, off-highway	1	1	1	1	**4**
Water tank truck, on-highway	0	1	0	0	**1**
Concrete pump truck w/ boom and hosing	1	1	1	1	**4**
Concrete trucks	3	2	3	2	**10**
Wheel-mounted asphalt paver	0	1	0	0	**1**
Vibratory compactor	1	1	1	0	**3**
Engine generator, 6.5 KW	1	1	1	1	**4**
Engine generator, 10 KW	0	1	0	1	**2**
Air compressor, 100 psi	2	2	2	2	**8**
Air compressor, 150 psi	0	1	0	0	**1**
Air-track drill, 4” hole	0	1	0	1	**2**
Pavement breaker	1	2	1	2	**6**
Acetylene torch	1	2	1	2	**6**
Submersible pump, 4-inch	2	2	2	4	**10**
Highway dump truck	1	0	1	1	**3**
Tower crane and bucket	1	0	1	0	**2**
Portable generator, 1 KW	2	0	2	0	**4**

Attachment B. Department of Interior's and Department of Commerce's Filing of Modified Terms, Conditions, and Prescriptions (Klamath Hydroelectric Project, No. 2082) Mandatory Conditions for Fish Passage

The following modified general prescriptions for fishways apply to each of the Services' specific prescriptions for the construction, operation, and maintenance of upstream and downstream fishways at the Project[5].

1.1.1. *Design and Construction Plans:* For each facility, the Licensee shall develop detailed design, construction, evaluation, and monitoring plans for review and approval by the Services prior to construction. All original plans, and subsequent modifications of facilities, shall be conducted according to NMFS guidelines for the design of fish screens, fishways, and other fish passage structures (National Marine Fisheries Service 1997, 2004). The Licensee, or their authorized and qualified agent(s),[6] shall have all designs reviewed by the Fisheries Technical Subcommittee (FTS) (which is to be established by the Services and comprised of engineers, biologists, and other fish passage specialists). The Licensee and its agents must establish close consultation with the Services' fisheries engineering and fish passage specialists at the outset of design and throughout the entire process. The initial design meetings shall commence at the pre-design or conceptual level design phase. Prior to advancing to feasibility-level of design, the Licensee must obtain concurrence from the Services with all preferred alternatives for each7 independent facility, or any major feature of a facility. The Licensee shall then proceed with the feasibility and final design phases providing detailed design, specification, and construction plans at the 50, 90, and 100 percent stage of completion. The Licensee shall schedule and provide a minimum of 90 days for the Services to review and approve comprehensive plans. Shorter review periods may be possible, depending on the nature of the subject, as approved by the Services. The Licensee shall implement any design modifications as required by the Services as necessary to fulfill the objective of safe, timely, and effective passage for all species considered.

[5] The following are taken from the DOI and DOC's "Modified Prescriptions for Fishways and Alternatives Analysis Pursuant to Section 18 and Section 33 of the Federal Powers Act for the Klamath Hydroelectric Project (FERC Project No. 2082), January 2007"

[6] "Authorized agents" will typically be qualified engineering and/or biological consulting firms who specialize in this area of work

1.1.2. *Access to Developments and Records*: The Licensee shall provide timely site access to the Services, CDFG, ODFW, and affected Tribes at all Klamath River Hydroelectric project developments, as well as pertinent Project records for the purpose of inspecting fishways to determine compliance with this fishway prescription.

1.1.3. *Maintenance Requirement*: The Licensee shall keep all fishways in proper order, and shall keep all fishway areas clear of trash, sediment, logs, debris, and other material that would hinder fish passage, or create a personnel safety hazard. The Licensee shall perform anticipated maintenance well in advance of any critical migratory periods so that fishways can be tested, inspected, and be operating effectively during fish migration. If any fishway system becomes seriously damaged or inoperable, the Licensee shall notify NMFS Engineering and the Service within 48 hours. The Licensee shall take remedial action in a timely manner and in a manner satisfactory to NMFS Engineering and the Service. Fish passage facilities shall be completed, and brought on line, in a phased schedule. This will allow appropriate time and sequencing for design, contracting, construction, and in some cases, studies of the optimal design for tailrace barriers, or other facility enhancements not immediately apparent. Unless otherwise approved, downstream fishways (screens, bypasses, and spillway modifications) at each development must be complete prior to the completion of the upstream fishway at any given development. The designs approved by the Services shall be filed with the Commission.

1.1.4. *Fishway Operation, Inspection, and Maintenance Plans:* The Licensee shall, in consultation with the Services, affected Tribes, CDFG, and ODFW, develop fishway operation, inspection, and maintenance plans describing anticipated operation, inspections, maintenance, schedules, inspections, and contingencies for each fish passage facility. The operation, inspection, and maintenance plans shall be submitted to the Service and NMFS Engineering for final review at the same time as final designs for fishway construction. To minimize fish losses, the Licensee must complete these plans and ensure adequate time for review and approval by the Service and NMFS Engineering prior to the completion of construction and operation of each upstream and downstream fish passage facility. After approval by the Services, the Licensee shall file these plans with the Commission.

1.1.5. *Post Construction Fishway Evaluation Plans:* Prior to the completion of construction of the new fishways, the Licensee shall, in consultation with the Services, ODFW, CDFG, and affected Tribes, develop post-construction monitoring and evaluation plans to assess the effectiveness of each fishway, spillway, and tailrace barrier prescribed below. The plans shall include hydraulic, water quality, and biological evaluations using Passive Integrated Transponder (PIT) or similar technology to detect and record fish passage and assess the performance of the fishway, including measures for follow-up evaluations of

effectiveness and fish survival through fishways. The Licensee shall provide a report to the Services on the monitoring and evaluation of the developments annually for the term of the new license.

Specifically, the plans shall include measures to estimate numbers of fish passed by species on a daily basis (including but not limited to spring-run and fall-run Chinook salmon, coho salmon, steelhead, Pacific lamprey, Lost River and shortnose suckers, and redband/rainbow trout), sampling of fish size, and the sampling of age class of fish passed at each development on a daily basis; a record of the daily observations by a qualified fisheries biologist on the physical condition of the fish using the fishways; and a continuous record of DO (dissolved oxygen) and water temperature at locations in the fishway as determined by the Services, and in front of and adjacent to the entrance(s) and exit(s) of the fishways; and an implementation schedule. The evaluation plans shall be submitted to the Services for final review and approval within six months of the date when final designs for fishway construction are approved by the Services. At least 60 days shall be provided for the Services to review the evaluation plans. The Licensee shall fund and implement the approved plans and any plan modifications, and operational or physical changes necessary for the safe, effective, and timely passage of fish as may be required by the Services. After approval by the Services, the Licensee shall file these plans with the Commission.

1.1.6 *Fishway Evaluation and Modification Plans:* The Licensee shall, in consultation with the FTS, prepare a Fishway Evaluation and Modification Plan (FEMP) for each fishway, spillway, and tailrace barrier prescribed to achieve the Services' fish passage goals and objectives. The Licensee shall provide an outline of the FEMPs to the Services no later than one year after license issuance. Consultation with the Services, CDFG, ODFW, and affected Tribes shall begin as soon as fishways are operational. The Licensee shall document all consultation, including the agencies' responses to requests for consultation, and include this documentation in the FEMPs. The complete FEMPs shall be submitted to the Services for review and approval no later than eighteen months from the date of license issuance. At least 60 days shall be provided for review. After receiving the Services' approval, the Licensee shall file the FEMPs with the Commission.

A. Each FEMP shall include:

1. A specifically quantified program to meet the Services' fish passage goals, objectives, and strategies;

2. The Services' criteria by which to measure progress towards fisheries management goals;

3. Procedures for redirecting effort, including funding, as necessary under adaptive fishway management to achieve the Services' goals and objectives;

4. A schedule for implementation of activities to achieve the Services' goals and objectives;

5. A monitoring plan to evaluate progress towards, and achievement of, the Services' goals and objectives; and

6. A format for the Annual Report and Annual Work Plan, which are described below.

B. The Services, in consultation with the ODFW, CDFG, and affected Tribes, will review the FEMPs and reserve the right to accept, reject, or modify the FEMPs, in whole or in part, to ensure the safe, timely, and effective passage of resident and anadromous fish. Any reviews or amendments to the FEMPs, over the term of the license, shall be subject to the same level of the Services' review and approval as the original FEMPs. After receiving the Services' approval, the Licensee shall file with the Commission FEMPs and any amendments therein.

C. By February 1 of every year, for the term of the License and all annual licenses, the Licensee shall submit to the Services for approval an Annual Report detailing the work accomplished under the FEMPs during the previous calendar year, progress made toward program goals and objectives, plans or suggestions to redirect effort per adaptive fishway management with a detailed justification of why this is warranted, and documentation of consultation with the Services and their responses. After receiving the Services' approval, the Licensee shall submit each Annual Report to the Commission.

D. By December 1 of every year, for the term of the License and all annual licenses, the Licensee shall submit to the Services for approval an Annual Work Plan detailing the Licensee's proposed activities for the next calendar year as necessary to implement the FEMPs. The work plan must provide sufficient detail for the Services to determine whether the Plan continues to provide for the safe, effective, and timely passage of resident and anadromous fish. The Annual Work Plan shall include, but not be limited to, detailed information on methods to be employed; schedule of activities; and explanations of how planned activities will help attain program goals. After receiving the Services' approval, the Licensee shall submit each Annual Work Plan to the Commission.

1.1.7. *Upstream Fishway Attraction Flows and Range of Design Flow*: The following general prescriptions for design flow ranges and attraction flows for fishways

apply to each of the specific prescriptions below for the construction, operation, and maintenance of upstream fishways at the Project. These prescriptions are included to ensure the effectiveness of the fishways. If other mandatory license conditions or regulatory conditions require greater flows, the Licensee shall provide attraction flows and design flows consistent with those greater flows.

A. Design Streamflow Range

In consultation with the FTS and the Services and according to the terms of Modified General Prescriptions applicable to facility designs, the Licensee shall design each upstream fish passage facility to pass migrants throughout a design streamflow range, bracketed by a designated High and Low Fish Passage Design Flow, in accordance with NMFS guidelines and criteria (National Marine Fisheries Service 2004), unless site-specific analysis conducted in consultation with the Services and results approved by the Services demonstrate a more suitable flow that meets the objectives of safe, timely, and effective fish passage.

B. Project-Specific Fishway Attraction Flows

Fishway attraction flow is the total amount of flow discharged from the fishway entrance pool at any given time. The Licensee shall design, construct, operate, maintain, and evaluate physical facilities for each upstream passage facility to produce attraction flow equal to at least 10 percent of High Fish Passage Design Flow determined in accordance with NMFS guidelines and criteria (National Marine Fisheries Service 2004), as measured at a point upstream of the hydropower diversion, unless site specific analysis conducted in consultation with the Services and the results approved by the Services, demonstrate a more suitable flow that meets the objectives of safe, timely, and effective fish passage. After approval by the Services, the Licensee shall file with the Commission the results of any such site-specific analyses that demonstrate a more suitable flow that meets the objectives of safe, timely, and effective fish passage.

During facility evaluations, the Licensee may alter or balance attraction flows for testing purposes between the range of 5 percent and 10 percent, in order to determine whether fish passage efficiency can be maintained at a lower attraction flow.

C. Bypass Channel Attraction Flows and Conditions

For the Copco II and J.C. Boyle bypass channels, the Licensee shall, in consultation with the Services, design, construct, operate, maintain, and evaluate physical structures, facilities, devices or channel modifications necessary to ensure that migrating anadromous fish are consistently attracted into the bypass reach without excessive delays, unless the Services determine based on site-specific evaluations that such physical facilities or channel modifications are unnecessary. The Licensee shall conduct engineering and biological analysis in consultation with the FTS and the Services during the facility design phase for Copco II and J.C. Boyle facilities, to determine the attraction flow and hydraulic conditions at the point of confluence between the fishway bypass reach and the hydropower discharge. Based on these analyses, or other analyses of fishway

effectiveness conducted under applicable prescriptions, the Licensee shall determine, in consultation with the Services, any physical facilities or channel modifications necessary to ensure that migrating anadromous fish are consistently attracted into the bypass reach without excessive delays.

Modified Specific Fishway Prescriptions for Klamath Hydroelectric Project Fishways

All modified general prescriptions above shall apply to the specific prescriptions below. The modified prescriptions for developments in the Project are summarized in Table 4.

In the Preliminary Prescriptions, the Services provided the rationale and scientific evidence providing the basis for the prescriptions. The Applicant subsequently submitted a request for hearing on disputed issues of material fact related to the preliminary prescriptions pursuant to the Federal Power Act as amended by the Energy Policy Act of 2005 (see 43 C.F.R. Part 41 and 50 C.F.R. Part 221), in which the Applicant disputed facts supporting the Services' prescriptions. After an evidentiary hearing that included direct written testimony, live cross-examination, some re-direct examination, and submission of thousands of pages of scientific studies and other evidence, the Administrative Law Judge (ALJ) in his decision made Preliminary and Ultimate Findings of Fact and Conclusions of Law, citing to the evidence submitted in the trial-type hearing process. The Modified Prescriptions incorporate by reference all of the scientific evidence cited by the Services in their preliminary prescriptions; in addition, the Services provide additional or revised discussions below in the Modified Specific Prescriptions that are based on relevant ALJ Findings, including short form citation to the relevant Findings. Where the Modified Specific Prescriptions reference the ALJ's Findings, the underlying citations to those Findings incorporate by reference supporting evidence and testimony developed in the hearing process. These citations offer further scientific support to the Services' prescriptions. These prescriptions also conform to a stipulation reached in the trial-type hearing regarding spillway modifications and tailrace barriers.

1. Iron Gate Dam

Upstream Prescription Rationale: Historically coho salmon, steelhead, and spring-run and fallrun Chinook salmon (Hamilton et al. 2005; ALJ Decision at 12, FOF 2A-3 through 2A-6) and resident trout migrated above the site of Iron Gate Dam to reach holding, spawning, incubation, and rearing habitat. Iron Gate Dam is a barrier to this passage and thus to suitable habitat in perennial streams such as Fall and Jenny Creeks (ALJ Decision at 34, FOF 6-11; ALJ Decision at 35, FOF 7-9), intermittent streams such as Camp and Scotch Creeks (ALJ Decision at 12, FOF 2A-5; ALJ Decision at 34, FOF 6-14; ALJ Decision at 35, FOF 7-9), and the main stem (ALJ Decision at 33, FOF 6-10; ALJ Decision at 35, FOF 7-9). The goal of the Services and the Klamath River Basin Fisheries Task Force is to successfully restore anadromous salmonids to their historical range and suitable habitat. A goal of the Service is to successfully restore resident fish to their historical range and suitable habitat as well. The means of reaching these goals is restoration of safe, timely, and effective fish movement. Volitional fish passage at Iron Gate Dam would be consistent with the goals and objectives of the Services and the Klamath River Basin Fisheries Task Force for resource management. These goals will be met with the provision of effective facilities, which will mitigate for the impacts of the dam. A holding, sorting, and

counting facility is necessary to segregate and mark fish for management purposes. The 5 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

Table 4. Summary of Modified Fishway Prescriptions and Timetable for the Klamath Hydroelectric Project (Commission Project #2082)

Development	***Target Species***	***Fish ladder and Passage Impediment Modification (In Chronological Order)***	***Tailrace Barrier[1]***	***Screens and Bypass***	***Spillway Modifications[1]***	***Interim, Seasonal Trap and Haul***
Copco 2 Bedrock Sill	Salmonids (includes Resident trout), lamprey	2 yrs (Bypass Barrier/Impediment Elimination)	Not Applicable (NA)	NA	NA	NA
J.C. Boyle (Bypass)	Salmonids, lamprey	2 yrs (Bypass Barrier/Impediment Elimination)	NA	NA	NA	NA
Eastside	Salmonids, lamprey, suckers	Reclamation current facility	3 yrs[2]	3 yrs[3] (to sucker criteria)	NA	Seasonal downstream trapping and hauling for Chinook
Westside	Salmonids, lamprey, suckers	Reclamation current facility	3 yrs[2]	3 yrs[3] (to sucker criteria)	NA	Seasonal downstream trapping and hauling for Chinook
Fall Creek	Resident trout	3 yrs (0.5 ft/drop and ≤ 10%)	5 yrs[4]	3 yrs	NA	NA
Spring Creek	Resident trout	3 yrs (0.5 ft/drop and ≤ 10% slope)	NA	3 yrs	NA	NA
Keno	Salmonids, lamprey	3 yrs (0.5 ft/drop and ≤ 10% slope)	NA	NA	3 yrs	Seasonal upstream trapping and hauling for Chinook
J.C. Boyle	Salmonids, lamprey	4 yrs (0.5 ft/drop and ≤ 10% slope)	4 yrs	4 yrs	4 yrs	NA
Iron Gate	Salmonids, lamprey	5 yrs (0.5 ft/drop and ≤ 10% slope)	NA	5 yrs	5 yrs	Modify existing trapping facility
Copco 2	Salmonids, lamprey	6 yrs (0.5 ft/drop and ≤ 10% slope)	8 yrs[4]	6 yrs	6 yrs	NA
Copco 1	Salmonids, lamprey	6 yrs (0.5 ft/drop and ≤ 10% slope)	8 yrs[4] (if adults in C2 pool)	6 yrs	6 yrs	NA

[1] As described in detail below, in accordance with a stipulation with the Applicant, the Services have revised the prescriptions for spillway modifications and tailrace barriers in the Modified Prescriptions to allow the Applicant to conduct site-specific studies on the need for and design of spillway modifications.
[2] Study of impacts to and the potential design and construction of tailrace barrier is given priority due to the presence of federally listed suckers.
[3] Screen and bypass system given priority due to the presence of federally listed suckers.
[4] Timing of Tailrace Barrier design and construction deferred for study to determine optimal design.

