U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Marine Fisheries Service

DRAFT ENVIRONMENTAL ASSESSMENT:

Authorization for Incidental Take and Implementation of the PacifiCorp Klamath Hydroelectric Project Interim Operations Habitat Conservation Plan for Coho Salmon

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
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Environmental Assessment
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Executive Summary

Proposed Action

In accordance with the National Environmental Policy Act (NEPA), the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) has developed this Environmental Assessment (EA) to evaluate the effects of issuing a proposed Incidental Take Permit (ITP) under Section 10(a)(1)(B) of the Endangered Species Act (ESA) of 1973, as amended, to PacifiCorp Energy (PacifiCorp, or the applicant) related to interim operation of the Klamath Hydroelectric Project (Project). The Klamath Hydroelectric Settlement Agreement (KHSA) anticipates that four dams within PacifiCorp's Klamath Hydroelectric Project on the Klamath River would be removed by the end of 2020. PacifiCorp is separately applying to NMFS and the U.S. Fish and Wildlife Service (USFWS) for ITPs to address the transition period before dam removal, Project decommissioning, and restoration of volitional fish passage. PacifiCorp is applying to NMFS for an ITP for a 10-year period authorizing the incidental take of Southern Oregon/Northern California Coast Evolutionarily Significant Unit of coho salmon (*Oncorhynchus kisutch*), which is listed as threatened under the ESA. PacifiCorp is separately applying to the USFWS for an ITP for a 10-year period that would authorize incidental take of Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*), which are listed as endangered under the ESA.

NMFS' issuance and continuation of the ITP would be contingent on the implementation of a Habitat Conservation Plan (HCP) developed, in coordination with NMFS, by the applicant (PacifiCorp 2011). This HCP includes a series of conservation measures to minimize and mitigate the effects of operation of the Project on potential take of listed coho salmon during this transition period until planned dam removal, or the establishment of volitional fish passage facilities where they currently do not exist.

The transfer of the Hydroelectric Project to a Dam Removal Entity (DRE) is anticipated by the KHSA to occur on or before December 31, 2020. If dam removal under the KHSA does not proceed, PacifiCorp would return to the Federal Energy Regulatory Commission (Commission, or FERC) relicensing process for the Project and would implement the conditions of a new Project license, including mandatory conditions prescribed by NMFS for installation of volitional fish passage facilities providing fish passage throughout the Project area. This EA analyzes a permit term of 10 years, assuming initial permit issuance in 2011.

Conservation/Mitigation Measures

The conservation or mitigation measures and their effects, summarized below, are derived from, among other things, Biological Opinions developed by NMFS and USFWS in conjunction with a Final Environmental Impact Statement (FEIS) developed by FERC for reissuing the federal license to operate the Project, without dam removal, for a 50-year period, and updated studies and analyses described in the HCP. This EA assesses potential impacts of issuing the proposed ITP and these conservation or mitigation measures, taking into account differences between the original 50-year FERC relicensing proposal and the current 10-year interim operation period.

The conservation or mitigation measures incorporated into the HCP include the following:

- The applicant would implement a system to introduce air into its turbine at Iron Gate dam ("turbine venting"). This would increase the levels of dissolved oxygen downstream of the dam, which would benefit habitat conditions for coho salmon and other aquatic species.
- The applicant would participate in the development and implementation of a plan to increase flow variability below Iron Gate dam during the fall/early winter period. Increased flow variability is expected to result in important habitat improvements for coho salmon and other aquatic species downstream of Iron Gate dam, including the potential reduction in disease-causing organisms.
- The applicant would implement measures to increase the quantity and functionality of large woody debris (LWD) downstream of Iron Gate dam, benefitting habitat conditions for coho salmon and other aquatic organisms.
- The applicant would establish a Fish Disease Research Fund, which would fund programs expected to contribute to disease reduction and thus benefit coho salmon and other aquatic species.
- The applicant would create and fund a Coho Enhancement Fund that would be used to implement various projects designed to benefit coho salmon (e.g., by enhancing habitat conditions).

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Acronyms and Abbreviations

BiOp	Biological Opinion
CDFG	California Department Fish and Game
CEQ	Council on Environmental Quality
cfs	cubic feet per second
DO	dissolved oxygen
DOI	U.S. Department of Interior
DRE	Dam Removal Entity
EA	Environmental Assessment
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission (or “Commission”)
HCP	Habitat Conservation Plan
HGMP	Hatchery Genetic Management Plan
IA	Implementing Agreement
ITP	Incidental Take Permit
KHSA	Klamath Hydroelectric Settlement Agreement
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
RM	river mile
SONCC	Southern Oregon and Northern California Coast (coho salmon)
USFWS	U.S. Fish and Wildlife Service

SECTION 1

Introduction

PacifiCorp Energy (PacifiCorp or the applicant) is applying to the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) for an incidental take permit (ITP) under Endangered Species Act (ESA) Section 10(a)(1)(B) for a 10-year period authorizing the incidental take of Southern Oregon/Northern California Coast (SONCC) Evolutionarily Significant Unit (ESU) of coho salmon (*Oncorhynchus kisutch*), which is listed as threatened under the ESA. The ITP would require implementation of a Habitat Conservation Plan (HCP) with measures to monitor, mitigate, and minimize effects of PacifiCorp's Klamath Hydroelectric Project (Project) on these listed coho salmon for this period. This Environmental Assessment (EA) analyzes the potential effects of NMFS's proposed action of issuance of an ITP as provided under the National Environmental Policy Act (NEPA) and implementing regulations and policy.

Project facilities at Iron Gate dam, which is the Project dam furthest downstream on the Klamath River, do not include fish passage structures. Thus, anadromous fish passage, including passage of listed coho salmon, is currently blocked at Iron Gate dam. Subject to certain conditions and a pending determination in March 2012 by the Secretary of the Interior, the Klamath Hydroelectric Settlement Agreement (KHSA)[1] anticipates that four Project dams (Iron Gate, Copco No.1, Copco No. 2, and J.C.Boyle) on the Klamath River will be removed on or before December 31, 2020 to accomplish volitional fish passage for listed coho salmon and other species. The removal of the dams envisioned in the KHSA modifies an earlier proposal by PacifiCorp to the Federal Energy Regulatory Commission (FERC) to relicense and continue to operate the Project for 50 years. The KHSA provides that operations of the Project, including these dams, will continue over the interim period until the dams are removed or, should dam removal not proceed, until FERC issues a new license to PacifiCorp for operation of the Project and volitional fish passage is implemented. Even if the dams are not removed under the KHSA for some reason, NMFS has prescribed mandatory fishways, which FERC must include as conditions of any new license for operation of the Project, in the FERC relicensing process. These fishways would provide volitional fish passage for listed coho salmon and other species (NMFS 2007a, b). Therefore, as further described in this EA below and in the HCP, NMFS expects that there would be volitional fish passage under either dam removal pursuant to the KHSA or FERC's issuance of a new license for the Project by approximately the end of 2020, and volitional fish passage under either of these processes will provide substantial benefits to coho salmon and other anadromous fish species at the completion of the interim term of this ITP. The HCP that PacifiCorp included with its application for an ITP includes a series of conservation measures to minimize and mitigate the effects of operation of the Project on potential

[1] Representatives of numerous organizations, including the states of California and Oregon, Indian tribes, counties, irrigators and conservation and fishing groups have developed a comprehensive solution to resolve many of the complex water-related issues of the Klamath Basin. Many of the participants in the Klamath settlement process signed the Klamath Basin Restoration Agreement and Klamath Hydroelectric Settlement Agreement on February 18, 2010. In order to access these agreements for more information, see http://klamathrestoration.gov

incidental take of listed coho salmon during this transition period until dam removal or FERC's issuance of a new license to PacifiCorp for operation of the Project.

1.1 Chronological Background

In 2004, PacifiCorp filed an application with FERC for a new license to operate the Project. The potential alternatives, environmental impacts and mitigation measures for the continued operation of the Project were considered in FERC's relicensing process, as documented in the Final Environmental Impact Statement (FEIS) prepared by FERC (FERC 2007; a hyperlink to this document is available in the References section of this EA). In December 2007, NMFS and U.S. Fish and Wildlife Service (USFWS) (NMFS and USFWS - the Services) issued Biological Opinions (BiOps) on FERC's proposed relicensing action. NMFS' Biological Opinion analyzed the effects on listed coho salmon of FERC's proposed relicensing action, which for purposes of the Biological Opinion included mandatory requirements to construct fishways for volitional passage of anadromous fish around the Project dams, but did not include removal of the Project dams. USFWS analyzed the effects of FERC's proposed relicensing action on endangered Lost River suckers and shortnose suckers in their 2007 Biological Opinion. The Services' Biological Opinions included incidental take statements that described the incidental take of those listed species expected as a result from Project operations, included reasonable and prudent measures necessary to minimize the impact of that incidental take, and included terms and conditions to implement those reasonable and prudent measures (NMFS 2007a, USFWS 2007).

To address the Services' concerns about the potential effects of Project operations identified in the BiOps and during the transition period (i.e., prior to potential dam removal under the ESA or relicensing of the Project by FERC), PacifiCorp submitted an Interim Conservation Plan to the Services (PacifiCorp 2008) identifying mitigation and minimization measures that PacifiCorp would implement until a decision regarding dam removal or relicensing has been made. On November 12, 2008, the Services confirmed receipt of the plan, noting that the plan contained an important set of actions that, if fully implemented, would reduce and help minimize the effects of interim operations on coho salmon, Lost River suckers, and shortnose suckers. However, the Services noted that they would need to subsequently review the measures of the Interim Conservation Plan pursuant to the Endangered Species Act (NMFS and USFWS 2008).

As described previously, a number of organizations entered into the KHSA on February 18, 2010. The KHSA provides for the abeyance of the FERC relicensing process for the Project pending the outcome of the Secretary of the Interior's 2012 determination regarding dam removal. If the Secretary of the Interior determines that dam removal should not proceed, or the KHSA terminates for other reasons, the FERC relicensing process for the Project would resume. The Department of the Interior has issued a notice of intent to prepare an Environmental Impact Statement/Environmental Impact Report on the Secretary of the Interior's determination regarding dam removal pursuant to the KHSA (75 FR 33634: June 14, 2010).[2]

[2] For more information related to the Secretary's determination, see http://klamathrestoration.gov

With technical assistance from NMFS, the applicant developed an HCP and included it with its application for an ITP under Section 10(a)(1)(B) of the ESA for an interim 10-year period until dam removal under the KHSA or relicensing of the Project by FERC (PacifiCorp 2011).

1.2 Purpose and Need

NMFS is reviewing the application from PacifiCorp for an ITP pursuant to Section 10(a)(1)(B) of the ESA for operation of its Klamath Hydroelectric Project (Project) for an interim 10-year period until anadromous fish passage is provided at its Project through either dam removal under the KHSA or the installation of volitional fish passage facilities under a new Project license issued by FERC. Pursuant to ESA Section 10(a), if NMFS finds that all requirements for issuance of an incidental take permit are met, NMFS shall issue the requested permit. Issuance of an incidental take permit is a Federal action subject to analysis for potential environmental impacts under NEPA.

NMFS' need in this action, therefore, is to review PacifiCorp's application of an incidental take permit, including the HCP that PacifiCorp submitted with its application, and decide whether to issue the requested permit pursuant to the requirements of Section 10(a)(1)(B) of the ESA, and in accordance with NEPA policy and guidelines.

SECTION 2

Description of Proposed Action and Alternatives

2.1 Proposed ITP

The proposed action, issuance of an ITP, would authorize incidental take of listed coho salmon (*Oncorhynchus kisutch*) during the proposed 10-year term of the ITP. Issuance and continuation of the ITP would be contingent on the implementation of the HCP developed by the applicant that includes a series of conservation or mitigation measures related to the interim operation of the Project (PacifiCorp 2011).

The USFWS will be separately processing a pending ITP application from PacifiCorp that would authorize incidental take of endangered Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*), which would likewise include the implementation of a HCP related to those species. Some of the conservation measures in the separate HCPs that PacifiCorp included with separate applications for ITPs from NMFS and USFWS will assist more than one affected species. However, each agency will process its ITP reviews and NEPA analysis separately. NMFS and USFWS will coordinate their processes for review of the applications as much as possible. Each ITP application process may proceed even if the other ITP application process is delayed or does not proceed for some reason.

2.2 No Action

Under this No Action Alternative, NMFS would not issue an ITP to PacifiCorp. This No Action Alterative would mean deferring or not implementing the additional mitigation measures outlined in the HCP submitted to NMFS. The Project would continue to operate under the terms and conditions of the existing FERC license in a manner consistent with current operations, which does not include minimization, mitigation, and conservation measures based on Project impacts identified by NMFS (NMFS 2007a).

2.3 Alternatives Considered but Dismissed for Further Analysis

2.3.1 Conservation Actions without an Incidental Take Permit

As is described above, PacifiCorp has been implementing certain interim conservation measures described in its Interim Conservation Plan, and the KHSA provides that PacifiCorp will implement certain interim conservation measures according to specific deadlines for each measure, unless the KHSA is terminated. As is described in the HCP Chapter XI, in discussions in development of the HCP, NMFS considered whether PacifiCorp would continue to implement these conservation measures in the absence of an ITP from NMFS authorizing take associated with such measures. Failing to obtain an ITP may prevent

PacifiCorp's full implementation of certain conservation measures that would benefit listed coho salmon, including flow variability below Iron Gate dam. Further, PacifiCorp has justified expenditures associated with the interim conservation measures on the basis that it would obtain an ITP from NMFS in a timely manner that provides additional regulatory certainty. Consequently, it is uncertain whether PacifiCorp could continue expenditures on conservation measures without issuance of an ITP by NMFS. Thus, due to this level of uncertainty, NMFS will not further analyze the effects of this Alternative in the remainder of this document.

2.4 Proposed Action

The proposed action is the issuance by NMFS of an ITP for listed SONCC coho salmon (*Oncorhynchus kisutch*) and the associated implementation of minimization and mitigation measures for coho salmon that would be implemented under an approved HCP. The proposed minimization and mitigation measures are based on analyses contained in the BiOp, FERC FEIS, and PacifiCorp HCP (NMFS 2007a, FERC 2007, PacifiCorp 2011), and are intended to monitor, minimize and mitigate the impacts of incidental take of coho salmon resulting from interim operation of the Project to the maximum extent practicable pursuant to ESA Section 10(a)(1)(B).[3] The term of the proposed ITP is 10 years, which is explained in greater detail below under the heading "Permit Duration."

2.4.1 Covered Activities

Activities covered under the ITP ("Covered Activities") include those activities that are necessary to operate and maintain Project facilities during the Permit duration as well as certain mitigation and conservation measures identified in the HCP.

Covered Activities under the HCP include activities that are otherwise necessary to operate and maintain Project facilities during the Permit Term. Hydroelectric generation is the primary activity conducted at Project facilities, with the exception of the Keno development, which does not include power-generating equipment. Many of these activities are governed by the existing FERC license or agreements with other entities (e.g., U.S. Bureau of Reclamation, or Reclamation), or through voluntary commitments from PacifiCorp. The majority of the operations activities were considered in the NMFS 2007 BiOp; therefore, the terms and conditions of the 2007 BiOp served as the basis for developing the avoidance, minimization, and mitigation measures contained in the HCP (PacifiCorp 2011). Detailed descriptions of Project facilities and their operations are provided in Chapter IV (*Current Conditions*) of the HCP. Detailed information on HCP Covered Activities can be found in Chapter 2 of the PacifiCorp HCP (PacifiCorp, 2011). As is described in the HCP, the Covered Activities necessary to operate and maintain Project facilities are:

- Operate and maintain the spill gates at Link River dam for regulation and releases of flows from Link River dam for purposes of hydroelectric generation

[3] The impacts of direct take of listed coho salmon from Iron Gate Hatchery operations, and the rearing and release of juvenile Chinook salmon that may potentially result in the incidental take of coho salmon, are addressed through the development of a Hatchery Genetics Management Plan (HGMP) by PacifiCorp and the California Department of Fish and Game (CDFG). In September 2010, CDFG included the HGMP in an application to NMFS for an enhancement permit, not an ITP, for the Iron Gate Hatchery under ESA section 10(a)(1)(A), which is described in greater detail below in the EA and in HCP Chapter IV (PacifiCorp 2011).

- Operate and maintain the East Side and West Side canals, penstocks, turbines, and powerhouse facilities
- Operate and maintain Keno dam, spill gates, and fish ladder
- Regulate the water level upstream of Keno dam in accordance with the agreement with Reclamation (per PacifiCorp's existing FERC license) and for irrigation withdrawal activities
- Operate and maintain J.C. Boyle dam, fish bypass system, water conveyance system, turbines, and powerhouse facilities
- Maintain an instream flow release from the J.C. Boyle dam to the river of not less than 100 cfs (per PacifiCorp's existing FERC license)
- Regulate flows from J.C. Boyle dam and powerhouse such that ramping rates of flow in the river do not exceed 9 inches per hour (as measured at the United States Geological Survey (USGS) gage located 0.5 mile downstream of the J.C. Boyle powerhouse) per PacifiCorp's existing FERC license
- Operate and maintain Copco No. 1 and Copco No. 2 dams, water conveyance systems, turbines, and powerhouse facilities
- Operate and maintain Iron Gate dam (and associated appurtenances), penstocks, turbines, and powerhouse facilities
- Regulate releases from Iron Gate dam in accordance with NMFS' BiOp on Reclamation's Klamath Project operations (NMFS 2010) which identifies instream flow and ramping rate requirements (as measured at the USGS gage located 0.5 mile downstream of Iron Gate dam).
- Regulate water levels at Keno, J.C. Boyle, Copco, and Iron Gate reservoirs

The minimization, mitigation, and conservation measures identified in the HCP include measures that comprise the *Coho Salmon Conservation Program*. The implementation of some of these measures are also Covered Activities. A general description of these measures that are also Covered Activities is:

- Implementation of turbine venting at Iron Gate dam to enhance dissolved oxygen concentrations in surface waters downstream of Iron Gate dam,
- Instream flow, flow variability, and flow ramping rate measures to benefit listed coho salmon downstream of Iron Gate dam, and consistent with NMFS' BiOp to Reclamation (NMFS 2010),
- Retrieving Large Woody Debris trapped at or near Project dams and placing it in mainstem or tributary waters downstream of Iron Gate dam, and
- PacifiCorp's funding of certain habitat enhancement projects and scientific research studies.

Detailed descriptions of the minimization, mitigation and conservation measures in the categories listed above are provided in Chapter VI (*Conservation Program*) of the HCP (PacifiCorp 2011).

In addition to the Covered Activities described above, PacifiCorp is facilitating the following conservation measures to provide further benefits to SONCC coho as further mitigation for Project effects:

- Habitat restoration projects designed to enhance the survival and recovery of listed coho salmon, funded through the Coho Enhancement Fund, and conducted by third parties;
- Research studies on fish disease conditions and causal factors downstream of Iron Gate dam, funded through the Klamath River Fish Disease Research Fund, and conducted by third parties; and
- Funding and participation in Iron Gate Hatchery measures developed to support a Hatchery and Genetic Management Plan (HGMP) to maximize conservation benefits of the hatchery program to coho salmon.

Specific habitat enhancement projects and fish disease research studies, while a part of the HCP, are not considered Covered Activities under the ITP because such activities, and the potential that the projects themselves may result in some form of take of SONCC coho even if beneficial overall, have not been completely identified yet and will be undertaken by third parties outside the direct control of PacifiCorp. PacifiCorp will be providing the funding for these enhancement projects and research studies that will benefit coho salmon, but third parties undertaking habitat projects and research studies must obtain all necessary State and federal permits and authorizations prior to conducting such activities. Thus, the environmental analysis for these conservation measures contained in the HCP and this EA is general in nature, but it should help expedite future permitting processes and any related environmental analyses required for specific projects.

Operation and maintenance actions at the Iron Gate Hatchery by California Department of Fish and Game (CDFG) involve purposeful take of coho salmon and will be addressed through a separate ESA permitting process involving the development of a HGMP by PacifiCorp and CDFG as described in the KHSA. PacifiCorp has agreed to fund the development and implementation of an HGMP for the Iron Gate Hatchery for approval by NMFS in accordance with the applicable criteria and requirements of 50 CFR Section 223.203(b)(5). On September 16, 2010, PacifiCorp and CDFG submitted an application for an ESA Section 10(a)(1)(A) enhancement permit incorporating the HGMP to NMFS for review and approval (CDFG 2011b). CDFG will implement the terms of the permit and related HGMP at Iron Gate Hatchery upon issuance of an ESA Section 10(a)(1)(A) permit by NMFS. Because an ESA Section 10(a)(1)(A) enhancement permit addresses purposeful take of coho salmon due to operation and maintenance actions at the Iron Gate Hatchery, and the permit would address activities by CDFG, NMFS' processing of the application for an ESA Section 10(a)(1)(A) permit may proceed separately from processing the ITP that is the subject of this EA, and NMFS will conduct a separate environmental analysis regarding its decision whether to issue the ESA Section 10(a)(1)(A) permit. Therefore, the environmental analysis for PacifiCorp's funding and participation in

Iron Gate Hatchery measures developed to support a Hatchery Genetic Management Plan described in the HCP and this EA is more general in nature.

2.4.2 Permit Area

PacifiCorp operates the Klamath Hydroelectric Project (Project), located in southern Oregon and northern California (Figures 1 and 2) under a license issued by FERC(FERC Project No. 2082). The Project consists of eight developments. Seven of the developments are located on the Klamath River between river mile (RM) 190.1 and 254.3, including (in order moving upstream) Iron Gate (RM 190.1 to 196.9), Copco No. 2 (RM 198.3 to 198.6), Copco No. 1 (RM 198.6 to 203.1), J.C. Boyle (RM 220.4 to 228.3), Keno (RM 233 to 253.1), East Side and West Side (both in Link River at RM 253.1 to 254.3). The eighth development is on Fall Creek, a Klamath River tributary at RM 196.3. Detailed descriptions of Project facilities on the Klamath River and their operations are provided in Chapter IV of the HCP.

The Permit Area includes PacifiCorp's existing Project facilities and the adjacent water and land areas potentially influenced by Project maintenance and operations, including the mainstem Klamath River and reservoirs from Link River dam at the outlet of Upper Klamath Lake down to the Klamath River estuary, inclusive (see Figure 1). Project facilities and their operations are described in Chapter IV (*Current Conditions*) of the HCP. Figure 2 shows PacifiCorp Project facilities in relation to the Klamath River.

2.4.3 Permit Duration

The term of the proposed ITP (referred to herein as "Permit Term" or "term of the ITP") will be for 10 years. The proposed permit term of 10 years is consistent with the target date for dam removal under the KHSA, if various conditions are met, on or before December 31, 2020. If the KHSA is terminated, the FERC relicensing proceedings for the Project would resume, and it is anticipated that FERC would issue a new license for the Project including mandatory conditions for volitional fish passage, which would be in place by the end of 2020. Thus, the ITP and HCP address the impact of anticipated incidental take of coho salmon from interim operations of the Project for 10 years until it is anticipated that anadromous fish passage will occur in the Klamath River upstream of Iron Gate dam either through dam removal under the KHSA or mandatory conditions in a new FERC license. The proposed Implementing Agreement (IA) for the ITP provides procedures for termination of the ITP in the event NMFS determines that circumstances have changed such that it is no longer reasonably certain that anadromous fish passage will occur in the Klamath River upstream of Iron Gate dam for the Project by the end of 2020 as described above. These termination procedures are designed to address the potential for any circumstances that would change these assumptions regarding anadromous fish passage.

In addition, the Permit Term may be extended as provided in the IA. However, extension of the Permit Term may require additional environmental analysis. By the terms of the KHSA, circumstances may arise resulting in the termination of the KHSA. In the event of termination of the KHSA, the ITP will remain in effect for the Permit Term of 10 years, as long as the HCP and IA are being adhered to, during which time the FERC relicensing process will resume. Incidental take associated with Project operations under a new FERC license may be authorized by NMFS under Section 7 of the ESA, and a resulting NMFS Biological Opinion is issued for FERC's action of issuance of a new Project license. In the event that the KHSA is terminated and that incidental take associated with Project operations under a new FERC license is not authorized under Section 7 of the ESA prior to the end of the 10-year term of the ITP, then PacifiCorp may initiate discussions with NMFS to extend the term of the ITP.

2.4.4 Conservation Strategy

The HCP describes actions to benefit the conservation of populations of SONCC coho salmon in the Klamath River downstream of Iron Gate dam during the interim period prior to providing volitional fish passage through the Project as described above. Therefore, installation of volitional fish passage is not contemplated under the interim period covered by this HCP. Instead, PacifiCorp proposes measures as described in Sections 2.4.4.1 and 2.4.4.2 of this EA, and more fully detailed in Chapter VI of the PacifiCorp HCP to mitigate the lack of access to habitat upstream of Iron Gate dam during the interim period. The measures in this HCP focus on enhancement of coho salmon habitat availability and use in the Klamath River basin downstream of Iron Gate dam during the interim period. As such, these interim conservation actions will not impede the survival and recovery of SONCC coho salmon prior to implementing fish passage past Iron Gate dam, and will further augment the anticipated future benefits of providing fish passage. The PacifiCorp HCP has at its foundation seven biological goals to aid the viability of SONCC coho salmon in the 10-year interim period. They are:

- Goal I: Offset biological effects of blocked habitat upstream of Iron Gate dam by enhancing the viability of the Upper Klamath coho salmon population.[4]
- Goal II: Enhance coho salmon spawning habitat downstream of Iron Gate dam.
- Goal III: Improve instream flow conditions for coho salmon downstream of Iron Gate dam.
- Goal IV: Improve water quality for coho salmon downstream of Iron Gate dam.
- Goal V: Reduce disease incidence and mortality in juvenile coho salmon downstream of Iron Gate dam.
- Goal VI: Enhance migratory and rearing habitat for coho salmon in the Klamath River mainstem corridor.
- Goal VII: Enhance and expand rearing habitat for coho salmon in key tributaries.

The HCP provides objectives and specific measures to implement these goals to improve habitat conditions during the interim period. These objectives and measures are more fully described in the HCP and are summarized in this EA into two categories: near-term operational improvements, and long-term planning and management investments.

[4] NMFS has divided the SONCC coho ESU into six separate diversity stratums. Within each stratum NMFS has identified functionally independent populations. The Upper Klamath River is considered by NMFS to be a functionally independent population within the Central Interior Stratum.

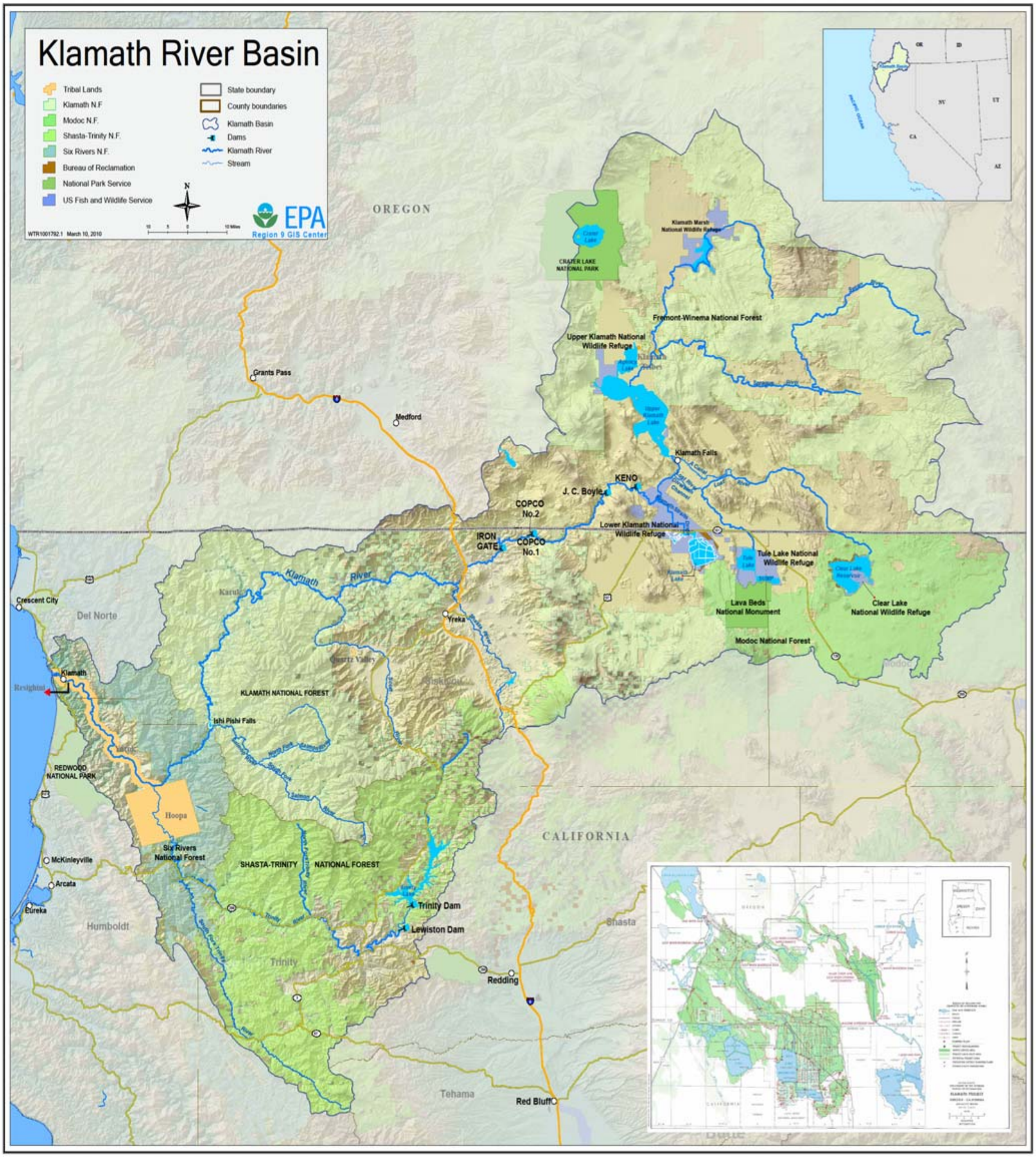

Figure 1. Map of Klamath River basin showing locations of rivers and lakes, Project facilities and federal and tribal lands within the basin (Source: USEPA Region 9)

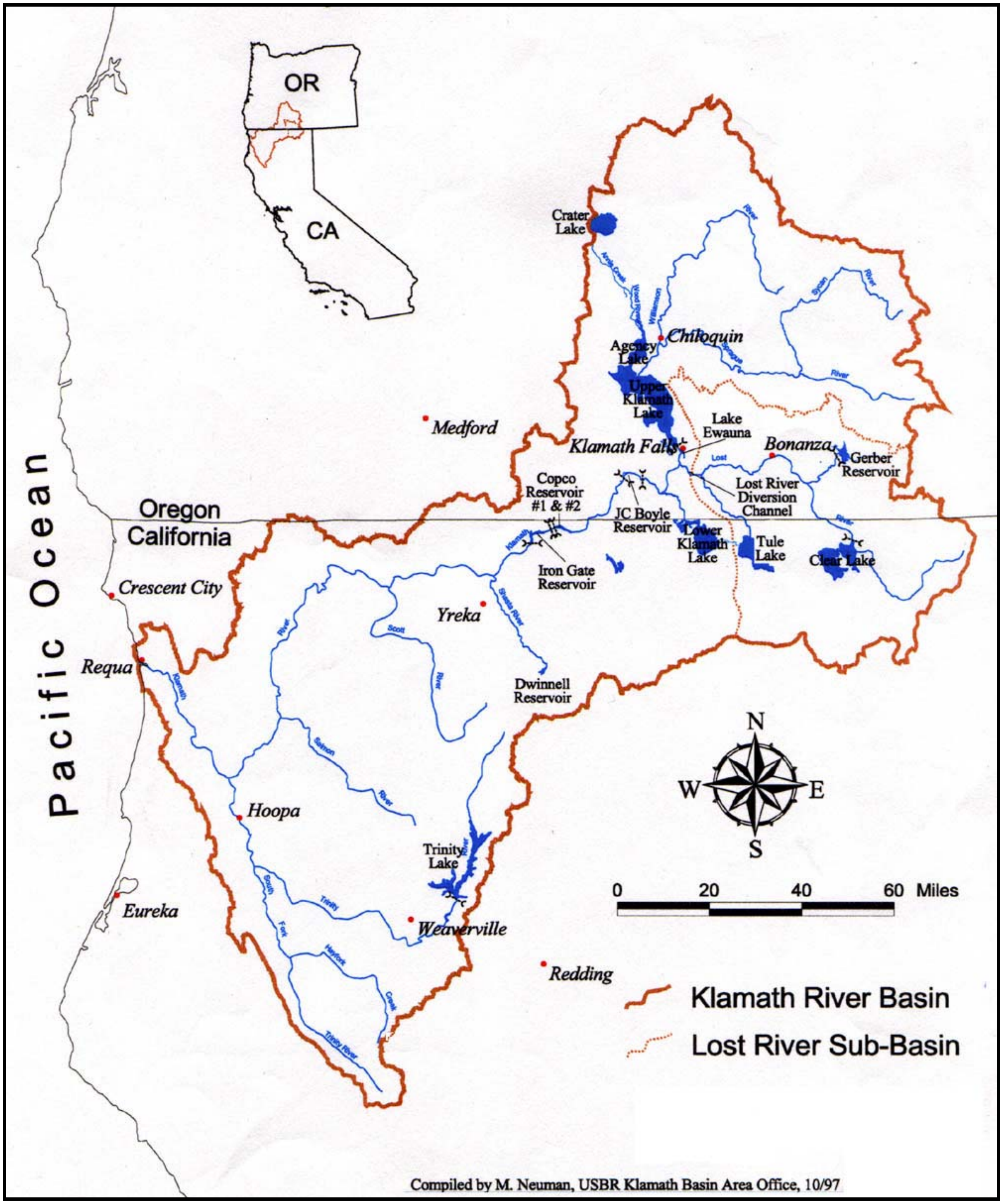

Figure 2. Map showing PacifiCorps Project Facilities in the Klamath River Basin (Source: GEC, 2006)

2.4.4.1 Near-Term Operational Improvements

Turbine Venting System

PacifiCorp will "vent" its turbine at Iron Gate dam using an existing valve that allows air to enter the turbine. The valve will be kept in a fully open setting during periods when dissolved oxygen (DO) levels fall below 87 percent saturation in the Klamath River immediately below Iron Gate powerhouse.[5]

To support this action, PacifiCorp will monitor DO concentration and percent saturation using equipment deployed downstream of Iron Gate dam near the Iron Gate Hatchery bridge (at RM 189.8). PacifiCorp will evaluate the turbine venting system at Iron Gate dam by conducting field tests to verify air flow and DO increases, and will quantify the potential effects of increased air flow on turbine efficiency. Upon completion of its evaluations, PacifiCorp will submit a final turbine venting plan to NMFS for review and approval, and will develop standard operating procedures in consultation with NMFS.

