FINAL

ENVIRONMENTAL ASSESSMENT
ISSUANCE OF AN ENDANGERED SPECIES ACT SECTION 10(a)(1)(A) PERMIT TO THE CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE FOR ACTIVITIES AT THE IRON GATE FISH HATCHERY

OCTOBER 31, 2014

Title of Environmental Review:	Environmental Assessment Prepared for a National Marine Fisheries Service Action Concerning Issuance of an Endangered Species Act Section 10(a)(1)(A) Permit to the California Department of Fish and Wildlife for Activities at the Iron Gate Fish Hatchery
Listed Species Affected:	Southern Oregon/Northern California Coast Coho Evolutionarily Significant Unit
Responsible Agencies and Officials:	William Stelle Regional Administrator National Marine Fisheries Service West Coast Region 7600 Sand Point Way Northeast Seattle, WA 98115
Contacts:	Jim Simondet Klamath Branch Chief National Marine Fisheries Service Coastal California Area Office 1655 Heindon Road Arcata, CA 95521
Location of Proposed Action:	Klamath River and Iron Gate Hatchery, California
Action Considered:	Permit issuance pursuant to Section 10(a)(1)(A) of Endangered Species Act
Legal Mandate:	Endangered Species Act of 1973, as amended, and implementing regulations in 50 CFR Part 222
Environmental Assessment Conducted by:	Department of Commerce National Marine Fisheries Service West Coast Region Coastal California Area Office Protected Resources Division 1655 Heindon Road Arcata, CA 95521

List of Acronyms

CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FERC	Federal Energy Regulatory Commission
FONSI	Finding Of No Significant Impact
HCP	Habitat Conservation Plan
HSRG	Hatchery Scientific Review Group
HGMP	Hatchery and Genetic Management Plan
HOR	Hatchery Origin
ICP	Interim Conservation Plan
IGH	Iron Gate Hatchery
KHSA	Klamath Hydroelectric Settlement Agreement
mgd	million gallons per day
NMFS	National Marine Fisheries Service
NOR	Natural Origin
NPDES	National Pollutant Discharge Elimination System
pHOS	Percentage of Hatchery Origin Spawners
PNI	Proportionate Natural Influence
pNOB	Proportion of Natural Origin Fish in the Hatchery Broodstock
SONCC	Southern Oregon Northern California Coast
TMDL	Total Maximum Daily Load
TRH	Trinity River Hatchery
UKL	Upper Klamath Lake

TABLE OF CONTENTS

Page

1. INTRODUCTION AND PURPOSE OF AND NEED FOR ACTION

This document describes the environmental effects of the National Marine Fisheries Service's (NMFS) proposed issuance of a permit to the California Department of Fish and Wildlife (CDFW) under Endangered Species Act (ESA) Section 10(a)(1)(A) for the coho salmon (*Oncorhynchus kisutch*) artificial production program at Iron Gate Hatchery (IGH). ESA Section 10(a)(1)(A) authorizes issuance of a permit for scientific purposes or to enhance the propagation or survival of the affected species. IGH is located aside the Klamath River near River Mile (RM) 189.7 just downstream of Iron Gate Dam (RM 190.1) in north-central California. The permit would be issued for a time period of 10 years and would result in application of an exception to prohibition of "take"[1] of Southern Oregon/Northern California Coast (SONCC) Evolutionarily Significant Unit (ESU) coho salmon. The permit term includes the interim period prior to when main stem Klamath River dams of the Klamath Hydroelectric Project (Federal Energy Regulatory Commission (FERC) Project No. 2082) are anticipated to be removed pursuant to the Klamath Hydroelectric Settlement Agreement (KHSA) if there is an affirmative determination by the Secretary of the Interior as described in the KHSA. This permit would authorize take associated with implementation of the coho salmon hatchery program under a proposed Hatchery and Genetic Management Plan (HGMP) for IGH. As provided under the National Environmental Policy Act (NEPA) and implementing regulations and policy, this Environmental Assessment (EA) analyzes the potential effects of NMFS' Proposed Action of issuance of this permit.

As described in section 4.0 of this EA, there are several potential sources of take associated with the IGH coho salmon program including take associated with the collection of coho salmon spawners at IGH and take of natural coho salmon juveniles by adverse interactions (predation and competition) with IGH production. Monitoring and evaluation activities to enumerate natural origin (NOR) and hatchery origin (HOR) coho spawning escapement in streams associated with the Upper Klamath Population unit, and trapping of juvenile coho in Bogus Creek could also result in take of additional coho salmon.

Two alternatives were identified and considered in this EA. Under Alternative 1 (No Action), if NMFS determines that the application does not comply with the criteria in applicable laws and regulations, NMFS would deny issuance of the ESA Section 10(a)(1)(A) permit to the applicant. Under Alternative 2 (Proposed Action), if NMFS determines that the application does comply with applicable criteria, NMFS would issue an ESA Section 10(a)(1)(A) permit to CDFW[2], permitting implementation of the actions described in the application and associated HGMP.

1.1. Purpose and Need

NMFS is reviewing the ESA Section 10(a)(1)(A) permit application submitted by CDFW and PacifiCorp to evaluate whether the application meets applicable criteria specified in ESA Section 10(a)(1)(A) and NMFS' implementing regulations, and NMFS is reviewing under ESA Section 7 whether issuance of the permit is not likely to jeopardize the continued existence of any endangered species or threatened

[1] ESA Section 3(19) defines "take" as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

[2] CDFW operates IGH, and would be the permit holder of the ESA Section 10(a)(1)(A) permit . PacifiCorp funds operations of IGH consistent with the Company's license obligations and obligations under the Klamath Hydroelectric Settlement Agreement. CDFW will be principally responsible for implementing the terms of the HGMP and any related ESA Section 10 permit.

species or result in the destruction or adverse modification of any critical habitat designated for such species under the ESA. As provided in ESA section 10(a)(1)(A), the purpose for such a permit is for scientific purposes or to enhance the propagation or survival of the affected species, which is the SONCC ESU of coho salmon for this permit application. If NMFS determines that the application meets all of the applicable criteria, NMFS shall issue the ESA Section 10(a)(1)(A) permit for implementation of the program proposed in the permit application and associated HGMP. Issuance of an ESA Section 10(a)(1)(A) permit is a Federal action subject to analysis for potential environmental impacts under NEPA.

1.2. Background

PacifiCorp and CDFW submitted an application for an ESA section 10(a)(1)(A) permit that would authorize CDFW to implement the coho salmon program described in the HGMP at IGH for scientific purposes, and to enhance the propagation and survival of the SONCC coho salmon ESU. The SONCC ESU includes all naturally spawned coho salmon populations in coastal streams between Cape Blanco, Oregon and Punta Gorda, California, as well as three artificial propagation programs, including the Iron Gate Hatchery coho hatchery program. Coho salmon were once numerous and widespread within the Klamath River basin (Snyder 1931), but now only small populations remain and occupy limited habitat within tributary watersheds and the main stem Klamath River below Iron Gate Dam (CDFW 2002, NRC 2004). The Klamath Basin contains nine populations of coho salmon within three distinct diversity strata (Klamath, Trinity, and Central Coastal) (Williams et *al.* 2006). Coho salmon propagated at IGH are part of the Upper Klamath Population unit of the SONCC coho salmon ESU. The Upper Klamath Population unit occupies the mainstem Klamath River and its tributaries between Iron Gate dam (RM 190.1) and Portuguese Creek (RM 128). Other populations in the vicinity of IGH include the Shasta River Population unit (the Shasta River enters the Klamath River at RM 176.6), and the Scott River Population unit (the Scott River enters the river at RM 143). Artificial propagation of coho salmon is necessary because recent adult coho returns to the Upper Klamath Population unit have been decreasing over time to the point where 46 coho returned to the hatchery and only 7 coho returned to Bogus Creek in 2009. Bogus Creek is located at RM 189.6 and is likely the largest coho producing stream associated with the Upper Klamath Population unit. Based on the declining adult escapement data, it appears that habitat conditions are likely insufficient to maintain this population over time, thus justifying the need for a hatchery program to conserve the remaining genetic resources of the coho population and reduce short-term extinction risks. In addition, recent genetic evidence indicates the need for hatchery reform to reduce inbreeding depression of the hatchery population.

Hatchery operations and management typically involve a variety of different methods and techniques for fish propagation, primarily related to broodstock collection, spawning, mating, fertilization, egg incubation, rearing, tagging, release, in-hatchery and in-river monitoring (e.g., fish health and genetic monitoring), water quality monitoring, adult spawning and weir surveys, and juvenile surveys. Several of the artificial propagation (hatchery) activities proposed in the coho salmon program at IGH could lead to the take of ESA-listed coho. Therefore, NMFS is considering whether to issue a permit under ESA section 10(a)(1)(A) covering activities such as adult broodstock collection, spawning, rearing, tagging, and release of progeny.

Information about the history of salmon propagation in the Klamath River was scarce until the Federal Bureau of Fisheries constructed a fish weir near the Klamathon town site at River Mile (RM) 185.6. From 1910, the weir provided a means to count fish and take eggs for mitigation of a dam built by the Siskiyou Power Company at the current Copco Dam site. In 1911, Sisson Hatchery (Mount Shasta Hatchery) released coho salmon fry into both the Sacramento and Klamath rivers from eggs taken at the weir (Snyder 1931).

In 1912, the Bureau of Fisheries also built a hatchery near Hornbrook and raised Chinook and coho salmon from 1912 to 1916 (HGMP Table 14). The federal government closed the hatchery in 1919. In 1919, the California-Oregon Power Company built a fish hatchery on Fall Creek and rebuilt the Klamathon weir to mitigate for lost habitat above Copco No. 1 dam (Leitriz 1970). The California Fish and Game Commission funded Fall Creek Hatchery as a source of salmon and steelhead eggs until 1961. Approximately 3,400,000 Chinook salmon and 600,000 steelhead were released on average between 1930 and 1948 (KRBTTF 1991).

The IGH facilities were completed in 1966 by Pacific Power and Light (PacifiCorp's predecessor) as mitigation for the loss of spawning habitat in the Klamath River and its tributaries between the Iron Gate Development and the Copco Developments. The Federal Energy Regulatory Commission (FERC) license for PacifiCorp's Klamath Hydroelectric Project (FERC Project No. 2082) stipulates specific production goals from the hatchery for coho, fall Chinook and steelhead. The IGH is owned and funded by PacifiCorp and operated by CDFW. IGH is located on Copco Road, approximately eight miles east of Hornbrook, Siskiyou County, California. The primary spawning facility is located at the base of Iron Gate Dam. This facility includes a fish ladder consisting of 20 ten-foot weir-pools that terminates in a trap, a spawning building and six 30-foot circular holding ponds. The main hatchery is located about ½ mile downstream from the dam and consists of three buildings, office, hatchery and shop, 32 concrete raceways, four employee residences, as well as an eight-step auxiliary fish ladder and trap adjacent to the hatchery rearing ponds.