Benefits: Specific benefits of fishways at Iron Gate Dam include:

- Resident Trout: For the resident redband trout currently present both above and below Iron Gate Dam, fishways would restore historical seasonal movement for immature fish, restore population connectivity and genetic diversity, and allow greater utilization of existing habitat and refugial areas. Fish passage at Iron Gate Dam alone would restore the connectivity of resident redband populations in the mainstem Klamath River with those in the Copco 2 bypassed channel and Slide, Scotch, Camp, Jenny, Salt, and Fall Creeks. These tributaries also provide important habitat elements, such as spawning and temperature related refugial areas. In particular, Fall Creek provides a steady volume of high quality water and historically provided good habitat for resident fish, including rainbow/redband trout, Klamath small-scaled suckers (*Catastomus rimiculus*), and Klamath sculpin (*Cottus klamathensis*) (Coots 1957). With fish passage, seasonal migration of trout and access to refugial areas would be restored.

- Coho: Coho salmon are present in the Klamath River below Iron Gate Dam and were present historically above the dam. Iron Gate Dam blocks these fish species from reaching elements of their historical habitat. Between Iron Gate Dam and the next barrier upstream (Copco 2 Dam), access to habitat would benefit coho salmon by: a) extending the range and distribution of the species, thereby increasing the reproductive potential; b) increasing genetic diversity in the coho stocks; c) reducing the species vulnerability to the impacts of degradation; and d) increasing the abundance of the coho population (ALJ Decision at 86, Ultimate Finding of Fact 9; ALJ Decision at 36, FOF 7-16). National Research Council (National Research Council 2003) considered the amount of tributary habitat between Iron Gate Dam and the next barrier upstream to be substantial. Coho salmon were reported in Scotch Creek in 1950 (California Department of Fish and Game 2006) and are known to have spawned in Fall Creek (California Department of Water Resources 1964; Coots 1954; Coots 1957; Coots 1962). In both 1951 and 1952, at least 10 adult coho spawned in Fall Creek and greater than 29,600 young of the year and juvenile coho salmon outmigrated in 1954 (Coots 1954). Little documentation is available for Slide, Camp, and Jenny Creeks, but the lower reaches of these streams are relatively low gradient and appear to be suitable coho habitat. With fish passage, coho will likely have access to this habitat and access to refugial areas would be restored.

- Fall-run Chinook: With fish passage at Iron Gate Dam, fall-run Chinook salmon access would be restored to 11.1 miles of habitat, including Scotch, Camp, Jenny, and Fall Creeks (Table 3 of the Preliminary Prescription, hereafter referred to as Table 3) between Iron Gate Dam and the next barrier upstream (Copco 2 Dam). Prior to the construction of Iron Gate Dam, escapement of Chinook salmon to Jenny and Fall Creeks averaged 215 and 1,384 adults, respectively, from 1950 to 1960 (Coots 1957; Coots 1962; Coots and Wales 1952; Wales and Coots 1954). With fish passage, fall-run Chinook will again have access to this habitat. Seasonal migration of fall-run Chinook and access to refugial areas would be restored.

- Spring-run Chinook: With fish passage at Iron Gate Dam, spring-run Chinook salmon would regain access to cool water refugial areas necessary for this run of fish (McCullough 1999) such as Fall Creek. Spring-run Chinook would also regain access to upstream migration corridors necessary to reach historical spawning areas in the Upper Klamath Basin (California Department of Fish and Game 1990).

- Pacific Lamprey: With fish passage at Iron Gate Dam, Pacific lamprey would gain access to habitat, including tributaries and the Copco 2 bypass reach (Table 3) between Iron Gate Dam and the next barrier upstream (Copco 2 Dam). Although the historical upstream distribution of Pacific lamprey is unknown, suitable habitat for spawning and juvenile rearing is available within tributaries and stream reaches in the Project area (ALJ Decision at 37, FOF 8-3). Access to habitat would benefit Pacific lamprey by increasing their viability through: a) extending the range and distribution of the species; b) providing additional spawning and rearing habitat; c) increasing the genetic diversity of the species; and d) increasing the abundance of the Pacific lamprey population (ALJ Decision at 38, FOF 8-9).

- Steelhead: With fish passage at Iron Gate Dam, steelhead would regain access to 13.7 miles of habitat, including tributaries and the Copco 2 bypass reach (Table 3), between Iron Gate Dam and the next barrier upstream (Copco 2 Dam). Adult steelhead have been documented in Fall Creek (Coots 1957, 1962). During 1951–1952, 471 steelhead spawners were counted in Fall Creek and between January and April 1954, more than 6,500 fry and 1,200 yearling steelhead emigrated from Fall Creek (Coots 1954). Steelhead have also been reported in Scotch and Camp creeks (California Department of Fish and Game 2006). Steelhead are generally tributary spawners and able to access reaches of tributaries upstream from areas where salmon spawn (Platts and Partridge 1978). Therefore, with fish passage, steelhead would have access to habitat in its entirety in tributaries above Iron Gate Dam. Steelhead would have access to 13.7 miles of habitat including Scotch, Camp, and Fall Creeks (ALJ Decision at 12, FOF 2A-5) as well as Slide and Jenny creeks. Seasonal migration of steelhead and access to refugial areas would be restored.

Downstream Prescription Rationale: Downstream fishways as modified herein are prescribed for Iron Gate Dam. Redband/rainbow trout and other resident fish (including federally listed suckers) are currently present in Iron Gate Reservoir. The Services conclude that trout (in particular fry and juveniles) move downstream (Hemmingsen 1997), a significant portion move through the powerhouse, and turbine entrainment at Iron Gate Dam causes significant mortality to downstream migrating redband trout (see discussion of turbine-caused mortality later in this paragraph). In addition, with the construction of a functional adult fish ladder at Iron Gate Dam, salmon and steelhead would return to hold, spawn, and rear in habitat where they were present historically (Hamilton et al. 2005, ALJ Decision at 12, FOF 2A-3 through 2A-6; ALJ Decision at 14, FOF 2A-12). However, the progeny of these fish must negotiate not only the reservoir but the dam, powerhouse, and spillway during their outmigration. Migration is one of several defining life history characteristics of resident trout and anadromous fish, especially salmonids (ALJ Decision at 27, FOF 3-7; ALJ Decision at 13, FOF 2A-10). To ensure that the fish can outmigrate, downstream passage through the dam, powerhouse, and spillway is necessary.

Unless protected by fish screening and bypass systems, fish migrating downstream can suffer injury or death by passing through turbines at hydroelectric plants (Electric Power Research Institute 1987). Turbine caused mortality can have serious consequences for fish populations, especially among anadromous species (Cada 2001). Survival of juvenile salmonids passing dams during their seaward migration is highest through spillways and lowest through turbines (Muir et al. 2001), turbine mortality being caused by pressure changes, cavitation, shear stress, turbulence, strike, and grinding (Cada 2001). The Electric Power Research Institute (Electric Power Research Institute 1987) reported that Francis turbines, which are used at Iron Gate Dam, had average mortality to downstream moving fish of about 24 percent. In light of the foregoing evidence, the Services conclude that turbine entrainment at Iron Gate Dam presently causes a degree of mortality to downstream migrating resident fish comparable to that cited in the studies above and would cause comparable losses of reintroduced anadromous fish populations in the future, absent effective fish screening systems. The Applicant has acknowledged, based on their initial review of other studies, that tens of thousands of resident fish are likely entrained annually at each of the unscreened mainstem Klamath River developments and estimated that between 7 to 21 percent of those fish are killed passing through the Iron Gate Powerhouse ((PacifiCorp 2004a), Exhibit E 4-113). It is estimated that "several tens of thousands of resident fish" are annually entrained at "each of the Projects" facilities (ALJ Decision at 28, FOF 4-2). It is anticipated that annual entrainment of anadromous fish would be on the same order of magnitude, if not greater. Once entrained, the fish face a high risk of mortality. For juvenile fish, the risk is between 10 to 30 percent (ALJ Decision at 29, FOF 4-5). Volitional fish passage would be consistent with fish movement through Klamath River system for purposes such as spawning, rearing, feeding, and seasonal use of habitat, as well as ensuring that the goals and objectives of the Klamath River Basin Fishery Task Force and the Services for resource management are met. The 5 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

Spillway Prescription Rationale: Spill survival estimates for salmonids are numerous and range from 76 percent to 100 percent, depending on species, life stage, amount or proportion of water spilled, spillway configuration, tailwater hydraulics, the methodology of estimating survival, and predator conditions (National Marine Fisheries Service 2000). Fish passing down a spillway may experience physical, chemical, and biological effects. Turbulent mixing of spilled water with receiving waters may result in gas supersaturation and resultant gas bubble disease in fish. Dissolved nitrogen concentrations of more than 130 percent of normal equilibrium levels have been measured in tailwaters on the Columbia River (Ebel and Raymond 1976). The threshold value for significant mortality among juvenile Chinook salmon and steelhead trout occurs when nitrogen gas levels are about 115 percent of normal. Along the Columbia River, where many spillways discharge from a given dam and there are many consecutive dams along the stream course, supersaturation increases cumulatively from one dam to the next. Losses of salmon and steelhead trout in this river due to supersaturation have been severe in years of high spillage (Ebel and Raymond 1976). Fish passing over spillways can be injured by strikes or impacts with solid objects (e.g., baffles, rocks, or walls in the plunge zone), rapid pressure changes, abrasion with the rough side of the spillway, and the shearing effects of turbulent water. Given the steepness and configuration of the Iron Gate Dam spillway, the Services conclude that spillway

mortality will likely occur at levels near the high end of the range found in the studies above. Therefore, a 5 year timeline is necessary to meet resource goals and objectives as quickly as possible.

In the Preliminary Prescriptions, the Services based specific spillway prescriptions on the evidence cited above. In its request for hearing on disputed issues of material fact, the Applicant disputed facts supporting the spillway prescriptions. The Applicant subsequently withdrew its request for hearing regarding spillway prescriptions based on a stipulation with the Services (In the Matter Of: Klamath Hydroelectric Project, Docket Number 2006-NMFS-0001, Order Granting the Applicant's Motion to Withdraw USFWS/NMFS Issues 5 and 9, September 14, 2006 (Administrative Law Judge 2006b)). In accordance with the stipulation, the Services have revised the spillway prescriptions in the Modified Prescriptions below to allow the Applicant to study the need for and design of spillway modifications for anadromous and native resident fish. The Applicant must perform any such studies in consultation with the Services, and provide the results of any such studies to the Services for approval before design and construction of the spillway modifications in order to inform the need for and design of spillway modifications. However, unless and until such site-specific studies are done, the Services must rely on the available information in concluding that spillway modifications are necessary for the safe, timely, and effective fish passage where prescribed.

Tailrace Barrier: The Services have not prescribed the construction of tailrace barriers at Iron Gate Dam because anadromous and resident fish are currently present below the dam and the Services are aware of no reported problems with fish injury or delay during upstream migration to the hatchery.

Iron Gate Dam Upstream Fishway

1.1 Iron Gate Dam Upstream Fishway

1.1.1 *Fishway Design Features and Performance Standards*: The Licensee shall construct, operate, maintain, and evaluate a volitional fishway at Iron Gate Dam to provide for the safe, timely, and effective upstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The fishway shall be operated year-round and shall consist of a fish ladder designed in accordance with NMFS criteria for anadromous fish (National Marine Fisheries Service 2004) or alternative criteria for other species approved by the Services. The ladder shall provide for the uninterrupted passage of fish over the full range of river flows for which the Project maintains operational control. The ladder shall have a minimum of two entrances and associated entrance pools. An auxiliary water system (AWS) shall be designed to augment ladder flow from the forebay, or a suitable alternative source. The AWS shall be screened in accordance with NMFS juvenile fish screen and bypass criteria (National Marine Fisheries Service 1997) or such alternative criteria as may be determined acceptable to the Services. The AWS shall be designed to provide the suitable water quality and quantity to effectively attract fish.

The fish ladder and AWS together must be designed to supply attraction flows according to the terms of Modified General Prescriptions 1.1.7. The ladder shall have a maximum drop between pools of 0.5 ft and the maximum slope of the fish ladder shall not exceed 10 percent (Table 1 in Preliminary Prescription herein referred to as Table 1). The ladder shall include features to detect and record data for PIT-tagged (or fish identified using similar technology) upstream migrating fish. The construction shall include features to modify the existing development to hold, count, and mark fish and to sort fish by age, species, and origin for the purposes of fish population restoration and management. The upstream fishway shall be constructed to current criteria for passage of Pacific lamprey and the existing ladder to the CDFG trap and holding tanks shall be modified to current criteria (Table 1) for lamprey passage and resident trout passage. The Licensee shall complete construction and begin operation of the fishway within 5 years of the issuance of the new license.

1.1.2 *Design Consultation*: The ladder design shall include features to detect and record data for PIT-tagged upstream migrating fish (or fish identified using similar technology). The Licensee shall develop design and construction plans according to the terms of Modified General Prescriptions 1.1.1 above within 2 years of the issuance of a new license for review and approval by the Services prior to construction. The design shall include features to modify the existing development to hold, count, and mark fish; and to sort fish by age, species, and origin for the purposes of fish population restoration and management.

1.1.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

1.2 Iron Gate Dam Downstream Fishway

1.2.1 *Intake Fish Screens and Bypass Facilities*: The Licensee shall, to provide for the safe, timely, and effective downstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout, construct, operate, maintain, and evaluate a fish screen and bypass facility for volitional fish passage at Iron Gate Dam. The screens and bypass shall be operated year-round and shall be designed in accordance with NMFS juvenile fish screen criteria (National Marine Fisheries Service 1997) or alternative criteria as determined by the Service and NMFS Engineering. The screens and bypass shall provide for the uninterrupted passage of fish over the full range of river flows for which the Project maintains operational control. The bypass facility shall include features to detect and record data for PIT-tagged downstream migrating fish (or fish identified

using similar technology). The Licensee shall complete construction and begin operation of the fishway within 5 years of the issuance of the new license.

1.2.2 *Design Consultation*: The bypass facility design shall include features to detect and record data for PIT-tagged downstream migrating fish (or fish identified using similar technology). The Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 2 years of the issuance of the new license for review and approval by the Service and NMFS prior to construction.

1.2.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

1.3 Iron Gate Spillway

1.3.1 *Spillway Modification*: Unless the Services determine based on site specific studies that spillway modifications are unnecessary in accordance with Modified Specific Prescriptions 1.3.2 and 1.3.3, the Licensee shall modify, maintain, and evaluate hydraulically-engineered spillway modifications to improve volitional downstream fish passage at Iron Gate Dam for Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The purpose of all spillway modifications is to improve hydraulic conditions and overall fish passage conditions on the downstream side of the dam, to prevent false attraction to non-passable areas, and to make the entrance of the fishway more accessible. The spillway modifications shall be constructed and operational within 5 years of the issuance of the new license.

1.3.2 *Spillway Modification Studies*: The Licensee may, in consultation with the Services, study the need for and design of hydraulically-engineered spillway modifications to improve volitional downstream fish passage at Iron Gate Dam for Chinook and coho salmon, steelhead trout, Pacific Lamprey, and redband trout. The Licensee shall submit a plan for any such studies to the Services for review and approval prior to conducting studies. After approval of any such plan, the Licensee shall complete the studies and submit study results and recommendations on the need for and design of spillway modifications for review and approval by the Services consistent with the provisions for timing of the spillway design consultation under Modified Specific Prescriptions 1.3.3.

1.3.3 *Spillway Design Consultation:* Unless the Services determine based on site-specific studies that spillway modifications are unnecessary in accordance with Modified Specific Prescriptions 1.3.2, within 3 years of the issuance of the new license, the Licensee shall develop design and

construction plans according to the terms of the Modified General Prescriptions 1.1.1 above for review and approval by the Service and NMFS Engineering.

1.3.4 *Spillway Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

2. Fall Creek Diversion Dam

The prescriptions for fishways at the Fall Creek Diversion Dam are made solely by the Service. The prescription for the Fall Creek Powerhouse Tailrace Barrier is made jointly by NMFS and the Service.