The final turbine venting plan could include installation of a permanent turbine venting system including a blower to increase air entrainment into the turbine draft tube. This measure is described in greater detail in HCP Chapter VI.

Instream Flow, Flow Variability, and Flow Ramp Rate Measures

Over the permit term PacifiCorp will implement measures to provide instream flows, flow variability, and flow ramp rates in the Klamath River downstream of Iron Gate dam to improve coho salmon survival during the permit term. Reclamation must implement these measures as described in the NMFS (2010) BiOp on Reclamation's Klamath Project Operations. Although PacifiCorp has been coordinating with Reclamation in order for Reclamation to implement these measures, PacifiCorp's implementation of these measures through issuance of an ITP and implementation of the proposed HCP will help ensure coordination and implementation of these measures. For instream flows, PacifiCorp will coordinate with Reclamation to ensure releases from Iron Gate dam that are consistent with instream flow requirements stipulated in the NMFS (2010) BiOp on Reclamation's Klamath Project Operations. These consist of instream flow releases described for Reclamation's Proposed Action, and modified by the Reasonable and Prudent Alternative (RPA) for flows stipulated in the NMFS (2010) BiOp. The modified RPA flows include recommended adjustments to flows under Reclamation's Proposed Action for some monthly exceedance categories (per Table 18 in the NMFS [2010] BiOp). PacifiCorp will also coordinate with Reclamation to ensure implementation of any further adjustments to instream flow releases from Iron Gate dam that may arise from related flow monitoring activities as stipulated in the Terms and Conditions of the NMFS (2010) BiOp.

PacifiCorp will coordinate with Reclamation to ensure implementation of the *Fall and Winter Flow Variability Program* (Flow Variability Program) as described in the NMFS (2010) BiOp. As described in Section RPA A(1) of the NMFS (2010) BiOp, the Flow Variability Program will provide up to 18,600 acre-feet of water in the fall and winter period to simulate short-term flow increases from significant precipitation runoff events that would naturally occur at the point of Iron Gate dam release. Specific procedures for implementing

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[5] The saturation level of 87 percent is intended to provide a margin of safety helping to ensure that DO levels do not fall below 85 percent, which is the proposed standard for DO (North Coast Regional Water Quality Regional Board 2008).

the Flow Variability Program are still under development. NMFS has developed a recommended Flow Variability Protocol to assist in the implementation of this Flow Variability Program. A Variable Flow Technical Team, including NMFS, Reclamation, PacifiCorp, USFWS, states, and tribes, has been convened to further refine and develop protocols and procedures for implementing the Flow Variability Program as discussed in a letter from Reclamation to NMFS dated January 3, 2011 (Reclamation, 2011).

The flow plan would be developed in a manner consistent with PacifiCorp's existing license requirements (e.g., ramping restrictions, minimum flow requirements, if any), and would contain exceptions for forced and planned outages (such exceptions include unforeseeable equipment malfunctions or failures and foreseeable events, such as powerhouse maintenance, dam and spillway repairs, and other planned maintenance activities). PacifiCorp intends to implement this measure within the operational capabilities of the existing Project without the need for construction of new equipment or the addition of new personnel.

PacifiCorp will undertake maintenance actions at Iron Gate powerhouse to maintain flow ramp rates as specified in the NMFS (2010) BiOp. These ramp rates are designed to avoid or reduce potential stranding of fish that might otherwise occur due to flow changes from Project operations (as specified in NMFS 2010). The ramp rates specify that, if flows are greater than 1,750 cfs, but less than 3,000 cfs, the rate at which flows can be decreased will be no more than 300 cfs in 24 hours and no more than 125 cfs in any 4-hour period. If flows are less than or equal to 1,750 cfs, the rate at which flows can be decreased will be no more than 150 cfs in 24 hours and no more than 50 cfs in any 2-hour period.

The 2010 BiOp (NMFS 2010) does not contain specific daily or hourly ramp rates when the flow release at Iron Gate dam is greater than 3,000 cfs. The 2010 BiOp (NMFS 2010) assumes Reclamation's proposed approach that the ramp-down of flows greater than 3,000 cfs should mimic natural hydrologic conditions of the basin upstream of Iron Gate dam. PacifiCorp will coordinate with Reclamation to ensure that the ramp-down of flows greater than 3,000 cfs is done to be consistent with natural hydrologic conditions, and is practicable based upon the physical limitations of the Iron Gate facilities as well as other safety considerations.

Large Woody Debris (LWD)

Over the term of ITP, PacifiCorp will increase the abundance of large woody debris (LWD) in the Klamath River downstream of Iron Gate dam to contribute to the river's habitat elements and habitat forming features. PacifiCorp will retrieve LWD trapped at or near Iron Gate, Copco 1, and Copco 2 dams, and release retrieved LWD pieces to the river channel below Iron Gate dam. This measure will offset the impacts of the Project on LWD recruitment to the river and enhance the habitat forming functioning of LWD in the river.

2.4.4.2 Long-Term Planning and Management Investments

Fish Disease Research

PacifiCorp established a Klamath River Fish Disease Research Fund for research in the Klamath River below Iron Gate dam. PacifiCorp will proactively solicit and fund fish disease research projects to enhance understanding and fill knowledge gaps related to factors and conditions causing disease in coho salmon in the Klamath River. In a letter agreement dated May 21, 2009 (see Appendix B of the HCP), PacifiCorp and NMFS set forth the terms concerning the use and administration of the Klamath River Fish Disease Research Fund. PacifiCorp will work with the Klamath River Fish Health Workgroup to identify research projects that address key scientific questions concerning fish disease and disease impacts on coho salmon in the Klamath River basin. These projects will be funded and implemented within the 10-year Permit Term and the results used to inform management and further research decisions.

Coho Enhancement Fund

PacifiCorp established a Coho Enhancement Fund in coordination with NMFS and CDFG. During the Permit Term, PacifiCorp will make an annual payment in the amount of $510,000 into the Coho Enhancement Fund by January 31 of each year[6]. If the term of the ITP continues beyond the 10-year permit term, the annual payments of $510,000 would continue for each additional year.

Implementation of the Coho Enhancement Fund will include coho salmon enhancement projects jointly recommended by CDFG and NMFS. The projects selected would comply with applicable agency policies, regulations, and planning documents relating to salmonid conservation in the Klamath River basin, including the pending Recovery Plan for coho salmon.[7] The applicant would evaluate and approve the selected projects to ensure consistency with applicable license conditions and other regulatory requirements.

The Coho Enhancement Fund will be used to facilitate projects designed to have immediate benefits to coho salmon, by achieving the Goals listed above and the objectives and measures described in detail in HCP Chapter VI (PacifiCorp 2011). These measures will include projects to:

- Improve access and remove barriers to otherwise suitable salmonid habitats (e.g., culvert replacements, fish ladders).
- Improve and protect thermal refugia in the mainstem Klamath River and at the mouths of tributaries downstream from Iron Gate dam.
- Improve the quality of coho salmon rearing habitat in the mainstem Klamath River corridor and in tributaries downstream from Iron Gate dam (e.g., habitat enhancements, water rights acquisitions, diversion screening improvements)
- Augment gravel to enhance spawning habitat downstream of Iron Gate dam.

Other fishery and habitat protection projects that provide immediate benefits and that will achieve the Goals and Objectives identified in the HCP (PacifiCorp 2011) will also be considered. The focus area includes cold water tributaries of the Klamath River with adult coho access and juvenile rearing habitat downstream from Iron Gate dam to the Pacific Ocean.

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[6] PacifiCorp created the Coho Enhancement Fund and made its first contribution earlier in 2009. See HCP Appendix A.

[7] NMFS is current preparing a Recovery Plan for the Southern Oregon/Northern California Coast (SONCC) evolutionarily significant unit (ESU) of coho salmon. A draft Recovery Plan is expected late in 2011.

Hatchery Management

PacifiCorp will provide funding for the implementation of a Hatchery Genetic Management Plan (HGMP) developed by the California Department of Fish and Game (CDFG), which is the hatchery manager, and PacifiCorp for Iron Gate Hatchery as may be authorized by NMFS in an ESA Section 10(a)(1)(A) enhancement permit. The primary goal of an HGMP is to devise biologically-based hatchery management strategies that contribute to the enhancement of salmon and steelhead. Implementation of the HGMP is important to ensure that ongoing Iron Gate Hatchery operations contribute to the enhancement of listed coho salmon in the Klamath River basin.

The HGMP has been incorporated into an application by CDFG for a permit under ESA Section 10(a)(1)(A), which was submitted to NMFS (CDFG, 2011b). Section 10(a)(1)(A) permits allow for authorization under the ESA for scientific research actions or actions to enhance the propagation or survival of an ESA-listed species that will likely result in the take of the species. Hatchery operations, genetic research, and monitoring of coho salmon are among the activities at Iron Gate Hatchery for which a Section 10(a)(1)(A) permit is being sought. Upon issuance of a permit under ESA Section 10(a)(1)(A) for the Iron Gate Hatchery, CDFG and PacifiCorp will implement all measures contained in the HGMP as provided in the permit.

During the term of the ESA Section 10(a)(1)(A) permit, the coho program at the Iron Gate Hatchery will be operated in support of the basin's coho salmon recovery efforts by conserving a full range of the existing genetic, phenotypic, behavioral, and ecological diversity of the run. The program will include conservation measures, genetic analyses, broodstock management, and rearing and release techniques that maximize fitness and reduce straying of hatchery fish to natural spawning areas. Monitoring and evaluation activities will also be conducted to ensure that the performance standards and indicators identified for the program are achieved, and that critical uncertainties are addressed.

SECTION 3

Affected Environment

Information for the Affected Environment Section has been generated from several source documents that contain descriptions of the resources potentially affected by the actions considered in this EA. In an effort to incorporate efficiencies and utilize relevant information from other documents, NMFS has adopted pertinent language from parts of these source documents and incorporated by reference pertinent information in this chapter. Readers of this EA are encouraged to review these source documents for more detailed information than that which is summarized in this EA. These source documents are:

- *FERC Final Environmental Impact Statement for Relicensing of the Klamath Hydroelectric Project No. 2082-027 (Issued: November 16, 2007),*
- *PacifiCorp Klamath Hydroelectric Project Interim Operations Habitat Conservation Plan for Coho Salmon, dated March 15, 2011,*
- *Draft Fruit Growers Supply Company Multi-Species Habitat Conservation Plan, dated September 2009,*
- *The North Coast Regional Water Quality Control Board (NCRWQB) Final Staff Report for the Klamath River Total Maximum Daily Loads (TMDLs) Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in California, the Proposed Site Specific Dissolved Oxygen Objectives for the Klamath River in California, and the Klamath River and Lost River Implementation Plans, dated March 2010,*
- *The North Coast Regional Water Quality Control Board Action Plan for the Klamath River Total Maximum Daily Loads Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in the Klamath River in California and Lost River Implementation Plan, dated March 2010*
- *Yurok Tribe 2009 Report: Klamath River Estuary Wetlands Restoration Prioritization Plan*

3.1 Geologic Resources and Geomorphology of Permit Area

As habitat conditions in the Klamath River have evolved over time with the geology and geomorphic processes of the region, it is important to understand how land-forming processes affect areas of the basin differently, leading to variations in physical and biological dynamics of the Klamath mainstem an its tributaries. These variations can influence habitat suitability and the spatial distribution of species such as coho salmon.

The Klamath River runs a course approximately 260 miles in length from Upper Klamath Lake in Oregon to the mouth of the river at the Pacific Ocean near Requa, California (see Figure 1). In Oregon, the headwaters of the Klamath River lie within the Basin and Range geologic province. Moving into California, the Klamath River basin lies in the transition zone between the Modoc Plateau and Cascade Range physiographic provinces, with the Klamath River cutting west through the Klamath Mountain province and then the Coast Range province. Figure 3 shows the geomorphic provinces of California that lie within the Klamath River basin.

The transition from the Modoc Plateau to the Cascade Range province is subtle; the Klamath River enters the Cascade Range province roughly in the area below Keno dam. The portion of the Cascade Range province included in the Klamath River watershed is largely in the rain shadow of Mt. Shasta and the Klamath Mountains. With its porous volcanic geology and relatively moderate topography, runoff is slow, and there are relatively few streams compared to downstream provinces.

The Klamath River passes through four distinct geologic provinces, each of which changes the character of the river's channel morphology and that of its tributary watersheds, varying the supply of inputs such as water, sediment, nutrients, and wood. The Klamath River in the PacifiCorp facilities is a predominantly non-alluvial, sediment supply-limited river flowing through mountainous terrain. For most of its length to the Pacific Ocean, it maintains a relatively steep, high-energy, coarse-grained channel frequently confined by bedrock (Ayres Associates, 1999). Much of the river in the permit area is geologically controlled, interspersed with relatively short alluvial reaches. Floodplain development is minimal, and wider valleys allowing more alluvial channel migration processes are rare, increasing somewhat downstream of Interstate 5. A variable local climate and geology are reflected in the geomorphic and vegetative characteristics of the river valley, and generally, the channel changes character as it passes from one geologic province to the next.

The Upper Klamath basin, within the Modoc Plateau province, is bounded on its west side by the eastern edge of the Cascades Range; with tributaries of Wood River draining the flanks of the Crater Lake area (see Figure 1). To the east, the northwesterly trending fault-block mountains with intervening valleys are commonly interspersed with lakebed deposits, shield volcanoes, cinder cones, or lava flows. Shallow lakes (Upper Klamath, Lower Klamath, and Tule Lakes) and marshes (Klamath Marsh) are prominent features of the Modoc Plateau, as are areas drained by Anglo-American immigrants. Upper Klamath Lake is a shallow, regulated natural lake, which serves as a storage reservoir for extensive, irrigated lands (approximately 250,000 acres) in the basin. Sediment yield also is low relative to provinces downstream.

The Shasta River is the major tributary to the Klamath River within the Cascade Range province (see Fig. 1). The headwaters of the Shasta River originate on the flanks of Mt. Shasta and the majority of its watershed is comprised of the expansive Shasta Valley (Crandell, 1989). The western side of the Shasta River and Cottonwood Creek watersheds marks the western boundary of this province. Mass wasting and fluvial erosion are the main erosional processes within this province (USFS, 2005).

Land-forming processes affect the generation of sediment to streams that support aquatic resources such as salmon and Pacific lamprey. Too much sediment in a watershed can adversely impact spawning and rearing areas (sediment enriched), and too little sediment input can result in simplified habitats that are unsuitable for the formation of spawning gravels (sediment starved). The Klamath watershed in its entirety has a wide variety in geomorphic processes that result in the production of sediment, critical to the perpetuation of basin salmonids.

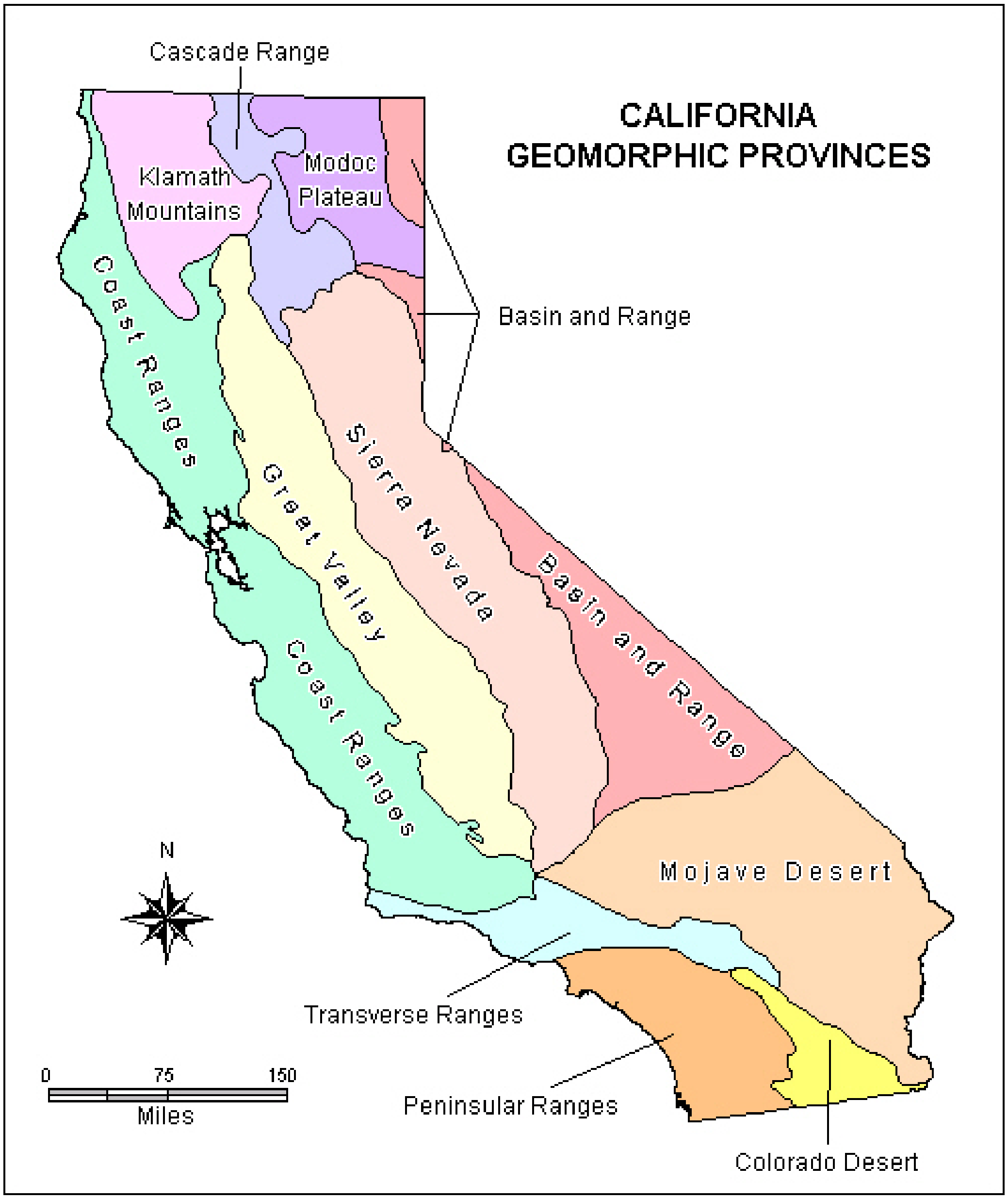

Figure 3. Geomorphic Provinces of California (derived from California Geologic Survey, Note 36)

The Klamath Mountains province includes a complex of mountain ranges in southwest Oregon and northwest California, collectively called the Klamath Mountains; they include the Trinity Alps, Salmon Mountains, Marble Mountains, and Siskiyou Mountains. Large tributary watersheds to the Klamath River in this province include the Scott, Salmon, and Trinity Rivers. Compared to all other areas of the Klamath River watershed, this province includes some of the steepest topography and tallest mountains; summits in the Trinity Alps exceed 9,000 feet in elevation. Gold-bearing deposits occur within this province, and the legacy effects of gold mining and dredging on aquatic environments including fish-bearing streams persist in some areas. Precipitation generally increases in proximity to the coast, so here soils are generally deeper than in upstream provinces. Deep soils, steep slopes, and high precipitation make mass wasting and fluvial erosion the main geomorphic processes in this province, particularly in the middle to lower portions of the mid-Klamath River (i.e., the Salmon River watershed) (USFS, 2005; de La Fuente and Haessig, 1993). Because of this, sediment yields are relatively high compared to upstream areas of the Klamath River watershed.

The lowermost 40 miles of the Klamath River (from the town of Weitchpec to the Pacific Ocean) traverse the Coast Range province. The Coast Range province comprises three linear belts of rock separated by faults (most notably the San Andreas and also including thrust faults that are presently increasing the height of the range). The Klamath River watershed portion of the Coast Range province comprises Franciscan Complex rocks. Because of Coast Range faulting, the relatively young Franciscan rocks are still uplifting, encouraging steep hillslopes and relatively high erosion rates resulting in high sediment yields.

3.1.1 Slope Stability/Landslides

Mass failures and other gravity-driven erosion processes require relatively steep slopes. Such conditions within the project area exist only within the Klamath River Canyon area from J.C. Boyle dam to just downstream of Iron Gate dam. Landsliding outside the project area is prevalent in the Franciscan geology of the lower Klamath River watershed and in certain Klamath Mountain province watersheds, such as the Salmon River (de la Fuente and Haessig, 1993). As previously mentioned, Project facilities (dams) block the transport of much of the landslide driven sediment resulting in sediment "starvation" downstream of Iron Gate dam for some distance.

For more detail on geology, geomorphology, and sediment in the basin please refer to the FERC FEIS Chapter 3.3 which has extensive detail on these subject matters.

3.2 Water Resources

Precipitation patterns in the basin, in addition to seasonality of water withdrawals for purposes such as irrigated agriculture and commercial and residential development determine river flow in the basin.

3.2.1 Climate and Water Flow

How water flows in the basin affects various aspects of important life history stages of aquatic species such as anadromous salmon. For example, natural flows in the late summer and early fall trigger adult run timing and migratory routes for certain salmonids, and natural flows in the spring trigger juvenile outmigration to the sea. Alterations in natural flow regimes can negatively affect these critical life history traits, as well as influence water temperatures in the basin which are important in the growth and survival of basin salmonids. The Klamath River watershed experiences natural and man-made variation in how water enters and moves through the basin which has an effect on salmonids as well as other aquatic species. In addition to the projects which captured and stored water in the upper basin, the construction of Iron Gate dam, the lowermost dam in the PacifiCorp Project facilities, not only further restricted flow in the upper basin, but also culminated in the total blockage of more than 300 miles of historic fish habitat in the upper basin.

The high elevation, semi-arid desert environment of the Modoc Plateau in the upper part of the basin receives an average of about 15 inches of precipitation annually. Precipitation occurs mostly during the late fall, winter, and spring and is mostly in the form of snow above elevations of 5,000 feet. Average yearly precipitation varies greatly with elevation and location and ranges from about 10 to more than 50 inches. Annual precipitation in Klamath Falls at the upper end of the Klamath River is 13.3 inches, 18.2 inches at Copco No. 1 Reservoir, and over 100 inches in some parts of the Lower Klamath watershed. Precipitation occurs primarily as rain, mostly during the fall and winter, with occasional afternoon thunderstorms occurring in the summer. Snow often occurs during winter, particularly in the higher elevations (i.e., above the canyon rim and east to Klamath Falls)

Streamflows normally peak during the late spring and/or early summer from snowmelt runoff. Low flows within this watershed typically occur during the late summer or early fall, after the snowmelt and before the runoff from the fall storms moving inward from the Pacific Ocean. Figure 4 depicts the average annual precipitation, in inches, for the Klamath River basin in California. The map shows the wide variation in annual rainfall amounts from the upper basin to the lower basin. Precipitation amounts in the upper basin in Oregon are similar to amounts depicted in the northeastern portion of the California.

The dams on the Klamath directly affect how long it takes for water to travel from Upper Klamath Lake to the estuary (except for Copco No. 2 dam, which has a small reservoir and does not appreciably affect water travel time). The dams increase the time it takes water to travel through the upper 65 miles of the river between Link River and Iron Gate. The transit time of waters released from Upper Klamath Lake to the estuary (as well as water released from the Klamath Irrigation Project to the river between Upper Klamath Lake and Keno dam) is about 1 to 2 months or more, except during high winter flow conditions when the transit time may be reduced to as little as 2 weeks. If no dams were in place, transit time from Upper Klamath Lake (Link River dam) to the estuary would be about a week during summer periods and less during winter high flow events.

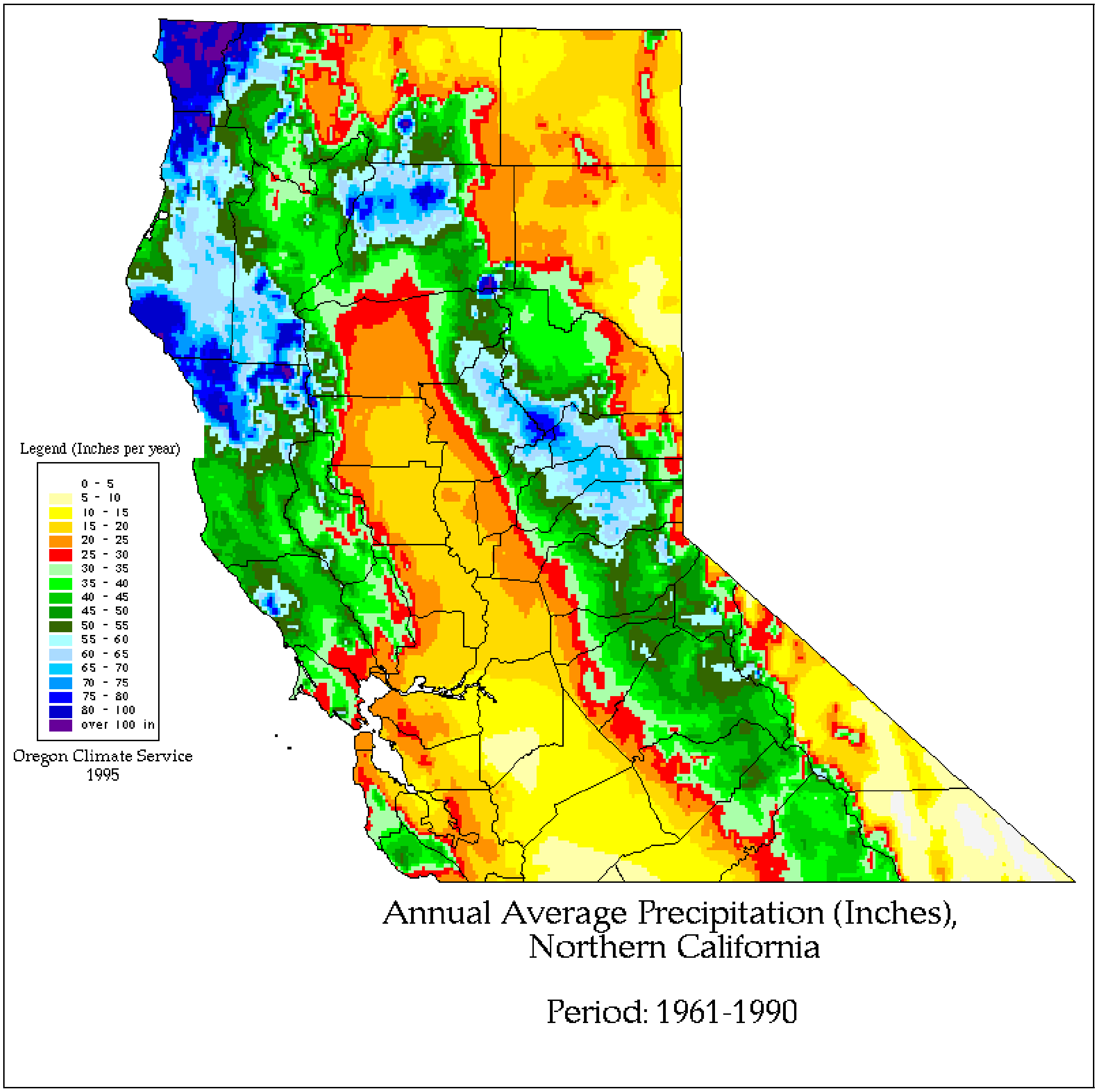

Figure 4. Average annual precipitation within the California side of the Klamath basin (Source: Oregon Climate Service)

Upper Klamath Lake is the dominant feature of the upper part of the Klamath River basin. Upper Klamath Lake receives most of its water from the Williamson and Wood Rivers (NRC 2004). The Williamson River watershed consists of two subbasins drained by the Williamson and Sprague Rivers, which together provide about 75 percent of the drainage area to Upper Klamath Lake. The Sycan River, a major tributary to the Sprague, drains much of the northeastern portion of the watershed. The Wood River drains an area northeast of Upper Klamath Lake extending from the southern base of the eastern slopes of the Cascade Mountains near Crater Lake to its confluence with the northern arm of Upper Klamath Lake, which is often referred to as Agency Lake. The balance of the water reaching Upper Klamath Lake is derived from direct precipitation and groundwater that flows from springs, small streams, irrigation canals, and agricultural returns. In addition, a relatively large set of springs discharges about 220 to 250 cfs into the Klamath River beginning about 0.5 miles downstream from J.C. Boyle dam.

Alterations to the basin's natural hydrologic character began in the late 1800s, accelerating in the early 1900s, including construction and operation of Reclamation's Klamath Irrigation Project. The Klamath Irrigation Project includes facilities to divert, store, and distribute water for irrigation, National Wildlife Refuges, and control of floods in the basin. The Klamath Irrigation Project's diversion of stored water occurs year-round, but primarily occurs from early April through mid-October in support of irrigated crop lands. Water is diverted from Upper Klamath Lake at Link River dam through "A" Canal, and also is diverted from the Klamath River through the North Canal, Ady Canal, and the Lost River Diversion Channel. A portion of the diverted water is returned to the Klamath River through Reclamation's Lost River Diversion Channel and the Klamath Straits Drain (see Figure 2).

Reclamation is responsible for management of flow volumes in the upper Klamath River, including flows that both enter (from Upper Klamath Lake at Link River dam at RM 254) and exit (from Iron Gate dam at RM 190.5) the area occupied by PacifiCorp's Project developments. Reclamation also manages Upper Klamath Lake elevations to meet ESA requirements and contractual irrigation demands of the Klamath Irrigation Project. Upper Klamath Lake has a total storage capacity of 873,000 acre feet and an active storage capacity of 465,000 acre feet. PacifiCorp's reservoirs on the mainstem of the Klamath River provide about 17 percent of the total water storage of the Klamath River, and about 3 percent of active storage. PacifiCorp's operation of their Project facilities therefore, has a relatively minor role in how water is stored and controlled in the basin as Reclamation plays the dominant role in basin water storage and delivery to upper basin users.