In 1965, IGH began coho salmon production with 85,020 fingerlings and 65,000 eggs imported from Trinity River Hatchery, which originated at Cascade Hatchery in Oregon (Riley 1967). During its first decade of coho production the hatchery stock used Klamath River coho and coho transferred from Trinity River Hatchery. Since 1976, IGH has used primarily Klamath River coho salmon as broodstock. A variable fraction of the annual return to IGH is of natural origin. Prior to Brood Year (BY) 1994, when hatchery fish were first 100 percent marked, it is likely that the hatchery spawned natural stock in the same proportion as they occurred in the return to the hatchery. Recently, consistent with early implementation of the HGMP (i.e., the Preferred Alternative) in 2011, the goal has been to incorporate between 20-50 percent unmarked adults in the broodstock. Typically, the hatchery has collected about 280 spawners to hedge against in-hatchery losses. The annual size of the IGH coho hatchery broodstock is determined by the mitigation smolt production goal of 75,000.

On May 6, 1997, the final rule was published for listing coho salmon in the SONCC ESU as threatened under the ESA (62 Fed. Reg. 24588). At the time of this listing determination, NMFS excluded hatchery stocks from the listing because artificially produced coho salmon were considered to be non-essential for recovery of the listed species. On June 28, 2005, a final rule was published for listing determinations for 16 salmon ESUs, including the SONCC ESU (70 Fed. Reg. 37160). This SONCC ESU listing included coho salmon produced at IGH, Trinity River Hatchery and Cole Rivers Hatchery (ODFW stock #52) as part of the ESU. The California Fish and Game Commission also listed coho salmon as a threatened species pursuant to the California Endangered Species Act within the California portion of the SONCC ESU on March 30, 2005.

Over the past several years a HGMP has been developed for the IGH coho salmon program to address actions that may result in the take of coho salmon. Recent HGMPs have been developed for individual programs rather than the entire hatchery due to the differences between programs when conducting the HGMP analysis. PacifiCorp and CDFW jointly developed the most recent draft of the coho salmon program HGMP with a conservation focus to protect the remaining genetic resources of the Upper Klamath Population unit.

NMFS uses the information provided in HGMPs to evaluate impacts on ESA-listed salmon and steelhead. HGMPs are used in some cases to evaluate and issue a Section 10 permit. The IGH coho salmon program HGMP describes the current and proposed coho salmon program, associated performance measures, program impacts, and associated monitoring and evaluation. Development of this HGMP has occurred in conjunction with development of the Interim Operations Habitat Conservation Plan (HCP) for Coho Salmon related to PacifiCorp's Klamath Hydroelectric Project, and the KHSA.

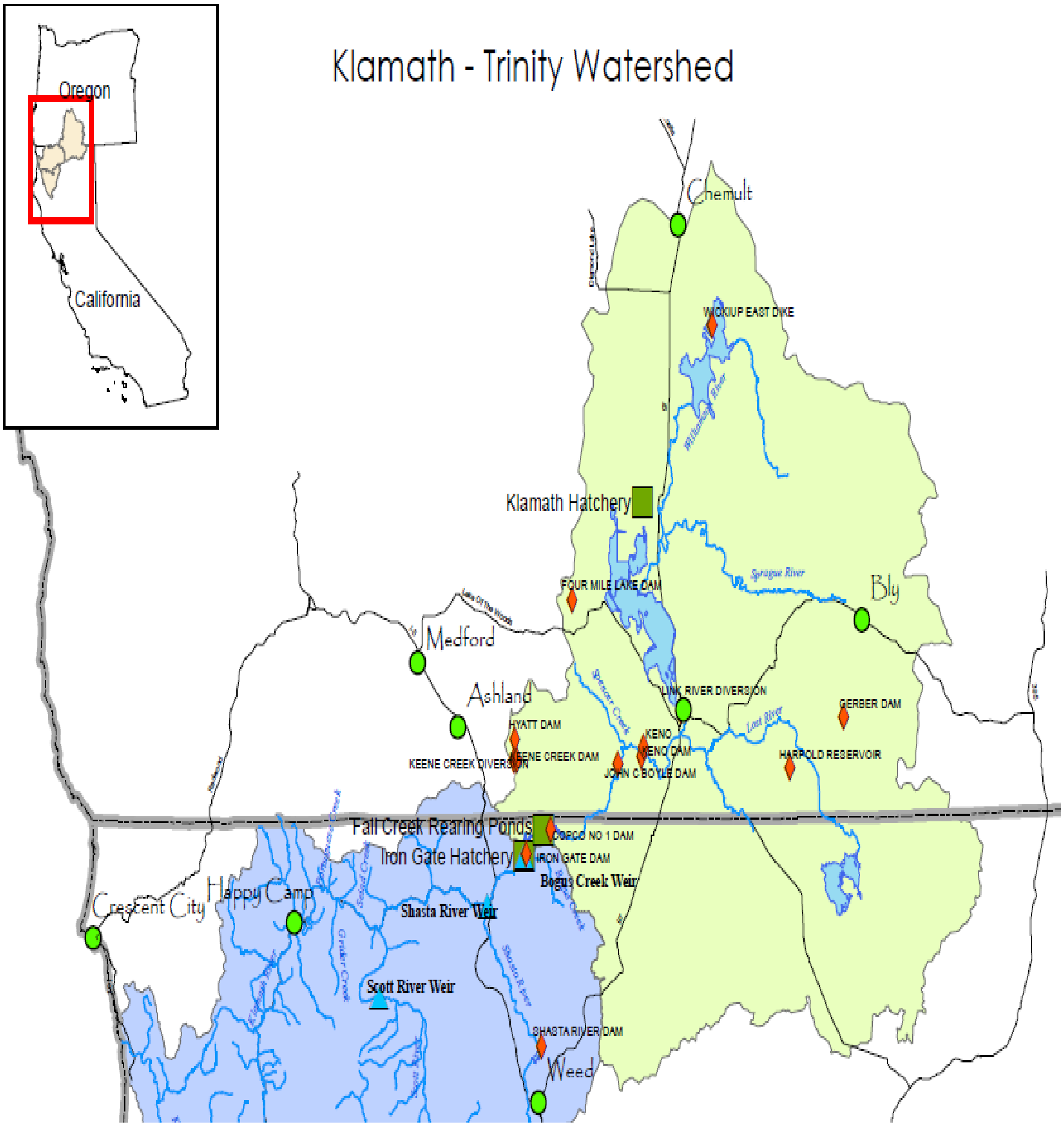

FIGURE 1.
Map of the Klamath River Basin showing the location of Iron Gate Hatchery.

The IGH coho salmon program HGMP is built around the principles and recommendations of the Northwest Hatchery Scientific Review Group (HSRG). The HSRG is the independent scientific review panel for a larger Pacific Northwest Hatchery Reform Project. This project has been aimed at reforming the management and practices of salmon hatcheries across the Northwest. Hatchery reform has been a major issue of concern for state and federal agencies over the past decade and this effort has just recently been completed for California hatcheries, including the IGH coho salmon program and associated HGMP (CHSRG 2012)[3]. Hatchery reform is aimed at conserving the indigenous salmonid genetic resources, maintaining fisheries resources, assisting with the recovery of naturally spawning salmonid populations, and improving the quality and cost-effectiveness of the hatchery program. The HSRGs have reached several critical summary conclusions regarding areas where current hatchery and harvest practices need to be reformed. Each of these conclusions is listed below and was incorporated into the development of the IGH coho salmon HGMP:

- Manage hatchery broodstock to achieve proper genetic integration with, or segregation from, natural populations;
- Promote local adaptation of natural and hatchery populations;
- Minimize adverse ecological interactions between hatchery- and natural-origin fish; and
- Minimize effects of hatchery facilities on the ecosystem.

Specific recommendations from the HSRGs were incorporated into the performance standards for the IGH coho salmon program (HSRG 2004, CHSRG 2012).

1.3. Relationship to Other Agreements, Plans, or Regulatory Requirements

The development of an ESA Section 10(a)(1)(A) permit application and the development and implementation of an HGMP for the IGH coho salmon program is occurring within the larger context of national interest in the Klamath River, its fisheries, and restoration and the interests of tribal fisheries, tribal trust resources, hatchery interests, and listed species recovery. Hatchery operations, hatchery reform, and salmon recovery are also related to several larger, overarching plans, agreements, and regulatory requirements within which the program operates.

In 1956, FERC issued a license to PacifiCorp for operation of the Klamath Hydroelectric Project (FERC Project No. 2082). Article 49 of the Project license required construction of the IGH and Article 50 requires PacifiCorp to fund 80 percent of the ongoing operations and maintenance costs of IGH. 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 under a new FERC license were considered in FERC's relicensing process, as documented in the Final Environmental Impact Statement (FEIS) prepared by FERC (FERC 2007). Since the license expired in March 2006, PacifiCorp has been operating the Project under annual licenses under the terms and conditions of the existing license until FERC takes final action on its application for a new Project license.

[3] The California Hatchery Scientific Review Group recommended that the HGMP for the IGH coho salmon program be approved and implemented.

The hatchery program is also operated consistent with the KHSA (KHSA 2010). Under the KHSA, PacifiCorp commenced funding 100 percent of ongoing hatchery operations and maintenance costs in 2010, including funding for a 25 percent constant fractional marking program for fall Chinook. KHSA requirements related to hatchery operations include PacifiCorp funding development and implementation of a Hatchery and Genetics Management Plan for IGH to meet ongoing hatchery mitigation objectives developed by CDFW in consultation with NMFS for a period of eight years following the potential decommissioning of Iron Gate Dam.

In addition, the KHSA provides for the abeyance of the Section 401 Clean Water Act water quality certification process related to PacifiCorp's relicensing application before FERC pending the outcome of the Secretary of the Interior's determination regarding removal of four Project dams, including Iron Gate Dam. 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. On September 22, 2011, a notice of availability was published for the Department of the Interior and the California Department of Fish and Wildlife's Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR) (76 Fed. Reg. 58833; September 22, 2011). The EIS/EIR evaluates the effects of removing four dams on the Klamath River in southern Oregon and northern California. The Final EIS/EIR was issued in April 2013 (http://www.klamathrestoration.gov).

Furthermore, as provided under the KHSA, PacifiCorp developed the HCP with technical assistance from NMFS and included the HCP with an application for an incidental take permit for coho salmon 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. NMFS analyzed the effects of NMFS' Proposed Action of issuance of the incidental take permit related to the HCP in an Environmental Assessment (NMFS 2012a) and issued the incidental take permit. NMFS (2012a) describes the relationship of the analysis of NMFS' proposed issuance of the incidental take permit and associated implementation of the HCP in that Environmental Assessment compared to the Proposed Action of issuing an ESA Section 10(a)(1)(A) permit, which is analyzed in this Environmental Assessment as follows:

> The application for issuance of a permit under ESA Section 10(a)(1)(A) and the associated HGMP will undergo a separate permitting process with a review under the National Environmental Policy Act. Therefore, this EA reviews PacifiCorp's funding of the HGMP and its implementation as part of the HCP conservation strategy in a general sense, but the review under the separate permitting process will specifically review actions to be undertaken under the proposed ESA Section 10(a)(1)(A) permit.

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

Two alternatives were identified and considered in this EA: Alternative 1 (No Action) and Alternative 2 (Issuance of the ESA Section 10(a)(1)(A) permit and implementation of the HGMP).