Upstream Prescription Rationale: There are currently no upstream fish passage facilities at the Fall Creek Diversion Dam for any species ((PacifiCorp 2004b) Fish Resources FTR). This dam is a seasonal or low flow barrier to the upstream movement of fish (Scott Snedaker, BLM pers. comm.). The Applicant has proposed an upstream fishway at this development. The Service's prescription is consistent with this proposal. Redband/rainbow trout are present in Fall Creek below the dam and above the dam. The fish need to be able to move between the two areas to make seasonal use of habitat. Volitional upstream passage would be consistent with the Service goal to successfully restore resident fish to their historical range. One objective of reaching this goal is the restoration of safe, timely, and effective fish movement, and to ensure the Project does not impair future restoration of fish populations in the upper Fall Creek and Klamath River systems. The 3 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

Downstream Prescription Rationale: There are currently no downstream fish passage facilities at the Fall Creek Diversion Dam for any species ((PacifiCorp 2004b) Fish Resources FTR, Exhibit E). The Applicant has proposed a downstream fish screen (but no bypass) at this development. We agree with the Applicant's proposal to screen downstream migrating fish. In addition, a bypass system is needed to guide the movement of redband/rainbow trout and restore historical fish populations in Fall Creek. Redband trout are present above the diversion. The Services conclude that trout (in particular fry and juveniles) move downstream here as they do in the Klamath River system elsewhere (Hemmingsen 1997), a significant portion move through the diversion canal, and that turbine entrainment at the Fall Creek Powerhouse causes significant mortality to downstream migrating redband trout (see the discussion for the Downstream Prescription Rationale for the Iron Gate Dam development). With the 5 cfs proposed for instream flows by the Applicant and the construction of a functional fish ladder at the Fall Creek Diversion Dam, biological connectivity for rainbow trout would be restored to some degree in upper Fall Creek. However, the progeny of these fish must be excluded from the power canal and turbines. Adequate passage conditions would be consistent with the Service's goal of restored fish populations in the Fall Creek system. The 3 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

Fall Creek Powerhouse Tailrace Prescription Rationale: With an upstream fishway at Iron Gate Dam, anadromous fish would migrate to Fall Creek to the powerhouse. Coots (1954; 1957; 1962) reported steelhead, coho, and Chinook salmon in Fall Creek downstream from the powerhouse. Depending on powerhouse operations, draft tube discharge velocities at Project facilities are between 3.4 and 10.4 feet per second (fps) (CH2MHill 2006); these velocities easily fall within the swimming abilities of salmonids (Weaver 1963). The types of injury sustained by some fish entering draft tubes or contacting turbines vary from site to site, as do immediate and delayed mortality rates. Several studies, however, attribute injuries in migrating salmonids to powerhouse structures associated with tailrace structures (Department of Fisheries Canada 1958; International Pacific Salmon Fisheries Commission 1976; Schadt et al. 1985; Williams 1985). To prevent injury or mortality to salmonids caused by attempts to swim upstream into the tailrace, a barrier is required to prevent fish from entering this area (National Marine Fisheries Service 2004). The 5 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

In the Preliminary Prescriptions, the Services based specific tailrace barrier prescriptions on the evidence cited above. In its request for hearing on disputed issues of material fact, the Applicant disputed facts supporting the tailrace barrier prescriptions. The Applicant subsequently withdrew its request for hearing regarding tailrace barrier prescriptions based on a stipulation with the Services (In the Matter Of: *Klamath Hydroelectric Project*, Docket Number 2006-NMFS-0001, Order Granting the Applicant's Motion to Withdraw USFWS/NMFS Issues 5 and 9, September 14, 2006 (Administrative Law Judge 2006b)). In accordance with the stipulation, the Services have revised the tailrace barrier prescriptions in the Modified Prescriptions below to allow time for the Applicant to study the need for and design of tailrace barriers for anadromous and native resident fish. The Applicant must perform any such studies in consultation with the Services, and provide the results of any such studies to the Services for approval before design and construction of the tailrace barriers in order to inform the need for and design of tailrace barriers. However, unless and until such site-specific studies are done, the Services must rely on the available information in concluding that tailrace barriers are necessary for the safe, timely and effective upstream passage of fish at Fall Creek Diversion Dam.

2.1 Fall Creek Diversion Dam Upstream Fishway

2.1.1 *Fall Creek Upstream Fishway*: The Licensee shall construct, operate, maintain, and evaluate a volitional upstream fishway at the Fall Creek Diversion Dam to provide for the safe, timely, and effective upstream passage of rainbow/redband trout. The fishway shall be operated year-round and shall consist of a fish ladder designed in accordance with NMFS criteria (National Marine Fisheries Service 2004) or alternative criteria as determined by the Service. The ladder shall provide for the uninterrupted passage of fish over the full range of Fall Creek flows. The ladder shall have a maximum drop between pools of 0.5 ft and the maximum slope of the fish ladder shall not exceed 10 percent (Table 1). The fishway shall be constructed and operational within 3 years of the issuance of the new license.

2.1.2 *Design Consultation*: The Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 1 year of license issuance for review and approval by the Service prior to construction.

2.1.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

2.2 Fall Creek Diversion Dam Downstream Fishway

2.2.1 *Intake Fish Screens and Bypass Facility*: The Licensee shall construct, operate, maintain, and evaluate a fish screen and bypass facility at the Fall Creek Diversion Dam to provide for the safe, timely, and effective downstream passage of rainbow/redband trout. The screens and bypass facility shall be operated year-round and shall be designed in accordance with NMFS juvenile fish screen and bypass facility criteria (National Marine Fisheries Service 1997) or alternative criteria as determined by the Service. The screens and bypass facility shall provide for the uninterrupted passage of fish over the full range of river flows. The downstream fishway shall be constructed and operational within 3 years of the issuance of the new license.

2.2.2 *Design Consultation*: The Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above, within 1 year of the issuance of the new license, for review and approval by the Service prior to construction.

2.2.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

2.3 Fall Creek Powerhouse Tailrace Barrier

2.3.1 *Tailrace Barrier Construction*: Unless the Services determine, based on site-specific studies, that a tailrace barrier is unnecessary in accordance with Modified Specific Prescriptions 2.3.2 and 2.3.3, the Licensee shall construct a tailrace barrier and guidance system at Fall Creek Powerhouse to provide for the safe and effective protection and guidance of Chinook salmon, coho salmon, steelhead, and redband trout away from the powerhouse. The tailrace barrier and guidance system shall be constructed according to approved design plans and within 5 years of the issuance of the new license.

2.3.2 *Tailrace Barrier Studies*: The Licensee may, in consultation with the Services, study the need for and design of tailrace barriers to protect

upstream migrating Chinook salmon, coho salmon, steelhead, and redband trout at the Fall Creek Powerhouse. The Licensee shall submit a plan for any such studies to the Services for review and approval prior to conducting studies. After approval of any such plan, the Licensee shall complete the studies and submit study results and recommendations on the need for and design of tailrace barriers for review and approval by the Services consistent with the provisions for timing of the tailrace barrier design under Modified Specific Prescriptions 2.3.3

2.3.3 *Tailrace Barrier Design*: Unless the Services determine based on site-specific studies that tailrace barriers are unnecessary in accordance with Modified Specific Prescriptions 2.3.2, the Licensee shall, within 3 years of the issuance of the new license, develop detailed design and construction plans for Service and NMFS Engineering approval for a tailrace barrier and guidance system to protect adult fish according to the terms of the Modified General Prescriptions 1.1.1 above.

2.3.4 *Tailrace Barrier Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

3. Spring Creek Diversion Dam

The prescriptions for fishways at the Spring Creek Diversion Dam are made solely by the Service.

Upstream Prescription Rationale: There are currently no upstream fish passage facilities at the Spring Creek Diversion Dam for any species ((PacifiCorp 2004b) Fish Resources FTR). The Applicant has proposed an upstream fishway at this development. We agree with this action and our prescription is consistent with the Applicant's proposal. Redband/rainbow trout are present in Spring Creek below the dam and above the dam. The fish need to be able to move between the two areas to make seasonal use of habitat. Volitional upstream passage would be consistent with the Service goal to successfully restore resident fish to their historical range. The objective in reaching these goals is the restoration of safe, timely, and effective fish movement, and to ensure the Project does not impair future restoration of fish populations in the upper Spring Creek, Jenny Creek, and Klamath River systems. The 3 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

Downstream Prescription Rationale: There are currently no downstream fish passage facilities at the Spring Creek Diversion Dam for any species ((PacifiCorp 2004b) Fish Resources FTR). The Applicant has proposed a downstream fish screen at this development. We agree with the Applicant's proposal to screen downstream migrating fish. In addition, a bypass system is needed to guide the movement of redband/rainbow trout and restore historical fish populations in Spring Creek. The Service concludes that trout (in particular fry and juveniles) move downstream here as they do in the Klamath River elsewhere (Hemmingsen 1997), a significant portion move through the Spring Creek diversion canal to Fall Creek, and turbine entrainment at

the Fall Creek Powerhouse causes significant mortality to redband/rainbow trout that have originated in Spring Creek (see the discussion for the Downstream Prescription Rationale for the Iron Gate Dam development). Volitional fish passage to a bypass around the Spring Creek Diversion Dam is consistent with the Service goals and objectives for resource management. With minimum flows and the construction of a functional fish ladder at the Spring Creek Diversion Dam, biological connectivity for rainbow trout would be restored to some degree in Spring Creek. However, these fish must be excluded from the power canal and turbines. Adequate passage conditions would be consistent with the Service's goal of restored fish populations in the Spring Creek system. The 3 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

3.1 Spring Creek Diversion Dam Upstream Fishway

3.1.1 *Spring Creek Upstream Fishway*: The Licensee shall construct, operate, maintain, and evaluate a volitional fishway at Spring Creek Diversion Dam to provide for the safe, timely, and effective upstream passage of rainbow/redband trout. The fishway shall be operated year-round and shall consist of a fish ladder designed in accordance with NMFS criteria (National Marine Fisheries Service 2004) or alternative criteria as determined by the Service. The ladder shall provide for the uninterrupted passage of fish over the full range of Spring Creek flows. The ladder shall have a maximum drop between pools of 0.5 ft (Table 1) and the maximum slope of the fish ladder shall not exceed 10 percent (Table 1). The fishway shall be constructed and operational within 3 years of the issuance of the new license.

3.1.2 *Design Consultation*: The Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 1 year of the issuance of the new license for review and approval by the Service prior to construction.

3.1.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

3.2 Spring Creek Diversion Dam Downstream Fishway

3.2.1 *Intake Fish Screens and Bypass Facility*: The Licensee shall construct, operate, maintain, and evaluate a fish screen and bypass facility at the Spring Creek Diversion Dam to provide for the safe, timely, and effective downstream passage of rainbow/redband trout. The screen and bypass facility shall be operated year-round and shall be designed in accordance with NMFS juvenile fish screen and bypass facility criteria (National Marine Fisheries Service 1997) or alternative criteria as determined by the Service. The screens and bypass facility shall provide for the uninterrupted passage of fish over the full range of river flows. The downstream fishway

shall be constructed and operational within 3 years of the issuance of the new license.

3.2.2 *Design Consultation*: The Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 1 year of the issuance of the new license for review and approval by the Service prior to construction.

3.2.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

4. Copco 2 and Copco 1 Dams

Copco 2 and Copco 1 Upstream Prescription Rationale: Historically coho salmon, steelhead, and spring-run and fall-run Chinook salmon (Hamilton et al. 2005; ALJ Decision at 12, FOF 2A-3 through 2A-6) and resident trout migrated above the site of Copco 2 and Copco 1 dams to reach holding, spawning, incubation, and rearing habitat. Copco Dams are a barrier to this passage and thus to suitable habitat in Shovel Creek, a perennial stream (ALJ Decision at 34, FOF 6-11; ALJ Decision at 35, FOF 7-9), intermittent streams such as Beaver and Deer Creeks (ALJ Decision at 34, FOF 6-14; ALJ Decision at 35, FOF 7-9), habitat areas cooled by springs (thermal refugia) in the J.C. Boyle bypass (ALJ Decision at 33, FOF 6-10), and the main stem (ALJ Decision at 33, FOF 6-10; ALJ Decision at 35, FOF 7-9). The goal of the Services and the Klamath River Basin Fisheries Task Force is to successfully restore corresponding life history phases of anadromous salmonids to their historical range and to this suitable habitat. The Service goal is to successfully restore resident fish to their historical range and suitable habitat as well. The objective in reaching these goals is restoration of safe, timely, and effective fish movement through volitional fish passage. Providing volitional fish passage at Copco 2 and Copco 1 Dams is consistent with goals and objectives for resource management of the Services and the Klamath River Basin Fisheries Task Force. The 6–8 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

Benefits – The Copco Dams are less than one half mile apart. Specific benefits of fishways at Copco 2 and Copco 1 Dams include:

- Resident Trout: For the resident redband/rainbow trout currently present both above and below Copco 2 and 1 Dams, fishways would restore historical seasonal migration patterns for immature fish, restore population connectivity and genetic diversity, and allow greater utilization of existing habitat and refugial areas. For resident rainbow/ redband populations, fish passage at the Copco Dams alone would result in restoring the connectivity of fish populations in the mainstem Klamath River below the Copco Dams with those in tributaries above the dams and the Klamath River reach designated as Wild Trout water by the CDFG (California Department of Fish and Game 2005). The lower 2.7 miles of Shovel Creek are accessible and provide important habitat elements for rainbow/redband trout, including spawning and temperature related refugial areas. With fish passage, Shovel Creek would again

become accessible to resident trout from below the Copco Dams and seasonal migration and habitat use would be restored.

- Coho: Coho salmon are present in the Klamath River below Iron Gate Dam and were present historically below and above Copco 2 and Copco 1 Dams. Copco 2 and Copco 1 Dams block these fish from reaching elements of their historical habitat. Access to habitat within the Project would benefit coho salmon by: a) extending the range and distribution of the species thereby increasing the reproductive potential; b) increasing genetic diversity in the coho stocks; c) reducing the species vulnerability to the impacts of degradation; and d) increasing the abundance (ALJ Decision at 86, Ultimate Finding of Fact 9; ALJ Decision at 36, FOF 7-16). Between Copco 1 and Copco 2 Dams and the next barrier upstream (J.C. Boyle Dam), coho salmon would have access to suitable habitat, including the J.C Boyle peaking and bypass reaches of the Klamath River mainstem (Table 3; ALJ Decision at 35, FOF 7-9). With fish passage, coho would have access to this habitat again and connectivity to refugial areas would be restored.

- Spring-run Chinook: With passage, spring-run Chinook salmon access to cool water refugial areas such as the 220 cfs of spring water in the J.C. Boyle bypassed reach would be restored. During summer months, this would provide key holding, coolwater refugial habitat necessary for this run of fish (McCullough 1999). Juvenile spring-run Chinook would be able to rear in the cool water habitat adjacent to the springs in the J.C. Boyle bypass reach. These springs also provide warmer, ice-free habitat during winter months (Hanel and Gerlach 1964). The temperature of incoming spring water does not vary substantially from 50 to 55°F throughout the year (USDI Bureau of Land Management 2003) and would be optimal for juvenile Chinook growth (McCullough 1999). Springrun Chinook adults would also have access to the main channel as an upstream migration corridor necessary to reach historical spawning areas in the Upper Klamath Basin (California Department of Fish and Game 1990).

- Fall-run Chinook: Between Copco 2 and Copco 1 Dams and the next barrier upstream (J.C. Boyle Dam), passage for fall-run Chinook salmon would restore access to 25.8 miles of habitat, including the J.C Boyle peaking and bypass reaches of the Klamath River mainstem (Table 3; ALJ Decision at 33, FOF 6-10; ALJ Decision at 34, FOF 6-11; ALJ Decision at 34, FOF 6-14 and ALJ Decision at 86, Ultimate Finding of Fact 8). Snyder (Snyder 1931) reported large numbers of salmon annually passed the point where the Copco Dams are now located. The lower 2.7 miles of Shovel Creek continue to provide good salmonid habitat. The reach of the Klamath River between Copco 1 Reservoir and the Oregon/California State line is designated Wild Trout water and is currently managed under the Wild Trout Program by the CDFG (California Department of Fish and Game 2005). With fish passage, this area would again become accessible to fall-run Chinook salmon.

- Pacific Lamprey: Between Copco 2 and Copco 1 Dams and the next barrier upstream (J.C. Boyle Dam), passage would allow access to habitat, including tributaries and the

mainstem Klamath River (Table 3). This access to habitat would benefit Pacific lamprey by increasing their viability through: a) extending the range and distribution of the species; b) providing additional spawning and rearing habitat; c) increasing the genetic diversity of the species; and d) increasing the abundance of the Pacific lamprey population (ALJ Decision at 38, FOF 8-9).

- Steelhead: Between Copco 2 and Copco 1 Dams and the next barrier upstream (J.C. Boyle Dam), passage would allow steelhead to regain access to 27.1 miles of habitat, including the J.C Boyle peaking and bypass reaches of the Klamath River mainstem (Table 3; ALJ Decision at 33, FOF 6-10; ALJ Decision at 34, FOF 6-11; ALJ Decision at 34, FOF 6-14 and ALJ Decision at 86, Ultimate Finding of Fact 8). Steelhead occurred historically above the Copco 2 and Copco 1 Dams (Hamilton et al. 2005). Steelhead are generally tributary spawners and able to access reaches of tributaries upstream from areas where salmon spawn (Platts and Partridge 1978). Therefore, with fish passage, steelhead would utilize habitat in its entirety in tributaries above the Copco Dams. This means that steelhead would fully have access to the 27.1 miles of habitat including Shovel Creek (ALJ at Decision 12, FOF 2A-5), Beaver and Deer Creeks (ALJ Decision at FOF 34, 6- 14; ALJ Decision at 35, FOF 7-9), as well as Long Prairie, Edge, Frain, Negro, Tom Hayden, and Topsy Creeks (Table 3).