Downstream of Link River dam, surface water volumes are largely controlled by Reclamation operations. Flows below Link River dam into the Link River are passed through the spill gates and/or PacifiCorp's East Side and West Side facilities depending on a variety of factors including: a) flow requirements under NMFS' BiOp for Reclamation's operation of its Klamath Project (NMFS, 2010), b) lake elevation of Upper Klamath Lake, c) seasonal shut down of PacifiCorp's facilities for maintenance, and d) inflow into Upper Klamath Lake. At no time are flows immediately below Link River dam less than 90 cfs. Keno reservoir is relatively shallow (average depth of 7.5 feet) and long (22.5 miles), and receives most of its water from Upper Klamath Lake via Link River. An agreement between PacifiCorp and Reclamation specifies that the maximum water surface elevation of Keno reservoir remains relatively constant most of the year. The minimum flow requirement below

Keno dam is 200 cfs per a cooperative agreement with Oregon Department of Fish and Wildlife (ODFW). J.C. Boyle reservoir is a relatively small mainstem reservoir; under typical peaking operations, the reservoir fluctuates about 3.5 feet, while average daily fluctuations are approximately 1 to 2 feet.

The flows that are released to the Klamath River from J.C. Boyle powerhouse during peaking operations are ramped up to either one turbine operation (up to 1,500 cfs) or two turbines operation (up to 2,500 cfs). When generation is not occurring at the J.C. Boyle powerhouse (and J.C. Boyle dam is not spilling), typical non-generation base flows in the J.C. Boyle peaking reach (i.e., the reach of the Klamath River between J.C. Boyle powerhouse and Copco reservoir) are about 320 to 350 cfs, consisting of the 100 cfs minimum flow release from J.C. Boyle dam and the accretion of 220 to 250 cfs of spring flow in the upstream J.C. Boyle bypass reach.

Water levels in Copco No. 1 reservoir are normally maintained within 6.5 feet of full pool (elevation 2,607.5 feet) and daily fluctuations in reservoir water levels of about 0.5 foot are due to peaking operation of the Copco No. 1 powerhouse and variance in the inflow from the J.C. Boyle peaking reach (PacifiCorp 2004; FERC 2006). Copco No. 2 reservoir has virtually no storage, and the water level within Copco No. 2 reservoir rarely fluctuates more than several inches. There is no minimum flow requirement below Copco 2 dam but PacifiCorp maintains a release of 5 cfs in this short reach (approximately 1 mile) between Copco 2 dam and Iron Gate reservoir. Because Reclamation's flow release requirements are met at Iron Gate dam, accretions from tributaries and naturally-occurring springs upstream of Iron Gate are generally managed and included within Reclamation's minimum flow requirements at Iron Gate. Operation of PacifiCorp's Project facilities therefore does not generally affect flow volumes in the Klamath River, but can affect rates of change in flows on a short-term basis (i.e., hourly, daily) due to flow ramping during powerhouse start-up or shut-off and seasonal spillway use.

Reclamation's management of flows in the upper Klamath River is based on operational plans developed in consultations with USFWS and NMFS to protect the federally listed Lost River and shortnose suckers, and SONCC coho salmon, and their designated critical habitats. In March 2010, NMFS issued its final BiOp on Reclamation's operation of the Klamath Project for the period 2010-2018 (NMFS 2010). That BiOp contemplates PacifiCorp's interrelated operations of Link River dam and Iron Gate dam consistent with the 2010 Reclamation BiOp, and it covers PacifiCorp's coordination with Reclamation over implementation of certain Reclamation operations. The BiOp also identifies modified minimum flow releases from Iron Gate dam.

3.2.2 Release Flows

Upstream of Iron Gate dam, PacifiCorp in coordination with Reclamation, stores and releases river water to both generate electricity, deliver water to irrigation project users and municipalities, and provide water for the protection of aquatic resources. Details on how water is stored and released upstream of Iron Gate dam can be found in their HCP (PacifiCorp 2011), but will not be described here in detail.

3.2.2.1 Iron Gate Dam

Reclamation has managed and continues to manage flow releases to the Klamath River to ensure flows at Iron Gate dam meet or exceed specific flow releases prescribed in the applicable 1999, 2001, 2002, and now applicable 2010 BiOps from NMFS on Reclamation's Klamath Project operations. These releases are considered under the "Proposed Action" in the Reclamation BiOps in which the action area includes the historically accessible portion of the mainstem Klamath River to Iron Gate dam (RM 190). PacifiCorp provides these required Reclamation flow releases at Iron Gate dam in coordination with Reclamation. The current NMFS modified RPA minimum flow releases from Iron Gate dam (NMFS 2010) are presented in Table 1.

Table 1. NMFS Modified RPA Monthly Instream Flow Releases (cfs) from Iron Gate Dam by Percent Flow Exceedance

	Oct	Nov	Dec	Jan	Feb	March	April	May	June	July	August 1-15	August 16-31	Sept
95%	1,000	1,300	1,260	1,130	1,300	1,275	1,325	1,175	1,025	805	880	1,000	1,000
90%	1,000	1,300	1,300	1,245	1,300	1,410	1,500	1,220	1,080	840	895	1,000	1,000
85%	1,000	1,300	1,300	1,300	1,300	1,450	1,500	1,415	1,160	905	910	1,001	1,000
80%	1,000	1,300	1,300	1,300	1,300	1,683	1,500	1,603	1,320	945	935	1,005	1,006
75%	1,000	1,300	1,300	1,300	1,300	2,050	1,500	1,668	1,455	1,016	975	1,008	1,013
70%	1,000	1,300	1,300	1,300	1,300	2,350	1,500	1,803	1,498	1,029	1,005	1,014	1,024
65%	1,000	1,300	1,300	1,300	1,323	2,629	1,589	1,876	1,520	1,035	1,017	1,017	1,030
60%	1,000	1,300	1,300	1,309	1,880	2,890	2,590	2,029	1,569	1,050	1,024	1,024	1,041
55%	1,000	1,300	1,345	1,656	2,473	3,150	2,723	2,115	1,594	1,056	1,028	1,028	1,048
50%	1,000	1,300	1,410	1,751	2,577	3,177	3,030	2,642	1,639	1,070	1,035	1,035	1,060
45%	1,000	1,300	1,733	2,018	2,728	3,466	3,245	2,815	1,669	1,077	1,038	1,038	1,066
40%	1,000	1,300	1,837	2,242	3,105	3,685	3,485	2,960	1,682	1,082	1,041	1,041	1,071
35%	1,000	1,300	2,079	2,549	3,505	3,767	3,705	3,115	1,699	1,100	1,050	1,050	1,085
30%	1,000	1,434	2,471	2,578	3,632	3,940	3,930	3,225	1,743	1,118	1,053	1,053	1,089
25%	1,000	1,590	2,908	2,627	3,822	3,990	4,065	3,390	2,727	1,137	1,058	1,058	1,097
20%	1,000	1,831	2,997	2,908	3,960	4,160	4,230	3,480	2,850	1,152	1,066	1,066	1,135
15%	1,000	2,040	3,078	3,498	4,210	4,285	4,425	3,615	2,975	1,223	1,093	1,093	1,162
10%	1,000	2,415	3,280	3,835	4,285	4,355	4,585	3,710	3,055	1,370	1,126	1,126	1,246
5%	1,000	2,460	3,385	3,990	4,475	4,460	4,790	3,845	3,185	1,430	1,147	1,147	1,281

Spill releases from Iron Gate dam in excess of the minimum flow requirements contained in Reclamation's BiOp generally only occur as a result of precipitation events that occur when there is insufficient available capacity in Upper Klamath Lake and Project reservoirs to store those flows. Although this is generally the rule, brief spill events can occur when operational adjustments to reduce flows at Link River dam in response to transient tributary inflows below Keno dam are determined to be impractical due to the requirement that PacifiCorp must salvage fish from the Link River when flows from Link River dam drop significantly. In addition, the lack of information on tributary contributions below Keno dam can result in spill if Project reservoirs are near maximum storage capacity and tributary contributions increase significantly as a result of localized precipitation. Finally, rain-on-snow precipitation events that occur within Reclamation's Klamath Irrigation Project can result in significant irrigation return flows to Keno Reservoir. If there is insufficient Project reservoir storage then spill may occur at Iron Gate in response to this type of event. Because these spill events occur as a result of precipitation events or due to lack of information regarding tributary flow accretions, these spill events are non-discretionary in nature.

3.2.3 Ramping Rates

Under current operations, PacifiCorp follows ramping rates below Iron Gate dam as specified in Reclamation's Operations Plan for the Klamath Irrigation Project (Reclamation 2010) in accordance with the 2010 NMFS BiOp (NMFS 2010). Ramp-down rates below 3,000 cfs are artificially set to minimize risks of stranding juvenile coho salmon (NMFS 2010). These ramping rates specify that when flows exceed 1,750 cfs, decreases in flow are limited to 300 cfs or less per 24-hour period, and no more than 125 cfs per 4-hour period (as measured at USGS gauging station 11516530 located approximately 0.6 mile downstream of Iron Gate dam). When flows are 1,750 cfs, or less, decreases in flow are limited to 150 cfs or less per 24-hour period, and no more than 50 cfs per 2-hour period.

The 2010 BiOp (NMFS 2010) does not contain specific daily or hourly ramp rates when the flow release at Iron Gate dam is greater than 3,000 cfs. The 2010 BiOp (NMFS 2010) assumes Reclamation's proposed approach that the ramp-down of flows greater than 3,000 cfs should mimic natural hydrologic conditions of the basin upstream of Iron Gate dam. PacifiCorp is currently coordinating with Reclamation to ensure that the ramp-down of flows greater than 3,000 cfs is done to be consistent with natural hydrologic conditions, and that is practicable based upon the physical limitations of the Iron Gate facilities as well as other safety considerations.

These ramp rates supersede the ramp rates managed by PacifiCorp in prior years as specified in PacifiCorp's FERC license. The ramping rates now being followed below Iron Gate dam are more restrictive than the current FERC license ramp rate of 250 cfs per hour. However, coordination between Reclamation and PacifiCorp is necessary to make sure enough water is available from upstream for release over the long ramp-down periods. PacifiCorp currently continues to implement these ramp rates to the maximum extent practicable based upon the physical limitations of the Iron Gate facilities, as well as other safety considerations. In instances in which upstream flow releases, natural conditions, operational issues, or other factors have resulted in deviation from these ramp rates, PacifiCorp has coordinated with NMFS to insure such events will not adversely affect listed species.

Above Iron Gate dam, the J.C. Boyle facility has a maximum ramp rate requirement of 9 inches per hour.

For more detailed information on how river flow is managed in the basin please refer to Chapter 3.3 of the FERC EIS and Chapter 4 of the PacifiCorp's HCP.

3.2.4 Water Quality

Water quality conditions in the Klamath River basin vary dramatically along the approximately 250 river miles from Upper Klamath Lake to the estuary at the Pacific Ocean. A wide range of natural and anthropogenic influences affect water quality throughout the system. Inflows to the system at Link River dam originate from hypereutrophic Upper Klamath Lake. Diversions and return flows for agriculture, as well as municipal and industrial use, occur in the reach between Link River dam and Keno dam. The river receives considerable inflow from major and minor tributaries between Iron Gate dam and the estuary. Due to an increasing stream gradient and inputs from tributaries with water that is both cooler and generally lower in nutrient concentrations, the Klamath River is generally less eutrophic as the river approaches the Pacific Ocean. However, despite this unique attribute, current source loads have overwhelmed the historic renewal capabilities of the Klamath River, leading to its impaired status. Both point and nonpoint sources of pollution contribute to the water quality impairments in the Klamath River. Land use pollutant source categories impacting Klamath River water quality are identified as wetland conversion, grazing, irrigated agriculture, timber harvest, and roads.

The Klamath River has a relatively low alkalinity (less than 100 mg/L). The low alkalinity provides for a weak buffering capacity of Klamath River water. Photosynthetic activity removes carbon dioxide in the water (in the form of carbonic acid) which increases the water pH. Natural alkalinity serves as a buffer to minimize the photosynthetically induced increase in pH. In low alkalinity waters such as the Klamath River, this buffering capacity is frequently exceeded and high pH values are observed during daytime hours when photosynthesis is occurring. The large daily variation of pH observed in the Klamath River is caused by photosynthetic activity in the low alkalinity water. Water quality data on pH concentrations taken in the years 2004-2006 by the USFWS, Karuk, and Yurok tribes show pH levels exceeding 8.5 routinely at stations located below Iron Gate dam. Measurements of pH above 8.5 commonly occurred more than 25 percent of the time at many stations within the Klamath mainstem, with some stations exceeding a pH of 8.5 more than 40 percent of the time. The North Coast Regional Water Quality Control Board (NCRWCB) sets the water quality objective for pH in the Klamath River at a maximum of 8.5 and a minimum of 7.0. Further studies into an examination of ammonia toxicity in the Klamath mainstem in which all three parameters (pH, NH_3, and temperature) were collected at the same time, gave results for which the NCRWCB concluded that acute ammonia toxicity likely does not occur regularly and that any toxic conditions that do form likely occur for short durations and a few days a year. The NCRWCB concludes that ammonia levels in the Klamath mainstem, which includes pH as a parameter, do not constitute an impairment of beneficial uses in the Klamath mainstem.

Further exacerbating the effect of the naturally productive and weakly buffered system is the presence of regionally high ambient summer air temperatures, and the resulting high heat load to the shallow and predominantly un-shaded Upper Klamath Lake. These naturally warm waters are the source of the Klamath River. In addition, the east-west aspect of much of the Klamath River also makes it prone to heating, even within the steep gorges of some reaches of the river.

Summary statistics compiled by the U.S. Environmental Protection Agency (USEPA) indicate that in June, water temperatures at locations between Iron Gate dam and above the confluence with the Scott River range from about 16 to 22°C, while in July, temperatures range from 16 to 26°C. In August the minimum temperatures are higher but the maximum temperatures are lower than in July.

Temperature modeling indicates human impacts are responsible for the elevated temperatures that are above biological temperature thresholds for rearing juvenile salmonids and reproductive success of adult salmonids. Under current conditions, the seasonal increase in temperatures during the winter and spring months is delayed in comparison to estimated natural temperatures. Similarly, the seasonal decline in temperatures during the fall months is also delayed in comparison to estimated natural temperatures. These phenomena due to the alteration in the rivers flow and storage capacities are known as "thermal lag." In essence, due to the presence of reservoirs and storage of water there is a lag in downstream temperatures than what would occur in a natural, unaltered system.

Dunsmoor and Huntington (2006) evaluated the effects of the delay in the seasonal fall temperature decline on salmonids due to the Klamath Hydroelectric Project. Their analysis of temperature alteration during the fall months indicates impaired spawning conditions resulting from the presence of the Klamath Hydroelectric Project. USEPA (2001) reviewed multiple literature sources and concluded that optimal protection of salmonids from fertilization through initial fry development requires that temperatures be maintained below 9-10ºC, and that daily maximum temperatures should not exceed 13.5-14.5ºC. Under current conditions, these temperatures are not reached until late October or November. However, the current Chinook salmon spawning season begins in mid-September and peaks in late October.

In 1996, the Klamath River mainstem was listed as impaired for organic enrichment/low dissolved oxygen (DO) from Iron Gate Reservoir to the Scott River, and for nutrient and temperature impairment in the remainder of the basin pursuant to Section 303(d) of the Clean Water Act. In 1998 the Klamath River mainstem was listed for organic enrichment/low dissolved oxygen in the reaches upstream of Iron Gate Reservoir and downstream of the Scott River. Iron Gate and Copco Reservoirs and the intervening reach of the Klamath River were listed for the blue-green algae toxin microcystin impairment in 2006. The 303(d) listings were confirmed in the Klamath River TMDL analysis. As the Klamath River has been listed as impaired for many years for temperature, dissolved oxygen, nutrients, and microcystin, on December 28, 2010, the USEPA approved the North Coast Regional Water Quality Control Board TMDLs for the Klamath River. The State Water Resources Control Board adopted a resolution on September 7, 2010 that approved amendments that approved the establishment of the following: (1) Site Specific Dissolved Oxygen Objectives for the Klamath River; (2) An Action Plan for the Klamath River Total Maximum Daily Loads Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in the Klamath River; and (3) An Implementation Plan for the Klamath and Lost River Basins. The TMDLs, Implementation Plan, and new Dissolved Oxygen Objectives are currently in effect.

Dissolved oxygen concentrations are regularly too low to comply with the NCRWQCB Basin Plan dissolved oxygen objectives. Water temperature conditions regularly exceed temperature thresholds protective of salmonids. Low dissolved oxygen concentrations and elevated water temperatures in the Klamath River, its tributaries, Copco No.1 and Copco No. 2, and Iron Gate Reservoirs, and seasonal algae blooms have resulted in degraded water quality conditions that do not meet applicable water quality objectives and that impair designated beneficial uses.

In summary, the solar exposure and seasonally high ambient air temperatures, coupled with the high levels of biological productivity and respiration that are enhanced by the high levels of biostimulatory nutrients, yield large volumes of organic matter, seasonally high water temperatures, daily low dissolved oxygen, and high pH levels. All of these water quality conditions can be extremely stressful to many forms of aquatic life. These natural background heat, nutrient, and organic matter loads to the Klamath River underscore the very limited capacity of the river to assimilate anthropogenic pollutant sources, and the necessity for establishing load allocations that will result in attainment of water quality standards.

Aiding somewhat in the amelioration of Project related elevated water temperatures and the problems associated with "thermal lag" discussed previously, is the presence of a limited number of locations downstream of Iron Gate dam that provide some amount of refuge from high mainstem water temperatures in the summertime. These thermal refugia locations along the Klamath River are used mostly by juvenile coho salmon in the range of the Upper Klamath coho salmon population unit upstream of Portuguese Creek (RM 134). Juvenile coho salmon have been observed residing within thermal refugia in the mainstem Klamath River throughout the summer and early fall when ambient water temperatures in the river are above about 22ºC (NMFS 2010). Mainstem refugia areas are often located near tributary confluences, where water temperatures are 2 to 6°C lower than the surrounding river environment (NRC 2004; Sutton et al. 2004) providing juvenile salmonids, as well as other aquatic species "refuge" from the warm waters of the Klamath mainstem in the summer.

For example, Soto (2007) reported robust numbers of rearing coho salmon within refugia at the mouths of Beaver Creek (RM 162) and Tom Martin Creek (RM 143). Sutton et al. (2004) indicate that juvenile coho salmon have not been documented, or have been documented in very small numbers, utilizing cold water refugia areas within the Middle and Lower Klamath population areas upstream of Portuguese Creek (RM 134) and the Trinity River (RM 40), respectively. During past refugia studies (Sutton et al. 2004), no coho salmon were observed within extensive cold-water refugia habitat adjacent to lower river tributaries such as Elk Creek (RM 107), Red Cap Creek (RM 53), and Blue Creek (RM 16). However, Naman and Bowers (2007) captured 15 juvenile coho salmon in the Klamath River between Pecwan Creek (RM 24.5) and Blue Creek near cold water seeps and thermal refugia during June and July of 2007.

3.2.5 Water Quality Conditions Contributing to Fish Disease and Fish Kills

Fish kills in the Klamath mainstem have become relatively frequent events in modern times. Juvenile fish kills have been documented for the years 1994, 1997, 1998, 2000, 2001, and 2004. Estimates of the number of dead fish occurring in these years range from 269,000 to 300,000 juvenile salmonids and non-salmonids. Disease was the ultimate cause of death in all juvenile fish kills documented. The effects of disease were exacerbated by poor water quality conditions, including low DO, high water temperature, extreme pH fluctuations, and low flow. Temperatures documented during these fish kills were as high as 25°C, well above the lethal threshold for juvenile salmonids. Additionally, DO levels as low as 3.1 mg/L were recorded during these fish kills, which is well below the current Basin Plan objective of 8 mg/L.

Documentation of adult fish kills in the Klamath River is available for 1997 and 2002. The 1997 fish kill was determined to be caused by Columnaris and other diseases and was exacerbated by maximum water temperatures around 26°C, low DO levels of 3.1 mg/L, and low flows (Hannum 1997; Hendrickson 1997). Multiple compounding factors likely contributed to the 2002 fish kill, including an early large run of fall Chinook, low river discharge which did not provide suitable attraction flows to trigger upstream migration, and warm water temperatures which were optimal for disease proliferation (CDFG 2004a, p.III, 33, 124; USFWS 2003, p.ii). Additionally, fish passage through the lower Klamath River may have been impeded by the shallow depth of the water flowing over some riffles, which were created by sediment deposition during high discharge events in the winters of 1997 and 1998 (CDFG 2004a, p.III; USFWS 2003, p.37). The majority of the dead adult fish examined were infected with the fish diseases *Ichthyophthiriasis* (Ich) and Columnaris, which was identified as the principal cause of death (CDFG 2004a, p.III; USFWS 2003, p.ii). It is believed this combination of high summer/fall water temperatures, low DO concentrations, elevated nutrient concentrations, and impairment of seasonal flows large enough to scour bedload sediment that provide habitat for disease-causing organisms, contribute to environmental conditions in the Klamath mainstem that cause disease outbreaks and mortality events of both juvenile and adult salmonids.

For more detailed information on water quality, water quality objectives, and beneficial uses within the basin and the role the Project reservoirs play in the water quality problems of the basin see the FERC FEIS, NCRWQCB report, and PacifiCorp's HCP.

3.3 Biological Resources

3.3.1 Upper Klamath River System (Above Iron Gate Dam and Reservoir)

3.3.1.1 Shortnose and Lost River Suckers

The following information is derived from the 2008 USFWS BiOp for the Bureau of Reclamation's Proposed Klamath Project Operations from 2008 to 2018.

Two species of endangered sucker fish, the endangered Lost River sucker (LRS) (*Delistes luxatus*) and the endangered shortnose sucker (SNS) (*Chasmistes brevirostris*), are part of a group of suckers that are large, long-lived, late-maturing, and live in lakes and reservoirs but spawn primarily in streams; collectively, they are commonly referred to as lake suckers (NRC 2004). Both of these species are managed by the USFWS. Zooplanktivory can also be linked to the affinity of these suckers for lakes, which typically have greater abundance of zooplankton than do flowing waters.

LRS and SNS grow rapidly in their first 5 to 6 years, reaching sexual maturity sometime between years 4 and 6 for SNS and 4 and 9 for LRS (Perkins et al. 2000). The LRS and SNS are very long-lived fish species and have been aged to 55 and 33 years, respectively. LRS and SNS spawn in riverine habitat from February through May. LRS and SNS do not die after spawning and can spawn many times during their lifetime. Most of the suitable spawning habitat occurs upstream of Keno Reservoir in the lakes of the Upper Klamath basin. Soon after hatching from river gravels, sucker larvae move out of the gravel. Larvae generally spend relatively little time upriver before drifting downstream to the lakes (Hodge, USFWS, pers. comm. 2007). Once in the lake, larval suckers disperse to near-shore areas (Cooperman 2004; Cooperman and Markle 2004). Larval habitat is generally along the shoreline, in water 10 to 50 cm deep and associated with emergent aquatic vegetation, such as bulrush (Buettner and Scoppettone 1990; Cooperman and Markle 2004). Emergent vegetation provides cover from predators, protection from currents and turbulence, and abundant prey (including zooplankton, macroinvertebrates, and periphyton). As they grow during the summer many move offshore. Adult suckers generally use water depths 3 feet or deeper (Peck 2000; Banish et al. 2007).

3.3.1.2 Other Fish Species

This information on Rainbow Trout is taken from the FERC FEIS

Behnke (1992) considers the strains of rainbow trout that predominate inland of the Cascade Range to be a separate subspecies from the coastal form. In the Klamath River Basin, he identifies the inland form as the Upper Klamath redband trout, *Oncorhynchus mykiss newberrii*, while he considers steelhead and resident rainbow trout downstream of Upper Klamath Lake to be primarily coastal rainbow trout, *Oncorhynchus mykiss irideus*. He indicates that there may be two distinct groups of redband trout in the upper basin, one that is adapted to lakes and another that is adapted to streams. Classification of resident rainbow trout populations in the lower part of the basin appears to be less distinct, as Behnke (1992) reports that trout in some of the small tributaries downstream of Upper Klamath Lake have characteristics that are typical of inland redband trout. Because some genetic mixing between the subspecies is likely to occur and the ancestry of specific populations cannot be determined without genetic testing, we refer to all resident *O. mykiss* in the basin as rainbow trout, and the anadromous form as steelhead.

Upper Klamath Lake supports a population of large rainbow trout which appear adapted to the harsh water quality conditions and resistant to *C. shasta.* This population supports a trophy-sized trout fishery.

3.3.2 Keno, JC. Boyle, and Copco Reservoirs

3.3.2.1 Shortnose and Lost River Suckers

Adult shortnose and Lost River suckers, numbering up to several hundred individuals, are in Keno, J.C. Boyle, and Copco reservoirs. The number of endangered suckers found in Project reservoirs diminishes in a downstream direction and there is no evidence that self-sustaining populations exist in any of the reservoirs (USFWS 2007). Although previous efforts have been made to survey suckers in the Klamath River reservoirs (Coots 1965; Beak Consultants 1987; Buettner and Scoppettone 1990; PacifiCorp 2004; and others cited in Buettner et al. 2006), the most intensive survey for suckers was performed in 1998 and 1999 (Desjardins and Markle 2000). SNS is the only lake sucker that occurs commonly in the reservoirs below

Keno Dam. LRS are rare in all three reservoirs (Buettner et al. 2006;Desjardins and Markle 2000). Although SNS adults are more abundant in Copco No.1 Reservoir, both Copco No.1 and Iron Gate Reservoirs contain primarily larger individuals than J.C. Boyle Reservoir which contains a wide range of size classes including juveniles (Buettner et al. 2006). These fish are probably expatriated from UKL (Desjardins and Markle 2000). Unidentified sucker larvae have been caught in all three reservoirs, and SNS spawn in the Klamath River above Copco No.1 Reservoir; although, there is no evidence that SNS larvae and juveniles consistently survive in the reservoir (Beak Consultants 1987; Buettner and Scoppettone 1990; Desjardins and Markle 2000). Poor summertime water quality, lack of larval and juvenile rearing habitat, and large populations of non-native fish predators likely limit sucker populations in the Klamath River reservoirs (NRC 2004). The National Research Council (2004) concluded that sucker populations in Klamath River reservoirs below Keno Reservoir do not have a high priority for recovery because they are not part of the original habitat complex of the suckers and probably are inherently unsuitable for completion of life cycles of suckers.

3.3.2.2 Other Fish Species

The dominant fish species found in Project reservoirs are warm water species that include yellow perch, various species of centrarchids, fathead minnows. chub species, bullheads, and golden shiners. Fish species found in the Klamath River reaches above Iron Gate reservoirs also include redband/rainbow trout, speckled dace, and marbled sculpin. With regard to redband/rainbow trout, see the discussion of Behnke (1992) above. The free-flowing reach of the Klamath River downstream of Keno reservoir supports a good trout fishery, although the fishing season is closed during the summer because high water temperatures cause excessive mortality in a catch-and-release fishery. The J.C. Boyle bypassed and peaking reaches also support good fisheries for redband/rainbow trout.

3.3.3 Iron Gate Reservoir

Iron Gate reservoir was formed when Iron Gate dam was constructed at RM 190.1 in 1962. The dam is 173 feet high and does not include any fish passage facilities. Water levels in Iron Gate reservoir are normally maintained within 4 feet of full pool, and daily fluctuations due to peaking operation of the upstream J.C. Boyle and Copco developments are typically about 0.5 foot. Large areas of thick aquatic vegetation are common in shallow areas. Nearshore riparian habitat is generally lacking, except at the mouths of Jenny and Camp Creeks, where well developed riparian habitat occurs. Due to the cliff-like nature of shorelines, only very small isolated pockets of wetland vegetation exist around the perimeter of the reservoir. Water quality in the reservoir during the summer is generally quite poor, large blooms of the *Aphanizomenon flos-aquae* occur annually, and surface water temperatures are warm. Fish collected in Iron Gate reservoir during Oregon State University’s 1998 and 1999 surveys were dominated by golden shiners, tui chub, pumpkinseed, unidentified chubs, yellow perch, unidentified larval suckers, and largemouth bass, which collectively comprised 95.1 percent of all fish collected. Netting efforts conducted in 2004 in Iron Gate Reservoir caught three species of fish (yellow perch, black crappie, and golden shiner), with yellow perch consistently being the most abundant species caught (PacifiCorp 2004). Redband/rainbow trout are also known to occur in Iron Gate Reservoir.

3.3.3.1 Shortnose and Lost River Suckers

Lost River suckers and shortnose suckers are known to occur infrequently in Iron Gate Reservoir. The shortnose sucker made up only 1 percent of the total catch of adult fish, and no Lost River suckers were collected in Iron Gate reservoir. Although 1,180 sucker larvae were collected in the reservoir, no juvenile suckers were collected, which may reflect predation by non-native species such as yellow perch, largemouth bass, and crappie (Desjardins and Markle, 2000). It is believed the larvae and occasional adult of SNS or LRS found in Iron Gate Reservoir had been washed down from the lakes of the Upper Klamath basin, but become lost to the population as there is little in the way of suitable habitat in the reservoir to complete their life-cycle. Predation rates are probably also high in Copco reservoir, where only 3 juvenile suckers were collected.

3.3.4 Klamath River Downstream of Iron Gate Dam

The river basin downstream of Iron Gate dam supports a variety of species of anadromous fish including fall-run and spring-run Chinook salmon, coho salmon, steelhead, green sturgeon, and Pacific lamprey. Klamath River fall Chinook salmon contribute to important commercial, recreational, and tribal fisheries; steelhead support a popular recreational fishery; and green sturgeon support a small tribal fishery. Coho salmon that occur in the basin are part of the Southern Oregon/Northern California Coast ESU, which is federally listed as threatened. Information on the abundance and distribution of anadromous fish, and the condition of aquatic habitat in the Klamath River and its tributaries is summarized below.

3.3.4.1 Anadromous Species (Coho, Chinook, and Steelhead)

SONCC Coho Salmon

In May, 1997, NMFS listed SONCC coho salmon as threatened due to significant declines in population abundance and spatial distribution since the 1940's (62 FR 24588; May 6, 1997). NMFS designated critical habitat for SONCC coho downstream of Iron Gate dam in May, 1999 (64 FR 24049; May 5, 1999).

Life History Pattern and Status of Coho Salmon in the Klamath River Downstream of Iron Gate Dam

Coho salmon in the Klamath River basin spend the first 14 to 18 months of their lives in freshwater, after which the fish live in the ocean until they return to freshwater to spawn at the age of 3 years (NRC, 2004). Adults typically start to enter the river in September, peak migration occurs between late October and the middle of November, and a few fish continue to enter the river through the middle of December (NRC, 2004). Most spawning takes place in tributaries, but coho salmon have been observed spawning in side channels, tributary mouths, and shoreline margins of the mainstem Klamath River between Beaver Creek (RM 161) and Independence Creek (RM 94) (T. Shaw, M. Magnusen, A. Olsen, personal communication, as cited by Trihey & Associates, 1996). Fry start emerging in late February and typically reach peak abundance in March and April, although fry-sized fish appear into June and early July (CDFG, 2002). Fry are not territorial and have a tendency to move around; some fry are captured in outmigrant traps at the mouths of the Shasta and Scott Rivers from March through May (Chesney and Yokel, 2003). Typical juvenile habitat consists of pools and runs in forested streams where there is dense cover in the form of logs and other large, woody debris. Preferred coho salmon rearing temperatures are from 12 to

14°C (Bell, 1991), although juvenile coho salmon can, under some conditions, live at 18 to 29°C for short periods (McCullough, 1999; Moyle, 2002).

Juvenile coho salmon transform into smolts and begin migrating downstream in the Klamath River basin between February and the middle of June (NRC, 2004). Most smolts captured in a screw trap at Big Bar are taken between mid-April and mid-June. Smolts may feed and grow in the estuary for a month or so before entering the ocean. Once at sea, they spend approximately 18 months as immature fish that feed voraciously on shrimp and small fish, and grow rapidly.

Within the Klamath River ESU diversity stratum, five populations of coho salmon were identified: Upper Klamath River, Middle Klamath River, Shasta River, Scott River, and Salmon River populations. Williams et al. (2006) characterized the Upper Klamath River, Shasta River and Scott River populations as "Functionally Independent," defined as those populations sufficiently large to be historically viable-in-isolation and whose demographics and extinction risk were minimally influenced by immigrants from adjacent populations. The Middle Klamath River and Salmon River populations were classified as "Potentially Independent," defined as those populations that were potentially viable-in-isolation, but that were demographically influenced by immigrants from adjacent populations (Williams et al. 2006).