2.1. Alternative 1 (No Action): NMFS Denial of 10(a)(1)(A) Permit – Coho Program without HGMP

Alternative 1 (No Action) would apply if NMFS concludes that the permit application does not meet ESA Section 10(a)(1)(A) permit issuance criteria. Under this alternative, NMFS would not issue an ESA Section 10(a)(1)(A) permit to CDFW for implementation of the coho salmon program at IGH. Hatchery operations would continue for Chinook salmon and steelhead.

If NMFS denies this permit application, CDFW and PacifiCorp would have to decide how to proceed in implementing the coho salmon program at IGH in a manner to avoid violating take prohibitions in 50 CFR § 223.203, which is a regulation that NMFS promulgated under ESA Section 4(d) to protect threatened anadromous fish, including the SONCC coho salmon ESU. Therefore, it is unclear at this point how all of the elements of such a program would be implemented.

2.2. Alternative 2 (Proposed Action): NMFS Issuance of 10(a)(1)(A) Permit – Coho Salmon Program with HGMP

The Proposed Action is NMFS' proposed issuance of a permit under ESA Section 10(a)(1)(A) to CDFW for operation of the coho salmon program at IGH under the proposed HGMP for a period of 10 years if NMFS determines that the application submitted by the CDFW and PacifiCorp meets the ESA section 10(a)(1)(A) permit issuance criteria. As a result of permit issuance, an exception to the take prohibitions in 50 CFR § 223.203 would apply to the authorized activities. These activities are outlined in the HGMP and permit application and include actions related to propagation of coho salmon at IGH (as described below in section 2.2.1) and monitoring of coho salmon in the Klamath River (as described below in section 2.2.2). Through implementation of this HGMP, the IGH coho salmon program will be operated to conserve listed species.

The Preferred Alternative (Alternative 2 in this EA) was developed based on the results of the alternatives analysis modeling presented in the HGMP (Appendix A) for the existing coho program. This alternatives analysis is more fully described in Appendix A of this EA. The key findings of this analysis were as follows:

1. Based on the data available, natural origin abundance of the Upper Klamath Population unit is below the high extinction risk abundance level (425) established by NMFS.

2. Adult coho natural production needs to be increased to reduce demographic and life history diversity risks to the population unit.

3. Hatchery operations need to strike a balance between genetic and demographic risk to the combined (hatchery origin and natural origin) coho population.

4. Habitat quality and quantity need substantial improvement to maintain natural coho production in the basin.

5. Hatchery production should not be reduced due to risks of decreased life history diversity, increased risks of inbreeding, and the possibility of gene swamping effects.

2.2.1. Artificial Propagation

The HGMP includes a number of biologically-based hatchery management strategies, all directed toward improving the propagation of coho salmon at IGH in a manner consistent with conservation of salmonid species. The management strategies and activities in the HGMP have been incorporated into the Section 10(a)(1)(A) permit, and are summarized as follows.

(1) Collection for Broodstock – Under existing hatchery operations, a maximum of 270 coho may be needed for broodstock. As the HGMP is implemented, it is expected that survival rates in the hatchery will improve and that the target of 135 coho for broodstock will be met. Of the fish needed for broodstock, up to 50 percent of these could be of natural origin (NOR). Additionally, some NOR adults not needed for broodstock may enter the facility. The collection, tagging and release of NOR fish back to the river may result in injury or mortality. Excess HOR adult coho may be returned back to the river, placed in tributary streams for supplementation purposes, or euthanized if population abundance goals have been achieved and hatchery fish abundance targets on the spawning grounds would be exceeded. The handling and lethal take of natural origin (NOR) and hatchery origin (HOR) adult coho for broodstock may occur at three locations: the Bogus Creek weir; the auxiliary fish ladder at IGH; and the main fish ladder below Iron Gate Dam. Broodstock will be collected at random throughout the entire run at all locations in accordance with procedures for fish collection and transportation described in HGMP Section 7. Any deviations to the above referenced broodstock collection targets must be approved by NMFS and CDFW annually.

(2) Measures to Address Genetic Concerns – In addition, the HGMP proposes certain hatchery management measures to minimize domestication and divergence, as well as mitigate adverse genetic or ecological effects to listed natural fish because of broodstock selection practices:

- All juvenile fish releases will be marked for identification upon return. This allows managers to determine and control the proportion of hatchery fish spawning naturally (reducing adverse genetic impacts) and implement selective fisheries for HOR adults if needed.
- Only local broodstock will be spawned - either hatchery fish originating from IGH or unmarked fish volitionally entering IGH or captured at the Bogus Creek weir. Fish locally adapted to the receiving environment are assumed to have higher survival rates and fitness.
- Trinity River Hatchery fish will not be used as broodstock. The use of non-locally adapted fish as broodstock reduces population fitness and survival.
- When available, a minimum of 20 percent and maximum of 50 percent of the broodstock will consist of natural origin (unmarked) fish. Incorporation of natural origin fish as broodstock ensures that the hatchery population does not diverge genetically from the natural population.
- Broodstock (ripe or near ripe) will be collected throughout the run with no bias toward physical characteristics (e.g., size). Collecting fish throughout the entire migration maximizes retention of natural run characteristics and helps ensure that hatchery practices are not selecting for specific traits that may reduce fitness.

- Genetic analysis will be performed on broodstock to develop a spawning matrix that will minimize inbreeding and improve fitness.
- Jacks will be incorporated into broodstock at rates as determined by the spawning matrix provided for in the HGMP. Jacks allow for gene flow between brood years and eliminate genetic divergence between years.
- The abundance and hatchery-wild composition of natural spawning escapement in Bogus Creek will be monitored and managed. The goal is to have the natural rather than the hatchery environment drive local adaptation, since fish adapted to the natural environment are likely to have higher survival rates and be more resilient to environmental change.
- Spawning escapement abundance and hatchery-wild composition in other Upper Klamath tributaries will be monitored. Hatchery fish strays spawning in the wild have the potential to reduce the fitness, diversity, and productivity and survival rates of natural populations. Pedigree analyses will be conducted to determine the productivity of natural origin (NOR) and hatchery origin (HOR) adults spawning naturally. These analyses will allow assessment of whether HOR fish spawning with NOR fish may be reducing the productivity of the natural population.
- Coho salmon will be volitionally released as yearling smolts so that only migratory fish leave the hatchery system. Fish that are ready to smolt are more likely to migrate rapidly to the estuary upon release, again reducing competition and predation effects on NOR coho salmon.
- To reduce impacts of hatchery releases to naturally produced coho, fish will be released at a size (15 fish per pound) that mimics the size of a wild coho juvenile. This action is anticipated to reduce HOR fish competition and predation on both NOR coho and fall Chinook salmon juveniles.

(3) Hatchery Management to Overcome Past Obstacles to Hatchery Breeding – The HGMP also proposes certain measures to address past impediments to artificial propagation. The number of eggs taken has averaged approximately 389,000 since 1993. Green egg-to-ponding survival rates from 1999 to 2011 have averaged 47 percent. The low survival rate is a result of low fertilization rates and low egg to smolt survival rates. The HGMP proposes to use multiple males per female and to improve egg incubation and rearing survival through changes to culture and rearing methods, including the installation of a moist air incubation system to address potential hatchery water supply water quality (high detritus load) effects on egg survival. With improved hatchery culture practices excess egg numbers are expected to be minimal. The hatchery goal is to not exceed egg-take by more than 10 percent of that needed to achieve the juvenile release target. Because coho are listed, all eggs will be reared to yearling smolts and released. No eggs will be purposely destroyed without the approval of NMFS. Ponding to yearling survival rates are low primarily due to bird predation. IGH employed temporary netting over the raceways from 1995-2000, but it was removed in 2001 because of worker safety concerns. A new safer netting system was installed at the hatchery to reduce bird predation on ESA-listed coho in 2010. The program has a goal of achieving a ponding to yearling smolt survival rate of 90 percent.

2.2.2. Monitoring and Evaluation

Included in implementation of the HGMP are monitoring efforts associated with the coho salmon program. These include coho spawner/carcass surveys, pedigree analysis, and smolt trapping and assessment. The HGMP Monitoring and Evaluation (M&E) program will also include conservation measures, genetic analysis, and rearing and release techniques that maximize fitness and reduce straying of hatchery fish to natural spawning areas. In accordance with applicable regulations, monitoring and evaluation activities in this HGMP are focused on ensuring that the performance standards and indicators identified for the program are achieved, and that critical uncertainties are addressed.

The focuses of the M&E program are:

- Ensuring that performance indicators and standards are achieved and that hatchery operations produce healthy, disease-free fish that survive to adulthood at high rates; and
- Addressing the critical uncertainties and assumptions that affect the combined performance and genetic makeup of the NOR and HOR components of the Upper Klamath Population unit of coho salmon (as described above in section 1.2).

Ultimately, the M&E program will be used to adaptively manage both the hatchery and natural components of the Upper Klamath Population unit. For example, as natural production increases, the number and proportion of HOR adults allowed on the spawning grounds will decrease. Additionally, actions such as the use of bird netting and water filtration to improve in-hatchery coho survival rates will be monitored and additional actions taken if survival goals are not achieved.

The components of the M&E Plan are:

Coho Surveys – Coho spawning and carcass surveys will be conducted yearly in the main stem Klamath River and tributaries associated with the Upper Klamath Population unit. The surveys will be conducted weekly starting in mid-September and continuing through January 15. Fish carcasses will be sampled for marks, sex and size (length). All females (or a subset if numbers are too high) will be sampled for spawning success (i.e., egg retention). Tissue samples will be collected from a subsample of the carcasses (HOR and NOR) for genetic analyses (see description below of pedigree analysis measure)[4]. These surveys may result in take of some coho salmon. It is estimated that up to 50 NOR live adults may be impacted by this work. Methods proposed in the surveys are designed to reduce this impact to the extent possible while still collecting needed data. Coho redds will be enumerated and uniquely marked (e.g., tape, GPS) during each survey. The combined carcass and redd counts will be used to estimate adult NOR and HOR escapement levels and spawn-timing to each stream and for the Upper Klamath Population unit as a whole. As part of its annual monitoring program, CDFW will continue to operate video counting stations in Bogus Creek, Shasta and Scott Rivers to determine coho escapement levels and composition (HOR and NOR). These data will be summarized and reported in annual reports for each basin.

Pedigree Analysis - A pedigree analysis using tissue samples taken from both hatchery and naturally produced coho adults from the survey streams will be used to determine the reproductive success of both the natural and hatchery components of the coho run. DNA results for the hatchery and natural components of the population will be compared to determine: 1) if they are genetically distinguishable, and 2) the reproductive success of each component.

Juvenile Migration - A downstream migrant trapping facility (e.g., screw trap, fyke net) will be operated in Bogus Creek (or just downstream) to collect demographic data on natural origin juvenile run-timing and abundance, size, smoltification levels and smolt-to-adult survival rates. This information will act as the standard hatchery fish are compared against to determine if hatchery practices are producing a high quality smolt capable of surviving in the natural environment.

[4] Sample size will be determined as more is learned about the number of adults returning to each stream.