Copco 2 and Copco 1 Downstream Prescription Rationale: Downstream fishways and fishway modifications are prescribed for Copco 2 and Copco 1 Dams. Redband/rainbow trout and other resident fish are currently present in Copco reservoirs. The Services conclude that trout (in particular fry and juveniles) move downstream here as they do in the Klamath River elsewhere (Hemmingsen 1997), a significant portion move through the powerhouses, and turbine entrainment at Copco 2 and Copco 1 Dams causes significant mortality to downstream migrating redband trout (see discussion of turbine-caused mortality later in this paragraph). In addition, with the construction of a functional adult fish ladder at Iron Gate Dam and the Copco Dams, salmon and steelhead would return to hold, spawn, and rear in habitat where they were present historically (Hamilton et al. 2005). The progeny of these fish must negotiate not only the reservoirs but the dams, powerhouses, and spillways during their outmigration. Migration is one of several defining life history characteristics of resident trout and anadromous fish, especially salmonids (ALJ Decision at 27, FOF 3-7; ALJ Decision at 13, FOF 2A-10). To ensure these fish can safely outmigrate, downstream passage around the dams, powerhouses, and spillways is necessary. Fish migrating downstream can suffer injury or death by passing through turbines at hydroelectric plants (Electric Power Research Institute 1987). Turbine caused mortality can have serious consequences for fish populations, especially among anadromous species (Cada 2001). Survival of juvenile salmonids passing dams during their seaward migration is highest through spillways and lowest through turbines (Muir et al. 2001), turbine mortality being caused by pressure changes, cavitation, shear stress, turbulence, strike, and grinding (Cada 2001). The Electric Power Research Institute (Electric Power Research Institute 1987) reported that Francis turbines, which are used at both Copco Dams, had average mortality to downstream moving fish of about 24 percent. In light of the foregoing evidence, the Services conclude that turbine entrainment at each Copco dam presently causes levels of mortality to downstream migrating resident fish comparable to those cited in the studies above and would cause comparable losses

of reintroduced anadromous fish populations in the future, absent effective fish screening systems. The Applicant has estimated that approximately 85,848 fish are entrained annually at each mainstem development and has estimated that between 7 to 20 percent of fish passing through the Copco 2 Powerhouse are killed and that between 6 to 18 percent of the fish passing through the Copco 1 Powerhouse are killed ((PacifiCorp 2004a), Exhibit E 4-113). It is estimated that "several tens of thousands of resident fish" are annually entrained at "each of the Projects" facilities (ALJ Decision at 28, FOF 4-2). It is anticipated that annual entrainment of anadromous fish would be on the same order of magnitude, if not greater. Once entrained, the fish face a high risk of mortality. For juvenile fish, the risk is between 10 to 30 percent (ALJ Decision at 29, FOF 4-5). Volitional fish passage would be consistent with fish movement through the Klamath River system for purposes such as spawning, rearing, feeding, and seasonal use of habitat. Volitional fish passage is consistent with the goals and objectives for resource management of the Klamath River Basin Fishery Task Force and the Services. The 6 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

Tailrace Prescription Rationale: Water discharging from the Copco 2 and Copco 1 powerhouses can represent the major portion of the total river flow of the Klamath. Under the current license, the powerhouses each can discharge up to ~3000 cubic feet per second (cfs) and the Copco 2 bypass reach contains as little as 5–10 cfs. Even with the Applicant's proposed minimum instream flow, the disparity in flow levels can contribute to false attraction of upstream migrating fish to an area which provides no upstream passage, and delay these fish in their migration. The natural tendency for fish attracted to such an area is to hold and wait for passage conditions to improve, or to attempt to move past the obstacle either by swimming or leaping. Depending on powerhouse operations, draft tube discharge velocities at Project facilities are between 3.4 and 10.4 feet per second (fps) (CH2MHill 2006); these velocities easily fall within the swimming abilities of salmonids (Weaver 1963). The types of injury sustained by some fish entering draft tubes or contacting turbines vary from site to site, as do immediate and delayed mortality rates. Several studies, however, attribute injuries in migrating salmonids to powerhouse structures associated with tailrace structures (Department of Fisheries Canada 1958; International Pacific Salmon Fisheries Commission 1976; Schadt et al. 1985; Williams 1985).

Adult anadromous fish are attracted into oncoming flows (National Marine Fisheries Service 2004). Migration upstream may be delayed when tailrace flows from the powerhouse exceed river bypass reach flows. A migration delay, or combined delays at several facilities, may prevent fish from reaching suitable spawning habitat when they are ready to spawn or conditions are optimal for survival. Migration delays caused by tailrace effects may have a greater impact on fish populations than injury and mortality from turbine impacts (Federal Energy Regulatory Commission 1994). Migration delays may occur to a greater percentage of migrating adults than the percentage of adults impacted by turbine mortality. Migration delays are well documented for anadromous salmonids in the Pacific Northwest (Haynes and Gray 1980; Rondorf et al. 1983; Schadt et al. 1985; Vogel et al. 1990). For migratory adults, false attraction occurs when upstream migrants are attracted to turbine discharge or spillway flows rather than to fishway flows. False attraction also occurs when upstream migrants detect the scent of their natal stream downstream of its natural outlet (Fretwell 1989). This happens when water from a natal stream is diverted through a canal or pipe to a hydroelectric project. In either instance, without proper project design or operation modifications, there may be migratory delays. To prevent injury,

delay, or mortality to salmonids, caused by attempts to swim upstream into the tailrace, a barrier is required to guide migrating fish away from this area and encourage them to continue their upstream migration (National Marine Fisheries Service 2004). The 8 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

In the Preliminary Prescriptions, the Services based specific tailrace barrier prescriptions on the evidence cited above. In its request for hearing on disputed issues of material fact, the Applicant disputed facts supporting the tailrace barrier prescriptions. The Applicant subsequently withdrew its request for hearing regarding tailrace barrier prescriptions based on a stipulation with the Services (In the Matter Of: Klamath Hydroelectric Project, Docket Number 2006- NMFS-0001, Order Granting the Applicant's Motion to Withdraw USFWS/NMFS Issues 5 and 9, September 14, 2006 (Administrative Law Judge 2006b)). In accordance with the stipulation, the Services have revised the tailrace barrier prescriptions in the Modified Prescriptions below to allow the Applicant to study the need for and design of tailrace barrier s for anadromous and native resident fish. The Applicant must perform any such studies in consultation with the Services, and provide the results of any such studies to the Services for approval before design and construction of the tailrace barriers in order to inform the need for and design of tailrace barriers. However, unless and until such site-specific studies are done, the Services must rely on the available information in concluding that tailrace barriers are necessary for the upstream passage of fish at Copco 1 and 2 Dams.

Spillway Prescription Rationale: Spill survival estimates for salmonids are numerous and range from 70 percent to 100 percent, depending on species, life stage, amount or proportion of water spilled, spillway configuration, tailwater hydraulics, the methodology of estimating survival, and predator conditions (National Marine Fisheries Service 2000). Fish passing down a spillway may experience physical, chemical, and biological effects. Turbulent mixing of spilled water with receiving waters may result in gas supersaturation and resultant gas bubble disease in fish. Dissolved nitrogen concentrations of more than 130 percent of normal equilibrium levels have been measured in tailwaters (Ebel and Raymond 1976). The threshold value for significant mortality among juvenile Chinook salmon and steelhead trout occurs when nitrogen gas levels are about 115 percent of normal. Along the Columbia River, where many spillways discharge from a given dam and there are many consecutive dams along the stream course, supersaturation increases cumulatively from one dam to the next. Losses of salmon and steelhead trout in the Columbia River due to supersaturation have been severe in years of high spillage (Ebel and Raymond 1976). Fish passing over spillways can be injured by strikes or impacts with solid objects (e.g., baffles, rocks, or walls in the plunge zone), rapid pressure changes, abrasion with the rough side of the spillway, and the shearing effects of turbulent water. After examining the height of Copco 1 Dam, the angle of the spillway, and the stair-stepped design of this spillway, the Services conclude that spill entrainment mortality at the Copco 1 development will likely occur at levels near the high end of the range found in the studies above. While Copco 2 Dam is not as high, mortality may occur here as well. Therefore, spillway modifications and a 6-year timeline are necessary to meet resource goals and objectives as quickly as possible.

In the Preliminary Prescriptions, the Services based specific spillway prescriptions on the evidence cited above. In its request for hearing on disputed issues of material fact, the Applicant disputed facts supporting the spillway prescriptions. The Applicant subsequently withdrew its

request for hearing regarding spillway prescriptions based on a stipulation with the Services (In the Matter Of: Klamath Hydroelectric Project, Docket Number 2006-NMFS-0001, Order Granting the Applicant's Motion to Withdraw USFWS/NMFS Issues 5 and 9, September 14, 2006 (Administrative Law Judge 2006b)). In accordance with the stipulation, the Services have revised the spillway prescriptions in the Modified Prescriptions below to allow the Applicant to study the need for and design of spillway modifications for anadromous and native resident fish. The Applicant must perform any such studies in consultation with the Services, and provide the results of any such studies to the Services for approval before design and construction of the spillway modifications in order to inform the need for and design of spillway modifications. However, unless and until such site-specific studies are done, the Services must rely on the available information in concluding that spillway modifications are necessary for the safe, timely and effective passage of fish at Copco 1 and 2 Dams.

Transverse Bedrock Sill Fish Barrier Evaluation/Elimination Rationale: A transverse bedrock sill is located about River Mile 197.3 or 0.5 mile above the Copco 2 Powerhouse (1 mile below Copco 2 Dam). Historical fish distribution upstream from this point (Hamilton et al. 2005) indicates this sill was not a fish barrier prior to the Project, but the sill is a depth barrier to salmonids under the current 5–10 cfs release during normal operation, except during periods of spill, and may continue to be a depth barrier under the flows specified in the new license. This impediment to fish was observed during the summer of 2005 (David K. White, NMFS, pers. comm.). Physical structures, facilities, or devices or sill modification are necessary to eliminate the barrier. The 2 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

4.1 Copco 2 Upstream Fishway

4.1.1 *Copco 2 Upstream Fishway*: The Licensee shall construct, operate, maintain, and evaluate a volitional fishway at Copco 2 Dam to provide for the safe, timely, and effective upstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The fishway shall be operated year-round and shall consist of a fish ladder designed in accordance with NMFS criteria (National Marine Fisheries Service 2004) or alternative criteria approved by the Services. The ladder shall provide for the uninterrupted passage of fish over the full range of river flows for which the Project maintains operational control. The ladder shall have a minimum of two entrances and associated entrance pools and the auxiliary water system (AWS) shall be designed to augment ladder flow from the forebay. The AWS shall be screened in accordance with NMFS juvenile fish screen criteria (National Marine Fisheries Service 1997) or such alternative criteria as may be determined acceptable to NMFS Engineering and the Service. The AWS shall be designed to provide the correct water temperature and water quality to attract fish. The fish ladder and AWS together must be designed to supply attraction flows according to the terms of Modified General Prescriptions 1.1.7 The ladder shall have a maximum drop between pools of 0.5 ft and the maximum slope of the fish ladder shall not exceed 10 percent (Table 1). The ladder shall include

features to detect and record data for PIT-tagged upstream migrating anadromous fish (or fish identified using similar technology). The upstream fishway must be constructed to current criteria for passage of Pacific lamprey (Table 1). The fishway shall be constructed and operational within 6 years of the issuance of the new license.

4.1.2 *Design Consultation*: The ladder design shall include features to detect and record data for PIT-tagged upstream migrating anadromous fish (or fish identified using similar technology). The Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 3 years of the issuance of the new license for review and approval by the Service and NMFS prior to construction.

4.1.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

4.2 Copco 2 Downstream Fishway

4.2.1 *Intake Fish Screens and Bypass Facility*: The Licensee shall construct, operate, maintain, and evaluate a fish screen and bypass facility for volitional fish passage at Copco 2 Dam to provide for the safe, timely, and effective downstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The screens and bypass facility shall be operated year-round and shall be designed in accordance with NMFS juvenile fish screen and bypass facility criteria (National Marine Fisheries Service 1997) or alternative criteria as determined by the Service and NMFS Engineering. The screens and bypass facility shall provide for the uninterrupted passage of fish over the full range of river flows for which the Project maintains operational control. The bypass facility shall include features to detect and record data for PIT-tagged downstream migrating fish (or fish identified using similar technology). The downstream fishway shall be constructed and operational within 6 years of the issuance of the new license.

4.2.2 *Design Consultation*: The bypass facility design shall include features to detect and record data for PIT-tagged downstream migrating fish (or fish identified using similar technology). The Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 3 years of the issuance of the new license for review and approval by the Service and NMFS Engineering prior to construction.

4.2.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

4.3 Copco 2 Spillway

4.3.1 *Spillway Modification*: Unless the Services determine based on site-specific studies that spillway modifications are unnecessary in accordance with Modified Specific Prescriptions 4.3.2 and 4.3.3, the Licensee shall modify, maintain, and evaluate a spillway for the volitional passage at Copco 2 Dam to provide for the safe, timely, and effective downstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The spillway modifications shall be constructed and operational within 6 years of the issuance of the new license.

4.3.2 *Spillway Modification Studies*: The Licensee may, in consultation with the Services, study the need for and design of hydraulically-engineered spillway modifications to improve volitional downstream fish passage at Copco 2 Dam for coho salmon, steelhead trout, Pacific lamprey, and redband trout. The Licensee shall submit a plan for any such studies to the Services for review and approval prior to conducting studies. After approval of any such plan, the Licensee shall complete the studies and submit study results and recommendations on the need for and design of spillway modifications for review and approval by the Services consistent with the provisions for timing of the spillway design under Modified Specific Prescriptions 4.3.3.

4.3.3 *Spillway Design*: Unless the Services determine based on site-specific studies that spillway modifications are unnecessary in accordance with Modified Specific Prescriptions 4.3.2, the Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 4 years of the issuance of the new license for review and approval by the Service and NMFS Engineering prior to construction.

4.3.4 *Spillway Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

4.4 Copco 2 Tailrace Barrier

4.4.1 *Tailrace Barrier Construction*: Unless the Services determine based on site-specific studies that tailrace barriers are unnecessary in accordance with Modified Specific Prescriptions 4.4.2 and 4.4.3, the Licensee shall construct a tailrace barrier and guidance system at Copco 2 Dam to provide for the safe, timely, and effective upstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The

tailrace barrier and guidance system shall be constructed according to approved design plans and within 8 years of the issuance of the new license.

4.4.2 *Tailrace Barrier Studies*: The Licensee may, in consultation with the Services, study the need for and design of a tailrace barrier and guidance system at Copco 2 Dam. The Licensee shall submit a plan for any such studies to the Services for review and approval prior to conducting studies. After approval of any such plan, the Licensee shall complete the studies and submit study results and recommendations on the need for and design of tailrace barriers for review and approval by the Services consistent with the provisions for timing of the tailrace barrier design under Modified Specific Prescriptions 4.4.3.

4.4.3 *Tailrace Barrier Design*: Unless the Services determine based on site-specific studies that tailrace barriers are unnecessary in accordance with Modified Specific Prescriptions 4.4.2, the Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 5 years of the issuance of the new license, for review and approval by the Service and NMFS Engineering prior to construction.

4.4.4 *Tailrace Barrier Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

4.5 Copco 2 Bypass Channel Barrier/Impediment Elimination

4.5.1 *Barrier Modification*: The Licensee shall construct physical structures, facilities, or devices or modify the sill (as provided in 4.5.2 below), unless the Licensee demonstrates through an evaluation (conducted in consultation with the Services and CDFG and in a manner approved by the Services) using accepted fish barrier evaluation methodology (Powers and Orsborn 1985) that the transverse bedrock sill approximately 0.5 miles above the Copco 2 Powerhouse in the Copco 2 bypassed reach is not a barrier to fish passage under normal operating flows specified for the Copco 2 bypassed reach in the new license. The evaluation shall be completed within six months of the issuance of the new license and its conclusions must be approved by the Services.

4.5.2 *Design and Construction*: The Licensee shall develop design and construction plans for the physical structures, facilities, devices or barrier modification according to the terms of the Modified General Prescriptions article 1.1.1 above within 1 year of the issuance of the new license for review and approval by the Service and NMFS Engineering prior to construction. The physical structures, facilities, devices or barrier

modification shall be constructed within 2 years of license issuance, in accordance with specified guidelines and criteria for fish passage (National Marine Fisheries Service 2004), including, if the sill is not bypassed, providing at least 1.0 foot of swimming depth across the sill and with adequate attraction, velocity, capacity, and vertical jump characteristics.

4.5.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

5. Copco 1 Dam

5.1 Copco 1 Dam Upstream Fishway

5.1.1 *Copco 1 Upstream Fishway*: The Licensee shall construct, operate, maintain, and evaluate a volitional upstream fishway at Copco 1 Dam to provide for the safe, timely, and effective upstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The fishway shall be operated year-round and shall consist of a fish ladder designed in accordance with NMFS criteria (National Marine Fisheries Service 2004) or alternative criteria approved by the Services. The ladder shall provide for the uninterrupted passage of fish over the full river flows for which the Project maintains operational control. The ladder shall have a minimum of two entrances and associated entrance pools and the auxiliary water system (AWS) shall be designed to augment ladder flow from the forebay. The AWS shall be screened in accordance with NMFS juvenile fish screen criteria (National Marine Fisheries Service 1997) or such alternative criteria as may be determined acceptable to NMFS Engineering and the Service. The AWS shall be designed to provide the correct water temperature and water quality as to attract fish. The fish ladder and AWS together must be designed to supply attraction flows according to the terms of Modified General Prescriptions 1.1.7 The ladder shall have a maximum drop between pools of 0.5 ft and the maximum slope of the fish ladder shall not exceed 10 percent (Table 1). The ladder shall include features to detect and record data for PIT-tagged upstream migrating anadromous fish (or fish identified using similar technology). The Licensee shall construct the upstream fishway according to current criteria for passage of Pacific lamprey (Table 1). The fishway shall be constructed and operational within 6 years of the issuance of the new license.

5.1.2 *Design Consultation*: The ladder design shall include features to detect and record data for PIT-tagged upstream migrating anadromous fish (or fish identified using similar technology). The Licensee shall develop design and construction plans according to the terms of the Modified

General Prescriptions 1.1.1 above within 3 years of the issuance of the new license for review and approval by the Service and NMFS Engineering prior to construction.

5.1.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

5.2 Copco 1 Downstream Fishway

5.2.1 *Intake Fish Screens and Bypass Facility*: The Licensee shall construct, operate, maintain, and evaluate a fish screen and bypass facility for volitional fish passage at Copco 1 Dam to below Copco 1 Dam to provide for the safe, timely, and effective downstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The screens and bypass facility shall be operated year-round and shall be designed in accordance with NMFS juvenile fish screen and bypass facility criteria (National Marine Fisheries Service 1997) or alternative criteria as determined by the Service and NMFS Engineering. The screens and bypass facility shall provide for the uninterrupted passage of fish over the full range of river flows for which the Project maintains operational control. The bypass facility shall include features to detect and record data for PIT-tagged downstream migrating fish (or fish identified using similar technology). The downstream fishway shall be constructed and operational within 6 years of the issuance of the new license.

5.2.2 *Design Consultation*: The bypass facility design shall include features to detect and record data for PIT-tagged downstream migrating fish (or fish identified using similar technology). The Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 3 years of the issuance of the new license for review and approval by the Service and NMFS prior to construction.

5.2.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

5.3 Copco 1 Spillway

5.3.1 *Spillway Modification*: Unless the Services determine, based on site-specific studies, that spillway modifications are unnecessary in accordance with Modified Specific Prescriptions 5.3.2 and 5.3.3, the Licensee shall modify, maintain, and evaluate a spillway for volitional passage at Copco 1 Dam to provide for the safe, timely, and effective downstream

passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The spillway modifications shall be constructed and operational within 6 years of the issuance of the new license.