Upper Klamath River Population Unit

In this population spawning has been documented in low numbers within the mainstem Klamath River. From 2001 to 2005, Magneson and Gough (2006) documented a total of 38 coho salmon redds between Iron Gate dam (RM 190) and the Indian Creek confluence (RM 109), although over two-thirds of the redds were found within 12 river miles of the dam. Many of these fish likely originated from Iron Gate Hatchery. In 2003 the total spawner abundance for surveyed streams was 10 adults. In 2004 it was 108 adults with the majority of fish found spawning in Seiad and Grider creeks (Karuk Tribe and HCRD, unpublished data).

Using a variety of methods, including data from a video weir on Bogus Creek and maps and an intrinsic potential (IP) database, Ackerman et al. (2006) developed run size approximations for tributaries in this stretch of river. They assumed that spawning in the mainstem was limited to fewer than 100 fish. From 2001 to 2004, the estimated number of adult spawners returning to the Upper Klamath River Population Unit (100 to 4,000) was below the Low Risk Abundance Level proposed by Williams et al. (2008) of 5,900 spawners. The lower range of the Ackerman estimate is below the depensation threshold for the population (425 spawners), meaning their numbers are so low that long-term survival of the population is unlikely. Coho salmon within the Upper Klamath River population spawn and rear primarily within several of the larger tributaries between Portuguese Creek and Iron Gate dam, namely Bogus, Horse, Beaver, and Seiad Creeks. A small proportion of the population spawns within the mainstem channel, primarily within the section of the river several miles below Iron Gate dam. Coho salmon parr and smolts rear within the mainstem Klamath River by using thermal refugia near tributary confluences to survive the high water temperatures and poor water quality common to the Klamath River during summer months. Surveys by CDFG between 1979 and 1999, and 2000 to 2004, showed coho salmon were moderately well distributed downstream of Iron Gate dam in the Upper Klamath population area. Juveniles were found in 21 of the surveyed 48 tributary streams. Based on juvenile surveys in the Upper Klamath between 2002 and 2005 there is low production in Upper Klamath tributaries with fewer than 200 juveniles found in most tributaries and most years (Karuk Tribe and HCRD, unpublished data). The greatest number of juveniles was just over 1,000, which were found in Horse Creek in 2005.

Habitat Conditions in the Upper Klamath River

Juvenile Summer and Winter Rearing Areas. For the Upper Klamath River Population Unit, juvenile summer rearing areas have been compromised by low flow conditions, high water temperatures, insufficient dissolved oxygen levels, excessive nutrient loads, habitat loss, disease effects, pH fluctuations, non-recruitment of large woody debris, and loss of geomorphological processes that create habitat complexity (NMFS 2010). Water released from Iron Gate dam during summer months is already at a temperature stressful to juvenile coho salmon, and solar warming can increase temperatures even higher as flows travel downstream (NRC 2004). Nighttime DO levels directly below Iron Gate dam are likely below 7.0 mg/L and highly stressful to coho salmon adults and juveniles during much of the late summer and early fall. Between Iron Gate dam and Seiad Valley, daily maximum pH values in excess of 9.0 have been documented, as high primary production within the weakly buffered Klamath River basin causes wide diurnal pH fluctuations (NMFS 2010).

Juvenile Migration Corridor. NMFS (2010) concludes that, in the Upper Klamath River reach, the juvenile migration corridor suffers from low flow conditions, disease effects, high water temperatures and low water velocities that slow and hinder emigration or upstream and downstream redistribution. The unnatural and steep decline of the hydrograph in the spring may slow the emmigration of coho salmon smolts, speed the proliferation of fish diseases, and increase water temperatures more quickly than would occur otherwise. NMFS (2010) indicates that disease effects, particularly in areas such as the Trees of Heaven site, likely have a substantial impact on the survival of juvenile coho salmon in this stretch of river.

Adult Migration Corridor. The current physical and hydrologic condition of the adult migration corridor in the Upper Klamath River reach likely functions in a manner that supports its intended conservation role. As adults are mainly running in the late fall and early winter when rain events have already begun in the basin, water quality is likely suitable for upstream adult migration, and flow volume is above the threshold at which physical barriers may form (NMFS 2010).

Spawning Areas. Coho salmon are typically tributary spawners. However, low numbers of adult coho salmon do spawn in the Upper Klamath River reach annually. Upstream dams reduce the transport of sediment into this reach of river. NMFS (2010) indicates that the lack of clean and loose gravel diminishes the amount and quality of salmonid spawning habitat downstream of dams, especially below Iron Gate dam. However, water temperatures and water velocities are generally sufficient in this reach for successful adult coho salmon spawning.

Middle Klamath River Population Unit

The Middle Klamath River Population Unit covers the area from the Trinity River confluence upstream to Portuguese Creek (inclusive). Spawning surveys by the Karuk tribe in 2003, 2004, 2007, and 2008 in some spawning tributaries found only a handful of redds and adult coho salmon each year. One estimate of the total population size for this population unit is from 2001 to 2004; Ackerman et al. (2006) estimated a run size between 0 and 1,500.

Juvenile counts indicate that productivity is relatively low with fewer than 12,000 juvenile coho salmon found between 2002 and 2009 during surveys of mid-Klamath tributaries (Six Rivers and Klamath National Forest and Karuk Tribe, unpublished data). Many of these juveniles are likely from other populations and the actual number of juveniles produced by the Mid-Klamath population could be much lower. Based on current estimates of the population, it is likely that the population is above depensation, but it is well below the low risk spawner threshold of 4,000 fish proposed by Williams et al. (2008).

Adults and juveniles appear to be well distributed throughout the Mid-Klamath area; however, use of some spawning and rearing areas is restricted by water quality, flow, and sediment issues in the mainstem and tributaries. Juvenile surveys have been conducted over the past several decades by various parties including the Karuk Tribe, the Mid Klamath Watershed Council (MKWC), and the Forest Service. These surveys have found coho salmon juveniles in Hopkins, Aikens, Bluff, Slate, Red Cap, Boise, Camp, Pearch, Whitmore, Irving, Stanshaw, Sandy Bar, Rock, Dillon, Swillup, Coon, Kings, Independence, Titus, Clear, Elk, Little Grider, Cade, Tom Martin, China, Thompson, Fort Goff, and Portuguese creeks (U.S. Forest Service unpublished data; Soto et al. 2008; MKWC, unpublished data). Most of the juvenile observations are of juveniles using the lower parts of the tributaries and it is likely that many of these fish are non-natal rearing in these refugial areas. Coho salmon spawning surveys have been limited in the Mid-Klamath and therefore information on adult distribution is scarce. Known adult spawning coho salmon have been documented in Bluff, Red Cap, Camp, Boise, South Fork Clear, Indian, and Grider creeks (Soto et al. 2008). Spawning surveys by the Karuk Tribe found adults spawning in Aikens, China, Elk, and the South Fork of Clear Creek.

Shasta River Population Unit

Currently, coho salmon entering the Shasta River are counted at the Shasta River Fish Counting Facility (SRFCF) operated by CDFG. Adult coho salmon returns were 30 and 9 in 2008 and 2009, respectively. Ackerman et al. (2006) used the coho salmon counts from this video weir combined with return timing information and the number of hatchery coho salmon carcasses recovered at the weir to develop approximations of run sizes for the Shasta River. The estimated number of adult coho salmon returning to the Shasta River ranges from 100 to 400 annually. At these low levels, depensation (e.g., failure to find mates), inbreeding, and genetic drift, which accelerate the extinction process, become a concern. These brood year population estimates are low, and have not trended upward over time. The current distribution of spawners is limited to the mainstem Shasta River from river mile 17 to river mile 23, lower Parks Creek, lower Yreka Creek, the upper Little Shasta River, and the Shasta River Canyon. Juvenile rearing is also currently confined to these same areas.

Scott River Population Unit

The Scott River coho salmon population size is not precisely known, although Ackerman et al. (2006) estimated total run size for the Scott River basin. Estimated run sizes were 1,000 to 4,000 in 2001, 10 to 50 in 2002 and 2003, and 2,000 to 3,000 in 2004. Variable rates of effort and differences in survey conditions between years may have influenced these estimates of run size. Uncertainty regarding mainstem spawning of coho salmon in the Scott River was also a source of concern (Ackerman et al. 2006). In 2009, 81 adult coho salmon returned to the river. The adult return estimates for the Scott River were less than the low risk spawner threshold in each of the years examined, and below high risk threshold in 2 of the 4 years.

Routine fish surveys of the Scott River and its tributaries have been occurring since 2001. These surveys have documented coho salmon presence in 11 tributaries, with the six most productive of these tributaries consistently sustaining rearing salmon juveniles in limited areas. The five other tributaries surveyed do not consistently sustain juvenile coho salmon, indicating that the diversity of this population is restricted by available rearing habitat.

Habitat Conditions in the Middle Klamath River

The Middle Klamath River section begins above the Trinity River confluence and extends upstream 85 miles to the mouth of Portuguese Creek. It is substantially different from the Klamath River upstream and downstream and adjacent sub-basins (Salmon and Scott Rivers), particularly in precipitation and flow patterns (Williams et al. 2006). NMFS (2010) concludes that the effects of Iron Gate dam on channel processes (e.g., recruitment of sediment and large woody debris) and water quality in the Klamath River diminish in the downstream direction as flow combines with tributary inputs. NMFS (2010) indicates that, while the effects of Iron Gate dam are minimal in this reach, they may combine with other factors to influence the coho salmon population.

Juvenile Summer and Winter Rearing Areas. Juvenile summer rearing areas in the Middle Klamath River are likely degraded relative to historical conditions (NMFS 2010). A few key tributaries within the Middle Klamath River Population Unit (e.g., Boise, Red Cap and Indian creeks) support populations of coho salmon and offer critical cool water refugia within their lower reaches when mainstem temperatures and water quality approach uninhabitable levels. High tributary sediment loads have caused chronically high sediment concentrations within most tributaries (NMFS 2010). Daytime water temperatures are at levels stressful to juvenile coho salmon, above 22ºC for much of July and August (NMFS 2010). Values for pH at Weitchpec tend to rise throughout the monitoring season toward peak values in late August. Daily maximum values were greater than 8.5 for most of the summer, but attenuated in early October. High pH, in combination with high water temperatures, can precipitate high ammonia levels during summer months. Highly fluctuating DO concentrations, such as those measured during summer 2004 at the Weitchpec site, are common throughout the mainstem, resulting from high primary productivity fueled by naturally elevated water temperatures and the large loads of nutrients from upstream sources, notably Upper Klamath Lake. DO levels at Weitchpec during 2004 peaked above 10 mg/L for several days in mid-October, but were generally above 7 mg/L for most of the summer (NMFS 2010). The exception was several days in both late August and early September, when DO levels as low as 5.5 mg/L were measured. NMFS (2010) concludes that disease effects likely have a substantial impact on the survival of juvenile coho salmon in this stretch of river. NMFS (2010) further concludes that, because the Klamath River is highly productive, food resources may not be limiting.

Juvenile Migration Corridor. Disease effects in this stretch of river can limit the survival of juvenile coho salmon as they emigrate downstream (NMFS 2010). Low flows can slow the emigration of juvenile coho salmon, which can in turn lead to longer exposure times for disease, and greater risks due to predation.

Adult Migration Corridor. Most migrating adult coho salmon are likely unaffected by elevated summer water temperatures characteristic of the Middle Klamath River section

(NMFS 2010). By late September when adult coho salmon migration begins, water temperatures are usually close to 19ºC throughout the Middle Klamath River section.

Spawning Areas. There is some evidence that limited spawning of coho salmon occurs in the Middle Klamath River reach (Magneson and Gough 2006). However, NMFS (2010) indicates that the quality and amount of spawning habitat in the Middle Klamath River reach is limited due the geomorphology and the prevalence of bedrock in this stretch of river. Coho salmon are typically tributary and headwater stream spawners, so it is unclear if there was historically very much mainstem spawning in this reach.

Chinook Salmon

Life History Pattern and Status in the Klamath River Downstream of Iron Gate Dam

In 1998, NMFS completed a status review for the Upper Klamath and Trinity Rivers Chinook (*Oncorhynchus tshawytcha*) salmon ESU (NMFS, 1998). Based on the health of the fall-run populations within the ESU, NMFS concluded that the ESU was not at significant risk of extinction, nor was it likely to become endangered in the foreseeable future, and therefore, did not warrant listing under the ESA (63 FR 11482, 11493; March 9, 1998). In January, 2011, NMFS received a petition to list Chinook salmon in the Upper Klamath Basin under the ESA. NMFS found that the petition presents substantial scientific information indicating that the petitioned action may be warranted; therefore, NMFS will convene a biological review team to assess the current status of the ESU (76 FR 20302; April 12, 2011).

Fall Chinook salmon reach their upstream spawning grounds within 2 to 4 weeks after they enter the river, after which they spawn and die. Bjornn and Reiser (1991) identified suitable water temperatures for Chinook salmon spawning as 5.6° to 13.9° C. Chinook salmon prefer to spawn in areas where the velocity ranges between 1 to 3 feet per second and depths exceeding 0.8 foot (Bjornn and Reiser 1991). Time to emergence is dependent on the temperature regime. In the mainstem Klamath River, alevins can emerge from early February through early April, but peak times vary from year to year. After they emerge, fry disperse downstream, and many then take up residence in shallow water on the stream edges, often in flooded vegetation, where they may remain for various periods. As they grow larger, they move into faster water. Some fry, however, keep moving after emergence and reach the estuary for rearing.

Most fall-run Chinook salmon adults returning to spawn in the middle Klamath River tributaries enter the mainstem in late summer, with peak migration occurring in late August and early September. Migration rate to the tributaries is variable and may be somewhat dependent on water temperatures. Fish enter the Scott River and other Klamath River tributaries beginning in September and continue to enter the tributaries through December. The peak of the upstream migration to the Scott River is in late October.

Spawning generally occurs soon after the fish arrive on the spawning grounds, but may be delayed when flow and temperature conditions are unsuitable.

Fall Chinook salmon fry rear in the mainstem at temperatures of 19 to 24°C (NRC, 2004). That pattern is consistent with the thermal tolerances of juvenile Chinook salmon, which can feed and grow at continuous temperatures up to 24°C when food is abundant and other conditions are not stressful (Myrick and Cech, 2001). Under constant laboratory conditions, optimal temperatures for growth are around 13 to 16°C. Continuous exposure to temperatures of 25°C or higher is invariably lethal, although the time until mortality depends on the acclimation temperature of the fish (McCullough, 1999). Juveniles can, however, tolerate higher temperatures (28 to 29°C) for short periods (NRC, 2004). In the lower Klamath River, the presence in late summer of refugia that are 1 to 4°C cooler than the mainstem and lower temperatures at night increase the ability of fry to grow and survive. Juvenile Chinook salmon are found in the Klamath estuary from March through September, over which time new fish constantly enter and older fish leave (NRC, 2004).

Spring Chinook salmon may have been the dominant run in the tributaries upstream of Upper Klamath Lake. NRC (2004) states that the spring run may have been nearly as abundant as the fall run in the basin overall. The Shasta, Scott, and Salmon Rivers all supported large runs, but the spring runs suffered a precipitous decline in the 19th century due to the effects of hydraulic mining, dams, diversions, and fishing (Snyder, 1931). A large run in the Shasta River disappeared around the time that Dwinnell dam was constructed in 1926. In the Klamath River basin upstream of the Trinity River confluence, only the Salmon River continues to support a run of spring Chinook salmon. Returns to the Salmon River between 1980 and 2002 have ranged from 143 fish in 1983 to 1,443 fish in 1995. Returns of spring Chinook salmon to the Trinity River between 1978 and 2002 have ranged from 1,315 fish in 1983 to 53,852 fish in 1988. The Trinity River run is supplemented by the annual release of approximately 1 million spring Chinook smolts each year from the Trinity River Hatchery. Although data indicate that returns to the hatchery constitute about a third of spring-run Chinook salmon in the Trinity River, NRC (2004) suggests that all of the Trinity River mainstem spawners may be of hatchery origin.

The spawning migration of spring-run Chinook salmon in the Klamath River typically begins in April and continues through June, rarely extending into August. Migration rate to the tributaries is variable; fish reach the tributaries in June and July. The adult fish hold in deep, cold, permanent pools in tributaries until spawning in the fall, generally in October and November. Emergence of fry occurs in January and February. Outmigration of fry and smolts in the Klamath River system occurs from February through mid-June. Like the fall-run, spring-run Chinook salmon adults generally return to the Klamath River in their third and fourth years, but 5-year-olds and 2-year-old males do also occur to a lesser extent (KRTAT 2003, 2004, 2006).

For the purposes of spawning, Chinook require clean gravels with a minimum amount of fine sediment to ensure successful egg-to-fry survival. Gravel beds that contain elevated levels of fine sediment can lead to egg and alevin mortality. Chinook adults can utilize larger coarse substrate for redd construction than either steelhead or coho. Once Chinook juveniles emerge from redds they begin their descent towards the estuary and, in contrast to coho salmon juveniles, are less dependent on complex habitats with deep pools formed by LWD or boulders, and are not as sensitive to cool water refugia while utilizing mainstem habitat.

In terms of abundance of Klamath and Trinity Rivers Chinook, fluctuations in run-size can vary widely and may be heavily influenced by ocean conditions during this stage of the Chinook life-cycle. Iron Gate Hatchery annually releases approximately six million juveniles into the Klamath River, thus abundance numbers are strongly influenced by hatchery production. The Trinity River Hatchery annually releases approximately 4.3 million juveniles into the system. As smolts leave the estuary and enter the Pacific Ocean to complete their pre-spawn adult life-cycle, the occurrence of upwelling along the west coast at the time of ocean entry may play a significant role in the smolt-to-adult survival rates as upwelling brings nutrient-rich waters to the surface enhancing primary productivity and available prey for Chinook.

In 2008 the Pacific Fishery Management Council (PFMC) estimated the Klamath River Chinook run size at 70,572 adults with an estimate of hatchery returns of 13,552 adults. The estimate of spawning escapement to the upper Klamath River tributaries (Salmon, Scott, and Shasta Rivers), totaled 7,935 adults. In these three upper tributaries, escapement is not likely influenced by hatchery strays. The Shasta River has been the most historically important Chinook salmon spawning stream in the upper Klamath River, supporting an estimated spawning escapement of 30,700 adults as recently as 1964, and 63,700 in 1935 (PFMC 2008). The estimated escapement in 2008 to the Shasta River was only 2,741 adults, while escapement to the Salmon and Scott Rivers was 1,749 and 3,445 adults, respectively (PFMC 2008). Of the 2008 total Klamath River system estimate, 16,356 adults were estimated to be Trinity River origin with most of these being naturally produced. Over the last 11 years the peak estimated in-river run of Klamath River fall Chinook was in 2000 at 218,077 adults (PFMC, 2008). Since 2007 the PFMC enacted significant reductions in ocean and in-river harvest of Chinook adults as the numbers of estimated natural adult spawners in the Klamath basin fell short of the 35,000 target, enacting restrictions on harvest. The PFMC pre-season 2011 forecast for the ocean abundance of Klamath River fall Chinook is 304,600 age-3 fish, the age-4 forecast is 61,600, and the age-5 forecast is 5,000 fish (PFMC, 2011). These numbers are in alignment with other river systems in California that have experienced higher 2010/11 levels of adult Chinook returns than in recent history.

Steelhead

Life History Pattern and Status in the Klamath River Downstream of Iron Gate Dam

NMFS considers all steelhead (*Oncorhynchus mykiss*) in the Klamath River basin to be part of the Klamath Mountains Province ESU. Moyle (2002) describes two life history forms within this ESU, a summer run and a winter run. Hopelain (1998), however, concluded that there are three distinct runs of steelhead in the Klamath River basin: a winter run that enters the river from November through March, a spring run that enters the river from March through June, and a fall run that enters the river from July through October. Other reports appear to consider the fall run described by Hopelain to be a component of the winter run, based on a run timing of August through February given for winter-run steelhead by Barnhart (1994; as cited by NRC, 2004).

The life history of steelhead differs from that of coho and Chinook salmon in several ways. Steelhead do not necessarily die after spawning, and a small number survive to become repeat spawners. Juvenile steelhead generally have a longer freshwater rearing requirement (usually from 1 to 3 years), and adults and juveniles are both more variable in the length of time they spend in fresh and salt water. Some individuals may remain in a stream, mature, and even spawn without ever going to sea; others migrate to the ocean at less than 1 year of age, and some may return to freshwater after spending less than 1 year in the ocean. Like other anadromous salmonids, steelhead typically return to their natal streams to spawn. Fall, winter, and summer runs are present in the Klamath River and Scott River systems, and there is considerable overlap in the timing of their life-stages. In larger tributaries of the upper Klamath River (for example, the Scott River), the fall steelhead run may begin as early as

September and continue through November, while the later winter steelhead run occurs from December through April. Summer steelhead migrate into Klamath River basin tributaries in May and June; hold over in deep, cold pools; and spawn the following winter. Because of their extended stay in freshwater, adult summer steelhead are vulnerable to elevated summer water temperatures and dewatering events.

Similar to other salmonids, steelhead lay their eggs in the gravel of the stream bottom where they incubate for approximately 3 to 12 weeks, depending on water temperature. After hatching, pre-emergent fry remain in the gravel for another 4 to 6 weeks; but factors such as redd (the spawning nest of trout or salmon) depth, gravel size, siltation, and temperature can speed or retard this time (Shapolov and Taft 1954). Emergence begins as early as March and can continue through July.

Juvenile steelhead of all three runs outmigrate from freshwater after spending 1 to 3 years in nursery streams (Busby et al. 1996). A large percentage of juvenile steelhead outmigrate during their first year of rearing (age 0) or after a full year of rearing (age 1+) (66 FR 9808; February 12, 2001). However, based on analysis of scales taken from returning adults, approximately 91 percent of Klamath River winter-run steelhead juveniles enter the ocean at age 2+, having spent two summers in freshwater (Hopelain 1998). Juvenile steelhead generally outmigrate from March through June, although smolts may outmigrate during nearly every month of the year.

Steelhead in the Klamath Mountains Province ESU were proposed for federal listing as threatened. The history of petitions and agency findings regarding the Klamath Mountain Province steelhead ESU are detailed in the February 12, 2001, listing proposal (66 FR 9808). After reviewing the best available scientific and commercial information, NMFS concluded in April 2001 that the Klamath Mountains Province ESU did not warrant listing (66 FR 17845; April 4, 2001). The not warranted finding for this ESU does not distinguish between runs.

Historically, the Klamath River supported large populations of steelhead, the anadromous form of rainbow trout. Steelhead were distributed throughout the mainstem and the principal tributaries such as the Shasta, Scott, Salmon, and Trinity River basins, and many of the smaller tributary streams. Steelhead also were likely distributed in the tributaries upstream of Upper Klamath Lake, but due to difficulty in differentiating steelhead from large resident rainbow trout, precise information on the upstream limit of their distribution is lacking. Hamilton et al. (2005) note that, in watersheds where both Chinook salmon and steelhead are present, the range of steelhead is usually the same, if not greater. Hardy and Addley (2001) state that, before 1900, runs of steelhead in the Klamath River basin may have exceeded several million fish. They cite more recent run size estimates of 400,000 fish in 1960; 250,000 in 1967; 241,000 in 1972; and 135,000 in 1977. In its most recent status review for the Klamath Mountains Province steelhead ESU, NMFS (2001) indicates that most California populations showed a precipitous decline to very low abundance around 1990 and stayed at low levels through 1999, but a modest increase in abundance was noted in 2000. Escapement estimates of summer steelhead to the Salmon River are consistent with the trend noted by NMFS, and in the Salmon River this increasing trend continued in 2002. The increased return of summer steelhead from 2000 to 2002 coincides with a period of strong returns of adult salmon and steelhead to the region caused by favorable ocean conditions that existed between 1998 and 2001. Information on the abundance of winter steelhead, which is considered to be the most abundant form, is very limited due to logistical difficulties in sampling adults during the winter season (NMFS, 2001).

3.3.4.2 Other Anadromous Species Found Downstream of Iron Gate Dam

Green Sturgeon

Green sturgeon (*Acipenser medirostris*) are an anadromous species that is known to range in nearshore marine waters from Mexico to the Bering Sea. NMFS has identified two distinct population segments: a northern coastal segment consisting of populations spawning in coastal watersheds northward of and including the Eel River and a southern segment consisting of coastal or Central Valley populations spawning in watersheds south of the Eel River. The Klamath River basin supports the largest spawning population of the species, which is included in the northern DPS and also includes fish that spawn in Umpqua, Rogue, and Eel Rivers. Green sturgeon enter the Klamath River to spawn from March through July (NRC, 2004). Most spawning occurs from the middle of April to the middle of June. Spawning takes place in the lower mainstems of the Klamath and Trinity rivers in deep pools with strong bottom currents. As noted previously, green sturgeon have been observed migrating into the Salmon River, but they are not thought to ascend the Klamath River beyond Ishi Pishi Falls (RM 66)(Moyle, 2002; NMFS, 2005). Juveniles stay in the river until they are 1 to 3 years old, when they move into the estuary and then to the ocean. Optimal temperatures for juvenile growth appear to be from 15 to 19°C, and temperatures above 25°C have been reported to be lethal (Mayfield, 2002, as cited by NRC, 2004). Outmigrant juveniles are captured each year in screw traps at Big Bar (RM 49.7) on the Klamath River and at Willow Creek (RM 21.1) on the Trinity River (Scheiff et al., 2001). After leaving the river, green sturgeon spend 3 to 13 years at sea before returning to spawn, and they often move long distances along the coast (NRC, 2004).

Green sturgeon support small tribal fisheries by the Yurok Tribe in the Klamath River and the Hoopa Valley Tribe in the Trinity River. Although Yurok and Hoopa Valley tribal catch has remained relatively constant in recent years, commercial and sport harvest has been greatly reduced by newly imposed fishing regulations in Oregon and Washington. Commercial fisheries targeting sturgeon have not been allowed in the Columbia River or in Willapa Bay, Washington, since 2001. In California, commercial fisheries for sturgeon are prohibited and regulations prohibiting the recreational harvest of green sturgeon took effect in March 2006.

NMFS published a final rule listing the Southern DPS as threatened (71 FR 17757; April 7, 2006). The Southern DPS includes Green Sturgeon populations south of the Eel River in Humboldt County. NMFS considers the Northern DPS, which includes the Klamath River population, a Species of Concern.

Pacific Lamprey

Pacific lamprey (*Lampetra tridentata*) are found in Pacific coast streams extending from Alaska to Baja California. They currently occur throughout the mainstem Klamath River and its major tributaries downstream of Iron Gate dam. The extent of their historical upstream distribution is uncertain due to the occurrence of several resident species of lamprey in the upper parts of the basin. Hamilton et al. (2005) note that Pacific lamprey are capable of migrating long distances, and generally show a similar distribution as anadromous salmon and steelhead. Pacific lamprey are anadromous nest builders that, like salmon, die shortly after spawning. They enter the Klamath at all times of the year and cease feeding as they migrate upstream. They spawn at the upstream edge of riffles in sandy gravel. Lamprey eggs hatch in approximately 2 to 4 weeks, and then the larvae (ammocoetes) drift downstream to backwater areas where they burrow into the substrate and commence feeding, tail embedded and head exposed, on algae and detritus (Kostow, 2002). Juveniles remain in fresh water for 5 to 7 years before they migrate to the sea at a length of about 6 inches and transform into adults (Moyle, 2002). They spend 1 to 3 years in the marine environment, where they parasitize a wide variety of ocean fishes, including Pacific salmon, flatfish, rockfish, and pollock. Their degree of fidelity to their natal streams is unknown (USFWS, 2004). Adult Pacific lamprey typically range between 30 and 76 centimeters (12 and 30 inches) in length (Moyle, 2002). Larson and Belchik (1998) interviewed 20 Yurok tribal elders about the historic and current lamprey fishery in the Klamath River. Most of those interviewed reported daily catches as high as 300 to 1,500 lamprey per person per day before the run declined some time between the late 1960s and the late 1980s. Reported catches since the decline have not exceeded 100 fish, with most respondents indicating that a catch of 20 lamprey was considered an extremely good catch. Pacific lamprey are collected regularly in screw traps fished in the Klamath at Big Bar and in the Trinity River at Willow Creek.

Eulachon

The eulachon (*Thaleichthys pacificus*) or candlefish is a smelt that reaches the southern extent of its range in the Mad River, Redwood Creek, and the Klamath River (Moyle, 2002). Historically, large numbers entered the river to spawn in March and April, but they rarely moved more than 8 miles inland (NRC, 2004). Spawning occurs in gravel riffles, and the embryos take about a month to develop before hatching. Upon hatching, the larvae are washed into the estuary. The eulachon in the Klamath River once was an important food of the Native Americans in the region (Trihey & Associates, 1996). Moyle (2002) states that eulachon have been scarce in the Klamath River since the 1970s, with the exception of 3 years: they were plentiful in 1988 and moderately abundant again in 1989 and 1999. Based on interviews with Yurok tribal elders, Larson and Belchik (1998) state that most tribal fishers perceived a decline in the mid to late 1970s, although a smaller number thought that it was in the 1980s. Similar declines have been noted elsewhere within the species range. Commercial landings in the Columbia River and its tributaries averaged between 1 and 3 million pounds prior to 1993, but declined ten-fold starting in 1994). A similar decline has occurred in the Fraser River, where landings decreased from about 100 metric tons (110 tons) prior to 1966 to about 20 metric tons (22 tons) in the early 1990s, leading to closure of the fishery in 1998, 1999, and 2000.

The Klamath River is believed to support the largest population of eulachon in California. The species is known to spawn at least as far as 40 km upstream in the Klamath River (Fry 1979, Hamilton et al. 2005), and Larson and Belchik (1998) noted that adults generally migrate up to Pecwan Creek or near Weitchpec. Specific spawning areas are not well known. In March, 2010 NMFS listed the Southern DPS, which includes the Klamath River population, of eulachon as threatened (75 FR 13012; March 18, 2010). Primary factors cited as threatening the species include climate change, commercial fisheries, and altered freshwater habitat. NMFS is unsure as to the viability of eulachon in the Klamath River as we are uncertain that abundance is large enough to support a self-sustaining population.

Coastal Cutthroat Trout and Other Anadromous Fish

NRC (2004) reports that coastal cutthroat trout (*Oncorhynchus clarkii clarki*) occur mainly in the smaller tributaries of the Klamath River within about 22 miles of the estuary; this species also has been observed further upstream in tributaries to the Trinity River (Moyle et al., 1995). Sea-run adults enter the river for spawning in September and October, and juveniles rear in fresh water for 1 to 3 years before going to sea during April through June. Other anadromous fish species that occur in the Klamath River basin include chum salmon (*Oncorhynchus keta*), white sturgeon (*Acipenser transmontanus*), and American shad (*Alosa sapidissima*). NRC (2004) reports that periodic observations of adult chum salmon and regular collection of small numbers of young suggest that this species continues to maintain a small population in both the Klamath and Trinity Rivers, though it has never been present in large numbers.

3.3.4.3 Other Non-Anadromous Fish

Although information on the abundance of non-anadromous species downstream of Iron Gate dam is limited, some information is available from sampling conducted to monitor the outmigration of juvenile salmon and steelhead in the lower Klamath River. Klamath smallscale sucker, Pacific lamprey, and speckled dace were the most common of the non-target species that were collected during screw-trap sampling conducted between 1997 and 2000 in the Klamath River upstream of its confluence with the Trinity River. Sculpins, threespine stickleback, and green sturgeon were the next most abundant species collected. Stillwater (2009) reports other non-anadromous species found below Iron Gate dam to the estuary include:

- Surf smelt (*Hypomesus pretiosus*)
- Golden shiner (*Notemigonus crysoleucas*)
- Fathead minnow (*Pimephales promelas*)
- Goldfish (*Carassius auratus*)
- Yellow bullhead (*Ameiurus natalis*)
- Brown bullhead (*Ameiurus nebulosus*)
- Black bullhead (*Ameiurus melas*)
- Channel catfish (*Ictalurus punctatus*)
- Kokanee (*Oncorhynchus nerka*)
- Brown trout (*Salmo trutta*)
- Brook trout (*Salvelinus fontinalis*)
- Arctic grayling (*Thymallus arcticus*)
- Sacramento perch (*Archoplites interruptus*)
- Green sunfish (*Lepomis cyanellus*)
- Pumpkinseed (*Lepomis gibbosus*)
- Bluegill (*Lepomis macrochirus*)
- Largemouth bass (*Micropterus salmoides*)
- Smallmouth bass (*Micropterus dolomieui*)
- Spotted bass (*Micropterus punctulatus*)
- White crappie (*Pomoxis annularis*)
- Black crappie (*Pomoxis nigromaculatus*)

- Yellow perch (*Perca flavescens*)

3.3.4.4 Beaver

Beaver (*Castor Canadensis*) dams measurably affect groundwater recharge rates and retention, increase summer flows, and elevate local water tables allowing riparian and wetland vegetation to expand. Beaver dams may retain enough sediment to cause substantial changes to the valley floor morphology.