Bogus Creek Weir Operations - The weir structure will be improved to operate at higher flows, better manage debris[5], and allow for the collection of adult and jack coho for hatchery broodstock if needed. Other purposes of the weir are the enumeration of coho spawning escapement and the control of the number of hatchery fish spawning in the stream once threats to demographic extinction are reduced.

The operation of the Bogus Creek weir to enumerate coho spawning escapement and collect broodstock for the program may result in the take of coho salmon. The level of take from capture during broodstock activities at Bogus Creek weir will vary with run size and range from 0 to 135 fish, with up to 50% being NOR. Broodstock will only be taken from Bogus Creek if hatchery returns do not provide enough adults for broodstock purposes. Intentional lethal take of fish for broodstock will range from 0-135 fish. Unintentional lethal take from transportation may result in up to 1% mortality of all fish that are transported from the Bogus Creek weir to the hatchery. Lethal take associated with juvenile downstream migration monitoring activities will be between 0 – 100 fish, depending on escapement levels. Potential take levels will be monitored directly by CDFW staff on a daily basis. If take is likely to exceed authorized levels, CDFW will consult with NMFS to determine appropriate actions. Take levels will not be exceeded without the permission of NMFS. See table 10 in the HGMP for more information on potential take levels.

The HGMP also includes in-hatchery and in-river monitoring to assess program effectiveness based on a series of performance metrics as described in HGMP Section 11.0. In-hatchery monitoring will collect data to determine and quantify in-hatchery performance for IGH with regard to the following metrics:

- Broodstock composition, timing, age structure
- Adult Holding and Spawning Survival Rate
- Proportion natural origin brood (pNOB) for each brood year
- Egg-to-Fry Survival Rate
- Fry-to-Parr Survival Rate
- Egg-to-Smolt Survival Rate
- Smoltification Level (based on ATPase data)
- Release Size (size of HOR fish at release)
- Smolt-to-Adult Survival Rate (SAR)
- Total Smolt-to-Adult Survival Rate (TSAR)

2.2.3. Duration

The term of the permit and time frame for implementation of the HGMP would be 10 years, from 2014-2024. Under the KHSA, PacifiCorp is obligated to fund continued hatchery operations for a period of 8 years after potential removal of Iron Gate Dam. Revised hatchery management goals and strategies will be developed by CDFW and NMFS in response to reintroduction of coho to habitat above Iron Gate Dam through dam removal under the KHSA or relicensing of the Project by FERC with fish passage facilities if dam removal does not occur under the KHSA (KHSA 2010). At that time it is expected that a new HGMP would be developed for any new or revised programs at Iron Gate or other hatchery facilities in the

[5] Debris caught on weir pickets is removed as needed to limit impacts such as descaling that may occur as juvenile fish pass through weir spacings.

area. NMFS cannot determine at this time what any new or revised coho salmon program would include. Therefore, NMFS cannot determine the effects of any such new or revised program. Any take associated with any new or revised coho salmon program would need to be authorized under a new ESA Section 10 permit.

2.3. Alternatives Considered but not Analyzed in Detail

In its analysis of the Iron Gate coho salmon program, NMFS, working with CDFW and PacifiCorp, conducted an alternatives analysis to determine the best approach for meeting identified conservation, harvest and policy goals (see Appendix A of the HGMP). Four of these alternatives, and the reasons they were not analyzed in detail in the EA, are more fully described in Appendix A of this EA.[6] The four alternatives were:

A. Eliminate hatchery production and improve habitat

B. Implement a segregated program consistent with Hatchery Scientific Review Group (HSRG) Guidelines

C. Implement an integrated program consistent with HSRG Guidelines

D. Implement a reduced hatchery program

NMFS concluded that none of these four alternatives would completely achieve the objective to enhance the propagation or survival of the SONCC coho salmon ESU consistent with the Purpose and Need for the action and ESA section 10(a)(1)(A) (see Appendix A of this EA for more explanation). Thus, NMFS will not analyze these alternatives in detail in this Environmental Assessment.

Improved habitat conditions and hatchery practices are expected to increase natural coho production to levels that can support both a viable natural population and the broodstock required to implement an integrated hatchery program operated consistent with HSRG guidelines. This combination of actions, implemented in phases, has been determined to be most likely to result in increased abundance, productivity and life-history diversity for the Upper Klamath Population unit.

Habitat improvement and research actions have been implemented as part of PacifiCorp's Interim Conservation Plan (ICP) and are currently being implemented as part of PacifiCorp’s HCP. Other coho salmon habitat improvement and research actions are also ongoing under the direction of CDFW, the U.S. Fish and Wildlife Service (USFWS), NMFS, and Klamath basin Tribes. Hatchery management under the HGMP and conservation actions under the HCP and other ongoing initiatives will be coordinated, where possible, to maximize the conservation benefits. It should be noted that increases in coho abundance and fitness expected from HGMP implementation are not dependent on the effectiveness of ongoing habitat actions.

[6] Appendix A of the HGMP also included an alternative to maintain the current hatchery program without issuance of a permit under ESA Section 10(a)(1)(A). Because of the factors described in section 4.1 of this EA, the effects of this alternative are analyzed in the analysis of the effects of Alternative 1 (No Action) in this EA. In addition, the effects of elimination of the IGH coho salmon program are analyzed in the analysis of the effects of Alternative 1 (No Action) in this EA. However, as listed above and described in Appendix A of this EA, Alternative A also included a component to improve habitat, which would not be a result of IGH operations.

3.AFFECTED ENVIRONMENT

The affected environment in this analysis is defined as that portion of the physical, biological, and social environment that may be affected by implementation of the alternatives. The Proposed Action would impact resources in the Klamath Basin and could impact resources in the marine environment because released coho salmon migrate to the ocean. Resources that could be impacted and are part of this environmental analysis include water resources (i.e., hydrology and water quality), biological resources (including fish species and fish-eating birds), socioeconomics and environmental justice. The Proposed Action is not expected to have effects on other resources (i.e., geologic resources, air quality, noise, visual resources, vegetation, and species of wildlife other than those addressed), so these other resources are not specifically addressed in this analysis.

3.1. Water Resources

Originating from Upper Klamath Lake (UKL) in southern Oregon, the Klamath River flows 254 miles from Oregon into northern California before emptying into the Pacific Ocean near Klamath, California. The river drains an area of about 13,000 square miles. The Klamath River watershed is only one of three drainages originating in Oregon that cut across both the Cascade and Coastal ranges. 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 Cascade range province where it reaches the Pacific Ocean. 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.

Built between 1903 and 1962, PacifiCorp's Klamath Hydroelectric Project consists of seven hydroelectric developments and one non-generating dam; all but one of these facilities is located on the Klamath River. UKL is formed by the Link River Dam which is owned by the U.S. Department of the Interior, Bureau of Reclamation. Water stored and released from Link River Dam is used to meet fish and wildlife habitat needs, for irrigation purposes, flood control requirements, and hydroelectric generation.

3.1.1. Hydrology

Flows in the Klamath River normally peak during the late spring and/or early summer from snowmelt runoff. Low flows in the Klamath River 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. The hydrology in the Klamath River 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 river (as described below in section 3.1.2), which are important in the growth and survival of basin salmonids. The dams on the Klamath River 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 60 miles of the river between Link River and Iron Gate dams. The transit time of waters released from Upper Klamath Lake to the estuary (as well as water released from Reclamation's Klamath 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.

3.1.2. Water Quality

The Klamath River system is complex and unique, particularly because water quality generally improves as water flows from its source at UKL towards the estuary. In most river systems, water quality is highest at its source and degrades as water flows downstream. Because the Klamath River defies this norm, the Klamath River is often referred to as "upside-down."

The area affected by both alternatives in terms of water quality is the Upper Klamath reach below Iron Gate Dam, which is the Project dam that is furthest downstream on the Klamath River, and it does not have facilities for passage of anadromous fish. The hatchery plays a minimal role in affecting Klamath River water quality conditions, which are naturally productive. The Klamath River downstream of Iron Gate Dam can be described as a eutrophic stream. Winter conditions are generally benign from a water quality perspective with cool to moderate water temperatures and dissolved oxygen conditions at or near saturation. Although there may be nutrients sufficient for primary production, low water temperatures and short day length preclude a large algal standing crop. Conditions change markedly with the onset of warmer weather. Water temperatures rise and primary production (benthic algae) can lead to deviations in dissolved oxygen (above and below saturation), but these effects are spatially variable. Primary production is driven in large part by nutrients from upstream sources, with tributaries generally providing waters that are lower in nutrients and organic matter. The information provided below has been summarized from NMFS (2012a), NMFS and USFWS (2013), NCRWQCB (2010), and Basdekas and Deas (2007) and more information on water quality conditions can be found in these sources.

3.1.2.1. Temperature

Water temperatures in this reach are generally at or near equilibrium with ambient air temperature, with the exception of immediately below Iron Gate Dam and in the vicinity of certain tributaries. 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.

Water temperatures below Iron Gate Dam may be at or slightly below equilibrium temperature of the river downstream of the dam in the spring (the river is considerably smaller in terms of volume per unit length, and thus cools and heats more quickly than the reservoir in response to the ambient meteorological conditions). During the fall period, water temperatures of releases from Iron Gate dam are higher than equilibrium temperature of the river due to the thermal lag caused by the Project reservoirs and water storage. This lag is largest at Iron Gate Dam and diminishes relatively quickly in the downstream direction as the river comes into equilibrium with the local meteorological conditions. By the time flows reach the Shasta River, the impact of the lag is diminished by approximately 50 percent, and continues to diminish in the downstream direction.

3.1.2.2. Dissolved Oxygen (DO)

DO concentrations vary considerably both spatially and temporally within the Klamath River mainstem, and are influenced primarily by high nutrient levels emanating from the upper basin (PacifiCorp 2006). Daily mean dissolved oxygen conditions are at or near saturation throughout much of the reach due to the many cascades, rapids, and riffles in this steep reach of river that provide mechanical reaeration. An exception is the reach immediately below Iron Gate Dam during late summer and fall periods, where relatively deep releases from Iron Gate reservoir entrain water with low dissolved oxygen concentration, resulting in discharges from the dam of water that is below 100 percent saturation.

Under the Klamath Hydroelectric Settlement Agreement's (KHSA) Interim Conservation Plan Interim Measures PacifiCorp agreed to begin implementing turbine venting (Interim Measure 3) to improve DO levels immediately below Iron Gate Dam. PacifiCorp started turbine venting on a trial basis in 2009, and turbine venting testing in combination with a forced air blower began in the fall of 2010. This effort demonstrated that dissolved oxygen saturation rose by 14.9 percentage points (a 29 percent increase) and average dissolved oxygen concentration rose by 1.81 mg/L (a 33 percent increase) during venting treatment as compared to no treatment (NMFS and USFWS 2013). In 2012 PacifiCorp completed the *Klamath Hydroelectric Project Interim Operations Habitat Conservation Plan for Coho Salmon* ("HCP"). In February of 2012, NMFS issued an Incidental Take Permit ("ITP") to PacifiCorp under the provisions of Section 10(a)(1)(B) of the Endangered Species Act ("ESA") for interim operations of PacifiCorp's Klamath Hydroelectric Project and implementation of the HCP. Under the HCP and ITP, PacifiCorp agrees to maintain DO concentrations at or above 85 percent saturation (percent saturation levels will not fall below 85 percent saturation for longer than 7 consecutive days) in the Klamath River from the dam to the Iron Gate Hatchery Bridge during the period from June 15 to September 30 (PacifiCorp 2012). Continuous (hourly) monitoring of DO during the summer of 2013 downstream of Iron Gate Dam showed that DO levels stayed in compliance with the terms of the ITP from June 15 to September 30 (PacifiCorp 2014).