5.3.2 *Spillway Modification Studies*: The Licensee may, in consultation with the Services, study the need for and design of hydraulically-engineered spillway modifications to improve volitional downstream fish passage at Copco 1 Dam for Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The Licensee shall submit a plan for any such studies to the Services for review and approval prior to conducting studies. After approval of any such plan, the Licensee shall complete the studies and submit study results and recommendations on the need for and design of spillway modifications for review and approval by the Services consistent with the provisions for timing of the spillway design under Modified Specific Prescriptions 5.3.3.

5.3.3 *Spillway Design*: Unless the Services determine based on site-specific studies that spillway modifications are unnecessary in accordance with Modified Specific Prescriptions 5.3.2, the Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 4 years of the issuance of the new license for review and approval by the Service and NMFS prior to construction.

5.3.4 *Spillway Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

5.4 Copco 1 Tailrace Barrier

5.4.1 *Tailrace Barrier Construction*: Unless the Services determine based on site-specific studies that tailrace barriers are unnecessary in accordance with Specific Modified Prescriptions 5.4.2 and 5.4.3, the Licensee shall construct a tailrace barrier and guidance system at Copco 1 Dam to provide for the safe, timely, and effective upstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The tailrace barrier and guidance system shall be constructed according to approved design plans and within 8 years of the issuance of the new license.

5.4.2 *Tailrace Barrier Studies*: The Licensee may, in consultation with the Services, study the need for and design of a tailrace barrier and guidance system at Copco 1 Dam. The Licensee shall submit a plan for any such studies to the Services for review and approval prior to conducting studies. After approval of any such plan, the Licensee shall complete the studies and submit study results and recommendations on the need for and design

of tailrace barriers for review and approval by the Services consistent with the provisions for timing of the tailrace barrier design under Modified Specific Prescriptions 5.4.3.

5.4.3 *Tailrace Barrier Design*: Unless the Services determine based on site-specific studies that tailrace barriers are unnecessary in accordance with Modified Specific Prescriptions 5.4.2, the Licensee shall, within 5 years of the issuance of the new license, develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 for review and approval by the Service and NMFS Engineering prior to construction.

5.4.4 *Tailrace Barrier Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

6. J.C. Boyle Dam

Upstream Prescription Rationale: Historically coho salmon, steelhead, and spring-run and fallrun Chinook salmon (Hamilton et al. 2005; ALJ Decision at 12, FOF 2A-3 through 2A-6) and resident trout (Hanel and Gerlach 1964) migrated above the current site of J.C. Boyle Dam to reach holding, spawning, incubation, and rearing habitat. The upstream fishway at J.C. Boyle Dam is obsolete and does not meet current design criteria. It is a partial barrier to trout passage and, thus, to critical holding, spawning, incubation, and rearing habitat in tributaries (Spencer, Hunters Park, and Miners Creeks) and the Boyle Reservoir to Keno Dam reach (Table 3). Suitable habitat for anadromous fish occurs in Spencer Creek, a perennial stream (ALJ Decision at 34, FOF 6-11; ALJ Decision at 35, FOF 7-9), intermittent streams (ALJ Decision at 34, FOF 6-14; ALJ Decision at 35, FOF 7-9), and the main stem (ALJ Decision at 33, FOF 6-10; ALJ Decision at 35, FOF 7-9).

The goal of the Services and the Klamath River Basin Fisheries Task Force is to successfully restore corresponding life history phases of anadromous salmonids to their historical range and this suitable habitat. The Service goal is to successfully restore resident fish to their historical range and suitable habitat as well. The objective in reaching these goals is the restoration of safe, timely, and effective fish movement. Providing fishways that meet current criteria at J.C. Boyle Dam is consistent with the goals and objectives for resource management of the Services and the Klamath River Basin Fisheries Task Force. The 4-year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

Benefits: Specific benefits of fishways at J.C. Boyle Dam include:

- Resident Trout: Fish passage at J.C. Boyle Dam alone would restore the unimpaired connectivity of resident redband trout populations in the mainstem Klamath River with those in Spencer Creek. This tributary, in particular, provides important habitat elements, such as spawning and temperature related refugial areas for redband trout. A number of reports document the importance of Spencer Creek habitat to redband trout (Buchanan et

al. 1990; Buchanan et al. 1991; Hemmingsen 1997; Hemmingsen et al. 1992; USDI Bureau of Land Management et al. 1995). The Spencer Creek population of Klamath River redband trout is migratory and has connectivity to the population in the mainstem Klamath River and nearby tributary watersheds. This Basin connectivity coupled with homing behavior (and straying of individuals) allows Spencer Creek redband/rainbow trout to be a source of adaptive variability in Klamath Basin trout populations (USDI Bureau of Land Management et al 1995). This connectivity has been greatly impaired by inadequate passage at J.C. Boyle Dam. The number of redband trout using the J.C. Boyle fish ladder have declined 90 percent or more since shortly after the dam was constructed (Hanel and Gerlach 1964; Hemmingsen et al. 1992; Oregon Department of Fish and Wildlife 2006). An upstream ladder, built to current criteria and with the entrance located to avoid false attraction flows, would provide for the safe, timely and effective passage around J.C. Boyle Dam for redband trout migrating to Spencer Creek and upstream. With fish passage, habitat in Spencer Creek and habitat between J.C. Boyle Dam and Keno Dam would be fully utilized. Seasonal migration of redband trout and access to refugial areas would be restored.

- Coho: Coho salmon are present in the Klamath River below Iron Gate Dam and were present historically below and above the J.C. Boyle Dam to at least Spencer Creek (Hamilton et al. 2005). Access to habitat within the Project would benefit coho salmon by: a) extending the range and distribution of the species thereby increasing the reproductive potential; b) increasing genetic diversity in the coho stocks; c) reducing the species vulnerability to the impacts of degradation; and d) increasing the abundance (ALJ Decision at 86, Ultimate Finding of Fact 9; ALJ Decision at 36, FOF 7-16). With passage at J.C. Boyle Dam, coho salmon would regain access to suitable habitat (Table 3; ALJ Decision at 35, FOF 7-9). With fish passage, access to this habitat would no longer be unutilized. Seasonal migration of coho and access to refugial areas would be restored.

- Spring-run Chinook: With fish passage at J.C. Boyle Dam, spring-run Chinook salmon would regain access to seasonal cool water refugial areas necessary for this run of fish (McCullough 1999) between J.C. Boyle Dam and the next dam upstream (Keno Dam). Spring-run Chinook would also have access to the main channel as an upstream migration corridor necessary to reach historical spawning areas in the Upper Klamath Basin (California Department of Fish and Game 1990).

- Fall Chinook: With fish passage, fall-run Chinook salmon would regain access to 14.3 miles of habitat, including tributaries and the mainstem Klamath River (Table 3) between J.C. Boyle Dam and the next dam upstream (Keno Dam). With fish passage seasonal migration of fall-run Chinook and access to refugial areas would be restored.

- Pacific Lamprey: With fish passage, Pacific lamprey would gain access to habitat, including tributaries and the mainstem Klamath River (Table 3) between J.C. Boyle Dam and the next dam upstream (Keno Dam). This access to habitat would benefit Pacific lamprey by increasing their viability through: a) extending the range and distribution of

the species; b) providing additional spawning and rearing habitat; c) increasing the genetic diversity of the species; and d) increasing the abundance of the Pacific lamprey population (ALJ Decision at 38, FOF 8-9).

- Steelhead: With fish passage, steelhead would regain access to 17.1 miles of habitat between J.C. Boyle Dam and the next dam upstream (Keno Dam). Steelhead are generally tributary spawners and able to access reaches of tributaries upstream from areas where salmon spawn (Platts and Partridge 1978). Therefore, with fish passage, steelhead would utilize habitat in its entirety in tributaries above J.C. Boyle Dam. This means that steelhead would fully have access to 17.1 miles of habitat including Spencer Creek (ALJ Decision at 12, FOF 2A-5), Hunters Park and Miners Creeks, as well as the mainstem Klamath River (ALJ Decision at 35, FOF 7-9) below Keno Dam (Table 3; ALJ Decision at 33, FOF 6-10; ALJ Decision at 34, FOF 6-11; ALJ Decision at FOF 34, 6-14 and ALJ Decision at 86, Ultimate Finding of Fact 8). Seasonal migration of steelhead and access to refugial areas would be restored.

Downstream Prescription Rationale: Redband/rainbow trout, federally listed suckers, and other resident fish are currently present in J.C. Boyle Reservoir ((Desjardins and Markle 2000; PacifiCorp 2004b) Fish Resources FTR). The Services conclude that trout (in particular fry and juveniles) move downstream as they do in the Klamath River elsewhere (Hemmingsen 1997) and that the vast majority of these move through the J.C. Boyle Powerhouse because the screens are ineffective and the facility seldom spills. Dam operators at the J.C. Boyle development generally do not spill until Klamath River discharge exceeds 3,000 cfs. Over the past 25 years the Klamath River exceeded this threshold a median of 4.5 days per year and in 12 years it did not exceed 3,000 cfs (Oregon Department of Fish and Wildlife 2006). The Services conclude that turbine entrainment at J.C. Boyle Dam causes significant mortality to downstream migrating redband trout (see discussion of turbine-caused mortality later in this paragraph; ALJ Decision at 86, Ultimate Findings of Fact 6 and 7). With the construction of a functional adult fish ladder at J.C. Boyle Dam, salmon, and steelhead would return to hold, spawn, and rear in habitat where they were present historically (Hamilton et al. 2005). However, the progeny of these fish would also move downstream and must negotiate not only the reservoir but the dam, powerhouse, and spillway during their outmigration. Migration is one of several defining life history characteristics of resident trout and anadromous fish, especially salmonids (ALJ Decision at 27, FOF 3-7; ALJ Decision at 13, FOF 2A-10). Turbine caused mortality at dams can have serious consequences for fish populations, especially among anadromous species (Cada 2001). Survival of juvenile salmonids passing dams during their seaward migration is highest through spillways and lowest through turbines (Muir et al. 2001), turbine mortality being caused by pressure changes, cavitation, shear stress, turbulence, strike, and grinding (Cada 2001). The Electric Power Research Institute (EPRI) (Electric Power Research Institute 1987) reported that the Francis turbines which are used at the J.C. Boyle development have an average mortality of about 24 percent for all subject species. EPRI's studies, and those of Milo Bell (Bell 1986; Bell et al. 1967) measured entrainment for some of the same species and under similar conditions as exist at J.C. Boyle Dam, and thus support the conclusion that entrainment mortality is presently occurring at significant levels for resident fish. The J.C. Boyle development, at 440 feet of head, may have even greater mortality due to turbine entrainment, as pressure gradients will be even greater. For projects with Francis turbines, the EPRI study found a high correlation (r = 0.77)

between head and fish mortality. Four hydroelectric developments with Francis turbines that had greater than 335 feet of head had mortality ranging from 33 to 48 percent (Electric Power Research Institute 1987); ALJ Decision at 29, FOF 4-10). The facilities in these studies have comparable or less hydraulic head than the J.C. Boyle development and comparable turbine types. Using the above evidence, the Services conclude that entrainment mortality at J.C. Boyle Powerhouse likely falls in this range (ALJ Decision at 30, Decision 4-11) rather than the 12 to 36 percent range estimated by the Applicant (PacifiCorp 2004a), Exhibit E 4-113). It is estimated that "several tens of thousands of resident fish" are annually entrained at "each of the Projects" facilities (ALJ Decision at 28, Decision 4-2). It is anticipated that annual entrainment of anadromous fish would be on the same order of magnitude, if not greater. Once entrained, the fish face a high risk of mortality. For juvenile fish, the risk is between 10 to 30 percent (ALJ Decision at 29, Decision 4-5). When anadromous fish are restored above J.C. Boyle Dam, outmigrating salmonid smolts, including federally listed coho, would be entrained and a significant portion killed during turbine passage absent downstream fish screens and bypass systems. Volitional fish passage would be consistent with fish movement through Klamath River system for purposes such as spawning, rearing, feeding, and seasonal use of habitat. It is also consistent with the goals and resource management objectives of the Klamath River Basin Fishery Task Force and the Services.

PacifiCorp recognizes that entrainment at J.C. Boyle dam is a "problem that needs to be addressed" (ALJ Decision at 30, FOF 4-12). The development of detailed design and construction plans for review and approval by the Service and NMFS Engineering is critical to ensure that effective passage measures are incorporated into the design. The 4-year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

Sidecast Rock Barrier Elimination Prescription Rationale: Sidecast rock extends from the J.C. Boyle canal access road into and across the J.C. Boyle bypass channel, blocking or inhibiting fish passage. Presently, all flows in the bypass reach filter through the sidecast rock and there is no unimpeded route for anadromous and resident fish passage at the typical bypass flows observed. The rock has been deposited in this channel recently and is sidecast from Project construction and operation of the J.C. Boyle canal and access road. This impediment to fish was observed during the summer of 2005 (David K. White, NMFS, pers. comm.). Historically, higher flows in the bypassed channel might have been able to disperse this material and restore fish movement. Physical structures, facilities, devices or barrier removal are necessary to achieve the safe, timely, and effective passage through the channel past this obstruction and would be consistent with the goals and objectives for resource management of the Services and the Klamath River Basin Fishery Task Force. The 2 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

Tailrace Prescription Rationale: Water discharging from the J.C. Boyle Powerhouse represents a significant portion of the total river flow of the Klamath River. Under the current license the powerhouse can discharge up to 3,000 cubic feet per second (cfs) and the bypass reach contains as little as 320 cfs. Even with the instream flow in the bypassed channel proposed by the Applicant, this disparity in flows contributes to false attraction for upstream migrating fish to an area which provides no upstream passage. The natural tendency for fish attracted to such an area is to hold and wait for passage conditions to improve or to attempt to move past the obstacle

either by swimming or leaping. Depending on powerhouse operations, draft tube discharge velocities at Project facilities are between 3.4 and 10.4 feet per second (fps) (CH2MHill 2006); these velocities easily fall within the swimming abilities of salmonids (Weaver 1963). The types of injury sustained by some fish entering draft tubes or contacting turbines vary from site to site, as do immediate and delayed mortality rates. Several studies, however, attribute injuries in migrating salmonids to powerhouse structures associated with tailrace structures (Department of Fisheries Canada 1958; International Pacific Salmon Fisheries Commission 1976; Schadt et al. 1985; Williams 1985).

Adult anadromous fish are attracted into oncoming flows (National Marine Fisheries Services 2004) as are resident fish. Migration upstream may be delayed when tailrace flows from the powerhouse exceed river bypass reach flows. A migration delay, or combined delays at several facilities, may prevent fish from reaching suitable spawning habitat when they are ready to spawn or conditions are optimal for survival. Migration delays caused by tailrace effects may have a greater impact on fish populations than injury and mortality from turbine impacts (Federal Energy Regulatory Commission 1994). Migration delays may occur to a greater percentage of migrating fish than the percentage of fish impacted by turbine mortality. Migration delays are well documented for anadromous salmonids in the Pacific Northwest (Haynes and Gray 1980; Rondorf et al. 1983; Schadt et al. 1985; Vogel et al 1990). For migratory fish, false attraction occurs when upstream migrants are attracted to turbine discharge or spillway flows rather than to fishway flows. False attraction also occurs when upstream migrants detect the scent of their natal stream downstream of its natural outlet (Fretwell 1989). This happens when water from a natal stream is diverted through a canal or pipe to a hydroelectric project. In either instance, without proper project design or operation modifications, there may be migratory delays.

In order to prevent injury, delay, or mortality to salmonids, caused by attempts to swim upstream into the tailrace, a barrier is required to guide migrating fish away from this area and encourage them to continue their upstream migration. The 4 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

In the Preliminary Prescriptions, the Services based specific tailrace barrier prescriptions on the evidence cited above. In its request for hearing on disputed issues of material fact, the Applicant disputed facts supporting the tailrace barrier prescriptions. The Applicant subsequently withdrew its request for hearing regarding tailrace barrier prescriptions based on a stipulation with the Services (In the Matter Of: Klamath Hydroelectric Project, Docket Number 2006- NMFS-0001, Order Granting the Applicant's Motion to Withdraw USFWS/NMFS Issues 5 and 9, September 14, 2006 (Administrative Law Judge 2006b)). In accordance with the stipulation, the Services have revised the tailrace barrier prescriptions in the Modified Prescriptions below to allow the Applicant to study the need for and design of tailrace barriers for anadromous and native resident fish. The Applicant must perform any such studies in consultation with the Services, and provide the results of any such studies to the Services for approval before design and construction of the tailrace barriers in order to inform the need for and design of tailrace barriers. However, unless and until such site-specific studies are done, the Services must rely on the available information in concluding that tailrace barriers are necessary for the safe, timely and effective upstream passage of fish at J.C. Boyle Dam.

Spillway Prescription Rationale: Spill survival estimates for juvenile salmonids are numerous and range from 76 percent to 100 percent, depending on species, life stage, amount or proportion of water spilled, spillway configuration, tailwater hydraulics, the methodology of estimating survival, and predator conditions (National Marine Fisheries Service 2000). Fish passing down a spillway may experience physical, chemical, and biological effects. Turbulent mixing of spilled water with receiving waters may result in gas supersaturation and resultant gas bubble disease in fish. Dissolved nitrogen concentrations of more than 130 percent of normal equilibrium levels have been measured in tailwaters (Ebel and Raymond 1976). The threshold value for significant mortality among juvenile Chinook salmon and steelhead trout occurs when nitrogen gas levels are about 115 percent of normal. Along the Columbia River, where many spillways discharge from a given dam and there are many consecutive dams along the stream course, supersaturation increases cumulatively from one dam to the next. Losses of salmon and steelhead trout in the Columbia River due to supersaturation have been severe in years of high spillage (Ebel and Raymond 1976). Fish passing over spillways can be injured by strikes or impacts with solid objects (e.g. baffles, rocks, or walls in the plunge zone), rapid pressure changes, abrasion with the rough side of the spillway, and the shearing effects of turbulent water.