The long history of beaver removal in the Klamath basin may have contributed to declines in anadromous salmonids as the formation of these complex habitats, in which juvenile salmonids are particularly inclined towards, is reduced when beaver have been eliminated from a watershed. Beaver populations are responsible for providing outstanding fisheries and waterfowl habitat by creating wetlands through dam building and maintenance activities. The beaver dams allow wetland conditions to persist during the summer, and store water year round. Currently, beaver dams exist in the Klamath River estuary wetlands and the beaver population seems to be on the rebound (Beesley and Fiori 2007). Studies conducted in central Oregon (Stack and Beschta 1989) showed that beaver can affect important stream characteristics such as pools as beaver within a system can lead to larger pool complexes than streams without beaver. Stream and river corridors can become wider and morphologically more complex and biologically diverse when beavers are present (McKinstry et al. 2001). In general salmonid productivity has been found to be higher, especially for coho salmon, in reaches upstream of beaver dams, relative to habitats were beaver dams were not present (Pollock et al., 2003, Beesley and Fiori, 2007).

3.3.4.5 Fish-Eating Birds in the Klamath Basin Downstream of Iron Gate Dam

Bald Eagle

Bald eagles (*Haliaeetus leucocephalus)* occur in North America from central Alaska and Canada south to northern Mexico (USFWS 1995). They are found primarily along coasts, inland lakes, and large rivers, but may also be found along mountain ranges during migration. Although the bald eagle is greatly reduced in abundance from historical levels, the current distribution is essentially the same (USFWS 1976). Many bald eagles withdraw in winter from northern areas, migrating north again in spring and summer to breed (Terres 1980). They generally nest in large old growth trees near ocean shore, lakes, and rivers. They require open water habitats that support an adequate food base. Bald eagles forage on fish and waterfowl from perch sites adjacent to foraging areas.

In the Klamath Province, which includes the area above and below Iron Gate dam, bald eagles typically nest in very large, emergent trees that may or may not be associated with dense older stands. Nest sites are usually associated with rivers, but may be located on steep mountainsides or drainages over a mile from aquatic habitats used for foraging. During winter, bald eagles often congregate near productive foraging areas (e.g., Klamath Project reservoirs and Klamath River) and use communal roost sites. Bald eagles are known to nest and overwinter along the Klamath River.

Osprey

The osprey (*Pandion haliaetus*) breeds in northern California from Cascade Ranges south to Lake Tahoe, and along the coast south to Marin County. Regular breeding sites include

Shasta Lake, Eagle Lake, Lake Almanor, and other inland lakes and reservoirs (CDFG 2011a).

Ospreys are found only in association with lakes, reservoirs, coastal bays, or large rivers. They feed predominantly on fish, although some mammals, birds, reptiles, and amphibians are also eaten. Ospreys require open, clear water for foraging, and swoop down while in flight or from a perch to catch fish at the water's surface. Large trees and snags near the water are used for roosting and nesting. This species nests on a platform of sticks at the top of large snags, dead-topped trees, on cliffs, or on human-made structures. Nests may be as much as 250 feet above ground. During the breeding season, ospreys generally restrict their movements to activities in and around the nest site, and between the nest and foraging sites.

Ospreys can forage along streams in nearly all forested landscapes, but larger, denser stands are more suitable for foraging. Habitat suitability for cover and reproduction is maximized in stands with large trees (CWHR size classes 4, 5 and 6) in the Klamath Mixed Conifer and similar forest types regardless of canopy density. However, stands with slightly smaller trees (CWHR size class 3) provide at least moderate suitability for cover and reproduction of this species. Ospreys are known to use riparian forests near the Klamath mainstem.

3.4 Socioeconomics and Environmental Justice

The FERC FEIS considered a six-county study area for PacifiCorp's socioeconomic analysis including Klamath, Jackson, and Curry counties in Oregon and Siskiyou, Humboldt, and Del Norte counties in California. The FEIS included detailed information regarding demographic characteristics (population, race, ethnicity, employment, and income) and project-related economic sectors (project employment, payroll, taxes, recreation, commercial fishing, tribal fishery, and irrigated agriculture). A detailed description of these resources is addressed in Section 3 of the FEIS. That information is incorporated herein by reference.

For purposes of the ITP issuance considered within this EA, evaluation of socioeconomic resources is linked to the HCP and the conservation or mitigation measures incorporated therein. Issuance of the ITP is contingent upon the HCP. Three of the HCP measures are downstream improvements (increased dissolved oxygen levels, increased flow variability, and increased quantity and functionality of woody debris). The remaining two measures are more wide-ranging and include (1) funding research and (2) enhancement projects designed to benefit Coho salmon by improving habitat conditions. In consideration of potential impacts from the proposed action NMFS assumes that local economies, services, and human resources could be affected by implementation of the HCP, most importantly, the coho conservation program. NMFS assumes that most restoration projects considered in the HCP will occur within 3 miles of the Klamath mainstem in smaller tributaries and within the larger Scott and Shasta River watersheds. This assumption is made as enhancement projects located in lower reaches of tributaries are likely to have the greatest benefit to coho which utilize low gradient stream reaches, and because the Scott and Shasta Rivers contain sizeable areas potentially suitable for coho, even if the habitat is currently in a degraded, but restorable condition.

3.4.1 Population, Race, and Ethnicity

The most current U.S. Census data from 2010 was queried to identify different race and ethnic distribution and is shown in Table 2. The total population within the six-county area is 500,083.

Table 2. Race and Ethnic Distribution by County within the Permit Area

County	Total Population	Percent White (alone)	Percent Racial Minority[a]	Percent Hispanic[b]
Curry County, OR	22,364	92.0	8.0	5.4
Klamath County, OR	66,380	85.9	14.1	10.4
Jackson County, OR	203,206	88.7	11.3	10.7
Del Norte County, CA	28,610	64.7	35.3	17.8
Humboldt County, CA	134,623	77.2	22.8	9.8
Siskiyou County, CA	44,900	79.5	20.5	10.3

Source: U.S. Census Bureau, 2010

[a] Racial minority includes all individuals who report a race other than White Non-Hispanic.
[b] Hispanics may be of any race.

3.4.1.1 Employment

The U.S. Bureau of Labor Statistics (BLS) database was queried to determine the average unemployment rate in the six counties between January 2010 and January 2011 (December 2010 and January 2011 data is preliminary). Unemployment averages for the six counties during this time period are Del Norte 13.7 percent; Humboldt 11.9 percent; Siskiyou 19 percent; Curry 19 percent; Jackson 12.6 percent; and Klamath 13.9 percent (BLS, 2011).

In its comments on the draft FERC EIS, the Yurok Tribe cites Bureau of Indian Affairs data (BIA, 2005) indicating the unemployment rate was as high as 75 percent for Yurok and 40 percent for Hoopa Valley tribal members in 2001. It is estimated these high rates of unemployment persist to this day.

3.4.1.2 Tribes

There are five Federally-recognized Native American tribes within the permit area. They are:

- The Quartz Valley Indian Community includes a federal reservation of Klamath, Karuk, and Shasta Indians in northwestern California near the community of Fort Jones, Siskiyou County, California. The total reservation area today is about 174 acres (San Diego State University, 2011).
- The Karuk Tribe, which is today one of the largest tribes in California, has a small land base, with most of the Karuk Tribe living in Humboldt and Siskiyou counties, California, and in southern Oregon (San Diego State University, 2011).

- The Yurok Indian Reservation encompasses 56,585 acres located 1 mile on either side of the Klamath River from the mouth at the Pacific Ocean upstream 22 miles, extending through Del Norte and Humboldt counties, California (San Diego State University, 2011).
- The 85,446-acre Hoopa Valley Indian Reservation is located along the Trinity River in northeast Humboldt County, California (San Diego State University, 2011).
- The Resighini Rancheria is a 228-acre federal reservation of Karuk Indians in Del Norte County, California. The reservation spans the mouth of the Klamath River (San Diego State University, 2011)

3.4.2 Recreation

See FERC FEIS Chapter 3 for detailed information on recreational activities and economics within the Project area

In the upstream subregion, the Klamath River and its reservoirs support a number of recreational pursuits, including whitewater boating (private and commercial), sport fishing (private and commercial), camping, and waterskiing. While Klamath River whitewater boating activity in the downstream subregion has increased over time, in-river fishing has varied from year to year. Severe restrictions in recent years due to low returns of adult Chinook spawners in both the Klamath River and Sacramento River are the cause for the recreational restrictions.

Recreational fishing effort in California was up substantially in 2010 as compared to 2009 effort levels since the sport fishery was not restricted in 2010 to a 10-day fishery in the Klamath Management Zone as it was in 2009. However, given the improvements in recreational fishing opportunities in 2010, fishing effort was still severely depressed compared to historical levels (PFMC 2011). For the 2010 fishing year, it is estimated approximately 5,000 Chinook were taken in the in-river recreational harvest which is below an average of 10,000 for the years 1978-2010 (CDFG 2011c). For all of California, 14,697 Chinook were caught in the 2010 recreational fishery from a total of 48,757 fishing trips, for a success rate of less than one fish per trip (PFMC 2011). Although there were increases in 2010 Chinook salmon adult returns and natural spawner escapement, recreational fishing catches remain depressed.

3.4.3 Commercial Fishing

Currently, salmon products contribute less than 1 percent to the economies of the west coast states. This was not always the case, however, and the contributions of commercial fishing can still be substantial to some coastal communities.

Historically, and in contrast to the current situation, the commercial salmon fishery and the associated canneries were substantial components of the west coast economies. The more recent history (1976 to the present) is characterized by downward trends in market prices, poor ocean condition cycles, and adverse habitat alterations (including construction of hydroelectric facilities) for all regions along the west coast of North America. These trends have caused substantial decreases in the amount of income and jobs in economies where salmon and steelhead fishing have historically been important. Coastal communities and tribes have experienced the greatest losses in this regard.

Chinook salmon continues to be the most abundant salmonid species present in the Klamath basin and supports important commercial, recreational, and tribal fisheries.
The commercial fishing fleet within the Klamath Management Zone (KMZ) boundaries consists of ships that generally fish in waters relatively close to their home ports and land their catch at ports close to the waters where the fish are caught. This fleet catches fish originating from the Klamath River. Reductions in fish produced in the Klamath can impact the KMZ commercial fishery. The KMZ falls under the jurisdiction of the states of California and Oregon, as well as PFMC. PFMC tracks fish landings and fishing effort by port, and generally publishes data for major port areas. The major port areas in the KMZ include Brookings in Oregon and Crescent City, Eureka, and Fort Bragg in California. Historically, significant Chinook salmon and coho salmon fisheries used the waters now designated as the KMZ. The harvest levels of Klamath River fall Chinook (KRFC) salmon in the KMZ were much higher in the mid- to late-1980s (in the tens of thousands of fish) than in the 1990s (in the tens or hundreds of fish). The harvest level recovered somewhat from 2001 to 2005, with the catch in the range of 1,400 to 3,900 fish. This pattern in Klamath River fall Chinook salmon harvest levels, coupled with changes (both up and down) in the ex-vessel price of all salmon caught in the KMZ, has been mirrored in the personal income received by commercial fishermen in the KMZ.

Since 2008, Klamath stocks have experienced reduced impacts from the mixed-stock ocean salmon fishery, as a result of management measures designed to protect continued low returns of Sacramento River fall-run Chinook salmon (SRFC). Despite widespread salmon fishery closures in 2008 and 2009, the 2010 abundance forecast of SRFC was the third lowest on record, with only 2008 and 2009 values being lower. As a result, the PFMC recommended very restrictive salmon fisheries south of Cape Falcon, Oregon again in 2010. Only two 4-day openings in early July were available for commercial fishing in California and no fall commercial fisheries were established south of Cape Falcon due to concerns over the status of SRFC. Retention of coho in the ocean salmon fishery off California was prohibited again in 2010, in accordance with ESA consultation standards designed to reduce fishery impacts on Klamath Basin coho salmon.

The PFMC established a conservation objective for KRFC which requires a long-term average escapement of 33 to 34 percent potential naturally spawning adults, but no fewer than 35,000 naturally spawning adults. Since 2008, the PFMC has been designing the ocean salmon fishery to achieve an escapement of at least 40,700 naturally spawning adults in order to enhance the status of the stock. Although the stock failed to achieve 35,000 naturally spawning adults in 2008, escapement exceeded 40,700 naturally spawning adults in 2009. In 2010, the stock successfully exceeded the conservation objective of 35,000 naturally spawning adults, but the total in-river return of adults was still below the average for the years 1978-2010 (CDFG 2011c).

In recent years, the commercial Chinook ocean fishery in California has been severely impacted due to low adult returns in the Sacramento and Klamath River systems. In 2010 California had its first commercial salmon fishery since 2007, although it remained heavily constrained by SRFC management objectives. The ex-vessel value of the California commercial ocean salmon catch in 2010 was $1.2 million compared with (inflation adjusted) $8.2 million in 2007 and a 1979-2009 average of $17.7 million (inflation adjusted) (PFMC 2011). In 2010, 216 vessels made salmon landings in California compared with zero vessels in 2008 and 2009. In 2007, there were 601 vessels active in California, compared with 477 vessels active in 2006 (PFMC, 2011).

3.4.4 Tribal Fishery

From 1987 through 1989, commercial tribal harvests of Chinook salmon averaged about 27,500 fish per year. The 1989 harvest, at an average weight of 15.4 pounds per fish, sold for $852,000 ($1.1 million in 2001 dollars). From 1990 through 1998 there was not commercial harvest in the estuary except in 1996 (PFMC, 2005). Based on an estimated 1996 harvest of 43,276 fall and spring Chinook salmon at an average weight of 13.5 pounds per fish, PacifiCorp estimated revenue from the 1996 tribal commercial catch at $525,000 ($575,000 in 2001 dollars). In its comments on the draft FERC EIS, the Yurok Tribe provided additional information with respect to that tribe's commercial harvest, noting that for the past 15 years, the Tribe has not had any commercial fisheries for species such as spring Chinook salmon, coho salmon, steelhead, lamprey, eulachon, and sturgeon because of their concern for the status of those species. In only four of those years did the Yurok have a minimal commercial fishery for fall Chinook salmon, while in the remaining 11 years the Tribal Council determined that the projected abundance of Klamath fall Chinook salmon was insufficient to support a commercial fishery. In its comments on the draft FERC EIS, the Yurok Tribe also presented survey data related to the effect of tribal commercial fishery closures on tribal members. They note that the survey results indicate that the hardships associated with the commercial fisheries closures have had a greater impact on respondents living within the ancestral territory than those living elsewhere, and that those losses have disproportionately affected those respondents who receive food assistance.

Data from PFMC (2011) for the in-river tribal fishery harvest (commercial and subsistence) of the Yurok and Hoopa estimates of both fall and spring-run Chinook adults in the Klamath River basin for 2008 is 22,901, 2009 is 28,565, and 2010 is estimated at 30,432. The 2010 estimates are above average tribal harvest catch in the Klamath basin for the years 1978-2010 (CDFG 2011c).

3.4.5 Land Use, Ownership, and Management

3.4.5.1 Land Ownership and Land Use

PacifiCorp owns the land adjacent to the Iron Gate dam, fish hatchery, and powerhouse, as well as most of the land along the Iron Gate reservoir shoreline and the nearby transmission line right-of-way.

PacifiCorp reports more specific land ownership data for its proposed project boundary. The proposed project boundary, containing 3,736.8 acres of submerged and non-submerged lands, encompasses lands adjacent to J.C. Boyle, Copco, Fall Creek, and Iron Gate developments, including the project reservoirs, hydroelectric generation facilities (dams and powerhouses), ancillary facilities such as fish hatcheries and river recreation areas, and certain transmission lines and access roads.

Land use and management outside the confines of PacifiCorp ownership in the project area can and has had a significant impact on habitat conditions in the Klamath River basin. Figure 5 shows land ownership throughout the Klamath River basin from its headwaters to the estuary. Nearly two-thirds of the entire Klamath River watershed is held in federal ownership. In the upper basin in the State of Oregon, the watershed is dominated by federal lands including Winema and Fremont National Forests, Crater Lake National Park, Klamath National Wildlife Refuges, the Cascade Siskiyou National Monument, and federal wilderness areas. As depicted in Figure 5, private lands in the upper basin include large areas of irrigated agricultural lands located north and south of Klamath Falls, Oregon. Moving south into California, land ownership grows in private ownership near the City of Yreka, with the eastern basin along the California/Oregon border dominated by federal lands including the Klamath and Modoc National Forests, National Wildlife Refuges, and Lava Beds National Monument. In the middle basin, near Yreka, the Scott and Shasta River watersheds are dominated by private lands with federal land holdings including the Shasta and Klamath National Forests, and small parcels owned by the U.S. Bureau of Land Management. Private lands in the middle Klamath basin include timber production and irrigated agriculture in the Scott and Shasta River valleys. Moving west along the mainstem, land ownership again is dominated by federal ownership including the Klamath, Trinity, and Six Rivers National Forests, along with several federal wilderness areas. Along the lower Trinity River lies the Hoopa Valley Indian Reservation, and along the lower mainstem of the Klamath River to the estuary lies the Yurok Indian Reservation. Other lands in the lower watershed include private lands which are primarily used for timber production.

3.4.5.2 Land Use Jurisdiction

Private land use jurisdiction and management in the northern basin is mainly under the purview of Klamath County, Oregon, with smaller jurisdictional lands falling within Lake and Jackson Counties, Oregon. On the California side of the basin, jurisdiction in the far eastern portion of the basin lies within the jurisdiction of Modoc County with the middle Klamath River basin mainly falling within the jurisdiction of Siskiyou County. Moving further west, the lower Klamath basin shares jurisdiction between Del Norte and Humboldt Counties, with the Trinity River basin tributary to the Klamath falling in the Trinity County jurisdictional boundary. All told, there are two states (California and Oregon), and eight counties that have jurisdiction for private land use in the entire Klamath River watershed.

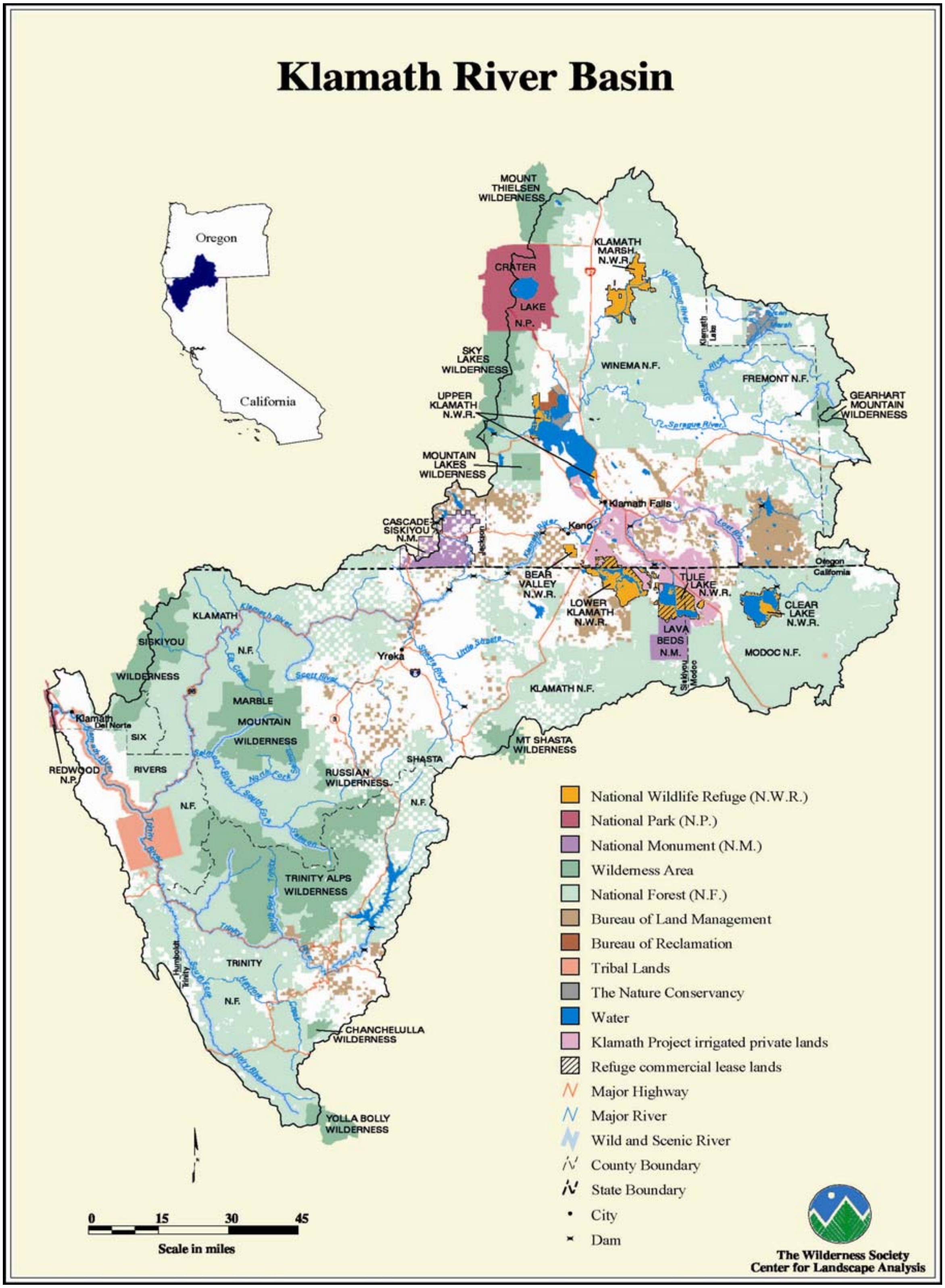

Figure 5. Klamath River Basin land ownership (Source: The Wilderness Society Center for Landscape Analysis)

SECTION 4

Environmental Consequences

4.1 Effects from Proposed Action

4.1.1 Geologic Resources and Geomorphology

Sediment transport downstream of Iron Gate dam is impeded as a result of Project dams and reservoirs being in place. The presence of Project dams and reservoirs will continue to impede the downstream transport of gravel during the period of interim Project operations. This dam-related effect on sediment transport is a current condition that is not expected to change during the permit term and therefore will not result in significant adverse impact. Avoidance of this impact, which would require elimination of the dams and reservoirs, is not practicable under interim operations. However, gravel augmentation actions implemented under the *Coho Conservation Strategy* (as described under Objective C: Gravel Augmentation in Chapter VI: Conservation Program in the HCP) will mitigate the continuing effect of the Project on gravel transport during the interim period. These actions will increase the supply of gravel in the mainstem Klamath River downstream of Iron Gate by augmenting the supply of gravel.

Summary: NMFS concludes that implementation of the proposed action, issuance of an ITP and implementation of the proposed HCP will not result in significant new impacts to the Klamath River mainstem because the proposed action will not cause an adverse change to current conditions related to dams and sediment transport. NMFS does anticipate there will be improvements during the permit term over baseline sediment conditions in the downstream area below Iron Gate dam with implementation of the HCP. The beneficial impacts of gravel augmentation will help compensate for the effects of Project dams and reservoirs on the reduction in suitable spawning gravel in the reach of the river from Iron Gate dam downstream to the confluence with Cottonwood Creek (at RM 182). The primary beneficial impact of gravel augmentation from implementation of the proposed HCP will likely be limited to this reach. There may be short-term adverse impacts to salmonids during gravel augmentation activities as the placement of gravel could disturb juveniles causing them to relocate temporarily, or could result in the crushing or killing of eggs and fry if the area isn't thoroughly surveyed before the work commences. Additionally, gravel placement could generate a sediment plume in the work area which may disturb or impair redds or juveniles located in the work area. NMFS expects these impacts, should they occur, will be short in duration and are not expected to affect long reaches of streams.

4.1.2 Water Resources

4.1.2.1 Climate and Water Flow

Instream Flows and Flow Variability

As explained in Chapter 3.0 (Affected Environment) PacifiCorp's operation of Project facilities has a minor role in how water is controlled in the basin as Reclamation plays the dominant role in water storage and delivery to upper basin water users.

Actions under the *Coho Conservation Strategy* (as described under Objective D: Flow in Chapter VI: Conservation Program in the HCP) will provide releases of instream flows from Iron Gate dam that adhere to instream flow commitments contained in the current NMFS Biological Opinion for Reclamation's Annual Operations Plan (NMFS 2010). Actions under the *Coho Conservation Strategy* (as described under Objective D: Flow in Chapter VI: Conservation Program in the HCP) also include implementation of a fall/winter flow variability program to further enhance flow releases at Iron Gate dam between October and February of each year of the ITP. The Coho Salmon Conservation Strategy's measure under the HCP to help facilitate flow variability downstream of Iron Gate dam enhances Reclamation's ability to implement a flow variability program as directed in the NMFS (2010) BiOp. The flow variability measure commits PacifiCorp to participate in a process with NMFS and Reclamation to implement the Flow Variability Program as outlined in the NMFS (2010) BiOp. Implementation of a Flow Variability Program will impact the environment by helping to improve water quality conditions downstream of Iron Gate dam, and have the added benefit of better mimicking a natural hydrograph which could aid in the emigration of juvenile salmonids out of poor habitat conditions to more suitable habitat downstream.

Based on information from Stocking and Bartholomew (2007), NMFS (2010) hypothesized that high flow pulses in the fall and winter have the benefit of redistributing adult salmon carcasses downstream that might otherwise become concentrated in the mainstem below Iron Gate dam. NMFS (2010) further hypothesized that static flow conditions combined with nutrient enrichment in the Klamath River reach favor proliferation of periphyton habitat preferred by the polychaete intermediate host of disease pathogens. NMFS believes that an increase in flow variability above required minimum flows would reduce outbreaks of disease in the areas below Iron Gate dam where disease activity is highest via the scour of gravels and the periphyton occurring in these gravels. Such a reduction in disease outbreaks would be a significant benefit to coho and Chinook in the basin. Increased flow variability resulting from this measure will be greatest in the upper Klamath River proximal to Iron Gate dam. Farther down the Klamath River, the accretions from larger tributaries contribute significantly to the volume of water and flow variability characteristics.

Flow Ramping Rates

Actions under the *Coho Conservation Strategy* (as described under Objective D: Flow in Chapter VI: Conservation Program in the HCP) will ensure flow ramping rates of releases from Iron Gate dam that adhere to commitments contained in the current NMFS BiOp for Reclamation's Annual Operations Plan (NMFS 2010). Ramp-down rates below 3,000 cfs are artificially set to minimize risks of stranding juvenile coho salmon (NMFS 2010). Daily and hourly ramp-down rate requirements are set to meter out the reduction in flow volume and avoid flow and water depth reductions that could harm coho salmon.

NMFS (2010) concludes that these flow ramping rates will protect rearing and migrating coho salmon within the Klamath River downstream from Iron Gate dam. The previous NMFS (2002) BiOp also concludes that the ramp-down rates below 3,000 cfs minimize adverse effects to essential features of coho salmon habitat (e.g., rearing, spawning habitat features). Hardy et al. (2006) concurred with NMFS' conclusion that decreases in flows of 150 cfs or less per 24-hour period and no more than 50 cfs per two-hour period when Iron Gate dam flows are 1,750 cfs or less are not likely to adversely affect juvenile coho salmon critical habitat.

The 2010 BiOp (NMFS 2010) does not contain specific daily or hourly ramp rates when the flow release at Iron Gate dam is greater than 3,000 cfs. The 2010 BiOp (NMFS 2010) recommends that the ramp-down of flows greater than 3,000 cfs should mimic natural hydrologic conditions of the basin upstream of Iron Gate dam. NMFS (2010) expects that habitat effects from these ramping rates will be representative of conditions that would be observed under flow conditions without Project influence. PacifiCorp is currently coordinating with Reclamation to ensure that the ramp-down of flows greater than 3,000 cfs is done to be consistent with natural hydrologic conditions, and that is practicable based upon the physical limitations of the Iron Gate facilities as well as other safety considerations.

Summary: As both the flow variability program and associated ramping down program, in combination, are expected to better mimic a natural, undammed hydrograph, NMFS believes these proposed measures will help to improve habitat and water quality conditions in the Klamath mainstem below Iron Gate dam and will not result in an adverse change to current conditions and, therefore, would not result in a significant new adverse impacts. NMFS does anticipate that improvements in flow variability and rates at which flows are ramped down via coordinated efforts between NMFS, Reclamation, and PacifiCorp will result in improvements to conditions downstream of Iron Gate dam that currently contribute to the development of habitats that lead to outbreaks of fish diseases; therefore, these actions would result in beneficial effects.

4.1.2.2 Water Quality

Water Temperature

The mass of water in the Project reservoirs will continue to cause a "thermal lag" compared to the same location in the Klamath River under a hypothetical "without-dam" or river-only scenario. The natural seasonal trends of warming river temperatures in the spring and cooling temperatures in the fall are expected to be "lagged" about 2 to 4 weeks with the existence of the reservoirs compared to a hypothetical "without-dam" or river-only scenario. The thermal lag is a product of presence of the reservoirs in place. Therefore, avoidance of this impact, which would require elimination of dams and reservoirs, is not practicable under interim operations and NMFS expects this condition to continue throughout the permit term. The proposed action will not change this scenario and therefore would not result in significant impact. However, thermal refugia enhancement actions implemented under the *Coho Conservation Strategy* (as described under Objective G: Refugia in Chapter VI: Conservation Program in the HCP) will help to mitigate the continuing effect of the Project on water temperature during the interim period until either dams are removed or FERC relicenses the Project.

The thermal refugia enhancement actions implemented under the *Coho Conservation Strategy* will improve the quality and carrying capacity of cold water refugia areas along the mainstem Klamath River downstream of Iron Gate. Collectively, refugia-related actions implemented under the *Coho Conservation Strategy* will enhance and maintain most of the significant refugia areas downstream of Iron Gate dam to the confluence of the Trinity River (RM 43). The proposed maintenance and enhancement of thermal refugia sites from Iron Gate dam to the confluence of the Trinity River extends beyond the distance NMFS believes the PacifiCorp Project adversely affects water temperature in the middle Klamath basin. There could be short-term adverse effects during refugia enhancement actions as juvenile salmonids could be flushed from an existing refugia site while the enhancement work takes place. NMFS anticipates this impact will be short-lived and juveniles will return to the area once the work is complete.

Summary: As the current conditions of dams and reservoirs and the resultant impact on water temperatures in the Klamath mainstem are expected to continue during the permit term, NMFS concludes the proposed action will not result in significant adverse impacts, but actions implemented under the HCP will result in improvements to the protection and enhancement of very important cold-water refuge sites downstream of Iron Gate dam.

Dissolved Oxygen

The NMFS 2007 BiOp (2007a) determined that Project operations, together with naturally occurring factors and the influences of other actions (e.g., agricultural activities and operation of the Klamath Irrigation Project), result in lowered DO levels downstream of Iron Gate dam (especially during the late summer and early fall, and during nighttime hours), which results in limitations to suitable habitat for coho salmon and other fish species. In this EA, NMFS confirms that the causes for low DO levels identified in 2007 are still the same and currently limits suitable fish habitat in area downstream of Iron Gate dam.

As a result of these concerns, FERC included a recommendation in their EIS that turbine venting be installed at Iron Gate dam immediately upon license reissuance and that DO monitoring be a component of the required changes (FERC 2007). The proposed HCP carries forward this measure and turbine venting will be implemented under the *Coho Conservation Strategy* (as described under Objective E: Water Quality in Chapter VI: Conservation Program in the HCP) to enhance DO conditions in releases from Iron Gate during the interim period. Turbine venting increases DO by implementing procedures to introduce air into the turbines at Iron Gate dam.