The Klamath River at several locations further downstream experiences "chronic" mild subsaturation during the warmer periods of the year (PacifiCorp 2008). These are conditions when the average dissolved oxygen concentration over a period of time (days or weeks) is below saturation, and dissolved oxygen never rises above saturation. It is postulated that this mild, persistent subsaturation is related to the appreciable organic load being carried by the river. During winter, DO conditions are typically at or near saturation throughout the reach.

3.1.2.3. pH

Given that the Klamath River below Iron Gate Dam remains in a weakly buffered state, pH levels throughout the river can experience wide daily fluctuations as a result of high primary production (i.e., algae and benthic macrophyte growth) during summer months. Photosynthesis and associated uptake of carbon dioxide by aquatic plants result in high pH (i.e., basic) conditions during the day, whereas plant and fish respiration at night decreases pH to more neutral conditions. Alkalinity is generally under 100 mg/L throughout the reach but it is not uncommon to observe pH values in excess of 9.0 in the early afternoon during late spring and summer periods in the Klamath River. Ammonia toxicity can be a concern in aquatic environments, like the Klamath River, where high nutrient concentrations coincide with elevated pH and water temperature. Ammonia toxicity may be a concern in the river from Iron Gate Dam to Seiad Valley (RM 128) where temperatures and pH, as well as macrophyte and algae concentrations, are appreciably higher than those common to the lower river (PacifiCorp 2006).

3.1.2.4. Nutrients and Algae

During summer and fall periods there is a considerable amount of particulate matter readily observable in the Klamath River in this reach. The proportion of this particulate matter that is derived from Iron Gate reservoir and upstream sources compared to that generated within the river downstream of Iron Gate Dam is unknown at this time but decreases with distance downstream. The eutrophic nature of the

Klamath River downstream of Iron Gate Dam is largely due to upstream sources of nutrients. This particulate matter (and presumably dissolved matter as well) is readily transported downstream and a portion ultimately settles in the Klamath River Estuary.

3.2. Biological Resources

The biological resources potentially affected by the Proposed Action are those within the Klamath River Basin below Iron Gate Dam. The status of listed and unlisted salmonid species is discussed below, as well as the status of other fish species in the Basin.

3.2.1. Fish Species

3.2.1.1. Fish Species Listed under the ESA

3.2.1.1.1. Southern Oregon/Northern California Coast Coho Salmon ESU

A full description of the status of the SONCC coho salmon ESU and the population units in the vicinity of IGH can be found in the draft HGMP and in recent reports, biological opinions, and status reviews (NMFS 2012a, Williams et al. 2008, NMFS and USFWS 2013, Ly and Ruddy 2011, Ackerman et al. 2006, Good et al. 2005). It is a requirement of the HGMP process and permit application to provide this information. A brief summary of the status of the species is provided here.

Coho salmon were once numerous and widespread within the Klamath River basin (Snyder 1931), but now only small populations remain and occupy limited habitat within tributary watersheds and the main stem Klamath River below Iron Gate Dam (CDFW 2002, NRC 2004). As described above in section 1.2, the Klamath Basin contains nine populations of coho salmon within three distinct diversity strata (Klamath, Trinity, and Central Coastal) (Williams et *al.* 2006). Populations in the vicinity of IGH include the Upper Klamath Population unit, which occupies the main stem and tributaries downstream of Iron Gate Dam and upstream of the confluence of Portuguese Creek; the Shasta River Population unit; and the Scott River Population unit.

Coho salmon adults migrate and spawn in small streams that flow directly into the ocean, or tributaries and headwater creeks of larger rivers (Moyle 2002, Sandercock, 1991). Adults migrate upstream to spawning grounds from September through late December, peaking in October and November (National Research Council 2004). Spawning occurs mainly in November and December, with fry emerging from the gravel in the spring, approximately 3 to 4 months after spawning. Hicks (2000) states that spawning activity in coho salmon typically occurs in the temperature range of 4.4 to 13.3°C. Bell (1991) suggested that daily average temperatures should be within the range of 10 to 13°C for successful spawning of coho salmon. Under current conditions, daily average water temperatures in the Klamath River during the November to January spawning period are typically less than 13°C (PacifiCorp 2008).

Coho salmon eggs typically hatch within 8 to 12 weeks following fertilization, although colder water temperatures may lengthen the process (Bjornn and Reiser 1991). Suitable water temperatures for egg incubation are similar to those for spawning (McCullough et *al.* 2001). Under current conditions, daily average water temperatures in the Klamath River during the November to March incubation period are typically less than 14°C (PacifiCorp 2008).

At a length of 38 to 45 mm, fry may migrate upstream a considerable distance to reach lakes or other rearing areas (Sandercock 1991, Nickelson et *al.*, 1992). Juvenile rearing usually occurs in tributary streams with a gradient of 3 percent or less, although they may move up to streams of 4 percent or 5 percent gradient. Juveniles have been found in streams as small as one to two meters wide. They may spend 1 to 2 years rearing in freshwater (Bell and Duffy 2007), or emigrate to an estuary shortly after emerging from spawning gravels (Tschaplinski 1988).

Suitable spawning and rearing habitat exists throughout the Klamath River basin, such as the Scott and Shasta Rivers, as well as smaller main stem tributaries throughout the basin, which were once highly productive coho salmon watersheds, but anthropogenic factors have severely degraded instream habitat conditions. Coho salmon juveniles are also known to redistribute into non-natal rearing streams, lakes, or ponds, often following rainstorms, where they continue to rear (Peterson 1982). Typical rearing habitat consists of slow moving, complex pool habitat commonly found within small, heavily forested tributary streams. Large woody debris and other instream cover are critically important to juvenile coho salmon survival, considering the relatively smaller coho salmon are often at a disadvantage during aggressive interactions with other juvenile salmonids (e.g., Chinook salmon and steelhead). Despite documented coho salmon preference for tributary rearing habitat, juvenile coho salmon have also been observed residing within the main stem Klamath River downstream of Iron Gate Dam within the upper reaches of the Klamath River throughout the summer and early fall (Soto 2007 in NMFS 2007a). These fish are almost always closely associated with cold water refugial habitat and extensive instream cover near tributary confluences, where water temperatures are 2-6°C lower than the surrounding river environment (NRC 2004, Sutton et *al*. 2004).

Emigration from streams to the estuary and ocean generally takes place from February through June, with the peak period being the end of April through May (USFWS 1998). Generally, the fish live in the ocean until they return to freshwater to spawn at the age of 3 years (NRC 2004) but some sexually mature males (jacks) return after one summer in the ocean.

Recent population data indicate that coho abundance in the Klamath River is quite low. In 2013 only 87 natural origin coho salmon returned to Bogus Creek to spawn (Knechtle and Chesney 2014). Bogus Creek is the only tributary in the Upper Klamath River Population Unit that has an intensive annual monitoring effort able to track population abundance trends over time and is generally believed to support the majority of naturally produced coho salmon in the Upper Klamath River Population Unit at this time. The depensation threshold for the Upper Klamath River Population is 425 fish and it appears based on currently available information that this population is at a high risk of extinction. A High Risk population is one where a species faces significant risks from internal and external processes that can drive a species to extinction Williams et al. (2008). The total number of coho salmon returning to Iron Gate Hatchery over the last five years has ranged from 45 fish in 2009 to 1,268 fish in 2013 (Chesney and Knechtle 2014). The percentage of hatchery origin coho salmon observed at Iron Gate Hatchery over the same period has ranged 80 percent to 95 percent of the total return. In their most recent status review for the SONCC coho salmon ESU, NMFS found that many coho salmon populations in the ESU are low in abundance, and may well be below their depensation thresholds indicating that the overall risk of extinction may be increasing (Ly and Ruddy 2011). The risk occurs because of low population abundance, spatial diversity (lack of strong population units) and low productivity.

3.2.1.1.2. Southern Distinct Population Segment of Pacific 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). The Southern Distinct Population Segment (DPS) of Pacific eulachon (hereafter referred to as eulachon) is listed as a threatened species (75 Fed. Reg. 13012; March 18, 2010). This DPS encompasses all populations within the states of Washington, Oregon, and California and extends from the Skeena River in British Columbia (inclusive) south to the Mad River in Northern California (inclusive).

Eulachon are a short lived, high fecundity, high mortality forage fish, and tend to have extremely large population sizes. Eulachon generally spawn in rivers that are either glacier or snowpack fed and that experience spring freshets. Spawning grounds are typically in the lower reaches of larger rivers fed by snowmelt and spawning typically occurs at night. Spawning occurs at between 0 to 10°C throughout the range of the species, and is largely limited to the part of the river that is tidally influenced (Lewis et *al.* 2002). Entry into spawning rivers appears to be related to water temperature and the occurrence of high tides (Ricker et *al.* 1954, Smith and Saalfeld 1955, Spangler 2002), and occurs in January, February, and March in the northern part of the DPS, and later in the spring in the southern parts of the DPS. It has been argued that because these freshets rapidly move eulachon eggs and larvae to estuaries, it is likely that eulachon imprint and home to an estuary into which several rivers drain rather than to individual spawning rivers (Hay and McCarter 2000). Eulachon eggs average 1 mm in size and are broadcast into the water column, attaching to a variety of substrates from sand to pea-sized gravel. Newly hatched young, transparent and 4-7 mm in length, are carried to the sea with the current (Hay and McCarter 2000). They rear in the pelagic zone and return to freshwater to spawn after 3 to 5 years at sea.

Historically, large numbers of eulachon entered the Klamath 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. 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 8 miles 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 given uncertainty that the abundance is sufficient to support a self-sustaining population. NMFS issued a final rule designating critical habitat for the Southern DPS of eulachon on October 20, 2011 (76 FR 65324). The designation includes the Klamath River from the mouth upstream to the confluence with Omogar Creek, but it excludes lands of the Resighini Rancheria and Yurok Tribe.

3.2.1.1.3. Southern Distinct Population Segment of Green Sturgeon

Green sturgeon (*Acipenser medirostris*) is an anadromous species that is known to range in near-shore 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 Distinct Population Segment (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.

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 the 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. 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.

3.2.1.2. Non-listed Fish Species

The Klamath River Basin has native populations of steelhead and Chinook, neither of which is listed as a protected population under the ESA.