The configuration of the J.C. Boyle Dam spillway includes numerous rocks and many such solid objects and it is reasonable to conclude that significant mortality will occur while passing fish through the spillway. Therefore, the following spillway modifications and 4 year timeline are necessary to meet resource goals and objectives as quickly as possible.

In the Preliminary Prescriptions, the Services based specific spillway prescriptions on the evidence cited above. In its request for hearing on disputed issues of material fact, the Applicant disputed facts supporting the spillway prescriptions. The Applicant subsequently withdrew its request for hearing regarding spillway prescriptions based on a stipulation with the Services (In the Matter Of: Klamath Hydroelectric Project, Docket Number 2006-NMFS-0001, Order Granting the Applicant's Motion to Withdraw USFWS/NMFS Issues 5 and 9, September 14, 2006 (Administrative Law Judge 2006b)). In accordance with the stipulation, the Services have revised the spillway prescriptions in the Modified Prescriptions below to allow the Applicant to study the need for and design of spillway modifications for anadromous and native resident fish.

The Applicant must perform any such studies in consultation with the Services, and provide the results of any such studies to the Services for approval before design and construction of the spillway modifications in order to inform the need for and design of spillway modifications. However, unless and until such site-specific studies are done, the Services must rely on the available information in concluding that spillway modifications are necessary for the safe, timely, and effective passage of fish at J.C. Boyle Dam.

6.1 J.C. Boyle Bypass Channel

6.1.1 *Barrier Elimination*: The Licensee shall construct physical structures, facilities, or devices to provide passage around or remove the sidecast rock barrier approximately 2.5 mile above the J.C. Boyle Powerhouse in the

J.C. Boyle Bypass reach within 2 years of the issuance of the new license to provide for the safe, timely, and effective upstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout.

6.1.2 *Design and Construction*: The Licensee shall develop design, construction, and maintenance plans according to the terms of the Modified General Prescriptions 1.1.1 above within 1 year of the issuance of the new license for review and approval by the Service and NMFS prior to construction.

6.1.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

6.2 J.C. Boyle Upstream Fishway

6.2.1 *J.C. Boyle Upstream Fishway*: The Licensee shall construct, operate, maintain, and evaluate a volitional fishway at J.C. Boyle Dam to provide for the safe, timely, and effective upstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The fishway shall be operated year-round and shall consist of a fish ladder designed in accordance with NMFS' criteria (National Marine Fisheries Service 2004) or alternative criteria approved by the Services. The ladder shall provide for the uninterrupted passage of fish over the full range of river flows for which the Project maintains operational control. The ladder shall have a minimum of two entrances and associated entrance pools and the auxiliary water system (AWS) shall be designed to augment ladder flow from the forebay. The ladder entrance shall be located downstream of the fish screen bypass outfall and existing velocity barrier below the existing ladder. The AWS shall be screened in accordance with NMFS juvenile fish screen criteria (National Marine Fisheries Service 1997), or such alternative criteria as may be determined acceptable by NMFS Engineering and the Service. The AWS shall be designed to provide the correct water temperature and water quality as to attract fish. The fish ladder and AWS together must be designed to supply attraction flows according to the terms of Modified General Prescriptions 1.1.7. The ladder shall have a maximum drop between pools of 0.5 ft and the maximum slope of the fish ladder shall not exceed 10 percent (Table 1). The ladder shall include features to detect and record data for PIT-tagged upstream migrating anadromous fish (or fish identified using similar technology). The upstream fishway shall be constructed to current criteria for passage of Pacific lamprey. The fishway shall be constructed and operational within 4 years of the issuance of the new license.

6.2.2 *Design Consultation*: The ladder design shall include features to detect and record data for PIT-tagged upstream migrating anadromous fish (or

fish identified using similar technology). The Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 2 years of the issuance of the new license for review and approval by the Service and NMFS Engineering prior to construction.

6.2.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

6.3 J.C. Boyle Downstream Fishway

6.3.1 *Intake Fish Screens and Bypass Facility*: The Licensee shall construct, operate, maintain, and evaluate a new fish screen and a bypass facility at J.C. Boyle Dam to provide for the safe, timely, and effective downstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The screen and bypass shall be operated year-round and shall be designed in accordance with NMFS juvenile fish screen and bypass facility criteria (National Marine Fisheries Service 1997) or alternative criteria acceptable to the Service and NMFS Engineering. The screen and bypass facility shall provide for the uninterrupted passage of fish over the full range of river flows for which the Project maintains operational control. The screen shall divert all fish to a bypass facility. The bypass facility shall include features to detect and record data for PIT-tagged downstream migrating fish (or fish identified using similar technology). The Licensee shall complete construction and begin operation within 4 years of the issuance of the new license.

6.3.2 *Design Consultation*: The bypass facility design shall include features to detect and record data for PIT-tagged downstream migrating fish (or fish identified using similar technology). The Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 2 years of the issuance of the new license for review and approval by the Service and NMFS Engineering prior to construction.

6.3.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

6.4 J.C. Boyle Spillway

6.4.1 *Spillway Modification*: Unless the Services determine based on site-specific studies that spillway modifications are unnecessary in accordance with Modified Specific Prescriptions 6.4.2 and 6.4.3, the Licensee shall modify, maintain, and evaluate a spillway for the volitional

passage at J.C. Boyle Dam to provide for the safe, timely, and effective downstream passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The spillway modifications shall be constructed and operational within 4 years of the issuance of the new license.

6.4.2 *Spillway Modification Studies*: The Licensee may, in consultation with the Services, study the need for and design of hydraulically-engineered spillway modifications to improve volitional downstream fish passage at J.C. Boyle Dam for Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The Licensee shall submit a plan for any such studies to the Services for review and approval prior to conducting studies. After approval of any such plan, the Licensee shall complete the studies and submit study results and recommendations on the need for and design of spillway modifications for review and approval by the Services consistent with the provisions for timing of the spillway design under Modified Specific Prescriptions 6.4.3.

6.4.3 *Spillway Design*: Unless the Services determine based on site-specific studies that spillway modifications are unnecessary in accordance with Modified Specific Prescriptions 6.4.2, the Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 3 years of the issuance of the new license for review and approval by the Service and NMFS Engineering prior to construction.

6.4.4 *Spillway Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

6.5 J.C. Boyle Tailrace Barrier

6.5.1 *Tailrace Barrier Construction*: Unless the Services determine based on site-specific studies that tailrace barriers are unnecessary in accordance with Modified Specific Prescriptions 6.5.2 and 6.5.3, the Licensee shall construct a tailrace barrier and guidance system at J.C. Boyle Dam to provide for the safe, timely, and effective passage of Chinook and coho salmon, steelhead trout, Pacific lamprey, and redband trout. The tailrace barrier and guidance system shall be constructed according to approved design plans and within 4 years of the issuance of the new license

6.5.2 *Tailrace Barrier Studies*: The Licensee may, in consultation with the Services, study the need for and design of a tailrace barrier and guidance system at the J.C. Boyle Powerhouse. The Licensee shall submit a plan for any such studies to the Services for review and approval prior to conducting studies. After approval of any such plan, the Licensee shall

complete the studies and submit study results and recommendations on the need for and design of tailrace barriers for review and approval by the Services consistent with the provisions for timing of the tailrace barrier design under Specific Modified Prescriptions 6.5.3.

6.5.3 *Tailrace Barrier Design*: Unless the Services determine based on site-specific studies that tailrace barriers are unnecessary in accordance with Modified Specific Prescriptions 6.5.2, the Licensee shall, within 3 years of the issuance of the new license, develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 for review and approval by the Service and NMFS Engineering prior to construction.

6.5.4 *Tailrace Barrier Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

7. Keno Dam

Upstream Prescription Rationale: Historically steelhead, spring-run and fall-run Chinook salmon (Hamilton et al. 2005; ALJ Decision at 12, FOF 2A-3 through 2A-5), and resident fish migrated through the current site of Keno Dam to reach holding, spawning, incubation, and rearing habitat. Keno Dam is a partial barrier to this passage and, thus, to holding, spawning, incubation, and rearing habitat in the Link River reach. The goal of the Services and the Klamath River Basin Fisheries Task Force is to successfully restore corresponding life history phases of anadromous salmonids to their historical range and suitable habitat. The goal of the Service is to successfully restore resident fish to their historical range and suitable habitat as well. The objective in reaching these goals is restoration of safe, timely, and effective fish movement. Providing fish passage that meets current standards at Keno Dam is consistent with goals and objectives for resource management of the Services and the Klamath River Basin Fisheries Task Force. The provision of effective fish passage facilities will meet these goals and provide mitigation for the impacts of the dam.

Keno Impoundment in its current state would be primarily a migration corridor for anadromous salmonids because the depth and velocity of the impoundment provide little suitable habitat. Link River is the only free flowing reach of the Klamath River between Keno Dam and Link River Dam. Link River provides habitat for Klamath large scale suckers (Catastomus snyderi) during all months of the year, and for Lost River and shortnose suckers in summer when water quality is poor in downstream Lake Ewauna (Rich Piaskowski, Reclamation, pers. comm.) For salmonids, Link River provides habitat most of the year other than summer months. During most years, the Lake Ewauna reach of the Klamath River (Link River Dam to Keno Dam) has dissolved oxygen concentrations greater than 6 mg/L and temperatures less than 20°C from mid-November through mid-June (Jason Cameron, Reclamation, pers. comm.). These conditions are within the criteria for migrating adult anadromous salmonids for these months (U.S. Environmental Protection Agency 2003). For steelhead trout, the Services expect that adult returns would occur primarily from October through March. Major runs of spring-run Chinook

and fall-run Chinook salmon would occur from March to June and September to December, respectively. Because of their run timing, passage of fall-run Chinook may be affected by conditions in Lake Ewauna. Interim, seasonal, upstream trap and haul for primarily fall-run adult Chinook salmon around Keno Impoundment and Lake Ewauna would be necessary during the period June 15 to November 15 when DO and temperature are out of criteria for this life stage of this species (U.S. Environmental Protection Agency 2003) and water quality conditions may not be suitable for migration. The Services expect trap and haul to be an effective interim, seasonal fish passage method for adult fall-run Chinook salmon during the period June 15 to November 15 because only this species would be transported and only for a short distance. Other species need volitional fishways to access habitat in Keno Impoundment and Link River year round. Conditions in this reach are expected to improve over time to a point when volitional passage will be effective year-round for all target species. Water quality is expected to improve over the term of a new Project license through the implementation of the Total Maximum Daily Load (TMDL) process, imposition of state water quality certification conditions, and provisions of a new license, including terms and conditions added by the Commission and based on the recommendations of the Agencies pursuant to FPA section 10(j). Upper Klamath Lake above Link River Dam currently provides habitat for salmonids. Water quality problems in the lake during the summer months are relatively short lived and springs in the lake provide thermal refugial areas for redband trout and other species. Redband trout are also well known for migrating upstream into the Wood and Williamson Rivers when Upper Klamath Lake water quality deteriorates. Once fish pass Keno Dam, Keno Impoundment, and Lake Ewauna, the current upstream fishway at Link River Dam would pass anadromous fish species (including Pacific lamprey) on their way to currently available, good quality upstream habitat (Huntington 2006; Oregon Department of Fish and Wildlife 1997). The 3 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

Keno Dam may impede native suckers occupying habitat below the dam from reaching elements of their historical habitat including Lake Ewauna, Link River, and Upper Klamath Lake, the core recovery area for this species (USDI Fish and Wildlife Service 1993). The existing fishway at Keno Dam does not meet Service and ODFW criteria for sucker passage (Table 1) because the slope is too steep (USDI Fish and Wildlife Service 2005). However, the potential contribution of the J.C. Boyle Reservoir population occupying habitat below Keno Dam for conservation of the species may be limited. Monitoring of fish passage at Keno Dam has demonstrated small numbers of fish moving upstream through the existing ladder at Keno Dam (PacifiCorp 1997).

Until additional information becomes available regarding the populations of federally listed suckers in J.C. Boyle Reservoir and the need for passage of federally listed suckers upstream, the Service reserves its authority to prescribe an upstream fishway to sucker criteria at Keno Dam.

Benefits of fishways at Keno Dam include:

- Resident Trout: Significant recreational fisheries for redband trout currently exist in the Project area, as well as in and upstream of Upper Klamath Lake. Upstream fish passage at Keno Dam would result in restoring the connectivity of resident redband populations in the mainstem Klamath River with those in Keno Impoundment/Lake Ewauna, Link River, and Upper Klamath Lake. In 2005, The Bureau of Reclamation completed a new fishway at Link River Dam designed to pass endangered suckers, trout, lamprey, and

other native species. Adequate upstream fish passage at Link River Dam has resulted in restoring the connectivity of resident redband populations in the Link River reach with those in Upper Klamath Lake and its tributaries. These tributaries, including the Wood, Williamson, and Sprague Rivers in particular, provide important habitat elements, such as spawning and temperature related refugial areas for redband trout (Oregon Department of Fish and Wildlife 1997). With fish passage, habitat between Keno and Link River Dam would be fully utilized. Seasonal migration of trout and access to refugial areas would be improved.

- Spring-run Chinook salmon, fall-run Chinook, and steelhead: All these species occurred historically above the current site of Keno Dam and Upper Klamath Lake (Hamilton et al. 2005; ALJ Decision at 12, FOF 2A-3 through 2A-5). With upstream fishways at downstream dams and the new ladder at Link River Dam, adequate anadromous fish passage facilities at Keno Dam would mean these runs would regain access to 49 significant tributaries in the Upper Klamath Basin, comprising 360 miles of currently productive anadromous fish habitat (if anadromous fish had access to this habitat) and an additional 60 miles of recoverable habitat (Huntington 2006). Large populations of spring-run Chinook were found in several of the tributaries to Upper Klamath Lake, including both the Williamson and Sprague Rivers (California Department of Fish and Game 1990). Historical run sizes in both the Williamson River and the Sprague River were estimated to be at least 5,000 spring-run Chinook salmon (California Department of Fish and Game 1990). Substantial numbers of what were apparently fall-run Chinook were still being harvested in the Sprague River up until about 1910 (Lane and Lane Associates 1981). Steelhead are generally tributary spawners and able to access reaches upstream from areas where salmon spawn (Platts and Partridge 1978). Therefore, with fish passage, steelhead would have access to tributaries above Keno Dam. Seasonal migration of anadromous salmonids and access to refugial areas would be restored.

- Pacific lamprey: At Keno Dam the existing fishway does not meet current criteria to accomplish lamprey passage because corners and ladder steps are not rounded (USDI Fish and Wildlife 2005). Lampreys occur long distances inland in the Columbia and Yakima river systems (Wydoski and Whitney 2003) and would likely do so in the Klamath River system as well, as habitat conditions are similar. Access to habitat above Keno Dam would likely benefit Pacific lamprey by increasing their viability through: a) extending the range and distribution of the species; b) providing additional spawning and rearing habitat; c) increasing the genetic diversity of the species; and d) increasing the abundance of the Pacific lamprey population (ALJ Decision at 38, FOF 8-9). Resident lamprey would benefit from a fishway that meets current criteria to accomplish lamprey passage.

Spillway Prescription Rationale: Spill survival estimates for salmonids are numerous and range from 76 percent to 100 percent depending on species, life stage, amount or proportion of water spilled, spillway configuration, tailwater hydraulics, the methodology of estimating survival, and predator conditions (National Marine Fisheries Service 2000). Fish passing down a spillway may experience physical, chemical, and biological effects. Fish passing over spillways can be injured by strikes or impacts with solid objects (e.g., baffles, rocks, or walls in the plunge zone), rapid

pressure changes, abrasion with the rough side of the spillway, and the shearing effects of turbulent water. Water exits Keno spillways via undershot gates with small openings and plunges into a wide, shallow bedrock sill that is an area known for predatory fish (Oregon Department of Fish and Wildlife 1997). It is likely that fish will be injured as water is passed through the gates under pressure and that predation will occur in the receiving waters. Therefore, the spillway modifications and 3 year timeline are necessary to meet resource goals and objectives as quickly as possible.

In the Preliminary Prescriptions, the Services based specific spillway prescriptions on the evidence cited above. In its request for hearing on disputed issues of material fact, the Applicant disputed facts supporting the spillway prescriptions. The Applicant subsequently withdrew its request for hearing regarding spillway prescriptions based on a stipulation with the Services (In the Matter Of: Klamath Hydroelectric Project, Docket Number 2006-NMFS-0001, Order Granting the Applicant's Motion to Withdraw USFWS/NMFS Issues 5 and 9, September 14, 2006 (Administrative Law Judge 2006b)). In accordance with the stipulation, the Services have revised the spillway prescriptions in the Modified Prescriptions below to allow the Applicant to study the need for and design of spillway modifications for anadromous and native resident fish.

The Applicant must perform any such studies in consultation with the Services, and provide the results of any such studies to the Services for approval before design and construction of the spillway modifications in order to inform the need for and design of spillway modifications. However, unless and until such site-specific studies are done, the Services must rely on the available information in concluding that spillway modifications are necessary for the safe, timely and effective passage of fish at Keno Dam.