Testing of turbine venting at Iron Gate dam was conducted by PacifiCorp in 2008 and the results of the tests showed a positive improvement in DO concentration measured in the Klamath River below Iron Gate powerhouse. Dissolved oxygen levels increased by up to 2.5 mg/L and 20 percent saturation as a result of full air admission through the existing turbine vent valve design at turbine flows of 1,000 to 1,500 cfs; the range of flows expected in late summer and early fall. The increases in DO from turbine venting were seen throughout the reach of the river for a distance of approximately 6 miles below the Iron Gate powerhouse. Although the 2008 tests indicate that turbine venting can provide enhancement of DO levels, the test results suggest that the amount of enhancement can vary depending time of year (as indicated by the differences between August and October test results) or river flow amount (as indicated by the differences between flow levels during the August test).

In addition, measurements indicated that turbine venting produces a negligible increase in total dissolved gas in turbine discharges to the river. In all cases, total dissolved gas measurements taken during the tests were below 110 percent, which is the criterion established by the USEPA to prevent fish harm from potential gas bubble disease (USEPA 1976).

Turbine venting at Iron Gate dam during the summer and early fall period (when DO levels below Iron Gate dam can be stressful to coho salmon) is expected to improve DO concentrations in the outflow from Iron Gate dam to at least the NCRWQCB proposed criteria of 85 percent saturation. This was demonstrated by turbine venting testing conducted in 2008. NMFS also estimates that turbine venting would contribute to increased DO levels in outflow water from Iron Gate dam when operated (NMFS 2007a). No adverse effects from increased DO concentrations are expected.

Summary: NMFS expects that the proposed action will result in substantial improvement in DO concentrations in the mainstem Klamath River downstream of Iron Gate dam for approximately six miles. NMFS expects that the improvements in DO concentrations will help to improve water quality conditions in this reach and does not expect any significant adverse impacts as a result of the proposed action.

4.1.3 Biological Resources

4.1.3.1 Upper Klamath River System (Above Iron Gate Dam and Reservoir)

This geographic area includes Keno, J.C. Boyle, and the Copco Reservoirs. Some of the following information is derived from the 2008 USFWS BiOp for the Bureau of Reclamation's Proposed Klamath Project Operations from 2008 to 2018.

In the Upper Klamath basin adult suckers must find suitable spawning habitats, avoid adverse water quality, and find food resources. Most sucker larvae drift downstream from riverine habitats where they were born to lake habitats where they rear. Juvenile suckers relocate themselves to find suitable habitats, avoid predators, and reduce competition. Most of the successful reproduction of both the endangered suckers occurs upstream of Keno Reservoir in lakes located in the upper portions of the watershed. NMFS' proposed action will not change any of the existing factors that make the Upper Klamath basin suitable for sucker viability. NMFS does not expect that during the permit term, the variable flow and ramping rate programs will affect habitat suitability of Upper Klamath Lake for the two listed sucker species in a manner substantially different than exists under current conditions.

For the other aquatic species identified in Chapter 3 of this EA and present above Iron Gate dam, such as rainbow trout, NMFS also does not expect that the variable flow and ramp rate programs will adversely impact aquatic species above Iron Gate dam as conditions are expected to remain essentially unchanged.

Summary: Because all the conservation measures proposed in the HCP occur downstream of Iron Gate dam, except for flow measures that will not affect habitat suitability in a manner substantially different than exists under current conditions, NMFS does not believe the proposed action will significantly adversely impact listed sucker populations or other aquatic biota occurring in the Klamath River above Iron Gate dam.

4.1.3.2 Keno, J.C. Boyle, and Copco Reservoirs

It is believed that the few listed sucker adults and larvae that have been collected in Keno, J.C. Boyle, and Copco reservoirs in the past are washed down from upper lakes. However, because these reservoirs contain little in the way of shallow shoreline habitat for growth and development of larvae and juveniles, maintain a well established predatory assemblage (e.g., largemouth bass), experience poor water quality in the summertime, and do not possess suitable accessible riverine spawning habitat, it is believed that the fish that do end up in Keno, J.C. Boyle, and Copco reservoirs are essentially losses to the overall population. NMFS' proposed action will not change any of these existing factors that make Keno, J.C. Boyle, and Copco reservoirs unsuitable for sucker viability. NMFS does not expect that during the permit term, the variable flow and ramping rate programs will affect habitat suitability of Keno, J.C. Boyle, and Copco reservoirs for the two listed sucker species in a manner substantially different than exists under current conditions.

For the other aquatic species identified in Chapter 3 of this EA and present in Keno, J.C. Boyle, and Copco reservoirs, such as yellow perch and largemouth bass, NMFS also does not expect that the variable flow and ramp rate programs will adversely impact reservoir biota as reservoir conditions are expected to remain essentially unchanged with slight variations in reservoir surface elevations during the flow variability program compared to conditions that currently exist.

Summary: The variable flow and ramp rate programs are not expected to affect aquatic biota in Keno, J.C. Boyle, and Copco reservoirs in a manner substantially different than Project operations under current conditions. Otherwise, all the conservation measures proposed in the HCP occur or have effects downstream of Iron Gate dam. Therefore, NMFS does not believe the proposed action will adversely impact listed sucker populations or other aquatic biota found in Keno, J.C. Boyle, and Copco reservoirs. Similarly, NMFS does not believe implementation of the conservation measures will impact fish-eating birds that inhabit areas near the Keno, J.C. Boyle, and Copco reservoirs as NMFS does not anticipate the conservation measures will have any impact on fish utilizing habitats above Iron Gate Reservoir.

4.1.3.3 Iron Gate Reservoir

Lost River and Shortnose Suckers and Other Species

Some of the following information is derived from the 2008 USFWS BiOp for the Bureau of Reclamation's Proposed Klamath Project Operations from 2008 to 2018.

Adult suckers must find suitable spawning habitats, avoid adverse water quality, and find food resources. Most sucker larvae drift downstream from riverine habitats where they were born to lake habitats where they rear. Juvenile suckers relocate themselves to find suitable habitats, avoid predators, and reduce competition. Most of the successful reproduction of both the endangered suckers occurs upstream of Keno Reservoir in lakes of the Upper Klamath basin. It is believed that the few adults and larvae that have been collected in Iron Gate Reservoir in the past, are washed down from upper lakes. However, because the reservoir contains little in the way of shallow shoreline habitat for growth and development of larvae and juveniles, maintains a well established predatory assemblage (e.g. largemouth bass), experiences poor water quality in the summertime, and does not possess suitable accessible riverine spawning habitat, it is believed that the fish that do end up in Iron Gate Reservoir are essentially losses to the overall population. NMFS' proposed action will not change any of these existing factors that make Iron Gate Reservoir unsuitable for sucker viability. NMFS does not expect that during the permit term, the variable flow and ramping rate programs will affect habitat suitability of Iron Gate Reservoir for the two listed sucker species in a manner substantially different than exists under current conditions.

For the other aquatic species identified in Chapter 3 of this EA and present in Iron Gate Reservoir such as yellow perch and largemouth bass, NMFS also does not expect that the variable flow and ramp rate programs will adversely impact reservoir biota as reservoir conditions are expected to remain essentially unchanged with slight variations in reservoir surface elevations during the flow variability program compared to conditions that currently exist.

Summary: NMFS does not expect that implementation of the variable flow program and ramping rate changes will result in impacts to suitable habitat for listed suckers or other aquatic species in Iron Gate Reservoir, NMFS does not believe the proposed action will adversely impact listed sucker populations or other aquatic biota found in Iron Gate Reservoir. Similarly, NMFS does not believe implementation of the conservation measures will impact fish-eating birds that inhabit areas near Iron Gate Reservoir as NMFS does not anticipate the conservation measures will have any impact on fish utilizing Iron Gate Reservoir.

4.1.3.4 Klamath River Downstream of Iron Gate Dam

Effects from Near-Term Operational Improvements

Turbine Venting and Flow Variability and Ramping Program

Anadromous Species (Coho, Chinook, and Steelhead). The NMFS 2007 BiOP (2007a) indicates that low DO conditions likely limit the nightly period during which juvenile fish leave refugia habitat to forage within the mainstem Klamath River. NMFS (2007a) also suggests that higher nighttime DO concentrations should afford juvenile coho salmon greater foraging opportunities outside the confines of the existing thermal refugia areas, ultimately resulting in higher survival rates for juvenile coho salmon that rear between Iron Gate dam and Seiad Valley each summer.

Throughout the permit term, with actions implemented under the Coho Salmon Conservation Strategy (as described under Objective E: Water Quality in Chapter VI: Conservation Program in the HCP), the increase in DO concentrations is expected to increase the over-summer survival rate for juvenile coho salmon because higher nighttime DO concentrations allow for greater foraging opportunities. Similar benefits are likely for other fish in the area downstream of Iron Gate dam, including Chinook salmon and steelhead. These benefits are expected to increase the viability of SONCC coho salmon as compared to current conditions, by increasing juvenile-to-adult survival rates. Individual juveniles in the downstream reaches with improved DO concentrations are likely to benefit from better water quality conditions enhancing their probabilities of survival to smoltification, and increases in smolt survival may increase adult abundance given favorable ocean conditions upon ocean entry. These improvements would be expected for Chinook and steelhead as well.

The changes to flow variability below Iron Gate dam with actions implemented under the Coho Salmon Conservation Strategy (as described under Objective D: Flow in Chapter VI: Conservation Program in the HCP) will provide a more natural hydrograph and beneficially influence fall redistribution of juvenile coho salmon in the upper reach of the Klamath River (i.e., below Iron Gate dam) (NMFS 2010). Increased fall flow variability will enhance transitory habitat for juvenile coho salmon by providing more side-channel and margin habitat areas preferred by juvenile coho salmon (NMFS 2010). NMFS (2010) concludes that this action will enhance the fitness and overwintering survival of juvenile coho salmon in the mainstem Klamath River, particularly in the reach from Iron Gate dam to the Scott River.

NMFS (2010) concludes that their recommended management of flow releases from Iron Gate dam, including both instream flow and flow variability components, will avoid the likelihood of jeopardizing the continued existence of listed SONCC coho salmon and avoid the destruction or adverse modification of its designated critical habitat. These flows are expected to promote an increase in the natural hydrologic function of the mainstem Klamath River and result in essential features of critical habitat for juvenile coho salmon that will improve the fitness of juvenile coho salmon individuals. NMFS (2010) concludes that these flows will ensure juvenile coho salmon benefit from higher spring flows and increased fall flow variability, which will result in improvements to the overall viability of three Klamath River Basin coho salmon population units.

NMFS (2010) concludes that this measure will provide ecological benefits that will contribute to minimizing and mitigating the impact of any potential take resulting from interim Project operations. Such beneficial effects in in-stream conditions can also have a positive effect on juvenile steelhead and Chinook.

<u>*Other Anadromous Species*</u>

Green Sturgeon: As green sturgeon occur in the Klamath River mainstem far downstream of the expected area of improved DO concentrations and therefore are unlikely to be exposed to improved DO conditions, NMFS does not expect that turbine venting will have any impact on green sturgeon. Similarly, the flow variability and ramping rate program is not likely to affect green sturgeon to any degree that is different than existing conditions as green sturgeon are likely to occur far downstream of the terminal point where changes in river flow from implementation of variable flows are expected. Where green sturgeon occur in the Klamath mainstem is heavily influenced by upstream tributary flows as compared the improved flows coming from Iron Gate dam via flow variability implementation.

Pacific Lamprey: Based upon limited current understanding of DO requirements for the growth and survival Pacific lamprey, NMFS anticipates that any improvement in DO concentrations to levels considered unimpaired for an aquatic system will be likely to have a beneficial effect on lamprey occurring in the mainstem reach six miles below Iron Gate dam. Implementation of the flow variability and ramping rate program is not expected to result in impacts greatly different than current conditions on Pacific lamprey. There may be some beneficial impact if expansion of side channel habitats results in increases in riverine food webs that could result in an indirect benefit to lamprey occurring in the mainstem directly below Iron Gate dam.

Eulachon: As eulachon distribution is currently understood to be generally below Weitchpec in the lower Klamath River, NMFS does not anticipate that improvements in DO concentrations from the turbine venting program, variable flows, or ramping rate changes will reach areas occupied by eulachon, and therefore NMFS anticipates no effects to eulachon.

Coastal Cutthroat Trout and Other Anadromous Fish: Coastal cutthroat trout are known to occur in the lower 22 miles of the Klamath River far downstream from expected improvements in DO concentrations and influence of the variable flow program. NMFS does not expect turbine venting, variable flows, or ramping rate changes below Iron Gate will affect this species. For other anadromous species such as chum salmon, white sturgeon, and American shad, NMFS expects that white sturgeon, like green sturgeon, will not be exposed to improved DO concentrations from turbine venting or be affected by variable flows and ramping rates, and chum salmon if they migrate to areas near Iron Gate dam are likely to receive benefits from improved DO conditions, variable flow and ramping rate changes in a fashion similar to other salmonids. American shad are not expected to be exposed to improved DO concentrations and variable flows as they are not known to occur in the Upper Klamath River.

Other Non-Anadromous Fish. Other fish species that occur near Iron Gate dam are expected to benefit from improved DO concentrations and variable flows in a similar fashion to salmonids described previously. Some of these species may prey upon juvenile salmonids, however, NMFS assumes increases in predator and prey would result in an overall neutral effect.

Beaver. NMFS does not expect that the turbine venting, flow variability or ramping rate program will have an effect on beaver populations downstream of Iron Gate dam any different than current conditions. NMFS does not expect beaver will be affected by improved DO concentrations downstream of Iron Gate dam as they are mammals (air breathers). The flow variability program could result in inundation of tributary beaver dens, but NMFS expects these inundation events to be infrequent during the permit term as beaver are more likely to build dens in tributaries away from the Klamath mainstem to avoid normal flooding events. Should river levels rise to such a degree that they do inundate a den, NMFS believes the inundation will be for a short period of time with a gradual ramping down of flows limiting the potential to damage beaver dens in the process. NMFS believes any damage to a den would likely be quickly repaired by the affected beaver after flows have subsided. As fish are not a component of beaver diets (they are primarily herbivores), NMFS does not expect that improvements in fish populations will benefit beaver.

Fish-Eating Birds. NMFS anticipates the turbine venting, flow variability, and ramping rate program will have an indirect beneficial effect on bald eagle and osprey during the permit term. NMFS expects beneficial effects to come in the form of improved fish populations downstream of Iron Gate dam with implementation of the HCP. Improvements in habitat conditions that enhance the viability of fish such as coho, and steelhead, indirectly benefit bald eagle and osprey in that more prey items may become available over the permit term. NMFS does not expect any other effects (adverse or improved) from the turbine venting, flow variability and ramping rate program on bald eagle and osprey.

Summary: NMFS believes implementation of the turbine venting and flow variability and ramping programs will provide direct beneficial effects to coho and Chinook salmon, steelhead, Pacific lamprey and possibly chum salmon if they occur near Iron Gate dam.

NMFS anticipates turbine venting and flow variability and ramping rate programs will have no effect on green and white sturgeon, eulachon, coastal cutthroat trout, American shad, and other anadromous species found long distances from Iron Gate dam. NMFS anticipates there will be some beneficial effect to non-anadromous fish species occurring near Iron Gate dam from improved water quality conditions. NMFS expects there will no effect on beaver from these conservation measures, but there could be a beneficial effect for fish-eating birds because the conservation measures are expected to result in increased fish abundance which serve as prey.

Large Woody Debris (LWD) Conservation Measures

Anadromous Species (Coho, Chinook, and Steelhead). The reduced in-river transport of LWD is a product of presence of the dams. Therefore, avoidance of this impact, which would require elimination of the dams and reservoirs, is not practicable during the permit term. Actions implemented under the Coho Salmon Conservation Strategy (as described under Objective I: LWD in Chapter VI: Conservation Program in the HCP) will minimize and mitigate the continuing effect of the Project on LWD transport on coho salmon and other anadromous species by increasing the abundance of LWD in the mainstem Klamath River downstream of Iron Gate dam by ensuring that available LWD pieces (greater than 16 inches in diameter and 15 feet in length) trapped at Project dams are released downstream (or alternatively made available for potential use in downstream habitat enhancement projects).

In-stream woody debris provides a fundamental habitat component for salmonids in the Pacific Northwest. The role of woody debris in forming habitat for salmonids is well documented (e.g., Spence et al. 1996). Large pieces of wood provide many habitat functions. These include:

- *Storage and routing of sediment.* Individual pieces and accumulations of wood act as check dams that moderate the delivery of sediment to downstream reaches. This helps to preserve downstream habitat features such as pools which might be wiped out with large, relatively instantaneous delivery of sediment. In steeper reaches, the storage of sediment behind debris jams may provide spawning habitat.
- *Pool scour.* Woody debris provides stable roughness elements in a channel where pools form, resulting in juvenile rearing and adult holding habitat.
- *Cover.* Pieces and jams provide cover from predation and high water velocities.

These functions of LWD are not as significant in large mainstem corridors, like the Klamath, as LWD is more transitory than LWD in smaller tributary reaches. The power of mainstem flows in the Klamath is likely to move released Project LWD much faster than occurs in tributaries. However, this expected movement of LWD does not mean it will not provide some benefit to developing juvenile salmonids, particularly providing cover from predation and slowing of high water velocities which may provide for areas of deeper mainstem pools, thus providing areas of relief from thermal stress. An increase in pool quantity and quality described above can contribute to rearing habitat and cover available for juvenile salmonids, particularly juvenile coho salmon which depend on pools as the principal habitat type for rearing (Meehan and Bjornn 1991, Tschaplinski and Hartman 1983). Greater amounts of large wood often equate to more frequent and larger pools, which in turn, results in a greater number of juvenile coho per channel length (Roni and Quinn 2001). Such improvements could help reduce juvenile competitive pressures and improve juvenile-to-smolt survival rates. The LWD conservation measures considered in the proposed action are likely to have beneficial effects on salmonids in the mainstem of the Klamath River, primarily coho who utilize LWD habitats for over-winter and summer rearing survival.

Other Anadromous Species. NMFS does not anticipate that the LWD conservation measures will have any effect on green sturgeon, Pacific Lamprey, eulachon, American shad, or white sturgeon. Most of these anadromous species spend a relatively short amount of their life-span in riverine environments and are not as dependent on LWD for growth and survival as are coho, Chinook, and steelhead. Coastal cutthroat trout and chum salmon, however may experience some benefit from increased abundance of LWD in the system.

Other Non-Anadromous Fish. As other fish species in the Klamath River could find some benefit associated with increased levels of LWD in the system via the introduction of increased available cover habitat and food resources (periphyton and invertebrates) that LWD can provide, NMFS anticipates that the addition of LWD into the Klamath mainstem could provide some benefit to non-anadromous fish in the Klamath River.

Beaver. NMFS believes beaver can benefit from the addition of LWD in that more woody material may become available in the Klamath River for beaver to utilize for dam and den building. NMFS is uncertain as to whether increased wood available for den building would result in an increase in the beaver population over the permit term.

Fish-Eating Birds. As with improvements in DO and flow variability, NMFS believes the input of LWD into the Klamath mainstem may have an indirect beneficial effect for fish-eating birds if the conservation activity results in an increase in juvenile-to-smolt survival rates. Such increases in survival rates may result in more fish being available for consumption by bald eagle and osprey. An increase in available food resources may contribute to an expansion of territories and increases in species abundance over the permit term.

Summary: NMFS anticipates implementation of the LWD conservation measures will result in direct benefits to coho, Chinook, steelhead, chum salmon, and coastal cutthroat trout occurring in the Klamath River mainstem. All of these species utilize LWD during the freshwater phase of their life-cycle for protection, the formation of deeper pools for cool water refugia, and sources of food and nutrients. NMFS expects indirect benefits from the addition of LWD to the mainstem Klamath River could occur for other non-anadromous fish, beaver, and fish-eating birds.

Effects from Long-Term Planning and Management Investments

Fish Disease Research

Anadromous Species (Coho, Chinook, and Steelhead). Disease is a factor affecting the survival and fitness of coho salmon in the Klamath River basin. Disease-related research and studies conducted under the Coho Salmon Conservation Strategy (as described under objective *F: Disease* in chapter *VI: Conservation Program* in the HCP) will identify actions that would reduce the incidence of fish disease in Klamath River coho salmon, and indirectly, other salmonids such as Chinook and steelhead as well. The Klamath River Fish Disease Research Fund provides the mechanism for funding the research and studies to inform management actions in the river to reduce the incidence of fish disease.

Disease-related research and studies conducted under the Coho Salmon Conservation Strategy are aimed at the causes and control of fish disease in the Klamath River system, primarily resulting from the myxozoan parasites *C. shasta* and *P. minibicornis*. The infection rate in coho salmon is known to be high, yet the relationships and conditions responsible for the incidence of disease are poorly understood (NMFS 2010). Klamath River Fish Disease Research Fund actions will address this uncertainty by funding research and studies that will inform and improve management actions to reduce the effects of disease.

PacifiCorp has already initiated the fund and solicitation of research proposals. Research projects are now underway that are investigating management actions to reduce the abundance of the intermediate polychaete host (*M. speciosa*) for disease pathogens *C. shasta* and *P. minibicornis* in the Klamath River through sediment scour and/or flow manipulations. Gaining a better understanding of factors that influence severity of the disease and the host species will inform resource management decisions, including future coho salmon recovery plan efforts in the Klamath River. It is not possible, however, to describe potential effects of specific actions funded by the Research Fund because those actions have not been completely determined yet. Individual research projects selected for funding will need to be analyzed to determine if those specific actions have any environmental consequences, and third parties implementing those specific actions will need to comply with any applicable laws and regulations. It is assumed, however, that these research actions would have no significant adverse effect as research is currently being conducted on hatchery-reared fish and not wild fish. Future management actions that may result from research findings would have a beneficial effect in contributing to disease reduction. Should researchers desire to take listed wild species in the conduct of their research, they would need to obtain a permit from NMFS under ESA Section 10(a)(1)(A), and NMFS would be required to perform an environmental analysis at that time on the impacts of the proposed research project before deciding on whether to issue the permit.

NMFS anticipates that although there may be little direct benefit from the proposed Fish Disease Research component of the HCP conservation strategy, indirect benefits will be experienced by better understanding the mechanisms for disease outbreaks in the Klamath River, and most importantly, how management actions can help to reduce the extent and magnitude of outbreaks. As disease outbreaks are having a significant impact on the Upper Klamath River coho population, and to a lesser extent the Chinook salmon and steelhead population in the area, having the ability to better understand how disease conditions form, and how to better control these disease-forming conditions by changes in water management strategies, will help to improve the viability of the coho population during the permit duration. This benefit can extend beyond the permit term until conditions which may contribute to disease outbreaks have been ameliorated (e.g. via dam removal).

Other Anadromous Species. NMFS anticipates that benefits to other anadromous species will likely be limited to chum salmon if they occur in the Klamath basin at a time when disease outbreak is occurring. If chum salmon are infected and susceptible to disease mechanisms in a manner similar to coho and Chinook, then benefits derived from the study of disease on the listed and commercially important salmonids should benefit chum salmon as well. NMFS is not aware that the disease-causing organisms that impact salmonids in the Upper and Middle Klamath adversely affect species such as sturgeon, Pacific lamprey, and eulachon. Coastal cutthroat trout occur far downstream of high infection areas, and thus NMFS does not expect disease research will benefit this salmonid species in the permit area.

Other Non-Anadromous Fish and Beaver. NMFS is not aware that the disease organisms and vector pathways that adversely affect coho and Chinook, adversely affect non-anadromous fish or beaver in the Klamath River downstream of Iron Gate dam. Therefore, NMFS does not anticipate that the Fish Disease Research Conservation program contemplated in the HCP will have an impact on non-anadromous fish species or beaver.

Fish-Eating Birds. NMFS anticipates there will be indirect benefits to fish-eating birds from implementation of the disease research program. Research that leads to implementation of management actions that in turn reduces the extent and magnitude of disease outbreaks can have the beneficial effect of lowering disease-related mortality events in Klamath River salmonids. A reduction in mortality events would help to increase the abundance and distribution of salmonids in the Klamath mainstem providing additional food resources for birds such as Bald eagle and osprey. An increase in available food resources may contribute to an expansion of territories and increases in species abundance over the permit term.

Summary: NMFS anticipates indirect effects of disease research that leads to implementation of management actions that reduces the extent of severity of disease outbreaks in the Klamath River mainstem. This will have benefits to coho and Chinook, and possibly steelhead and chum salmon. NMFS does not expect this conservation measure will have impacts on non-anadromous fish and beaver, but do anticipate indirect benefits to fish-eating birds should mortality events for salmonids be reduced over the permit term thereby increasing available prey items.

Improvements to Hatchery Management

Objective B: Hatchery Production of the HCP is based on one target; release at least 75,000 coho smolts each year from Iron Gate Hatchery under an approved Hatchery and Genetic Management Plan. Iron Gate Hatchery was originally constructed as mitigation for blocked habitat between Iron Gate and Copco No. 1 dams. The hatchery will continue operations throughout the permit duration. Actions under the HCP *Coho Conservation Strategy* include implementation of a Hatchery and Genetic Management Plan (HGMP) and related ESA Section 10(a)(1)(A) enhancement permit covering hatchery operations.

The HGMP contains measures to ensure hatchery operations are consistent with the most current plans for species conservation and reintroduction efforts. Although Iron Gate Hatchery is operated as a mitigation hatchery to compensate for habitat blocked between Iron Gate dam and the Copco developments, a conservation focus for the coho program has been deemed necessary to protect the remaining genetic resources of the Upper Klamath coho population unit. Recent adult coho returns to this population (and to the entire Klamath River) have been decreasing over time to the point where currently fewer than 60 fish returned to the hatchery and the largest tributary in this population unit (Bogus Creek) in 2009.

The HGMP program will operate in support of the Klamath River basin’s coho salmon recovery efforts by conserving a full range of the existing genetic, phenotypic, behavioral and ecological diversity of the run. The program’s conservation measures, including genetic analysis, broodstock management, and rearing and release techniques, are expected to maximize fitness and reduce straying of hatchery fish to natural spawning areas. Active broodstock management, based on real-time genetic analysis, is expected to reduce the rate of inbreeding that has occurred in the hatchery population over time. Additionally, the increase in the proportion of natural-origin fish in the total hatchery spawning population is expected to increase population diversity and fitness. Hatchery culture practices under the HGMP program are expected to increase egg-to-smolt survival rates by increasing survival during egg incubation and covering raceways with netting to reduce bird predation.

Summary: NMFS believes implementation of the HGMP will result in benefits to coho, but does not anticipate the HGMP program will result in impacts, beneficial or adverse, to Chinook and steelhead. The HGMP target of releasing 75,000 coho smolts annually is slightly less than the 10-year average (2000-2009) of 82,945 juveniles released from Iron Gate Hatchery (CDFG 2011b). Important objectives of the HGMP will be to preserve genetic resources of the small number of wild coho left in the Klamath Basin, and improve the smolt-to-adult survival rates of hatchery reared coho. These rates are currently believed to be quite low. Because there are millions of hatchery-reared Chinook released from Iron Gate Hatchery annually, NMFS does not believe the number of coho smolts released through the HGMP will have a significant adverse affect on Chinook juveniles rearing in the Lower Klamath River as it is unlikely the coho smolts will prey on a significant proportion of the Chinook population. NMFS does not anticipate the released coho smolts will prey on any significant proportion of the more abundant steelhead juveniles as well. Additionally, although hatchery-released coho smolts have the potential to prey on or outcompete wild coho juveniles, NMFS anticipates the predation will be minimal because of the large expanse of habitat hatchery and wild juveniles will have access to limiting the potential to concentrate hatchery and wild fish and therefore will not result in significant mortality of wild coho. NMFS believes improvements in the production of coho smolts at the hatchery may help to improve smolt-to-adult survival and improve their long-term viability. For other biological resources NMFS anticipates increases in smolt survival would have a beneficial impact on fish-eating birds that would have more prey available for consumption. NMFS anticipates no effect on non-anadromous fish or beaver from the HGMP program.

4.1.3.5 Coho Enhancement Fund

Improvement to Habitat Conditions and Access

Anadromous Species (Coho, Chinook, and Steelhead)

Thermal Refugia: Thermal refugia are considered critical to growth and survival of juvenile coho salmon (and other salmonid species) in the Klamath River. Objective G: Refugia, of the HCP has two targets, (1) Improve habitat cover and complexity (to about 30 to 50 percent of the total existing cover) or maintain habitat cover and complexity (if already suitable) at 28 coldwater refugia sites along the mainstem Klamath River, and (2) Increase the extent and/or duration (by about 30 to 50 percent of the total existing extent and/or duration) of nine coldwater refugia sites along the mainstem Klamath River. The maintenance and enhancement of these refugia sites, as contemplated in the proposed HCP, is critical to the conservation of the Klamath River coho populations and should also provide benefits to Chinook and steelhead populations which need cool water for juvenile rearing in the hot summer months. Chinook juveniles migrate to the Klamath River estuary relatively quickly after redd emergence so the benefit of this activity will not be as great as the benefits to coho and steelhead. Protection of the very limited thermal refugia sites in the Klamath River mainstem should help improve juvenile-to-smolt survival rates which will aid in improving viability for coho and other salmonids during the permit duration.

Improvements to Habitat Access: Actions under the *Coho Conservation Strategy* (as described under Objective A: Fish Passage in Chapter VI: Conservation Program in the HCP) will include specific projects to create, maintain, or improve access by coho salmon to habitats downstream of Iron Gate dam. These projects will serve to increase the distribution of coho salmon and improve the spatial structure of the population. Increasing available habitat below Iron Gate dam will help ensure that coho salmon populations remain stable and improve while parallel actions are taken to address volitional fish passage issues in the longer term.

The specific access-related projects implemented under the *Coho Conservation Strategy* (as described under Objective A: Fish Passage in Chapter VI: Conservation Program in the HCP) will collectively over a 10-year period, improve and maintain access to suitable habitat in approximately 60 miles of tributary habitat. Specific barrier removal projects also will be implemented over the permit duration to create permanent access for spawning and rearing in at least another mile of currently inaccessible habitat. These efforts will help to expand currently inaccessible habitat to coho, mitigating for the blocked habitat caused by Project dams. By the end of 2020, NMFS anticipates that the habitat currently blocked by Project dams will become accessible either through dam removal or the implementation of volitional fish passage. The habitat access improvement program contemplated in the HCP for coho habitat improvement should also provide benefits to Chinook and steelhead where these species co-occur with coho in Klamath River tributaries and are also blocked from accessing suitable spawning and rearing habitat.

Improvements to Habitat Conditions: The Coho Conservation Strategy includes several measures (as described in Chapter VI: Conservation Program in the HCP) that will enhance coho salmon habitat in the Klamath River and tributaries downstream of Iron Gate dam. These measures are targeted to provide mitigation for habitat-related effects resulting from the continued presence and operations of Project dams and reservoirs during the interim period (see Table 4 in Chapter VI: Conservation Program in the HCP). These include the effects as described previously for actions related to water flows, water quality, and gravel augmentation, which are important factors related to the suitability of habitat conditions in the Klamath River basin.

In addition to actions related to water flows, water quality, and gravel augmentation, the *Coho Conservation Strategy* includes additional measures for enhancement of habitat conditions. Actions under the *Coho Conservation Strategy* (as described under Objective J: Connectivity and Objective K: Tributary Rearing Habitat Enhancement in Chapter VI: Conservation Program in the HCP) will enhance flow and habitat conditions in important habitat for coho salmon in tributaries of the Klamath River. For example, Objective J is based on two targets, (1) Restore connectivity in 10 stream reaches of juvenile rearing habitat in tributaries of the Upper Klamath, Scott and Shasta Rivers, and (2) Fund a water transaction program to provide flow augmentation in key reaches used for coho spawning and juvenile rearing in these same watersheds. Objective K of the HCP (Mainstem Rearing Habitat Enhancement) will enhance rearing habitat in key rearing tributaries in the same watersheds as well as protect 10 miles of important summer rearing habitat. These actions will provide additional mitigation for potential indirect effects of the Project on the suitability of habitat for coho salmon in the Klamath River mainstem corridor downstream of Iron Gate dam. Although the habitat conditions in the Scott and Shasta Rivers are not affected by the Project, the current degraded conditions of these highly important tributary habitats for spawning and rearing can act to limit their use by coho, Chinook, and steelhead which results in higher utilization of the mainstem Klamath River than would otherwise occur if these tributaries provided year-round suitable habitat conditions (Chesney and Yokel 2003). The target watersheds currently experience low water conditions in the summer that strand juvenile salmonids, or concentrate juveniles into limited rearing habitat which can result in over-crowding adversely affecting juvenile growth and survival. Additionally, Objective H of the HCP (Mainstem Rearing Habitat Enhancement) is based on the target of enhancing rearing habitat in two key tributaries of the mainstem Klamath River corridor. Funds from PacifiCorp will be used to increase the amount of or quality of habitat conditions in Klamath River mainstem coho rearing habitat. Improvements could include channel realignment, alcove or pond deepening, riparian planting, and other actions. Rearing habitat is currently very limited in the Upper and Middle Klamath River, so any actions that protect and enhance existing or potential rearing habitat will help to aid the viability of coho populations in the permit duration. Improvements to rearing habitat could also provide benefits to juvenile steelhead and Chinook as well.