3.2.1.2.1. Upper Klamath-Trinity River and N. California Coastal Chinook Salmon

Fall and spring-run Chinook salmon upstream of the Trinity confluence are both considered to be part of the Upper Klamath-Trinity Rivers Chinook salmon ESU. NMFS considers fall-run Chinook salmon present downstream of the Trinity River-Klamath River confluence to belong to the SONCC Chinook salmon ESU. Neither ESU is currently listed under the ESA (77 Fed. Reg. 19597; April 2, 2012 and 64 Fed. Reg. 50394; September 16, 1999). Chinook salmon occur throughout the Klamath Basin in areas currently accessible to anadromous fish. Two runs of Chinook salmon are present in the basin with the more dominant life history being the fall run Chinook. Spring-run Chinook occur primarily in the Trinity and Salmon River watersheds. Fall-run Chinook numbers have declined over much of the last century, and spring-run Chinook, which were considered to be more abundant than the summer/fall-run fish prior to 1990, today consist of only remnant numbers (Hardy and Addley 2001). The total estimated catch and escapement of all Chinook salmon in the Klamath River between 1915 and 1928 averaged between 300,000 and 400,000 fish annually. Between 1978 and 1995, the average annual escapement of wild and hatchery-produced fall-run Chinook had declined to approximately 58,800 adults (Hardy and Addley 2001). The spring-run Chinook using the Salmon and Trinity subbasins, varied between approximately 200 and 1,500 adults per year between 1978 and 1995, and in 2002 was estimated to consist of just over 1,000 fish (Anderson 2003).

The total number of adult Klamath River fall Chinook that returned to the basin to spawn in 2013 was estimated to be 76,800 of which 17,100 returned to the hatcheries (KRTT 2014). Of the 59,600 adults that spawned naturally 2,240 returned to the Salmon River, 4,036 returned to the Scott River, 6,925 returned to the Shasta River and 3,925 returned to Bogus Creek. 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). Since 2010, the adult return to the Shasta River has fluctuated between a low of only 213 fish in 2011 to a high of 27,593 fish in 2012 (CDFW 2014). For 2014, fisheries managers are estimating that the total ocean abundance of Klamath River fall-run Chinook will be approximately 299,300 (PFMC 2014a). The number of adults predicted to return to the mouth of the Klamath River in 2014 is 92,800 fish, prior to in river harvest, and the minimum natural escapement floor is set at 40,700 adults (PFMC 2014b).

Approximately 59,627 adult fall-run Chinook salmon are forecasted to spawn naturally in the Klamath River Basin, which is about 147 percent of escapement floor (PFMC 2014c).

Fall-run Chinook salmon in the Klamath River typically spend less than a year in freshwater, a life history strategy that allows them to take advantage of streams in which temperature conditions may become unfavorable by late summer (Moyle 2002). The run peaks in early September and continues through late October (NRC 2004). Fall-run Chinook salmon reach their upstream spawning grounds within 2 to 4 weeks after they enter the river, after which they spawn and die. Spawning normally peaks during mid-October, and is complete by the middle of November (NRC 2004). Time to emergence is dependent on the temperature regime. In the main stem 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.

Spring-run Chinook salmon typically exhibit a stream-type life history, meaning that the juveniles remain in streams for a year or more before they migrate to the ocean. Adult spring-run Chinook salmon typically enter freshwater before they are sexually mature, and hold in deep pools for 2 to 4 months before spawning. In California, this strategy allows salmon to spawn and develop in upstream reaches of tributaries that may be inaccessible to fall-run Chinook salmon because of low flows and higher temperatures in lower reaches during the summer and fall (Moyle 2002).

Spring-run Chinook salmon enter the Klamath system from April through July (NRC 2004). Spawning peaks in October. Fry emerge from redds between March and early June, and reside through the summer in cool headwater streams. Some juveniles may move downstream to the estuary as temperatures decline in October, although most do not migrate until the following spring (Hardy and Addley 2001). The number of wild spring Chinook returning to the Klamath River is generally less than 2,000 fish with combined hatchery and wild escapement infrequently exceeding 50,000 fish.

3.2.1.2.2. Klamath Mountains Province Steelhead

NMFS considers all steelhead in the Klamath River Basin to be part of the Klamath Mountains province ESU, which is not listed under the ESA (66 Fed. Reg. 17845; April 4, 2001). Historically, the Klamath River supported large populations of steelhead, the anadromous form of rainbow trout. Steelhead were distributed throughout the main stem and the principal tributaries such as the Shasta, Scott, Salmon, and Trinity River basins, and many of the smaller tributary streams. Steelhead runs in the Klamath River basin prior to the 1900s may have exceeded several million fish (Hardy and Addley 2001). Subsequent steelhead runs in the Klamath Basin declined steadily to an estimated 135,000 fish in 1977. Hardy and Addley (2001) reported that in the 1980s, the hatchery-influenced summer/fall-run of steelhead throughout the Klamath Basin consisted of approximately 10,000 fish, while the winter-run steelhead component was estimated at approximately 20,000 fish.

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).

Moyle (2002) described two dominant life histories for this ESU, a summer run and a winter run. After entering the river, winter-run steelhead disperse throughout the lower basin and spawn mainly in tributaries but also show some main stem spawning. Spawning, which can take place any time from January through April, apparently peaks in February and March (NRC 2004). According to Moyle (2002), summer-run steelhead migrate upstream to the cool waters of the larger tributaries from late April through June. They typically hold in deep pools until December, when they spawn. Steelhead fry emerge from the gravel in the spring, and most spend 2 years in fresh water before going to sea. The rest spend either 1 or 3 years in fresh water (Hopelain 1998). Juvenile steelhead occupy virtually all accessible habitats in which conditions are physiologically suitable. Although spawning occurs mainly in tributaries, the juveniles distribute themselves widely, and many move into the main stem. Juveniles feed primarily on invertebrates, especially drifting aquatic and terrestrial insects, but fish (including small salmon) can be an important part of the diet of larger individuals. Aggressive 2- year-old steelhead (6 to 7 inches) often dominate in pools (NRC 2004).

Migrant sampling conducted from 1997 through 2000 at Big Bar on the Klamath River (RM 49.7) and at Willow Creek on the Trinity River (RM 21.1) indicates that the peak outmigration of steelhead smolts occurs from early April through mid- June in both rivers, with smaller numbers of steelhead smolts continuing to migrate through September, especially in the Trinity River (Scheiff et *al.* 2001). A majority of Klamath steelhead return to fresh water 3 to 4 months after their initial entry into salt water (as "half-pounders"). This life-history trait allows steelhead to consume eggs from the large numbers of Chinook salmon that enter the river in the fall (NRC 2004). Half-pounders usually stay in the lower main stem of the Klamath through March before they return to the sea to mature. Klamath steelhead spend 1 to 4 winters in the ocean before they return to spawn. About 30 percent of the steelhead in the Klamath spawn a second time after another year at sea, and about 5 percent survive to spawn a third time (Hopelain 1998).

3.2.1.2.3. 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 and, like salmon, die shortly after spawning. They enter the Klamath River 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 lampreys per person per day before the run declined sometime 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 lampreys 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.

Pacific lamprey also use or could use the Klamath River for spawning and rearing. The National Research Council (2003) reported that Pacific Lamprey was once very abundant in the California coastal rivers, but today their numbers are low and declining. Hardy and Addley (2001) reported no quantitative data are available on the status of Pacific lamprey, although their distribution is believed to be generally similar to that of steelhead.

3.2.2. Fish Habitat

The area of affected fish habitat encompasses the main stem Klamath River below IGH. This area includes critical habitat for the SONCC coho salmon ESU and Pacific Coast Salmon Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act (Appendix A of Amendment 14 to Pacific Coast Salmon Plan, January 1999). Critical habitat for the SONCC coho salmon ESU includes all accessible waterways, substrate, and adjacent riparian zones between the Mattole River in California, and the Elk River in Oregon, inclusive (64 Fed. Reg. 24049; May 5, 1999). Excluded are: (1) areas above specific dams identified in the Federal Register notice; (2) areas above longstanding natural impassible barriers (i.e., natural waterfalls); and (3) tribal lands. In the Klamath Basin, EFH has been designated for the main stem Klamath River and its tributaries from Iron Gate Dam to the mouth. It includes the water quantity and quality conditions necessary for successful adult migration and holding, spawning, egg-to-fry survival, fry rearing, smolt migration, and estuarine rearing of juvenile coho and Chinook salmon. In addition, NMFS issued a final rule designating critical habitat for the Southern DPS of eulachon on October 20, 2011 (76 FR 65324). The designation includes the Klamath River from the mouth upstream to the confluence with Omogar Creek at about RM 8, but it excludes Indian lands of the Yurok Tribe and Resighini Rancheria.

The analysis in this EA focuses on salmon habitat (including critical habitat) because those are the fish species most directly affected by the alternatives. The biological requirements for salmon are the habitat characteristics that support successful adult spawning, embryonic incubation, emergence, juvenile rearing, holding, migration and feeding. Generally, during salmonid spawning migrations, adult salmon prefer clean water with cool temperatures and access to thermal refugia, dissolved oxygen (DO) near 100 percent saturation, low turbidity, adequate flows and depths to allow passage over barriers to reach spawning sites, and sufficient holding and resting sites. Anadromous fish select spawning areas based on species-specific requirements of flow, water quality, substrate size, and groundwater upwelling (Sandercock 1991). Embryo survival and fry emergence depend on substrate conditions (e.g., gravel size, porosity, permeability, and DO concentrations), substrate stability during high flows, and, for most species, water temperatures of 14ºC or less (Quinn 2005). Habitat requirements for juvenile rearing include seasonally suitable microhabitats for holding, feeding, and resting (Moyle 2002). Migration of juveniles to rearing areas requires access to these habitats. Physical, chemical, and thermal conditions may all impede movements of adult or juvenile fish (Moyle 2002). Below we provide a summary of the condition of essential habitat types for salmon in the affected area. This information is largely drawn from a recent biological opinion on effects of the Bureau of Reclamation’s Klamath Project on coho salmon in the Klamath River (NMFS and USFWS 2013).

3.2.2.1. Juvenile Summer and Winter Rearing Areas

In the affected area, juvenile summer rearing areas for salmon have been affected 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. Water temperatures in the Klamath River downstream from Iron Gate Dam during summer months are potentially stressful to juvenile salmon (NRC 2004). The temperature of water released from Iron Gate Dam reaches a maximum of about 22ºC in August with minor diel change. By the time this water reaches Seiad Valley (RM 130), maximums are greater than 26ºC, and minimums are 22ºC (NRC 2004).

Nocturnal DO levels directly below Iron Gate Dam can fall below 7.0 mg/L and could be stressful to coho salmon juveniles during much of the late summer and early fall. To improve DO levels downstream of Iron Gate Dam, PacifiCorp began implementing turbine venting/blower operations in 2012 and continued these operations in 2013 (PacifiCorp 2014). Turbine venting/blower operations assist PacifiCorp in maintaining DO levels of at least 85 percent from June 15 to September 30 when DO levels below Iron Gate dam can be stressful to juvenile coho salmon. Additional activity in 2013 included the automation of the blower system so that it operates automatically when DO levels are approaching, or less than, the applicable water quality standard (PacifiCorp 2014). DO conditions downstream of Iron Gate dam were monitored in 2013 in connection with incidental take monitoring required under the Habitat Conservation Plan and the results indicated that DO conditions during 2013 met the requirements of the ITP (PacifiCorp 2014).