7.1 Upstream Fishway at Keno Dam

7.1.1 *Keno Upstream Fishway*: To provide for the safe, timely, and effective upstream passage of Chinook salmon, steelhead trout, Pacific lamprey, and redband trout, the Licensee shall modify, operate, and maintain the existing volitional fishway. The Licensee shall also construct, operate, and maintain a holding and sorting facility to accommodate upstream interim, seasonal trap and haul for anadromous salmonids at Keno Dam. In addition, the modification shall include features to trap, hold, and sort anadromous salmonids by age and species, as well as accomplish the transfer of Chinook salmon upstream above Link River Dam between June 15 and November 15 for the purposes of restoration and the safe, effective, and timely passage of fish. If agreed to by the Services, volitional passage shall be employed during this time in periods when dissolved oxygen concentrations are greater than 6 mg/L and temperatures lower than 20°C, as measured at Miller Island using a method that is acceptable to the Services. The upstream fishway shall be operated year-round regardless of trap and haul operations to allow for the passage of steelhead, Chinook salmon, redband trout, lampreys, suckers, and other species. The ladder shall provide for the uninterrupted passage of fish over the full range of river flows for which the Project maintains operational control. The

auxiliary water system (AWS) shall be designed to augment ladder flow from the forebay. The AWS shall be screened in accordance with NMFS juvenile fish screen criteria (National Marine Fisheries Service 1997) or alternative criteria approved by the Services. The AWS shall be designed to provide the correct water temperature and water quality as to attract fish. The fish ladder and AWS together must be designed to supply attraction flows according to the terms of Modified General Prescriptions 1.1.7 The ladder shall include features to detect and record data for PIT-Tagged upstream migrating anadromous fish (or fish identified using similar technology). The upstream fishway shall be modified to current criteria (Table 1) for passage of Pacific lamprey. The fishway shall be modified and operational within 3 years of the issuance of the new license.

7.1.2 *Design Consultation*: The Licensee shall develop design and modification plans according to the terms of the Modified General Prescriptions 1.1.1 above within 1 year of the issuance of the new license for review and approval by the Service and NMFS Engineering prior to construction. The design shall include features to hold and sort anadromous salmonids by age and species, as well as accomplish the transfer of Chinook salmon upstream between June 15 and November 15 for the purposes of restoration and the safe, effective, and timely passage of fish. Facilities shall be designed so that fish to be trapped and hauled above Keno are held a maximum of 8 hours before transport. The ladder design shall include features to detect and record data for PIT-tagged upstream migrating anadromous fish (or fish identified using similar technology). The upstream fishway must be modified to current criteria for passage of Pacific lamprey.

7.1.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

7.2 Keno Spillway

7.2.1 *Spillway Modification*: Unless the Services determine, based on site-specific studies, that spillway modifications are unnecessary in accordance with Modified Specific Prescriptions 7.2.2 and 7.2.3, the Licensee shall modify, maintain, and evaluate the radial gate(s) to provide a spillway at Keno Dam to provide for the safe, timely, and effective downstream passage of Chinook and coho salmon, suckers, lamprey, steelhead trout, and redband trout. The spillway modifications shall be constructed and operational within 3 years of the issuance of the new license.

7.2.2 *Spillway Modification Studies*: The Licensee may, in consultation with the Services, study the need for and design of hydraulically-engineered

modifications to the radial gate(s) to provide a spillway (s) at Keno Dam to provide for the safe, timely, and effective downstream passage of Chinook and coho salmon, suckers, lamprey, steelhead trout, and redband trout. The Licensee shall submit a plan for any such studies to the Services for review and approval prior to conducting studies. After approval of any such plan, the Licensee shall complete the studies and submit study results and recommendations on the need for and design of spillway modifications for review and approval by the Services consistent with the provisions for timing of the spillway design under Modified Specific Prescriptions 7.2.3.

7.2.3 *Spillway Design*: Unless the Services determine, based on site-specific studies, that spillway modifications are unnecessary in accordance with Modified Specific Prescriptions 7.2.2, the Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 2 years of the issuance of the new license for review and approval by the Service and NMFS engineering prior to construction.

7.2.4 *Spillway Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in the Modified General Prescriptions, above.

8. Eastside and Westside Developments

Eastside and Westside Downstream Prescription Rationale: The Applicant's Eastside and Westside developments divert water at Link River Dam to downstream powerhouses. Migration is one of several defining life history characteristics of resident trout and anadromous fish, especially salmonids (ALJ Decision at 27, FOF 3-7; ALJ Decision at 13, FOF 2A-10). Significant numbers of redband trout and other resident fish are presently moving downstream from Upper Klamath Lake and being entrained by the Applicant's Eastside and Westside developments, including tens of thousands of larvae and juveniles of federally listed suckers annually (Gutermuth et al. 2000). With the adult fish ladder in place at Reclamation's Link River Dam and construction of functional adult fish ladders at dams downstream of Link River, salmon and steelhead will return to hold, spawn, and rear in habitat where they were present historically (Hamilton et al. 2005). However, the progeny of these fish must also negotiate not only the reservoir but the dam, powerhouse, and spillway during their outmigration. Unless protected by fish screens and bypasses, both resident and anadromous fish can suffer injury or death by passing through turbines at hydroelectric plants (Electric Power Research Institute 1987). Turbine-caused mortality can have serious consequences for fish populations, especially among anadromous species (Cada 2001). Survival of juvenile salmonids passing dams during their seaward migration is highest through spillways and lowest through turbines (Muir et al. 2001); turbine mortality being caused by pressure changes, cavitation, shear stress, turbulence, strike, and grinding (Cada 2001). The Electric Power Research Institute (Electric Power Research Institute 1987) reported that Francis turbines, which are used at the Applicant's Eastside and Westside developments, have an average mortality of about 24 percent. It is estimated that

"several tens of thousands of resident fish" are annually entrained at "each of the Projects" facilities (ALJ Decision at 28, FOF 4-2). It is anticipated that annual entrainment of anadromous fish would be on the same order of magnitude, if not greater. Once entrained, the fish face a high risk of mortality. For juvenile fish, the risk is between 10 to 30 percent (ALJ Decision at 29, FOF 4-5). Based upon these studies and findings, turbine similarities, and known entrainment, the Services conclude that turbine entrainment at the Applicant's Eastside and Westside developments causes comparable levels of mortality to downstream migrating fish as found in studies cited above. Volitional fish passage would be consistent with fish movement through the Klamath River system for purposes such as spawning, rearing, feeding, and seasonal use of habitat. Volitional fish passage would be consistent with the goals and objectives for resource management of the Klamath River Basin Fishery Task Force and the Services. Downstream fishways at the Applicant's Eastside and Westside developments would screen and divert both resident and anadromous fish from turbine intakes. This would guide downstream migrating fish, minimize mortality of federally listed suckers, and ensure that delay and entrainment mortality of redband trout, other resident species, and anadromous outmigrants would be minimized. To ensure that these fish can outmigrate, downstream passage facilities at the Eastside and Westside developments are necessary.

Temporary, seasonal trap and transport for downstream migrants would be necessary due to seasonal water quality problems in Lake Ewauna and Keno Impoundment. During most years, the Lake Ewauna reach of the Klamath River (Link River Dam to Keno Dam) has dissolved oxygen concentrations less than 6 mg/L and temperatures greater than 20oC from mid-June through mid- November (Jason Cameron, Reclamation, pers. comm.). While there is evidence that some juvenile Chinook salmon can tolerate temperatures near 20oC in Upper Klamath Lake (Maule et al. 2007), these conditions are not within criteria (U.S. Environmental Protection Agency 2003) for outmigrating juvenile anadromous salmonids and may not be conducive to downstream migration during this period. Transporting outmigrant anadromous salmonids around Keno Impoundment during this period would avoid poor water quality during summer months until restoration efforts improve reservoir dissolved oxygen and water temperatures.

The Services expect that the major outmigrations of juvenile Chinook salmon would occur from March to June for spring-run Chinook and February to May for fall-run juveniles. The Services expect trap and haul to be an effective interim, seasonal fish passage method for Chinook salmon under these summer conditions because only this species would be transported for a short distance. Other species need volitional fishways to access habitat in Keno Impoundment\Lake Ewauna and Link River year round. Seasonal trap and haul would be performed on an interim basis. Water quality is expected to improve over the term of a new Project license through the implementation of the Total Maximum Daily Load (TMDL) process, imposition of state water quality certification conditions, and provisions of a new license (the inclusion of 10(j) recommendations).

Migrating suckers make use of habitat in Lake Ewauna as long as water quality is adequate (i.e., outside of July, August, September (Rich Piaskowski, Reclamation, pers. comm.)). Downstream migrating suckers captured during periods when water quality is inadequate in Keno Impoundment\Lake Ewauna would be returned to Upper Klamath Lake.

Eastside and Westside Tailrace Barrier Prescription Rationale: These developments have no tailrace barriers and have never been tested for mortality to federally listed suckers, other resident fish, or anadromous salmonids. Water discharging from the Eastside and Westside powerhouses represents a significant portion of the total river flow of the Klamath River. The natural tendency for fish attracted to such an area is to hold and wait for passage conditions to improve, or to attempt to move past the obstacle either by swimming or leaping. Depending on powerhouse operations, draft tube discharge velocities at Project facilities are between 3.4 and 10.4 feet per second (fps) (CH2MHill 2006); these velocities easily fall within the swimming abilities of salmonids (Weaver 1963). The types of injury sustained by some fish entering draft tubes or contacting turbines vary from site to site, as do immediate and delayed mortality rates. Several studies, however, attribute injuries in migrating salmonids to powerhouse structures associated with tailrace structures (Department of Fisheries Canada 1958; International Pacific Salmon Fisheries Commission 1976; Schadt et al. 1985; Williams 1985).

Adult anadromous fish are attracted into oncoming flows (National Marine Fisheries Service 2004). Migration upstream may be delayed when tailrace flows from the powerhouse exceed river bypass reach flows. A migration delay, or combined delays at several facilities, may prevent fish from reaching suitable spawning habitat when they are ready to spawn or conditions are optimal for survival. Migration delays caused by tailrace effects may have a greater impact on fish populations than injury and mortality from turbine impacts (Federal Energy Regulatory Commission 1994). Migration delays may occur to a greater percentage of migrating fish than the percentage of fish impacted by turbine mortality.

Migration delays are well documented for anadromous salmonids in the Pacific Northwest (Haynes and Gray 1980; Rondorf et al. 1983; Schadt et al. 1985; Vogel et al 1990). For migratory fish, false attraction occurs when upstream migrants are attracted to turbine discharge or spillway flows rather than to fishway flows. False attraction also occurs when upstream migrants detect the scent of their natal stream downstream of its natural outlet (Fretwell 1989). This happens when water from a natal stream is diverted through a canal or pipe to a hydroelectric project. In either instance, without proper Project design or operation modifications, there may be migratory delays. In order to prevent injury, delay, or mortality to suckers and salmonids, caused by attempts to swim upstream into the tailraces, barriers are required to guide migrating fish away from the tailrace area to continue their upstream migration. The 3 year construction timeline is necessary to meet resource goals and objectives as quickly as possible.

In the Preliminary Prescriptions, the Services based specific tailrace barrier prescriptions on the evidence cited above. In its request for hearing on disputed issues of material fact, the Applicant disputed facts supporting the tailrace barrier prescriptions. The Applicant subsequently withdrew its request for hearing regarding tailrace barrier prescriptions based on a stipulation with the Services (In the Matter Of: Klamath Hydroelectric Project, Docket Number 2006- NMFS-0001, Order Granting the Applicant's Motion to Withdraw USFWS/NMFS Issues 5 and 9, September 14, 2006 (Administrative Law Judge 2006b)). In accordance with the stipulation, the Services have revised the tailrace barrier prescriptions in the Modified Prescriptions below to allow the Applicant to study the need for and design of tailrace barrier s for anadromous and native resident fish. The Applicant must perform any such studies in consultation with the Services, and

provide the results of any such studies to the Services for approval before design and construction of the tailrace barriers in order to inform the need for and design of tailrace barriers. However, unless and until such site-specific studies are done, the Services must rely on the available information concluding that tailrace barriers are necessary for the safe, timely, and effective upstream passage of fish at the Eastside and Westside developments.

8.1 Eastside and Westside Downstream Fishways

8.1.1 *Intake Fish Screens and Bypass Facilities*: The Licensee shall construct, operate, maintain, and evaluate fish screens and bypass facilities at both Eastside and Westside developments to provide for the safe, timely, and effective downstream passage of Chinook salmon, steelhead trout, Pacific lamprey, federally listed suckers, and redband trout. The fish screens and bypass facilities shall be located as close as is practicable to the beginning of each diversion to minimize entrapment in the diversion canals. The fish screens and bypass facilities shall transport fish to holding, sorting, counting, and tagging facilities. Fish would then continue through the bypass facility downstream except during the period from June 15 and November 15, when trap and haul downstream to below Keno Dam would be employed for the purposes of restoration and the safe, effective, and timely passage of fish. If agreed to by the Services, seasonal trap and haul downstream shall be discontinued and fish routed downstream through the bypass when dissolved oxygen concentrations are greater than 6 mg/L and temperatures lower than 15°C, as measured at Miller Island using a method that is acceptable to the Services. The bypass facilities shall include features to detect and record data for PIT-tagged downstream migrating fish (or fish identified using similar technology), including features to detect and record data from fish tagged above the facilities to evaluate survival and fishway effectiveness. The downstream fishway shall be operated year-round regardless of trap and haul operations to allow for the passage of steelhead, redband trout, lampreys, suckers, and other species. The screens and bypass facilities shall be operated year-round and shall be designed in accordance with sucker criteria (Table 2 in Preliminary Prescription), or alternative criteria as acceptable to the Services. The screens and bypass facilities shall provide for the uninterrupted passage of fish over the full range of river flows for which the Project maintains operational control. The construction shall include features to return suckers to Upper Klamath Lake. The downstream fishways shall be constructed and operational within 3 years of the issuance of the new license.

8.1.2 *Design Consultation*: The Licensee shall develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 above within 1 year of the issuance of the new license for review and approval by the Service and NMFS Engineering. The design of the bypass facilities shall include features to detect and record data for PIT-tagged

downstream migrating fish (or fish identified using similar technology) and to hold, sort, count, and mark downstream migrating anadromous fish by age and species. The facilities shall include features to detect and record data from fish tagged above the facilities to evaluated survival and fishway effectiveness. The design shall include features to accomplish the transfer of these fish downstream between June 15 and November 15 for the purposes of restoration and the safe, effective, and timely passage of fish. The design shall include features to return suckers to Upper Klamath Lake. Facilities shall be designed so that fish to be trapped and hauled are held a maximum of 8 hours before transport.

8.1.3 *Monitoring, Reporting, and Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

8.2 Tailrace Barriers at Eastside and Westside Developments

8.2.1 *Tailrace Barrier Construction*: Unless the Services determine, based on site-specific studies, that tailrace barriers are unnecessary in accordance with Modified Specific Prescriptions 8.2.2 and 8.2.3, the Licensee shall construct a tailrace barrier and guidance system at the Eastside and Westside powerhouses to provide for the safe, timely, and effective upstream passage of Chinook salmon, steelhead trout, suckers, redband trout, and lamprey. The tailrace barriers and guidance system shall be constructed according to approved design plans and within 3 years of the issuance of the new license.

8.2.2 *Tailrace Barrier Studies*: The Licensee may, in consultation with the Services, study the need for and design of a tailrace barrier and guidance system at Eastside and Westside Developments. The Licensee shall submit a plan for any such studies to the Services for review and approval prior to conducting studies. After approval of any such plan, the Licensee shall complete the studies and submit study results and recommendations on the need for and design of tailrace barriers for review and approval by the Services consistent with the provisions for timing of the tailrace barrier design under Modified Specific Prescriptions 8.2.3.

8.2.3 *Tailrace Barrier Design*: Unless the Services determine based on site-specific studies that tailrace barriers are unnecessary in accordance with Modified Specific Prescriptions 8.2.2, the Licensee shall, within 1 year of the issuance of the new license, develop design and construction plans according to the terms of the Modified General Prescriptions 1.1.1 for review and approval by the Service and NMFS Engineering prior to construction.

8.2.4 *Tailrace Barrier Evaluation*: The Licensee shall complete reporting, monitoring, and evaluation of this facility as specified in Modified General Prescriptions, above.

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United States Department of the Interior, Modified Terms and Conditions and Prescriptions for Fishways Filed Pursuant to Sections 4(e) and 18 of Federal Powers Act with the Federal Energy Regulatory Commission for the Klamath River Hydroelectric Project, Project NO. 2082 Klamath River, Siskiyou County, California; and Klamath County, Oregon.

U.S. Department of the Interior Modified 4(e) Conditions – BLM Reservation

BLM Modified Condition 1: Activities on or Affecting Bureau of Land Management-Administered Lands

(a) For any proposed activity to be implemented by the Licensee on or affecting BLM administered lands that are added to the Project boundary, the Licensee shall request and obtain a BLM use authorization prior to conducting the activity. The Licensee shall fund any required environmental analysis related to the issuance of the use authorization, as determined by the BLM. As part of the request for the use authorization, the Licensee may provide environmental analysis of the proposed action that meets BLM requirements for implementing the National Environmental Policy Act (NEPA) in existence at the time the request is made, including changes in statutes or regulations governing BLM NEPA procedures. The Licensee may also refer to or rely on any previous NEPA analysis for the proposed measure to the extent the analysis is currently applicable, as determined by BLM. The use authorization may contain stipulations for fire protection, spoils disposal, hazardous materials, safety or other standard use authorization measures consistent with the requirements in effect at the time for implementation of similar actions on BLM-administered land.

(b) The Licensee shall prepare site-specific plans for the approval of the BLM for activities required by the license that have the potential to impact BLM administered lands or resources. The site-specific plans shall include, at a minimum:

(i) a map depicting the location of the proposed activity;
(ii) the land use allocation and management designation including standards and guidelines for the area of the proposed activity;
(iii)site-specific designs for the proposed activity;
(iv) proposals for Project-specific mitigation measures, including, but not limited to, applicable measures addressing safety, inspections, spoils disposal, hazardous substances, and restoration needs;
(v) proposals for implementation and effectiveness monitoring necessary to meet standards and guidelines; and
(vi) data from surveys, biological evaluations, or consultation required by regulation and as applicable to activities on BLM-administered lands.