Improvements to Disease-Forming Conditions and Spawning Habitat: Objective C: Gravel Augmentation of the HCP is based on one target; provide 500 cubic yards of gravel augmentation either annually or 3,500 yards over the term of the ITP downstream from Iron Gate dam. Gravel augmentation is planned to serve two purposes, improve or create suitable coho spawning habitat, and aid in the reduction of disease outbreaks via gravel scour. The augmentation of gravel in the river downstream from Iron Gate dam will enhance conditions for coho and Chinook salmon spawning in the river during fall, and also will enhance gravel-related scour of the disease host *M. speciosa*, particularly during runoff events. Implementation of a gravel augmentation plan is expected to provide some improvement in the viability of the Upper Klamath coho population by increasing their abundance, productivity, and survival. Viability improvements are expected via expansion of potential suitable spawning areas and reduction in disease outbreaks that cause mortality in juvenile coho and Chinook salmon. Improving viability will help conserve coho salmon during the permit duration prior to potential dam removal as specified in the Settlement Agreement or other long-term mitigation and enhancement measures for gravel addressed under a new FERC license. Steelhead may also benefit from a reduction in disease-forming conditions, but are not found to be as susceptible to the known disease pathogens as coho and Chinook.

Summary: NMFS anticipates that projects funded through the Coho Enhancement Fund will result in long-term improved habitat conditions and access to habitat and will result in beneficial impacts to coho primarily, and indirectly Chinook and steelhead as well. Although implementation of restoration projects can result in the potential for short-term adverse effects (e.g. juvenile displacement from work sites, temporary increase in turbidity levels downstream from worksites), NMFS believes such adverse effects will be short-lived while the benefits from the projects NMFS anticipates will be long-term and far outweigh the short-term impacts associated with implementation of projects.

Other Anadromous Species

Thermal Refugia: NMFS anticipates that protection and maintenance of thermal refugia sites in the Klamath River mainstem will provide indirect benefits to other anadromous species such as chum salmon, and coastal cutthroat trout which utilize cold water habitats. Species like white and green sturgeon, eulachon, and Pacific lamprey are not as dependent on cold water habitats as are salmonids, and therefore NMFS expects protection and maintenance of thermal refugia sites will have no effect on their growth or survival in the freshwater environment.

Improvements to Habitat Access: NMFS anticipates implementation of the habitat access improvement program may provide some benefit to chum salmon that spawn in the lowermost portion of tributaries where habitat improvement projects are implemented. Such improvements could result in the improvement of chum spawning grounds. NMFS does not anticipate benefits to coastal cutthroat trout as most improvement projects are likely to occur far upriver from where cutthroat trout occur. However, should habitat improvement projects occur in downstream areas where this species is known to occur, NMFS anticipates beneficial impacts to the species by improving habitat access to suitable spawning tributaries. NMFS does not anticipate any impacts to eulachon, Pacific lamprey, or white or green sturgeon as these species are mostly mainstem spawners.

Improvement to Habitat Conditions: NMFS anticipates implementation of projects that improve water quality, water flow, and spawning habitats may result in beneficial impacts to chum salmon which may spawn in the reaches improved for coho. Since the targeted watersheds for these conservation measures are the Upper Klamath, Scott, and Shasta Rivers, NMFS does not anticipate impacts to other anadromous species such as eulachon, Pacific lamprey, cutthroat trout, or white or green sturgeon. These species spend most of their freshwater life history phase in the Klamath River mainstem far removed from these upper reaches, and therefore will not be affected by projects designed to benefit coho. Some indirect benefit to these species may be achieved if habitat condition projects result in some improvement to Klamath River water quality, but NMFS expects any such improvements are likely to be small in scope and would not result in any measurable water quality improvements to the entire Klamath River mainstem.

Improvements to Disease-Forming Conditions and Spawning Habitat: NMFS anticipates the gravel augmentation program envisioned in the HCP is unlikely to affect other anadromous species besides coho, steelhead, and Chinook. The program will be specifically targeted to improve spawning habitat for coho, and aid in the reduction of disease outbreaks in the Upper Klamath River below Iron Gate dam. Species such as sturgeon, eulachon, and Pacific lamprey are either unlikely to occur where these projects will occur or are not known to be susceptible to the same disease pathogens that result in mortality events on coho, steelhead, and Chinook.

Summary: NMFS anticipates implementation of projects designed to improve habitat access and habitat conditions for coho salmon will result in benefits for other anadromous species such as chum salmon and coastal cutthroat trout who utilize similar habitats for growth and survival during the freshwater phase of their life cycles. Where these two species co-occur in a watershed targeted for coho improvement, they are most likely to benefit from the improvement to habitat conditions, or access to habitat. Although implementation of restoration projects can result in the potential for short-term adverse effects (e.g. juvenile displacement from work sites, temporary increase in turbidity levels downstream from worksites), NMFS believes such adverse effects will be short-lived. Other species such as eulachon, sturgeon, and Pacific lamprey will not be affected by the coho projects as the projects are likely to occur far upriver from where these primarily mainstem species reside.

Other Non-Anadromous Fish and Beaver
The projects designed to improve habitat access and conditions for coho salmon are unlikely to impact other non-anadromous fish in the basin, as habitat access and conditions are not known to be limiting the growth and survival for species such as brown trout and largemouth bass. NMFS does not anticipate the coho habitat projects are likely to have an effect on beaver unless the targeted projects result in the modification or destruction of beaver dams. NMFS does not anticipate this is likely however, as beaver activity in salmonid streams is generally considered beneficial to salmonids growth and survival.

Fish-Eating Birds
NMFS anticipates the habitat access and improvement projects could result in an increase in the abundance and distribution of coho, Chinook, and steelhead. An increase in these species during the permit duration may result in an increase in available food resources for fish-eating birds which may contribute to an expansion of territories and increases in bird abundance over the permit term.

4.1.4 Socioeconomics and Environmental Justice

This EA examines the proposed action and its potential impacts to socioeconomic and environmental justice issues in the Klamath basin. Some of these issues were previously identified in the FERC FEIS and the reader is directed to that document for further detail on general socioeconomic considerations in the Klamath basin.

4.1.4.1 Recreation

In the upstream subregion, the Klamath River and its reservoirs support a number of recreational pursuits, including whitewater boating (private and commercial), sport fishing (private and commercial), camping, and waterskiing. Whitewater boating and river based fishing are recreational activities that may be affected by implementation of the HCP, specifically with regard to flow variability. For example, generally April through October is considered the peak water sport recreation season in the Klamath River, however fishing for steelhead is highest in winter months to coincide with the steelhead run. It is not practicable to estimate how increasing flow variability downstream of Iron Gate dam in the fall and early winter might translate into actual impact on recreational activity days. NMFS anticipates there may be some instances where flow releases in the early winter may coincide with steelhead migration and recreational fishing for steelhead may be interrupted or impaired during the increased flow periods. NMFS believes this effect will likely be minor and not result in a significant reduction in fishable conditions for steelhead over the season.

Flow variability might slightly overlap the whitewater boating season for a short period of time (September/October), but variance in flows is not anticipated to significantly impact this recreational activity due to most of the whitewater activity occurring above Copco Reservoir, or near Happy Camp far downstream of Iron Gate Reservoir. However, development and implementation of a plan to increase flow variability below Iron Gate Dam would likely take whitewater boating safety below Iron Gate into consideration. Impacts to this activity are difficult to determine, as increasing river flows can either draw more whitewater boaters who prefer more challenging river conditions, or reduce whitewater boaters who prefer more tranquil river conditions. Which type of boater could be impacted by variable flows is difficult to determine, but NMFS anticipates the impacts on whitewater boating are likely to be neutral. Additionally, NMFS does not anticipate implementation of the HCP would result in any impact on camping or waterskiing opportunities as implementation of the conservation measures would have no effect on either of these two recreational activities.

4.1.4.2 Commercial Fishing

In recent history, commercial fishing has been characterized by downward trends in market prices, poor ocean condition cycles, and adverse habitat alterations for all regions along the west coast of North America (FERC, 2007). Such trends have led to a substantial decrease in income and jobs in economies that rely on fisheries (salmon and steelhead). Tribes have also been greatly affected as their commercial catch of Chinook salmon has been severely curtailed since the 1990's. Implementation of the HCP as a condition of the ITP is anticipated to lead to an increase in fishing overall if implementation of conservation measures result in increased freshwater survival and adult returns for Chinook and steelhead, as an indirect benefit of coho based projects. Disease reduction would potentially increase fish populations benefiting recreation and commercial fishing as a result of the Fish Disease Research Fund.

4.1.4.3 Environmental Justice

Minority or low income populations will not be disproportionally adversely impacted by the proposed action. A potential beneficial impact is anticipated for tribes in the area. Potential positive impacts on harvest quotas available to the tribes to enhance their commercial and subsistence salmon harvest are anticipated due to the required HCP and associated beneficial impacts to salmonid populations. Increased salmon populations and harvests would allow access to a more traditional diet and lifestyle resulting in improved physical, cultural, and spiritual health. It is anticipated tribal fisheries restoration programs in the Klamath basin, such as those of the Karuk and Yurok tribes, will be instrumental in implementing habitat protection and improvement projects considered in the HCP. This collaboration between these programs and the Coho Enhancement Fund provide the opportunity to provide jobs to tribal and non-tribal members involved in restoration projects, a positive benefit of the ITP.

It is not anticipated that issuance of a 10-year ITP for the Project will negatively impact any of the socioeconomic resources in and around the entire permit area and more specifically downstream of the Iron Gate Dam. The ITP and associated HCP conservation mitigation measures would support the economies (e.g., employment and income) as a result of stream restoration activities leading to projects that would utilize local resources (e.g., contractors and suppliers).

Summary: NMFS anticipates minor beneficial effect to socioeconomic and environmental justice concerns with implementation of the HCP. NMFS makes this determination based upon the assumption that an important minority population (tribes) will benefit from funding for restorative projects when this population is a part of the implementation and monitoring of these projects. Additionally, NMFS anticipates there may be some reductions to fishable steelhead days during implementation of the flow variability program in the winter, but does not anticipate this impact will be significant. There may be some improvement to recreational opportunities should implementation of the HCP result in an increase in adult returns of Chinook and steelhead during the permit duration, allowing for stable and perhaps increasing adult returns available for capture. NMFS anticipates no impacts to camping opportunities. Although impacts to whitewater boating from flow variability may be neutral, there may be adverse impacts limited to short periods and limited area of overlap, but no significant adverse impacts to whitewater boating are expected.

4.1.5 Land Use

NMFS does not anticipate implementation of the HCP will lead to any significant impacts on land use. Most of the conservation measures outlined in the HCP will be limited to instream projects (e.g. culvert removal, thermal refugia enhancement, gravel augmentation, etc…). In the Scott and Shasta River basins conservation measures that are designed to keep or get more water into river mainstem or tributary habitat could result in the conversion of some irrigated agricultural lands to other land uses with a lower water demand (e.g. livestock grazing). NMFS cannot predict with any certainty however whether and how such land uses change would occur. NMFS does not anticipate such conversions would be significant in these two basins during the permit term however.

4.2 Effects from No Action (No ITP and no Implementation of the HCP Including the Coho Conservation Strategy)

4.2.1 Geologic Resources and Geomorphology

Without implementation of the conservation measures outlined in the HCP, the presence of Project dams and reservoirs would continue to impede the downstream transport of gravel during the interim period without any mitigating actions. The dams in the basin significantly impede the transport of gravel downstream of Iron Gate dam which results in the reduction of spawning habitat and scouring potential from flow events which results in the development of more favorable habitat conditions for the disease host *M. speciosa*. Under the No Action Alternative, these effects would be expected to continue throughout the permit duration and gravel augmentation efforts to create more spawning habitat for coho and efforts to reduce the development of conditions that lead to disease outbreaks would not occur.

Summary: NMFS expects the No Action alternative would continue unfavorable sediment transport conditions and result in continued development of disease-forming conditions and limited availability of coho spawning gravels downstream of Iron Gate dam without mitigating actions to limit the impacts of these conditions over the next 10 years.

4.2.2 Water Resources

4.2.2.1 Climate and Water Flow

Instream Flows and Flow Variability

PacifiCorp's facilities operations do not determine or control the availability of flows released from Iron Gate dam as flows are determined by Reclamation which consults with NMFS on the effects of these flows. If the HCP were not implemented as would be the case under the No Action alternative, the loss of effective coordination to implement flow variability as a strategy to mitigate for the presence of dams in the basin, which has resulted in altered natural hydrology, would continue to adversely affect coho and likely Chinook and steelhead during the permit term. Thus, the No Action alternative may result in adverse effects to habitat quality and could impair salmonid migration and rearing opportunities.

NMFS (2010) indicates that the current and post-dam building flow regimes may interfere with environmental cues that initiate the redistribution of juvenile coho salmon in the river and potentially other important ecological functions. The loss of these important life history patterns (juvenile redistribution) may prevent juvenile coho from leaving poor over-wintering habitat in the upper Klamath River when they should seek more favorable overwintering habitat downstream. Failure to redistribute to more suitable habitat can result in lower overwinter juvenile survival. Failing to implement a coordinated variable flow program, as may occur under a No Action alternative, might also reduce the amount of short-term (i.e., transitory and refugial) rearing habitat that would become available during artificially induced flow events. NMFS believes this impairment to the natural (undammed) flow regimes and distribution pattern of juvenile coho and other salmonids can negatively influence the fitness and overwintering survival of juvenile salmonids in the mainstem Klamath River, particularly in the reach from Iron Gate dam to the Scott River (NMFS 2010). NMFS (2010) also indicates the loss of flow variability in the spring may result in habitat reductions for juvenile coho salmon in portions of the Upper Klamath River reaches (R-Ranch to Trees of Heaven). Impediments to smolt outmigration timing with a concurrent reduction in smolt size appear to be related to smallscale habitat variability (Weitkamp et. al 1995) including mainstem river flows. Additionally, NMFS believes modifications in controllable fall/early winter flows may reduce disease risks from *P. minibicornis* and *C. shasta* on juvenile coho salmon in the upper reach of the Klamath River.

Flow Ramping Rates

Under a No Action alternative, PacifiCorp would likely continue to follow ramping rates below Iron Gate dam as specified in Reclamation's Operations Plan for the Klamath Irrigation Project (Reclamation 2010) in accordance with the 2010 NMFS BiOp (NMFS 2010). However, the No Action alternative may result in PacifiCorp not having the ability to cooperatively participate in a ramping rate strategy that provides the most achievable benefit for juvenile coho and other salmonids in the Klamath mainstem while taking into consideration other important factors such as operational and human safety. Failure to cooperatively participate in a flow ramping program could result in greater potential for ramped down flows to result in stranding of juvenile coho below Iron Gate dam, as well as reduce habitat made available for juvenile cover and growth during implementation of controlled higher flow events.

Summary: NMFS believes that the No Action alternative, in which PacifiCorp would not be included in cooperative effective implementation of a flow variability and ramp rate program is likely to result in continued adverse impacts to coho salmon populations in the Klamath River. These impacts include flow-related interference with environmental cues that cause juvenile coho to leave unfavorable overwintering habitat to more favorable habitat, potential stranding of juvenile coho during ramp down flows that have not adequately taken into consideration the distribution of coho in the upper basin. As a result, these No Action conditions may lead to not only mortality of individual coho, but can also reduce adequate growth and survival of juvenile coho, leading to poor juvenile-to-smolt survival rates or poor smolt-to-adult survival rates continuing the existing trend of declining coho populations in the Klamath River. Similar impacts could occur to juvenile steelhead, but are likely not as severe as impacts to coho. As Chinook migrate towards the Klamath River estuary upon redd emergence and do not overwinter in mainstem waters, they are not as susceptible to the same threats and limitations as coho and steelhead. As such, NMFS does not expect the No Action alternative, as it relates to the Project's limited control over water flow, would affect Chinook.

4.2.2.2 Water Quality

Water Temperature

Water temperature patterns below Iron Gate dam would be similar under a No Action alternative, as compared to the Proposed Action during the proposed permit term, most notably meaning there would be little change in late summer/early fall water temperatures in the upper Klamath River mainstem below Iron Gate. Project reservoirs will continue to cause a "thermal lag" and this lag could affect the timing (or periodicity) of coho salmon life stages below Iron Gate dam, or affect coho salmon egg pre-spawn viability and juvenile growth (bioenergetics), foraging, and fitness.

A No Action alternative would not provide for any mitigation of these thermal impacts however on juvenile salmonids. Under No Action, the thermal refugia enhanced or maintained as outlined in the HCP would not be implemented. The effect of this may result in a continuance of poor habitat conditions for juvenile salmonids in the late summer/early fall whose growth and survival to smolt stage may be impaired due to a lack of access to cold water refugia sites. Such access to cold water refugia NMFS considers beneficial to the growth and survival of coho in the upper Klamath.

Dissolved Oxygen

The No Action alternative would result in the turbine venting strategy at Iron Gate dam not being implemented during the proposed permit term of the Proposed Action. The substantial improvement expected in DO concentrations downstream of Iron Gate dam via turbine venting would not occur and the current state of poor DO habitat conditions for at least 6 river miles downstream of Iron Gate would continue for the next 10 years. NMFS (2007a) believes that these low DO conditions would continue to limit the nightly period during which juvenile fish leave refugia habitat to forage within the mainstem Klamath River. Continuation of these impairments to distribution and foraging opportunities would likely continue the declining trend of coho populations in the Upper Klamath River below Iron Gate dam. This coho population is most at risk to the effects from Project operations and would continue to be exposed to stressful habitat conditions for the next 10 years.

Summary: In regards to the No Action alternative and effects on water temperature and water quality, NMFS anticipates No Action would result in continued stress on coho populations as well as other salmonids occurring in the vicinity of Iron Gate dam, and would not result in improvements to water quality downstream of Iron Gate for the next 10 years. Without the benefits associated with protection and enhancement of in-river thermal refugia sites, and improvements to DO levels, these conditions would be likely to contribute to further declines in the Upper Klamath River coho population, and thus the resiliency of the entire Klamath River coho population would remain at risk.

4.2.3 Biological Resources

4.2.3.1 Upper Klamath River System (Above Iron Gate Reservoir)

Shortnose and Lost River Suckers and Other Fish Species

NMFS anticipates there would be no effect on SNS, LRS, or other fish species identified in Chapter 3 of this EA. As the No Action alternative would result in no implementation of the PacifiCorps HCP, current conditions in the Upper Klamath River system would remain. As mentioned under the proposed action Upper Klamath Lake supports a trophy-sized trout fishery and NMFS anticipates this would continue under the No Action alternative. NMFS anticipates the distribution and abundance of SNS and LRS in Keno, J.C. Boyle and Copco reservoirs would remain the same under the No Action alternative.

4.2.3.2 Iron Gate Reservoir

Lost River and Shortnose Suckers and Other Species

The No Action Alternative would not implement the flow variability program described in the HCP, however, as described under the Proposed Action NMFS does not anticipate the variable flow program, even if implemented, would affect habitat suitability of Iron Gate Reservoir for the two listed sucker species in a manner substantially different than exists under current conditions. As such, NMFS does not believe implementation of the No Action alternative would result in impacts to these two species. For the same reasoning, NMFS expects there would be no impact to other aquatic species present in Iron Gate Reservoir from the No Action alternative.

4.2.3.3 Klamath River Downstream of Iron Gate Dam

No Turbine Venting, Flow Variability and Ramping Programs

Anadromous Species (Coho, Chinook, and Steelhead)

As mentioned above, the No Action alternative would not implement the turbine venting, flow variability, and ramping rate programs outlined in the HCP. Failing to implement these programs would likely result in continued adverse effects on Upper Klamath River coho populations, as well steelhead and Chinook occurring in the Upper Klamath River. These adverse effects are the continued occurrence of low DO conditions below Iron Gate dam, lack of flows which mimic natural flows in the basin, and ramp down rates that do not fully consider the needs of juvenile salmon located in reaches subject to the effects from ramp down events. The benefits anticipated from mitigating actions outlined in the HCP (improvements in DO concentrations, improvements in foraging opportunities, providing access to additional suitable overwintering habitat, etc...) would not occur leaving coho, Chinook, and steelhead susceptible to unfavorable mainstem habitat conditions for the next

10 years. NMFS believes such a scenario would further adversely impact declining coho populations in the basin. NMFS also believes the No Action alternative would adversely impact Chinook and steelhead populations as well, as these species can also be limited by poor habitat conditions in the Klamath River mainstem.

Other Anadromous Species

Under a No Action alternative the potential benefits contemplated under the proposed action for Pacific lamprey and chum salmon, which may occupy areas downstream of Iron Gate dam on occasion, would not be realized. Lamprey that may utilize mainstem habitat below Iron Gate dam would not be exposed to improved DO conditions, nor would they benefit from variable flows that could result in improved side-channel habitats which may result in improvement to food resources downstream of Iron Gate. Should current poor water quality conditions in the mainstem of the Klamath River be a factor in the decline of lamprey in the Klamath River, the No Action alternative is likely to have an adverse impact on this species. For other anadromous species such as white and green sturgeon, eulachon, and coastal cutthroat trout NMFS anticipates the No Action alternative which would not implement turbine venting, flow variability, and ramping programs, would result in no effect to these species. As noted previously, these species are generally found below mainstem habitat that NMFS expects will be influenced by either the water resources components of the Proposed Action or No Action alternatives.

Other Non-Anadromous Fish

Implementation of the No Action alternative would not improve water quality conditions in reaches immediately downstream of Iron Gate dam. NMFS anticipates that the No Action alternative would have no impact on other non-anadromous fish species found downstream of Iron Gate dam.

Beaver

NMFS expects implementation of the No Action alternative would not affect beaver in the Klamath River basin. Failing to implement a program to improve DO levels near Iron Gate dam, or artificially induced seasonal variable flows in the Klamath River mainstem would not affect beaver as they are air breathers and do not eat fish which could increase in numbers over the permit term by implementation of the HCP. In summary, beaver do not appear to be limited in the Klamath River by poor water quality conditions or river flows.

Fish-Eating Birds

Implementation of the No Action alternative could affect fish-eating birds in that continuation of current poor water quality conditions and flows with variability below Iron Gate dam, may lead to further declines of salmonids in Klamath River for the next 10 years. Continued declines in Klamath River fish abundance can indirectly impact species such as bald eagle and osprey that depend on fish as the major component of their diets. Continued reductions in coho and steelhead abundance could result in a corresponding reduction in the numbers of fish-eating birds that inhabit the Klamath River mainstem corridor.

No Large Woody Debris Improvement

Anadromous Species (Coho, Chinook, and Steelhead)

The No Action alternative would mean PacifiCorp would not implement a program to transport large woody debris caught at project facilities downstream of Iron Gate dam. Additionally, PacifiCorp would not provide this LWD for restoration projects that intend to use this material for the construction of complex wood jams in Klamath River tributaries. As described previously in this EA, large woody debris plays a crucial role in the growth and survival of salmonids including providing cover from predators, slowing of high velocity waters, and can lead to the development of deeper pools which can provide food resources as well as areas of thermal refugia. Under current conditions, the Project dams can trap the movement of large woody debris down the Klamath River mainstem effectively removing the important ecological role this debris provides throughout the mainstem to the estuary. NMFS believes the No Action alternative, which would result in no LWD being transported downstream of Iron Gate dam or made available to build suitable habitat structures, would result in adverse effects to coho, Chinook, and steelhead. The adverse effect would be continued low levels of LWD transported down the Klamath mainstem, particularly near Iron Gate dam, resulting in fewer areas for fish cover, protection, and food resources for basin salmonids who benefit from the presence of LWD in mainstem channels even if it is transitory in nature.

Other Anadromous Species
As with coho, Chinook, and steelhead, chum salmon and coastal cutthroat trout in the Klamath River could benefit from the addition of LWD to the mainstem system. NMFS expects the No Action alternative would not result in additional LWD being available to these two species that derive the same benefit from LWD as other salmonids. NMFS expects no effect from the No Action alternative on white and green sturgeon, eulachon, and Pacific lamprey as these species are not as dependent on the presence of LWD in mainstem habitats and tributaries for their adequate growth and survival during the freshwater phase of their life-cycles.

Other Non-Anadromous Fish
Implementation of the No Action alternative could result in the removal of some of the benefits LWD can provide to non-anadromous fish including cover and food resources. Although NMFS believes the role LWD plays for non-anadromous fish is relatively minor, nonetheless, it does provide ecological services to other species including surface area for periphyton and invertebrates which can serve as food resources to other fish. NMFS believes the No Action alternative would not affect other non-anadromous fish in the Klamath River mainstem.

Beaver
The No Action alternative would not benefit beaver in the Klamath River as pieces of LWD can be utilized by beaver for den construction. From a bioenergetics standpoint, beaver could benefit from wood being available in river habitat for den building, saving the energy expended to physically cut down trees and reserving this energy for feeding and other activities. Generally, as organisms are able to conserve energy for feeding and reproduction, their populations tend to be more robust and resilient to environmental changes. NMFS believes the No Action alternative would have a negative impact on beaver in the Klamath mainstem corridor as they would not experience the presence of more wood pieces available for den building.

Fish-Eating Birds
NMFS believes that implementation of the No Action alternative could negatively affect fish-eating birds in that failing to improve LWD levels in the Klamath mainstem and

important tributaries through the construction of complex wood jams, could lead to further declines of coho and steelhead in the Klamath River for the next 10 years. Continued reductions in coho and steelhead abundance could result in a corresponding reduction in the numbers of fish-eating birds that inhabit the Klamath River mainstem corridor.

No Fish Disease Research

Anadromous Species (Coho, Chinook, and Steelhead)

Even though PacifiCorp has previously provided funding for disease research, the No Action Alternative would mean PacifiCorp would not be required to fund research examining the physical and biological processes that occur in the Klamath River that lead to disease outbreaks as they would under the proposed action. These disease outbreaks are negatively affecting the survival and fitness of coho in the Klamath River, and to a lesser extent Chinook and steelhead as well. The importance of research on disease processes is that it can lead to changes in river management that could lessen the extent or duration of disease-forming conditions, and thus result in improvements to the populations of the three salmonids. For example, increasing flows in the winter below Iron Gate dam could scour riverbed habitat and dislodge sediment that currently is believed to be the origins of the disease-forming conditions. Implementing the No Action alternative may mean further research on disease mechanisms may be limited, and the response to changes in river management may not be well understood resulting in continued threats to salmonids from disease.

Other Anadromous Species

Implementation of the No Action alternative would mean one other anadromous species, chum salmon, which might be affected by the same disease pathogens that affect coho, Chinook, and steelhead would not benefit from the findings and management changes that fish disease research may bring to the Klamath mainstem.

Other Non-Anadromous Fish and Beaver

As NMFS is not aware that disease pathogens affecting salmonids also adversely affect other non-anadromous fish and beaver, NMFS anticipates the No Action alternative would have no disease-related effects on non-anadromous fish or beaver in the Klamath River basin.

Fish-Eating Birds

NMFS believes that implementation of the No Action alternative could indirectly negatively affect fish-eating birds in that failing to control and reduce disease outbreaks and the impacts disease has on salmonid populations could lead to further declines of coho, Chinook, and to a lesser extent steelhead in the Klamath River for the next 10 years. These continued reductions in salmonid abundance could result in a corresponding reduction in the numbers of fish-eating birds that inhabit the Klamath River mainstem corridor.

No Coho Enhancement Fund and Hatchery Genetic Management Plan

Anadromous Species (Coho, Chinook, and Steelhead)

The No Action alternative would mean PacifiCorp would not be required to provide resources for the Coho Enhancement Fund (CEF) to fund projects that improve habitat conditions for coho salmon (e.g. improving thermal refugia, improving fish passage, gravel augmentation, etc…) for the next 10 years. Failing to take actions that improve habitat conditions for coho salmon in the Klamath River basin would likely lead to further declines in the Klamath River coho population for the next decade, as significant other factors that are exacerbated by Project operations and that have led to their decline will continue at or near existing conditions in this timeframe (e.g., poor water quality and high water temperatures below Iron Gate dam). The No Action alternative would result in the lack of improvement in conditions for the adequate growth and survival of coho in the basin because PacifiCorp may forego fully implementing additional mitigation for impacts attributable to Project operations associated with HCP *Coho Conservation Strategy*. Failing to take measures that increase juvenile-to-smolt survival is likely to lead to continued trends of poor adult returns. Similarly, because coho often utilize habitats shared by steelhead and Chinook, the benefits of restorative projects would not be realized for these two species under a No Action alternative as well which may result in further declines in their abundance, diversity, or spatial structure.

Under the No Action alternative the HGMP for coho at Iron Gate hatchery may not be implemented, or may be delayed as PacifiCorp would not be required to provide full funding for implementing the HGMP. Failure to implement the HGMP would likely lead to further impacts on the genetic conservation goals for coho remaining in the river basin, and would not result in the target of releasing at least 75,000 coho smolts each year from the hatchery under improved hatchery management practices. NMFS is concerned that without this program coho in the Klamath River basin would be adversely affected because of genetic bottlenecks and potential inbreeding from low population dynamics. Similar to the proposed action, NMFS does not anticipate that failing to implement a coho HGMP under the No Action alternative would have impacts on Chinook, or steelhead.

Other Anadromous Species

NMFS believes the No Action alternative would result in no indirect benefits from restorative projects for coho being realized by other anadromous species such as chum salmon, and coastal cutthroat trout. These two species could benefit from the protection and enhancement of habitats utilized by coho (e.g. thermal refugia, removal of passage barriers) and failing to implement projects that improve habitat where coho and chum salmon, or coastal cutthroat trout co-occur, will not aid in improving the abundance or spatial diversity of these other anadromous species.

Other Non-Anadromous Fish and Beaver

NMFS does not expect implementation of the No Action alternative, which would result in coho-based restoration projects not being implemented, would have an effect on non-anadromous fish or beaver in the Klamath River basin.

Fish-Eating Birds

NMFS believes that implementation of the No Action alternative could indirectly negatively affect fish-eating birds in that failing to implement projects designed to increase the abundance and diversity of coho in the Klamath River downstream or Iron Gate dam could lead to further declines of coho in the Klamath River for the next 10 years. Continued reductions in salmonid abundance could result in a corresponding reduction in the numbers of fish-eating birds that inhabit the Klamath River mainstem corridor.

4.2.4 Socioeconomics and Environmental Justice

NMFS anticipates implementation of the No Action alternative would not affect whitewater boating, camping, and waterskiing opportunities as nothing would change beyond current conditions. NMFS does expect that the No Action alternative could result in negative impacts to recreational and commercial fishing opportunities for salmonids over the next 10 years. Failing to implement actions that improve habitat conditions for coho, which would have an indirect benefit for Chinook and steelhead (e.g. habitat access improvement, thermal refugia enhancement, etc…), could result in further years of poor rates of survival to the adult life stage for Chinook, and to a lesser degree steelhead, leading to reductions in available harvest for both commercial and recreational fishers. Failing to improve current poor conditions for freshwater survival in the Klamath River mainstem could lead to declines in both Chinook and steelhead runs over the next decade. In recent years, the curtailment of Chinook fishing opportunities implemented by fishery managers has had significant impacts on local economies and employment resulting in the need for federal fishery disaster relief funds.

Additionally, failing to implement actions that improve poor conditions for salmonid survival in mainstem and tributary waters could result in fewer fish being available for tribal commercial and subsistence harvest. Further impacts to tribes in the Klamath basin could occur under the No Action alternative as funding set aside for coho enhancement projects would not be available for tribes to access and implement restoration projects. Not implementing these projects may mean fewer employment opportunities for tribal and non-tribal people in the basin as NMFS anticipates this source of funding for the next 10 years will provide employment to biologists, contractors, heavy equipment operators, project managers, and other personnel.