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 (PacifiCorp 2006). Riparian recruitment within the first several miles below Iron Gate Dam is likely impaired by the typically fast recession of the spring hydrograph, because the roots of newly established vegetation are unlikely to keep up with the rapidly lowering water table (FERC 2006). This can limit the amount of cover available to rearing coho salmon.

Although sediment recruitment in the Klamath River upstream of Iron Gate Dam is limited, dams nonetheless impair gravel and fine sediment recruitment downstream of PacifiCorp's Project reservoirs, which contribute to poorly functioning floodplains that fail to support healthy riparian recruitment. Winter rearing areas suffer from non-recruitment of large woody debris and stream habitat simplification for a number of reasons, including the dams and restrictions on movement of large woody debris due to the existence of a road on one side of the river.

PacifiCorp's HCP, NMFS' BO and the ITP include conservation measures to increase recruitment of gravel and large woody debris downstream of Iron Gate Dam (PacifiCorp 2012, NMFS 2012b). These conservation measures are intended to improve the quality and carrying capacity of refugia and rearing habitats along the mainstem Klamath River downstream of Iron Gate Dam. The biological objective of gravel augmentation will be to provide 500 cubic yards of gravel annually in the river or a total of 3,500 cumulative cubic yards over the term of the ITP. It is estimated that augmentation will occur in about 7 of the 10 years during the term of the ITP, since planning will occur during the initial year, and augmentation likely will not be required in every subsequent year of the ITP term. In some years, it may not be necessary to provide any augmentation if previous gravel has remained at locations that would provide appropriate spawning habitat (e.g., during relatively dry years). Monitoring of gravel augmentation efforts would establish if the project objectives are being met and enable subsequent augmentation efforts to reflect findings from previous replenishment. Volume, location, and frequencies of recurring (approximately annually) gravel augmentation would be based on monitoring of initial gravel placements and assessment of bed mobilizing flow recurrence intervals.

Under the HCP and ITP, PacifiCorp will increase the abundance of large woody debris downstream of Iron Gate Dam to increase habitat elements and habitat forming features to benefit SONCC coho salmon. Under this conservation measure PacifiCorp will retrieve large woody debris (greater than 16 inches in diameter and 15 feet in length) trapped at or near project facilities on a quarterly basis as part of PacifiCorp's Project maintenance activities (NMFS 2012b). Large woody debris retrieved would be placed in the Klamath River downstream of Iron Gate Dam and may also be used to enhance thermal refugia habitats.

3.2.2.2. Juvenile Salmon Migration Corridor

In the Upper Klamath River reach, juvenile salmon migration corridors have been affected by 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 emigration of coho salmon smolts, speed the proliferation of fish diseases, and increase water temperatures more quickly than would occur otherwise. Disease effects (primarily due to the myxosporean *Ceratomyxa shasta*) likely have a substantial impact on the survival of juvenile coho salmon in the main stem Klamath River. Disease rates increase substantially with distance from the dam, peak at approximately RM 173, then decrease again in the lower Klamath River.

3.2.2.3. Adult Migration Corridor

The current physical and hydrologic conditions of the adult salmon migration corridor in the Upper Klamath River reach likely functions in a manner that supports its intended conservation role. Water quality is suitable for upstream adult migration, and flow volume is above the threshold at which physical barriers may form.

3.2.2.4. Spawning Areas

Coho salmon are typically tributary spawners, however, low numbers of adult salmon do spawn in the Upper Klamath River reach annually. Upstream dams block the transport of sediment into this reach of river. The lack of clean and loose gravel diminishes the amount and quality of salmonid spawning habitat downstream of dams. This condition is especially prevalent immediately below Iron Gate Dam (FERC 2006). As described in Section 3.2.2.1 above, to improve habitat conditions in the Klamath River downstream of Iron Gate Dam, PacifiCorp will place 500 cubic yards of gravel annually in the river or a total of 3,500 cumulative cubic yards over the 10 year term of the ITP (NMFS 2012b). Gravel augmentation will improve substrate conditions for spawning and rearing salmon and is also anticipated to improve sediment transport rates increasing scour of disease host habitats through strategic placement of coarse sediment annually in the river.

Water temperatures and water velocities are generally sufficient in this reach for successful adult coho salmon spawning.

3.2.3. Fish-Eating Birds

3.2.3.1. 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., Project reservoirs and the Klamath River) and use communal roost sites. Bald eagles are known to nest and overwinter along the Klamath River.

3.2.3.2. 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 (CDFW 2011). 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 (California Wildlife Habitat Relationship (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.

3.3. Cultural Resources, Socioeconomics, and Environmental Justice

3.3.1. Cultural Resources

Cultural sites associated with IGH were described in the recent CDFW Hatchery and Stocking Program EIR/EIS (ICF Jones & Stokes 2010) and that information is summarized here. The cultural resources inventory that was used included a records search, a review of archival information, and Native American consultation. The records search was conducted in December 2008. No prehistoric or archaeological resources were recorded within the IGH area. One historic site was identified within 0.25 mile of the hatchery area. It consists of a rock wall, partially collapsed, and was recorded in 2003. One multi-component resource was identified within 0.25 mile of the hatchery area. This site consists of a single rock shelter, a small lithic scatter, and some historic debris (ceramics, glass, and metal fragments). It was recorded in 2003. As described below, none of these cultural resources will be impacted by the proposed action.

3.3.2. Socioeconomic Environment

IGH is located in Siskiyou County, California. The most current U.S. Census data from 2010 indicates that Siskiyou County has a population of 44,900 people, with race and ethnicity distribution of 79.5 percent White, 10.3 percent Hispanic[7], and 20.5 percent Racial Minority[8].

There are five Federally-recognized Native American tribes within the Klamath River basin downstream of Iron Gate Dam (San Diego State University 2011). They are:

[7] Hispanics may be of any race.

[8] Racial Minority includes individuals who report a race other than White Non-Hispanic.

- 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.
- 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.
- 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.
- The 85,446-acre Hoopa Valley Indian Reservation is located along the Trinity River in northeast Humboldt County, California.
- 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.

The U.S. Bureau of Labor Statistics database indicates an average unemployment rate of 19 percent in Siskiyou County between January 2010 and January 2011. Total per capita personal income is approximately $42,000. The hatchery currently employs seven permanent positions, which include a Fish Hatchery Manager II, Fish Hatchery Manager I, Office Technician, Fish and Wildlife Technicians (4) and seasonal personnel when funds are available.

PacifiCorp constructed IGH and historically supplied 80 percent of the annual operating cost while CDFW contributed 20 percent of the annual budget. Starting in 2010 PacifiCorp began funding 100 percent of hatchery operations and maintenance costs pursuant to the KHSA. PacifiCorp will continue to fund IGH and implementation of the HGMP, the costs of which PacifiCorp will seek to recover from its customers in the six western states it serves.

3.3.3. Recreation

The lower portion of the Klamath River, beginning at 3,600 feet downstream of Iron Gate dam to the Pacific Ocean (about 189 miles), was designated as a national Wild and Scenic River by Congress in 1981. There are 286 miles (including portions of the Salmon and Scott rivers and Wooley Creek) of which 12 miles are classified as “wild,” 24 miles as “scenic,” and 250 miles as “recreational.” The Outstanding Recreation Value (ORV) for this river is anadromous fisheries (steelhead and salmon). The importance of anadromous fisheries extends into cultural, recreational, and socioeconomic resources.

The Klamath River and the Project reservoirs support a number of recreational pursuits, including boating (standard and whitewater), sport fishing (private and commercial), camping, and day use. Most of the developed recreational capacity in the vicinity of IGH is located at Iron Gate reservoir. There are campgrounds, day use areas, boat launches, and a scenic overlook. Among all of the Project reservoirs, Iron Gate reservoir is the most popular for boating; existing peak use boating density is at 47 percent of the theoretical maximum density. At IGH, there is a day-use area adjacent to the hatchery with tables, an interpretive kiosk, restrooms, parking area, and an ADA-accessible trail to the river/fish return area. There is public access to the river with a graveled road to the shoreline for launching small boats located on the northwest side of the river (accessed from Copco Road).

The Klamath River downstream of Iron Gate Dam has high quality angling opportunities extending nearly 200 miles to the Pacific Ocean. The main Klamath River from 3,500 feet downstream of Iron Gate dam is open to fishing year round. This reach attracts and supports several fishing outfitter services that focus on salmon, steelhead, and trout fisheries. However, angling in the Lower Klamath River is dependent on the annual status of the fall-run Chinook salmon run, so the number of businesses that offer angling guide services changes from year to year. Low returns of adult Chinook spawners in both the Klamath River and Sacramento River have been the basis for recreational fishing restrictions in some years.

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, approximately 4,866 Chinook were taken in the in-river recreational harvest, which is below an average of 10,000 for the years 1978-2010 (CDFW 2011a). Since 2010, in-river recreational harvest levels have rebounded substantially. In 2011, 2012 and 2013 total harvest of fall-run Chinook salmon within the Klamath River were estimated to be 14,128, 17,782, and 21,989 fish respectively (CDFW 2014). The in-river recreational fishery quota for the 2014 season is 4,128 fish over 22 inches. The quota is reduced in response to lower abundance estimates relative to previous years.

The Klamath River downstream of Iron Gate Dam also has extensive boating opportunities. Whitewater boating opportunities exist mainly on the 123-mile segment of the Klamath River from downstream of Iron Gate Dam to the confluence with the Salmon River. Standard boating opportunities are available in most reaches depending on access.

3.3.4. Commercial Fishing

Chinook salmon continues to be the most abundant salmonid species present in the Klamath River 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. The PFMC tracks fish landings and fishing efforts 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.

Klamath stocks have experienced reduced impacts from the mixed-stock ocean salmon fishery from about 2007 through 2010, 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. 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). The value of exvessel commercial troll landings of Chinook salmon along the California coast has been increasing since 2010. The inflation adjusted value of Chinook salmon landings were $5.3 million in 2011, $13.7 million in 2012, and $23.6 million in 2013. Last year's commercial troll harvest produced California's highest inflation-adjusted landings value since 1988 ($66.7 million), although landings revenues in 2013 were still 21 percent below the 1979-1990 inflation-adjusted average of $29.9 million (PFMC 2014c).

3.3.5. Tribal Fishing

In addition to tribal cultural and ceremonial fishing in the basin, commercial harvest of Chinook salmon also occurs. Total tribal harvest of fall-run Chinook salmon in the gill net fishery has ranged from a low of 6,151 fish in 1992 to a high of 95,563 fish in 2012, and has averaged approximately 26,052 for the years from 1978 to 2013 (CDFW 2014). Commercial sales in the Yurok and Hoopa Valley Reservation Indian fall gillnet fisheries in the Klamath River occurred in 1987-1989, 1996, 1999-2004, and 2007-2013 (PFMC 2014c). The average commercial catch of fall Chinook was about 22,900 fish. Spring run Chinook also have harvested and sold commercially in 1989, 1996, 2000-2004, and 2007-2013, with an annual average of about 1,100 fish sold. A lack of adequate returns in 2005 and 2006 prevented commercial sales in those two years. In 2013 approximately 51,400 commercial fall Chinook were harvested, which although the second highest total since 1987, was 36 percent below the 2012 harvest of 80,900 fish (PFMC 2014c). The spring Chinook commercial harvest in 2013 was 971 fish, 13 percent higher than last year and the highest total since 2,300 were harvested in 2007. By comparison, only 33 spring Chinook were taken in 2011, and 259 were harvested in 2010 (PFMC 2014c).