(c) Upon BLM approval of the site-specific plans, the Licensee shall conduct any additional environmental analysis deemed necessary by the BLM to ensure consistency with statutes, regulations and policies, including the National Historic Preservation Act (NHPA), the Archaeological Resources Protection Act (ARPA), the Native American Grave Protection Act (NAGPRA), the Clean Air Act, the Clean Water Act, and the Endangered Species Act (ESA) and the BLM direction in the National Environmental Policy Act Handbook 1790-1 (USDI BLM 1988), or as amended. As part of the

site-specific plan, the Licensee may provide environmental analysis of the proposed activity that meets BLM requirements for implementing the National Environmental Policy Act (NEPA) in existence at the time the request is made. The Licensee may also refer to or rely on any previous site-specific NEPA analysis for the proposed activity to the extent the analysis is currently applicable, as determined by BLM. The Licensee shall obtain written authorization of the BLM prior to the implementation of the activity.

(d) The Licensee shall avoid disturbance to all public land survey monuments, private property corners, and BLM boundary markers. In the event that any markers or monuments are destroyed by an act or omission of the Licensee, in connection with the use and/or occupancy authorized by the license or a BLM use authorization, depending on the type of monument destroyed, the Licensee shall reestablish or reference same in accordance with (1) the procedures outlined in the "Manual of Instructions for the Survey of the Public Land of the United States," (2) the specifications of the County Surveyor, or (3) the specifications of the BLM. The Licensee shall ensure that any such official survey records affected are amended as provided for by law.

(e) The Licensee shall maintain Project-related improvements and facilities located on BLM-administered lands to accepted standards of repair, orderliness, neatness, sanitation, and safety. The Licensee shall comply with all applicable Federal, State, and local laws, regulations, including but not limited to, the Federal Water Pollution Control Act, 33 U.S.C. § 1251 et seq., the Resources Conservation and Recovery Act (RCRA), 42 U.S.C. § 6901 et seq., the Comprehensive Environmental Response, Control, and Liability Act (CERCLA), 42 U.S.C. § 9601 et seq., and other relevant environmental laws, as well as public health and safety laws and other laws relating to the siting, construction, operation, and maintenance of any facility, improvement, or equipment.

(f) The Licensee shall restore BLM-administered lands affected by the Project to a condition satisfactory to BLM prior to any surrender of the Project license. At least one year in advance of license surrender, the Licensee shall file with the Commission a restoration plan approved by the BLM. The plan shall identify Project-related improvements to be removed, restoration measures, and time frames for implementation and estimated restoration costs.

(g) Prior to the abandonment of any Project-related facilities on or affecting BLM administered lands, including impacts due to changes in the Project boundary from that in the original license, the Licensee shall restore such lands and improvements to a condition acceptable to BLM. At least one year in advance of the abandonment of these Project-related facilities, the Licensee shall file with the Commission a restoration and maintenance plan approved by the BLM. The plan shall identify, at a minimum, improvements that will be removed, improvements abandoned but not removed, restoration and maintenance measures, time frames and costs.

(h) The Licensee shall, within one year of license issuance, develop a standard operating procedures plan that the Licensee shall implement in the event of Project-related emergencies. At a minimum, the plan shall address BLM administered lands potentially

affected by the Project, and address procedures, environmental permits, and subsequent mitigation measures for any Project related impacts to BLM administered lands including, but not limited to, the J.C. Boyle emergency spillway and canal and slope failures. This plan shall be developed with consultation and approval by BLM. The plan shall include implementation strategies for agency coordination, restoration actions, monitoring and evaluation, and potential mitigation measures.

(i) The Licensee shall exercise diligence in protecting from damage the land and property of the BLM covered by and used in connection with this license, including any buildings, bridges, roads, trails, lands or other property of the BLM; and shall restore, reconstruct or compensate the BLM for any damage resulting from negligence and from the violation of the terms of this license or any law or regulation applicable to the BLM by the Licensee, or by any agents or employees of the Licensee acting within the scope of their agency or employment. Arrangements to restore, reconstruct, or compensate for damages shall be made with the BLM.

(j) The Licensee shall indemnify, defend, and hold the United States harmless for any costs, damages, claims, liabilities, and judgments arising from past, present, and future acts or omissions of the Licensee in connection with the use and/or occupancy of BLM-administered lands or resources authorized by the license. This indemnification and hold harmless provision applies to any acts and omissions of the Licensee or the Licensee's heirs, assigns, agents, employees, affiliates, subsidiaries, fiduciaries, contractors, or lessees in connection with the use and/or occupancy authorized by this license which result in: (1) violations of any laws and regulations which are now or which may in the future become applicable, and including but not limited to environmental laws such as the CERCLA, RCRA, Oil Pollution Act, Clean Water Act, Clean Air Act; (2) judgments, claims, demands, penalties, or fees assessed against the United States; (3) costs, expenses, and damages incurred by the United States; or (4) the release or threatened release of any solid waste, hazardous substances, pollutant, contaminant, or oil in any form in the environment.

BLM Modified Condition 2: Consultation with the Bureau of Land Management

A. The Licensee shall consult with the Bureau of Land Management (BLM) at least annually and prepare a report on the status of implementing conditions of the license, including, at a minimum, those that may affect BLM-administered lands and resources. The report shall include, but is not limited to, the:

1. Results of any monitoring preformed over the previous year for reporting effectiveness of license requirements;

2. Review of any non-routine maintenance;

3. Discussion of any foreseeable changes to Project facilities or operations;

4. Discussion of any necessary revisions or modification to plans approved as part of this license; and

5. Discussion of elements of current year maintenance plans, e.g. road maintenance.

B. A copy of the records, plan reports, monitoring reports, and other pertinent records shall be provided to the BLM at least 10 days prior to the annual meeting, unless otherwise agreed.

C. Within 60-days of issuance of the report to BLM, the Licensee shall file the record of consultation and any BLM comments and recommendations with the Commission.

D. The Licensee shall consult with the BLM on a as-needed basis to identify and resolve potential conflicts with BLM policy and direction prior to initiating activities on BLM-administered lands,

E. The Licensee shall consult with the BLM at least annually to determine if any Project related activity may affect other authorized activities on BLM-administered lands in the Project area. If a Project-related activity may affect other authorized uses, then the Licensee shall resolve potential conflicts with representatives of those permitted uses.

The Licensee shall submit copies of other reports related to Project safety, including Spill Prevention Control and Countermeasure Plans and annual emergency and hazardous chemical inventories, and non-compliance to the BLM concurrently with submittal to the Commission. These include, but are not limited to, any non-compliance report filed by the Licensee for facilities or operations on or affecting BLM-administered lands.

BLM Modified Condition 3: Roads Inventory Analysis and Roads Management

A. Within six months of license issuance, the Licensee shall complete, in consultation with the Bureau of Land Management (BLM), a Project Roads Inventory Analysis (Analysis) and file the Analysis with the Commission for approval. The Licensee shall prepare a draft Analysis after consultation with the BLM. The Licensee shall allow a minimum of 60 days for the BLM to comment and make recommendations on the draft Analysis before finalizing the Analysis and filing it with the Commission. The Licensee shall include with the Analysis documentation of consultation, copies of comments and recommendations and a description of how the comments and recommendations are accommodated by the Analysis. If the Licensee does not adopt a recommendation, the filing shall include the Licensee's reasons, based on Project specific information. At the time it files the Analysis with the Commission, the Licensee shall serve a copy of the filed documents upon the BLM. At a minimum, the Analysis shall address all roads that cross BLM-administered lands included within the geographical scope of the *Study Area Roadway Inventory Analysis and Project Roadway Management Plan – Klamath Hydroelectric Project (FERC Project No. 2082)* (PacifiCorp 2004m), including in the analysis the estimated percentage of use that is associated with Project operations and maintenance and other Project-related activities such as Project-related recreation. The

Analysis, at a minimum, shall identify and map the roads, bridges, culverts and other transportation-related structures within the broader overall study area, as described above, as well as identifying the estimated percentage of Project-related use these transportation-related facilities sustain.

B. Within one year of license issuance, the Licensee shall develop, in consultation with the BLM, a Road Management Plan (Plan) and file the Plan with the Commission for approval. The Licensee shall prepare a draft Plan after consultation with the BLM. The Licensee shall allow a minimum of 60 days for the BLM to comment and make recommendations on the draft Plan before finalizing the plan and filing it with the Commission. The Licensee shall include with the Plan documentation of consultation, copies of comments and recommendations and a description of how the comments and recommendations are accommodated by the Plan. If the Licensee does not adopt a recommendation, the filing shall include the Licensee's reasons, based on Project specific information. At the time it files the Plan with the Commission, the Licensee shall serve a copy of the filed documents upon the BLM. The Plan shall include all roads that cross BLM-administered lands (BLM Roads) that are identified in the Project Roads Inventory Analysis that sustain Project-related uses, including Project related recreation.

1. At a minimum, the Plan shall include the items specified in the Final License Application (PacifiCorp 2004a, Executive Summary, page 8-5; Land Use, Visual, and Aesthetic Resources Final Technical Report, page 3-7; and Appendix 3C) and shall:

(a) Identify roads, bridges, culverts and other transportation-related structures necessary for Project-related activities, including Project-related recreation;

(b) Identify transportation-related operations and maintenance (O&M) activities required for the continued operation of the Project;

(c) Identify transportation-related activities required to address Project-related recreation uses;

(d) Include provisions for use and cost-sharing agreements for Project and Project-related transportation related structures;

(e) Identify the Licensee share for management and maintenance of BLM Roads affected by the Project;

(f) Identify BLM roads previously used but which are no longer necessary to operate and maintain the Project or used for Project-related recreation, and include plans for decommissioning these roads as appropriate;

(g) Provide for continued protection of natural and cultural resources along Project-related roadway corridors;

(h) Identify appropriate standards for the maintenance of Project-related roads and other transportation-related structures;

(i) Identify and implement Best Management Practices for maintaining and protecting cultural resources, vegetation resources (including management for noxious weeds), aquatic resources, and minimizing soil erosion; and

(j) Identify relevant BLM policies for transportation management of BLM Roads affected by Project-related activities.

2. The Roads Plan shall accommodate unrestricted access by the BLM necessary to manage and administer BLM lands and resources that are affected by Project operations. The plan shall include provisions for the maintenance of crossings and rights-of-way (ROW) required by and consistent with permit requirements for powerlines, penstocks, ditches, and pipelines.

C. The Licensee shall consult with the BLM prior to erecting any signs on BLM administered lands that are necessary for operation or maintenance of Project operations or facilities. The Licensee must obtain approval from the BLM specific to the location, design, size, color, and content of signs. The Licensee shall be responsible for maintaining all Licensee-erected signs to neat and presentable standards.

BLM Modified Condition 4: River Corridor Management

A. J.C. Boyle Bypassed River Reach

1. Required Minimum Streamflows – The Licensee shall, within one year after license issuance, operate J.C. Boyle Development to accomplish the following:

(a) Proportional flow requirement: Provide no less than 40% of the inflow to J.C. Boyle Reservoir to the J.C. Boyle Bypassed River Reach, to be measured at a new gage below the J.C. Boyle Dam near RM 225. Inflow to J.C. Boyle Reservoir shall be calculated by averaging the previous three days of the combined daily flows as measured at the Keno gage #11509500 and Spencer Creek gage #11510000 (Calculated Inflow).

(b) Minimum base flow requirement: When Calculated Inflow is less than 1,175 cubic feet per second (cfs), no less than 470 cfs shall be provided to the J.C. Boyle Bypassed River Reach, except that when the Calculated Inflow is less than 470 cubic feet per second (cfs), then flow shall be provided to the J.C. Boyle Bypassed River Reach in an amount equal to the Calculated Inflow.

(c) Seasonal high flow requirement: When Calculated Inflow to J.C. Boyle Reservoir exceeds 3,300 cfs during the period between February 1st and April 15th, diversion to the J.C. Boyle Power Canal shall be suspended at least once and continued for a minimum of seven days.

2. Ramping During Controlled Events – The Licensee shall, within one year after license issuance, operate J.C. Boyle Development to not exceed an up-ramp rate or down-ramp rate of two inches per hour as measured at the new gage below J.C. Boyle Dam when conducting controlled flow events (e.g., scheduled maintenance and changes in minimum flow requirements), except when implementing the seasonal high flow or when turbine capacity is exceeded. The Licensee, in consultation with the BLM, shall develop and implement an appropriate ramp rate to follow after the seasonal high flow to prevent stranding fish in the J.C. Boyle Bypassed Reach.

B. J.C. Boyle Peaking Reach

1. Streamflow Requirements – The Licensee shall, within one year after license issuance, operate the J.C. Boyle Development from May 1st to October 31st to provide a minimum streamflow of 1,500 cfs a maximum of once a week, such that these flows occur at the Spring Island Boat Launch between 0900 and 1400 hours from Friday through Sunday, in the priority of Saturday, Sunday, and then Friday.

2. Ramping During Controlled Events – The Licensee shall, within one year after license issuance, operate the J.C. Boyle development to not exceed an up-ramp rate or down-ramp rate of two inches per hour when conducting controlled flow events (e.g. scheduled maintenance, power generation, changes in streamflow requirements), except during implementation of the seasonal high flow, as measured at the J.C. Boyle Powerhouse gage USGS #11510700.

3. Flow Continuation Measure – The Licensee shall, within one year of license issuance, implement a flow continuation measure at the J.C. Boyle canal and powerhouse to provide a minimum of 48 hours of continuous flow under powerhouse shutdown conditions.

C. Streamflow Measurement and Reporting: J.C. Boyle Bypassed River and Peaking Reaches

1. Instream Flow Measurement – The Licensee shall, within one year after license issuance:

(a) Continuously measure the stage of water at three existing gage sites. Existing gage stations shall include the Klamath River below Keno Dam (#11509500), Spencer Creek above the confluence with the J.C. Boyle Reservoir (#11510000), and Klamath River below the J.C. Boyle Powerhouse (#11510700).

The Licensee shall operate and maintain the gages at these sites if the gages are no longer operated or maintained by the current operators.

(b) The Licensee shall establish and operate one additional gage on the Klamath River J.C. Boyle Bypassed River Reach below all outlets from the J.C. Boyle Dam and above the springs near RM 225, using the most current USGS protocol for gage station installation, maintenance, and data collection.

2. Instream Flow Reporting - The Licensee shall, within one year after license issuance:

(a) Provide instantaneous 30-minute real time streamflow data in cfs via remote access that is readily available and accessible to the public.

(b) Design and maintain a database, similar to the most current version of the USGS National Water Information System (NWIS) for reporting on surface water. The database shall store gage network data and streamflow tracking procedures. BLM shall review and approve the database.

3. The Licensee shall, within two years after license issuance, submit a report for each water year (i.e. October 1st through September 30th) of streamflow data reported in cfs to the BLM. The report shall be filed with the BLM within six months of the end of each water year.

U.S. Department of Interior Modified 4(e) Conditions – Reclamation Reservation

1) The Licensee shall enter into new or amended contract with Reclamation for the operation and maintenance of Link River and Keno Dams under terms and conditions satisfactory to the Secretary of the Interior. Such terms shall be substantially similar to the terms of the current contract and shall specifically include the following terms necessary for the protection of Klamath Reclamation Project operations:

a. The Licensee shall continue to operate and maintain Link River Dam. Such operation shall be consistent with the Klamath Reclamation Project Annual Project Operations Plans.

b. For the period of the contract the Licensee would agree to furnish electric power for the purposes of pumping Klamath Water for use on Project Land and for drainage of Project Land at rates no higher than the cost of service from Project 2082.

c. The Licensee shall, at its own expense, maintain the approach channel to the "A" Canal of the Klamath Reclamation Project to the satisfaction of Reclamation so far an may be necessary to carry a flow of not less than 1200 cfs into the "A" Canal with the water of Upper Klamath Lake at an elevation of 4137 (USBR datum).

d. The Licensee shall assume any and all liability for damages resulting from operation of the Link River Dam by the Licensee or resulting from its regulation and control of the water levels of Upper Klamath Lake. The Licensee would undertake to hold the United States harmless from any and all liability for damage arising out of the operation by the Licensee of Link River Dam and the regulation and control by the Licensee of Upper Klamath Lake provided for in the contract.

e. Nothing in the contract shall curtail or in anywise be construed as curtailing the rights of the United States to Klamath Water or to the lands along or under the margin of Upper Klamath Lake. No Klamath water shall be used by PacifiCorp when it may be needed or required by the United States or any irrigation or drainage district, person, or association obtaining water from the United States for use for domestic, municipal, and irrigation purposes on Project Land.

f. PacifiCorp shall operate Keno Dam so that the upstream water level will not be below the minimum normal objective operating height of elevation 4085.0 (USBR Datum), at or near the location of the present Highway No. 66 bridge at Keno, Oregon.

g. PacifiCorp shall operate Keno Dam to accommodate the discharge of three thousand (3,000) cubic feet per second from the Lost River Diversion Channel, and six hundred (600) cubic feet per second from the Klamath Straits Drain.

2) The Licensee, in consultation with Reclamation, shall develop operating criteria that provides for coordination with the operations of Link River Dam and Iron Gate Dam, or the most downstream dam within Project No. 2082 to allow Reclamation to meet its responsibilities.

3) The Licensee, in consultation with Reclamation, shall develop operating criteria that provides for coordination with the operations of Keno Dam and Iron Gate Dam, or the most downstream dam within Project No. 2082, as in Attachment 2.

4) The Licensee shall provide Reclamation with area capacity curves for all facilities within Project No. 2082, and will provide Reclamation with real time access to reservoir elevations and releases for facilities within Project No. 2082.

5) Any operations or modifications to Project No. 2082 that could affect the federal Klamath Reclamation Project are prohibited unless approved by Reclamation.

6) The licensee shall have no claim against the United States arising from the effect of any changes in releases from, operations of, or elevation changes in Upper Klamath Lake or Lake Ewauna related to the Reclamation's Klamath Project operations or use of water for the Upper Klamath, Lower Klamath or Tule Lake National Wildlife Refuges.

7) Authority is reserved to the Commission to require the Licensee to implement such conditions for the protection and utilization of Reclamation reservations as may be provided by the Secretary of the Interior, pursuant to Section 4(e) of the Federal Power Act, 16 U.S.C. § 797(e).