Summary: NMFS anticipates the No Action alternative will have no effect on whitewater boating, camping, or waterskiing opportunities within the area analyzed. NMFS does anticipate the No Action alternative could lead to adverse effects to commercial, recreational, and tribal fishing opportunities, and could adversely affect employment opportunities for tribes and other members of the public employed in stream restoration actions. The adverse effects would be the potential for continued declines in commercial and recreational fisheries, as fish populations would be subjected to continued poor habitat conditions without any mitigating actions taken to improve habitat conditions. Poor habitat conditions over the next decade NMFS expects would result in further declines in species abundance, making fewer fish available for harvest or capture.

4.2.5 Land Use

NMFS anticipates the No Action alternative would have no effect on land use within the basin, because there would be no change how land is currently being managed and used.

SECTION 5

Cumulative Effects

This chapter describes what NMFS believes are cumulative impacts occurring in the Klamath River basin. NMFS has not included future dam removal or the establishment of volitional fish passage above Iron Gate dam as a cumulative effect consideration as such actions would occur beyond the permit term this EA analyzes.

5.1 Sediment Supply

Project dams limit the transport of sediment throughout the basin, particularly below Iron Gate dam. Segments of the Klamath River upstream of Iron Gate dam are naturally "sediment starved" when looking at the basin as a whole due to naturally low levels of sediment upstream of Iron Gate dam. This condition is exacerbated by the presence of Iron Gate dam, which inhibits sediment transport and delivery in the Klamath River immediately downstream of Iron Gate dam until sediment supply to the river increases from tributaries below Iron Gate dam. However, there are other land management activities in the basin such as livestock grazing, and timber harvest activities on steep terrain, that can add sediment to the aquatic system at rates above normal background levels. For instance, road building associated with timber harvest or livestock grazing can result in road failures (landslides) and hydrologically connected road segments that deliver coarse and fine-grained sediment to adjacent watercourses.

Over the period of time of European settlement in the Klamath basin, these activities have resulted in localized areas of an oversupply of sediment which has impacted salmonid habitat by, among other things, smothering redds and widening channels making them too shallow and too warm for successful salmonid spawning and rearing. Historical gold mining in the region has also resulted in severe alterations of the natural sediment bedload characteristics in watersheds such as the Scott River. Gold mining within the Klamath and Scott watersheds was the primary resource for extraction from the mid-1850s through the 1930s. Mining was very destructive to fish habitat in the lower Klamath basin in the 1800s (NRC 2004). Hydraulic mining diverted creeks to supply water to high pressure nozzles that leveled entire hillsides and rearranged much of the riparian areas in the basin. Waterborne soil, rocks, minerals, and debris were directed into sluices containing mercury which extracted the gold. Sluicing and hydraulic mining operations increased turbidity and siltation, which adversely affected benthic invertebrates, smothered salmon redds, destroyed riparian areas, and filled pools with sediment. Deforestation associated with mining destabilized hillslopes, increased erosion, flooding, and fires. Miners also directly impacted aquatic resources through overfishing, damming, and stream diversions (Malouf and Findlay 1986). Taft and Shapovalov (1935) identified severe damage to fish habitat caused by Yuba dredges, which usually left the coarsest boulders on the surface of the streambed, armoring the finer sediments underneath (NRC 2004). Ditches that intercepted tributary flows were also constructed throughout the valley to support mining operations and early agricultural irrigation (NRC 2004). These past activities that have altered the natural rate of sediment supply and transport out of the system have resulted in degraded habitat conditions in many areas since the 1930's which has impacted salmonid populations.

As land management practices have improved over the last several decades and have resulted in less impact to stream environments, improvements to stream health has occurred and many streams are recovering and becoming more suitable for salmonid spawning and juvenile rearing. NMFS anticipates these stream systems will continue to recover with careful land management practices, but does not expect significant improvement over the next decade as recovery from severe habitat degradation generally occurs over several decades.

Within the last 10 years or so both federal and private timber management plans have improved harvesting practices and NMFS anticipates this to occur into the future. For example, significant acreage of private timberland in the Klamath basin is already or is likely to soon become managed under Habitat Conservation Plans (HCP) approved by NMFS and the USFWS. These HCPs, along with improved forest practices on federal and other private lands, will result in improved aquatic habitat conditions for salmonids over the next decade. In addition to improved timber management practices, NMFS anticipates that impacts associated with private and federal timber activities in the basin will decline compared to historical trends as timber harvest levels have been lower than rates of harvest in the last few decades due to the current economic recession and impact to the U.S. and global housing markets. The current economic conditions and depressed housing market, which began in 2006-7, have led to a significant drop in timber prices making the profit margin for harvested timber much smaller than it historically has been.

5.2 Water Quality and Quantity

Some of the following discussion on cumulative effects concerning water quality is taken from the FERC FEIS (FERC, 2007) and readers are encouraged to review the FEIS for more details on cumulative water quality effects in the basin.

Construction of the project dams resulted in areas of the river where the physical processes that control water quality have experienced a shift, as the processes in lakes are markedly different relative to the river environment. Although at times water quality meets applicable state water quality objectives (typically during the winter, high flow months) the water quality within some of the project impoundments (i.e., Keno, Copco, and Iron Gate reservoirs) has evolved to mimic highly productive lakes, which experience algal blooms and complex nutrient cycling and loading processes. Diversion of water for hydroelectric generation has substantially altered flow and temperature regimes in the bypassed reaches; however, under the existing hypereutrophic conditions, diversion of water from the J.C. Boyle bypassed reach has resulted in an improvement to that reach's water quality.

Implementation of the TMDL for Upper Klamath Lake and the subsequent reduction in phosphorous loading to the lake should, over time, improve water quality within the lake and in releases to the Link River, in addition to releases to the Klamath Irrigation Project through the A canal. Development of the TMDL for the Klamath River will build on the existing TMDL for Upper Klamath Lake and allocate acceptable nutrient loads to the Klamath River from point and non-point sources throughout the Upper Klamath Basin. Once loads have been established, NPDES permit holders and agricultural land owners would become eligible to apply for funding to implement measures to reduce the nutrient loads leaving their properties and entering the Klamath River. This program would provide benefits to water quality throughout the Klamath River. NMFS anticipates the TMDL program will lead to improvements in water quality over the duration of the permit term.

Water demands in other tributary watersheds to the Klamath River (e.g. Scott River) can put an additional strain on the resources that rely on a healthy Klamath River. The California State Water Project controls releases from the Trinity River to the Klamath through diversions to the Central Valley, which, depending on the water year type, can have a substantial effect on flows in the lower Klamath River. Diversions of water result in reduced volume entering the Klamath River, exacerbating high temperatures, especially during low flow years, and further stressing anadromous fish. The headwaters of the Trinity are largely undeveloped resulting in good water quality that, before the California State Water Project, would help dilute the naturally high nutrient loads within the Klamath River and buffer temperature extremes. Historical and continued demand for these tributary water sources limits the ability of the natural system to provide protection to the biological resources that rely on it.

An unknown number of permanent and temporary water withdrawal facilities exist within the Klamath River basin. These include diversions for urban, agricultural, commercial, and residential use, along with temporary diversions, such as drafting for dust abatement. Approximately 81,070 acre feet of water is diverted from the Scott River annually (Van Kirk and Naman 2008). Numerous other water diversions in the systems that feed the Klamath River decrease the quantity of mainstem flows on the Klamath River mostly during the summer months. Increasing numbers and extent of stream and spring diversions for the propagation and growth of medicinal and non-medicinal marijuana crops is also a growing concern, as a substantial number of these growing operations occur on Forest Service lands, or within other forested terrains where water that feeds suitable salmonid spawning and rearing habitat is being removed. Many of these activities occur without proper state or local permits.

In the fall of 2009, the CDFG released a Final Environmental Impact Report (FEIR) on the Scott River Watershed-Wide Permitting Program (WWPP) which accompanied a process by which agricultural operators in the Scott River watershed could receive incidental take coverage for coho salmon under state law if the operator diverts water from a stream by means of an active diversion for an agricultural purpose, or is involved in an agricultural operation on property in the WWPP area through which or adjacent to which a stream flows (CDFG, 2009). The WWPP also implements certain stream restoration projects in the Scott River watershed identified in the California Fish and Game Commission's (Commission) *Recovery Strategy for California Coho Salmon* (CDFG, 2004b) as key coho recovery projects. One of DFG's objectives for this program is to eliminate unauthorized take of coho salmon caused by water diversions in the Scott River watershed and avoid, minimize, and fully mitigate take of coho salmon incidental to diverting water with a valid water right, recovery actions, and other lawful activities. Among other general ITP conditions, improvements to water management and water rights, fish screen improvements, targeted priority fish passage improvements, and stream crossing improvements are all a part of the program designed to both provide take coverage for landowners as well as implement a longer-term strategy to improve habitat conditions for coho in the Scott River. The term of the WWPP is 10 years from date of issuance. In 2011 the WWPP was challenged in a court action and is currently temporarily suspended. NMFS anticipates the program may be reinstated within the next 10 years and efforts to minimize impacts to salmonids in the Scott River from agricultural diversions will occur.

Given the complexities of the regulatory programs aimed at reducing instream impacts associated with water use, it is possible more landowners will transition from instream diversion for their water needs, to off channel wells and pumps. Although there would be a benefit to salmonids from ending instream pumping and diversions such as entrapment and impingement of younger salmonid life stages within pump systems, there is currently a poor understanding of how groundwater withdrawals could affect near stream surface flows. A greater reliance on groundwater withdrawals could lead to similar reductions in streamflows which results in localized dewatering of reaches and depleted flows necessary for migration, spawning, rearing, flushing of sediment from the spawning gravels, gravel recruitment, and transport of LWD.

5.3 Biological Resources

5.3.1 Iron Gate Reservoir

The following information on cumulative effects on Shortnose and Lost River Suckers is derived from the FERC FEIS (FERC, 2007).

5.3.1.1 Shortnose and Lost River Suckers

Habitat conditions for the two federally listed sucker species have been degraded over the past 150 years by agriculture, grazing, forestry, and to a smaller degree, urbanization (USFWS, 2002). Nearly all streams and rivers in the Klamath basin have been degraded, some seriously, by the loss of riparian vegetation, geomorphic changes, introduction of return flows from agricultural drainage ditches and water pumped from drained wetlands, stream channelization, dams, and flow reductions from agricultural and hydroelectric diversions. Wetland losses have been especially harmful for sucker populations, since wetlands provide habitat for larval and juvenile suckers and have important water quality functions. Along the perimeter of Upper Klamath Lake, about 40,000 acres of wetlands have been diked and drained for agriculture, and extensive amounts of wetland have been drained elsewhere in the basin. Lower Klamath and Tule lakes no longer support suckers or have been reduced to a few hundred acres of suitable habitat.

The Klamath Hydroelectric Project may cause mortality to suckers that are entrained through turbines at the mainstem developments downstream from Keno dam. Upstream migration of suckers is blocked by Iron Gate and the Copco dams, which do not have fish ladders, and the ladders at J.C. Boyle and Keno dam do not meet criteria for sucker passage. As mentioned earlier in this EA, the few instances where larval suckers have been found in Iron Gate Reservoir are thought to be individuals washed down from suitable upstream habitats and are essentially considered “lost” to the sucker populations. However, prior to the construction of the Klamath Hydroelectric Project, the Klamath River downstream of Lake Ewauna did not include any lake or reservoir habitat suitable to support rearing of these species. Based on their limited swimming ability compared to salmonid species, it is unlikely that any suckers that moved downstream past the high gradient rapids in the Keno and J.C. Boyle peaking reaches would be able to return upstream to suitable rearing habitat, and they too were probably lost from the spawning population.

5.3.2 Klamath River below Iron Gate Dam

5.3.2.1 Coho, Chinook, and Steelhead

The following information on cumulative effects on coho, Chinook, and steelhead is derived from the FERC FEIS (FERC, 2007).

The settlement and development of the Klamath River Basin has caused substantial adverse cumulative effects on the habitat and population size of coho salmon. Although also adversely affected from development in the basin, Chinook and steelhead have not suffered as significant declines as coho. In addition to the gold mining, timber harvest and grazing impacts previously discussed, starting around 1905, construction and operation of facilities associated with Reclamation's Klamath Irrigation Project resulted in extensive draining of wetlands, increased agricultural diversions, increased nutrient loading, and reduced dissolved oxygen levels. In the 1920s, the water resources in the Shasta and Scott Rivers were developed to support irrigated agriculture, and the construction of Dwinnell dam blocked access for salmonids to the southern headwaters. Agricultural diversions in these tributaries and in the tributaries to Upper Klamath Lake have reduced flows, increased water temperatures, and increased nutrient inputs. Construction of Copco No. 1 dam in 1918 blocked Chinook salmon from accessing more than 350 miles of habitat upstream of Upper Klamath Lake and 55.7 miles of mainstem habitat between Copco No. 1 dam and Upper Klamath Lake. Construction of Iron Gate dam in 1962 blocked access to additional mainstem habitat and tributaries including Fall and Jenny creeks. Diversion of up to 80 percent of the flow from the Trinity River basin to support agriculture in the Sacramento River Basin started in 1964 with the completion of Trinity and Lewiston dams.

Overfishing also contributed to the decline of coho salmon in the basin, although NMFS (2002) believes that fishing mortality has been reduced substantially since the retention of naturally produced coho salmon south of Cape Falcon, Oregon, was prohibited in 1994. Competition with Chinook and coho salmon produced at Iron Gate and the Trinity River hatcheries has also adversely affected wild runs of coho salmon and possibly Chinook. NMFS (2002) reports that approximately 95 percent of the coho salmon run in the Trinity River above Willow Creek and about 65 percent of the coho salmon run in the Klamath River above Weitchipec consist of hatchery fish. Prior to the construction of Iron Gate dam in 1962, peaking operations at the Copco developments adversely affected anadromous fish by causing large daily fluctuations in flow, which likely resulted in extensive fish stranding. The Klamath Hydroelectric Project contributes to adverse cumulative effects on coho salmon by blocking access to tributary habitats upstream of Iron Gate dam and contributing to poor water quality below Iron Gate dam.

Periodic changes in Pacific currents, winds, and upwelling regimes have substantial effects on the primary and secondary productivity of the northeast Pacific Ocean (Brown et al., 1994; Mantua et al., 1997). These oceanic events, described as El Niño/Southern Oscillation (ENSO) and Pacific decadal oscillation (PDO) are associated with declines and increases in ocean survival and decreases and increases in size of coho and Chinook salmon (Johnson, 1988; Spence et al., 1996; Tschaplinski, 1999; Cole, 2000; Ryding and Skalski, 1999; and Koslow et al., 2002). Steelhead appear to be more resilient to fluctuating ocean conditions. Substantial changes in salmonid ocean survival associated with these cyclical oceanic oscillations can make it difficult to isolate and determine the effects of both long- and short-term changes in the condition of freshwater spawning and rearing habitats, and of conditions in the migration corridor downstream of Iron Gate dam. Despite the role ocean conditions play in returns of adult salmonids to the Klamath River, NMFS considers poor freshwater survival a significant threat to the long-term conservation of naturally produced salmonids in the basin.

5.3.2.2 Other Anadromous Species

Pacific Lamprey

The overall distribution and abundance of Pacific lamprey on the Pacific Coast has been severely reduced due to effects associated with hydropower development. The construction of numerous mainstem and tributary dams has reduced the amount of habitat that is accessible for freshwater spawning and rearing of this species over most of its range. Although a substantial amount of habitat suitable for lampreys remains accessible in the Klamath River Basin, accounts given by tribal elders indicate that the number of lampreys in the river has declined precipitously from historic levels (Larson and Belchik, 1998). The decline in the number of Pacific lamprey returning to the Klamath River may be an outcome of the overall coast-wide decline of the species. The Klamath Hydroelectric Project contributes to adverse cumulative effects on Pacific lamprey by blocking access to potential habitat upstream of Iron Gate dam.

Sturgeon

It is not believed white and green sturgeon occurred above Iron Gate dam except for a few sturgeon planted in Upper Klamath Lake. The principal threats to sturgeon on the West Coast are water diversions and the associated impacts of reduced flows, changed flow regime, increased temperatures, and reduced oxygen concentrations. Other major impacts result from land use practices that can lead to increased sedimentation. The Klamath River has the only major in-river harvest of green sturgeon (Yurok and Hoopa tribal harvest in the Klamath-Trinity River system). However, ocean and estuarine green sturgeon harvest was considered a species-wide threat, and current total harvest of green sturgeon has been significantly reduced compared to harvest levels of the 1980's.

Chum Salmon, Eulachon, and Coastal Cutthroat Trout

Threats to chum salmon are similar to that of other widely-ranging salmonids. Although their populations are quite sizable in Alaska, populations south of Alaska in the U.S. have seen declines due to dam building as well as other habitat altering projects. In the Klamath River, these species are not known to have occurred above Iron Gate dam. Threats to eulachon include major habitat altering activities such as dam building which interrupts the natural flow of cool spring waters to lower portions of rivers where eulachon spawn. Other threats include climate change which may be changing the timing and volume of spring flows in the northwest and altering eulachon's spawning patterns and prey base. Historical commercial and recreational harvest of eulachon and high rates of sediment loading into suitable spawning grounds may have also contributed to their current depressed status. Regional declines in eulachon led to NMFS listing it as a threatened species in 2010. The species is listed from the Mad River in Humboldt County, north to the Canadian border. Threats to coastal cutthroat trout are similar to that of other salmonids, most notable habitat degradation and poor freshwater survival. Coastal cutthroat trout can spend more than 2 years in the freshwater lifecycle phase making them more susceptible to land use changes than a species like Chinook salmon. California coastal cutthroat trout are managed by the USFWS and are not currently listed as endangered or threatened under the ESA.

Non-Anadromous Species

NMFS is not aware that any of the non-anadromous fish species found in the Klamath River below Iron Gate dam have experienced adverse cumulative effects.

Beaver and Fish-Eating Birds

Beaver were widely trapped in California and other western states during the fur-trade of the mid-1800's. The fur trade led to the decimation of most beaver populations in California to a point where it was no longer profitable for trappers. In the Klamath River basin they were likely trapped for pelts up until the 1920's. After the fur-trade collapse, beavers were commonly removed from stream systems by fish and game wardens who received complaints from landowners that beaver activity was resulting in flooding events on their property. In recent years the important role beavers play in a healthy riverine system has led to their reintroductions in some areas and allowance of expansion of populations in others. Beaver are now widely recognized in the aquatic conservation community as an important component to healthy salmonid populations. Besides the occasional removal of beavers by private landowners concerned about flooding, NMFS is unaware of any current threats to beaver.

Bald eagle and osprey have made a strong comeback from the mid 1960's and 70's when they were severely impacted by the use of DDT, a widely used pesticide now banned in the United States. DDT caused significant declines in fish-eating birds as the chemical was accumulated by prey and resulted in reproductive failures of the birds. Populations of these species are considered stable and expanding and the bald eagle was removed from the list of endangered and threatened species in the U.S. in 2007. In the Klamath River basin it is believed bald eagles are expanding their numbers and breeding and foraging ranges. Similar trends are observed with the osprey.

5.4 Socioeconomics and Environmental Justice

Employment has grown consistently in the permit area in the past 25 years, but at a pace slower than the Oregon and California averages. Employment growth has been accompanied by a shift in jobs away from the manufacturing sector and into other sectors, including services, retail trade, and government, as well as agriculture in some areas. Historically, communities along the coast were dependent on ocean commercial and recreational sportfishing. Along with commercial fishing, the coastal communities also depended on the packing and processing plants that prepared the fish for market. However, most of the packing and processing plants, whose employment used to be reported as part of the manufacturing sector, have closed. Declines in salmonid abundance since the 1980's has significantly impacted coastal fishing communities as previously described in this EA. Continued wide fluctuations in Klamath and Sacramento River Chinook stocks are likely to lead to further impacts on local fishing communities and local economies the commercial and recreational fisheries support. Such wide fluctuations make it difficult for fishers to plan for annual income and leads to abandonment of salmon fishing as a reliable source of income.

The tribal communities in the permit area experience significantly higher rates of food insecurity, poverty, and unemployment than non-Indian communities. Additionally, they suffer from substantially higher rates of some diseases, including diabetes and heart disease. These problems are linked to the loss of the tribes' traditional ability to rely on the Klamath River and its resources for their subsistence, culture, spiritual traditions and practices, and economic security. The blockage of salmonids from historical upstream habitat as a result of the project dams and other actions in the Klamath Basin, as well as the degraded water quality resulting from project impoundments, upstream land management practices, and water management in tributary watersheds, have contributed to that loss.

5.5 Land Use

NMFS anticipates land use will not change significantly during the permit term; however expansion of commercial and residential developments is likely to occur particularly in cities such as Yreka, California, and Klamath Falls Oregon. Obviously, European settlement of the basin since the mid-1800's has significantly altered the natural landscape and developed native habitats into land uses such as irrigated agriculture, mining areas, timber production zones, and residential and commercial development. This human development has significantly altered the natural environment including the Klamath River watershed.

5.6 Other Cumulative Effect Considerations

5.6.1 Recreation, Including Hiking, Camping, Fishing, and Hunting

Expected recreation impacts to salmonids include increased turbidity, impacts to water quality, barriers to movement, and changes to habitat structures. Streambanks, riparian vegetation, and spawning redds can be disturbed wherever human use is concentrated. Campgrounds can impair water quality by elevating nutrients in streams. Construction of summer dams to create swimming holes causes turbidity, destroys and degrades habitat, and blocks migration of juveniles between summer habitats. Impacts to salmonid habitat are expected to be localized, mild to moderate, and temporary. Fishing within the permit area, typically for steelhead or Chinook salmon, is expected to continue subject to CDFG regulations. The level of impact to salmonids within the permit area from angling is unknown, but is expected to remain at current levels.

5.6.2 Residential Development and Existing Residential Infrastructure

Human population growth in the permit area is expected to continue. Most of this growth is expected to occur in the valley bottom settings near Yreka and in the Scott and Shasta Valleys. Impacts on water quality related to residential infrastructure would be expected to be regulated under applicable state and local laws.

Once development and associated infrastructure (roads, drainage, water development, etc.) are established, the impacts to aquatic species are expected to be permanent. Anticipated impacts to aquatic resources include loss of riparian vegetation, changes to channel morphology and dynamics, altered hydrologic regimes (increased storm runoff), increased sediment loading, and elevated water temperatures where shade-providing canopy is removed. The presence of structures and/or roads near waters may lead to the removal of LWD in order to protect those structures from flood impacts. The anticipated impacts to Pacific salmonids from continued residential development are expected to be sustained and locally intense. Commonly, there are also effects of home pesticide use and roadway runoff of automobile pollutants, introductions of invasive species to nearby streams and ponds, attraction of salmonid predators due to human occupation (e.g.,raccoons), increased incidences of poaching, and loss of riparian habitat due to land clearing activities. All of these factors associated with residential development can have negative impacts on salmon populations.

5.6.3 Agricultural Activities

Agricultural activities in the permit area include grazing, dairy farming, and the cultivation of crops. Impacts on water quality would be expected to be regulated under applicable laws. The impacts of this use on aquatic species is anticipated to be locally intense, but the longevity of the impact depends on the degree of grazing pressure on riparian vegetation, both from dairy and beef cattle. Grasses, willows, and other woody species can recover quickly once grazing pressure is reduced or eliminated (Platts 1991) through fencing, seasonal rotations, and other measures. If appropriate measures are not taken to improve practices over time and reduce grazing pressure, impacts to aquatic species are expected to remain static. Grazing impacts include decreased bank stability, loss of shade- and cover-providing riparian vegetation, increased sediment inputs, and elevated nutrient levels.

5.6.4 Chemical Use

NMFS anticipates that chemicals such as pesticides, herbicides, fertilizers, and fire retardants will continue to be used within the permit area. Chemical application is under the jurisdiction of several federal, state, and local agencies and their use is expected to be conducted under applicable laws.

5.6.5 Control of Wildland Fires on Non-Federal Lands

Control of wildland fires may include the removal or modification of vegetation due to the construction of firebreaks or setting of backfires to control the spread of fire. Also, the use of fire retardants may adversely affect salmonid habitat. An undetermined amount of suitable habitat for Pacific salmonids may be removed or modified by these activities.

5.6.6 Climate Change

In summary, climate change poses a high threat to salmonids within the permit area, particularly coho salmon. The impacts of climate change in this region will have the greatest impact on juveniles, smolts, and adults. The current climate in the permit area is generally warm, and long-term modeled regional average temperatures shows a large temperature increase; with average ambient temperatures increasing by as much as 3 ^{o}C in the summer and by 1^{o} C in the winter, while annual precipitation in this area is predicted to trend downward over the next century. Additionally it is predicted that snowpack in upper elevations of the Klamath basin will decrease with changes in response to changes in temperature and precipitation (California Natural Resources Agency 2009). It is possible that during the Proposed Action permit term (10 years) the Klamath River basin could experience some degree of rising temperatures due to climate change, even though climate models are generally run over long time series such as 50 or 100 years. Rearing and migratory habitat are most at risk to climate change. Increasing water temperatures and changes in the amount and timing of precipitation and snowmelt will impact water quality and hydrologic function in the summer and winter. Adults will also be negatively impacted by ocean acidification and changes in ocean conditions and prey availability (ISAB 2007, Feely et al. 2008, Portner and Knust 2007). Overall, the range and degree of variability in ambient temperature and precipitation are likely to increase in all populations, creating long term threats to the persistence of coho salmon in this area. These predictions further highlight the importance of providing suitable refugia habitat in mainstem tributaries.

5.6.7 Habitat Restoration Projects

NMFS anticipates that, as monitoring information accumulates on past projects, the focus of stream restoration projects will gradually shift toward more effective restoration actions. Because such activities are usually coordinated with one or more of the resource agencies, NMFS anticipates that all applicable laws will be followed. Restoration activities conducted through the CDFG fisheries restoration grant program are covered by a Section 7 consultation with the U.S. Army Corps of Engineers. Restoration activities that are not conducted pursuant to the CDFG grant program may cause temporary increases in turbidity, alter channel dynamics and stability, and injure or scare salmonids if equipment is used in the stream. Properly constructed stream restoration projects may increase habitat complexity, stabilize channels and streambanks, increase spawning gravels, decrease sedimentation, and increase shade and cover for salmonids. These projects often focus on identifying source problems in an area (i.e., roads) and apply corrective measures to eliminate or minimize the adverse effects to aquatic resources.

NMFS does not know how many restoration projects will be completed outside of the CDFG grant program therefore, the effects of these projects cannot be predicted. However, NMFS anticipates many of these projects may still require a Corps permit, and, thus, require consultation with NMFS.

5.6.8 USFWS Issuance of a Permit to PacifiCorp Authorizing the Take of Listed Suckers in the Upper Klamath Basin

NMFS expects that the USFWS will issue an incidental take permit to PacifiCorp which will authorize taking of the two listed sucker species in the Upper Klamath basin from PacifiCorp's Project operations. Issuance of an ITP will require the development of an HCP. NMFS assumes the HCP will include conservation measures that avoid, minimize, or mitigate for take of listed suckers from PacifiCorp's maintenance activities and entrainment in Project dams. NMFS cannot predict at this time however, how the HCP would impact the human environment as a draft HCP has not yet been made available for review.

Summary: While there are a myriad of adverse impacts to the environment, including aquatic species, which have occurred from past Federal and non-Federal actions in the basin, NMFS believes that the proposed action will not contribute to significant adverse impacts. To the contrary, NMFS believes the proposed action will result in beneficial impacts as PacifiCorp will be taking actions to improve the human environment over the next 10 years until fish passage is established either through dam removal or volitional fish passage. Section 4.1 of this EA details the benefits that will result from the proposed action.

SECTION 6

Summary of Effects

Table 3 summarizes NMFS' analysis of effects from the Proposed Action (Issuance of an ITP and implementation of the PacifiCorp HCP) and No Action (No Issuance of an ITP and no implementation of the PacifiCorp HCP). In summary, the Proposed Action is likely to result in many beneficial effects including improvements to salmonid populations and their habitat in the basin, potential for expanded prey base for fish-eating birds along the Klamath River mainstem, and improvements to employment opportunities for tribal and non-tribal workers in the basin. The No Action alternative would in general not change effects from those under current conditions, but continued degraded conditions in the Klamath River mainstem would occur with no mitigating actions taken to improve these degraded conditions.

Table 3. Comparison of Effects on Resources Associated with the Proposed Action and No Action

Resource	Proposed Action	No Action
Geology and Geomorphology	Beneficial effects in areas immediately downstream of Iron Gate dam via the augmentation of gravels mitigating for blockage of sediment transport from Project dams. Potential for short-term adverse effects during gravel placement (e.g., salmonid displacement and turbidity).	Sediment transport would continue to be blocked by Project dams without any mitigating actions. Impacts below Iron Gate dam from sediment "starvation" would continue.
Water Resources • Climate and Water Flow • Water Quality	**Climate and Water Flow**: Beneficial effect to water flows as flow variability program will better mimic a natural (undammed) flow regime given constraints of Iron Gate facility capacities and safety factors. **Water Quality**: Beneficial effect from the protection and enhancement of cold-water refugia sites downstream of Iron Gate dam. Potential for short-term adverse effect during refugia enhancement actions (e.g., temporary flushing and displacement of juveniles during refugia work). Beneficial effects to current degraded DO conditions downstream of Iron Gate dam. Turbine venting expected to result in achievement of water quality criteria for DO at least six river miles downstream of Iron Gate dam.	**Climate and Water Flow:** Degraded conditions in the Upper and Middle Klamath River reaches would continue without any mitigating actions. Impacts to coho, Chinook, and steelhead would continue without any improvement to water quality and quantity conditions. **Water Quality:** Poor water quality conditions would continue without any mitigating actions unless directed by other regulatory mechanisms (e.g. TMDL implementation plan).
Biological Resources • Upper Klamath River System (Above Iron Gate Reservoir) • Iron Gate Reservoir • Klamath River Downstream of Iron Gate	**Upper Klamath River System (Above Iron Gate Reservoir):** No Substantial change from effects of current conditions **Iron Gate Reservoir:** No substantial change from effects of current conditions **Klamath River Downstream of Iron Gate:** Direct and indirect beneficial effects to coho and Chinook salmon, steelhead, Pacific lamprey, coastal cutthroat trout and possibly chum salmon. Beneficial effect to non-anadromous fish species occurring near Iron Gate dam from improved water quality conditions. Indirect beneficial effect for fish-eating birds as the conservation measures result in increased fish abundance which serve as prey. Generally, no effect on green and white sturgeon, eulachon, and American shad. Potential for short-term adverse effects during thermal refugia enhancement work and gravel augmentation actions (e.g. juvenile displacement from work sites, temporary increase in turbidity levels downstream from worksites).	**Upper Klamath River System (Above Iron Gate Reservoir):** No change from effects of current conditions **Iron Gate Reservoir:** No change from effects of current conditions **Klamath River Downstream of Iron Gate:** Continued degraded habitat conditions, particularly in the Upper and Middle Klamath reaches, without any mitigating actions. Continued declines in Klamath River coho populations would be likely as important projects to improve and protect suitable coho habitat and improve Iron Gate Hatchery operations would not occur. Potential for continued declines in Chinook and steelhead populations as degraded habitat conditions for these two species would persist. No effect on other species. Continued degraded river conditions could result in ecosystem effects (e.g. declining fish could lead to declines or stagnation in fish-eating bird populations).
Socioeconomics and Environmental Justice	Beneficial effect to socioeconomic and environmental justice concerns with implementation of the HCP. Tribal members as well as non-members will likely benefit from funding for restorative projects including implementation and monitoring of these projects. Potential adverse impact to fishable steelhead days during implementation of the flow variability program in the winter. NMFS anticipates this impact, if it occurs, will be of short duration. Beneficial effect to recreational opportunities as implementation of the HCP is expected to result in an increase in adult returns of Chinook and steelhead during the permit duration. Although impacts to whitewater boating from flow variability may be neutral, there may be adverse impacts limited to short periods and limited area of overlap, but no significant adverse impacts to whitewater boating are expected. No effect on camping opportunities.	Continued degradation of habitat could lead to further declines in important subsistence and commercial fish species (e.g. Chinook) which would continue a trend of negative impacts on tribal communities in the Klamath River basin. Significant lack of employment opportunities for minority and non-minority populations in the basin would likely continue without improvement from habitat restoration under the Proposed Action.
Land Use	Possible effect in the Scott and Shasta River basins if conservation measures are implemented that could result in the conversion of some irrigated agricultural lands to other land uses with a lower water demand (e.g. livestock grazing). NMFS does not believe such a conversion would result in a significant impact.	No change from effects of current conditions.

SECTION 7

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SECTION 8

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