3.3.6. Land Ownership and Land Use

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

In the Klamath River basin area in the vicinity of IGH, the land ownership is dominated by federal lands including the Klamath, Modoc, and Shasta National Forests, National Wildlife Refuges, Lava Beds National Monument, and small parcels owned by the U.S. Bureau of Land Management. Land ownership grows in private ownership near the City of Yreka, and in the Scott and Shasta River watersheds, which include private lands used primarily for timber production and agriculture. Private land use jurisdiction and management in the Klamath River basin area in the vicinity of IGH falls mainly within the jurisdiction of Siskiyou County.

4. ENVIRONMENTAL CONSEQUENCES

This section provides the scientific and analytic basis for comparing the two proposed alternatives. It includes a discussion of the probable consequences of the two proposed alternatives on environmental resources. All resource impacts from a single alternative are presented under the discussion of that alternative. Resources that could be impacted and are part of this environmental analysis include water resources (i.e., hydrology and water quality), biological resources (including fish species and fish-eating birds), cultural resources, socioeconomics and environmental justice. Differences between the No Action and Proposed Action alternatives are primarily related to incremental biological improvements as a result of full implementation of the HGMP over the next ten years. As discussed previously, the environmental impacts from both alternatives are not expected to extend beyond 10 years. Changes in operations to IGH are expected to occur in 2020 or soon thereafter should removal of the hydroelectric facilities be approved as described in the KHSA, or through relicensing of the Project by FERC with fish passage facilities if dam removal does not occur under the KHSA. These changes would trigger the need to apply for a new ESA Section 10(a)(1)(A) permit.

4.1. Effects from Alternative 1 (No Action)

4.1.1. Effects on Water Resources

Under Alternative 1 (No Action), NMFS would not issue an ESA section 10(a)(1)(A) permit. Under the No Action alternative, CDFW and PacifiCorp would have to decide how to proceed in implementing the coho salmon program at IGH in a manner to avoid violating take prohibitions in 50 CFR § 223.203. Therefore, as described in Section 2.1, it is unclear at this point how all of the elements of such a program would be implemented. Regardless of whether elements of the coho salmon program would continue, other ongoing hatchery operations for Chinook salmon and steelhead that affect water quality, hydrology, and other resource areas would continue to occur at levels similar to current hatchery operations.

4.1.1.1. Hydrology

Water for IGH operations is supplied from Iron Gate Reservoir. During daily operations, flows ranging from 7.75 to 34.9 mgd (12.0 to 54.0 cfs) pass through the IGH facilities and discharge into the Klamath River. Under Alternative 1 (No Action), this level of water use would continue. This level of continued water use is not expected to have a significant effect on hydrologic conditions and resources. No appreciable consumption of water will occur under Alternative 1 since water diverted to IGH from Iron Gate Reservoir is returned to the river. Also, the amount diverted is small relative to the total river flow (less than 1 percent), and causes no effects on other water uses in the short reach (about 0.5 miles) of the Klamath River between the IGH water intake in Iron Gate Reservoir and the return discharge from IGH.

4.1.1.2. Water Quality

Under Alternative 1 (No Action), impacts on water quality would likely continue as they currently occur. Water discharged from IGH into the Klamath River would continue to contain contaminants generated during the feeding and care of the fish produced in the hatchery. Water used at IGH would continue to be put through the settling ponds, and treated water would be discharged into the Klamath River. The water quality characteristics of the discharge with regard to nutrients and organic matter would likely be unchanged from current conditions. For example, the North Coast Regional Water Quality Control Board

(NCRWQCB) Total Maximum Daily Load (TMDL) analysis found that nutrient loading due to IGH operations through the raceways and settling ponds is approximately 2,109 lbs of total nitrogen and 567 lbs of total phosphorous. These results indicate that the hatchery is a relatively minor source of nutrients to the Klamath River. Organic matter loading of hatchery operations was not estimated in the TMDL analysis but is also expected to be minor. Therefore, Alternative 1 is not expected to result in significant impacts to nutrients and algae in the Klamath River.

Under Alternative 1 (No Action), the characteristics of the IGH discharge with regard to other water quality constituents also would likely be unchanged from current conditions. CDFW would continue to operate the IGH pursuant to an individual National Pollutant Discharge Elimination System (NPDES) permit issued by the NCRWQCB to both CDFW and PacifiCorp (NPDES Permit No. CA 0006688, WDID 1A800520SIS). The NCRWQCB permit establishes conditions for the IGH discharge to maintain compliance with the Clean Water Act including adherence to water quality standards that establish limits or prohibitions on direct discharge of effluent containing detectable levels of potential contaminants to the Klamath River. The NPDES permit and the standards outlined in the NPDES permit were developed to be protective of designated beneficial uses (including salmonids rearing, spawning, and migration), so it is expected that the hatchery effluent will have a negligible impact on Klamath river water temperatures, pH, and DO under Alternative 1. This conclusion is consistent with Item 11 under the existing permit, where the Regional Water Board considers the discharge to have very low potential to cause nonattainment of toxicity standards due to minimal chemical treatment of fish and high discharge dilution in the receiving waters. In addition, the NPDES permit requires a chemical pollutant scan under the California Toxics Rule every five years. The scan was last performed and submitted in 2012, and did not identify any chemicals discharged from IGH above background levels. Therefore, Alternative 1 is not expected to result in significant impacts to other water quality constituents in the Klamath River.

4.1.2. Effects on Biological Resources

4.1.2.1. Anadromous Salmonid Species

Under Alternative 1 (No Action) as described in section 2.1, if NMFS does not issue the ESA Section 10(a)(1)(A) permit, CDFW and PacifiCorp would have to decide how to proceed in implementing the coho salmon program at IGH, and it is unclear at this point whether and how all of the elements of the program would be implemented. Under Alternative 1, there would be no authorized take of listed coho salmon at IGH. Without take authorization, collection and handling of listed coho salmon may cease, and other sources of hatchery broodstock would need to be identified (see sections 2.1 and 4.1.1). However, it is unclear whether collection and handling of listed coho salmon would cease, and, if it does cease, what other sources of hatchery broodstock might be identified.

Elimination of the coho salmon hatchery program at IGH could have significant adverse conservation consequences. As discussed in Appendix A, if the coho salmon hatchery program at IGH were eliminated, all potential negative impacts of the IGH coho salmon program to biological resources including anadromous salmonid species would be eliminated. However, if the IGH coho salmon program were eliminated entirely, modeling predicts that the total (NOR + HOR) average coho salmon population abundance would decrease from 1,376 (NOR + HOR) to 563 (NOR), and the minimum population size would decrease from 685 to 258. This reduction in population size would increase extinction risks in the near term.

Given the adverse conservation consequences of eliminating the IGH coho salmon program, the history of the program operating similar to current operations, and the uncertainty regarding whether elements of the program would continue or not, NMFS believes it is appropriate to also analyze the effects of continuing current operations of the IGH coho salmon program under the No Action alternative, even though such operations may change without issuance of a Section 10 permit. Under such circumstances, the program would collect enough adult coho broodstock each year to produce 75,000 smolts (between 135-270 adults). Of the fish needed for broodstock, 20 to 50 percent (27 to 135 adults) would be NOR. Adults may enter the facility and not be used for broodstock; the handling and release of these adult coho back to the river may result in injury or mortality. Excess adult fish may be returned back to the river, or placed in tributary streams for supplementation purposes. After population abundance goals are achieved, excess HOR adult fish may be euthanized to achieve a Proportionate Natural Influence (PNI) value of >0.5. Less than 1 percent of the fish collected and released are expected to suffer injury sufficient to result in mortality (Keith Pomeroy, Hatchery Manager II, pers. comm. 2012).

Once broodstock are collected, coho eggs are incubated and reared to age-1. Egg to yearling survival has averaged 32 percent over the past four years. This is expected to increase with changes implemented beginning in 2010 including the addition of bird netting to raceways, decreases in egg densities during incubation, the installation, in 2011, of a moist air incubation system for coho egg rearing, and decreases in hatchery inbreeding. It is expected that in-hatchery survival from egg to yearling will exceed 50 percent. The total smolt production is expected to remain at 75,000 smolts per year. Additional excess smolts produced at the hatchery would be released into the Klamath River.

One of the major impacts of hatchery propagation at IGH is the genetic and demographic consequences of inbreeding. Inbreeding results when closely related adults are spawned at the hatchery. When inbreeding occurs, survival of progeny is decreased. The high degree of inbreeding in the coho salmon program has resulted from a number of factors including small program size, the avoidance of jacks (grilse) in the broodstock, and the lack of a genetic broodstock management program at the hatchery.

The potential for indirect impacts to naturally-spawned juvenile salmon would likely result from competitive and predatory interactions, disease transfer, and interbreeding between HOR and NOR individuals in the Klamath River. Interactions occur between HOR coho salmon and NOR coho salmon, Chinook, and steelhead. These interactions are an indirect impact of the coho salmon program at IGH and result in both positive and negative effects on salmon populations.

Predation – Predation of NOR fry by hatchery yearlings has been reported in previous studies (Allee 1981, Larkin, 1956, Naman 2008). Based on the time and size at release, hatchery coho salmon yearlings may prey on naturally-produced coho, steelhead, and Chinook fry. With regard to coho, there is no specific data on the impact HOR coho predation may be having on NOR coho populations in the Klamath. Some of the hatchery coho salmon yearlings reside in the Klamath River above Big Bar for approximately 1.5 to 2 months and then migrate quickly to the ocean (CDFW 2003). The time period of likely predatory impacts is from March to May. During this time there is the potential they may prey on subyearling NOR coho salmon. The impacts of this predation are expected to be relatively minor given the small number of fry in the main stem at the time when yearling HOR coho would be migrating and the relatively low number of HOR coho released from IGH. This assumption is consistent with modeling results presented in the HGMP, which showed that hatchery coho induced mortality on naturally produced coho from predation, competition and disease was less than 6 percent.

With regard to steelhead and Chinook, the impact of predation depends, in part, on the prey population size, that is, the effect of predation on small populations could be potentially significant. Given the small population abundance of natural coho populations, predation by hatchery fish could have a substantial impact some years. The larger population sizes of Chinook and steelhead in the Klamath indicate that hatchery predation may impact these species less.

Competition – Similar to the impacts of predation there is potential for competition between HOR coho salmon and NOR coho, Chinook and steelhead. Flagg et *al*. (2000) found that, except in situations of low fish density, increasing release numbers of hatchery fish can negatively impact naturally produced fish because naturally produced fish can get displaced from portions of their habitat. Competition between hatchery and naturally produced salmonids can also lead to reduced growth of naturally produced fish (McMichael et *al*. 1997). Competition between hatchery and natural salmonids in the ocean has also been shown to lead to density-dependent mechanisms that affect natural salmonid populations, especially during periods of poor ocean conditions (Beamish et *al*. 1997, Levin et *al*. 2001, Sweeting et *al*. 2003). In the Klamath River the most significant impact from competition likely occurs as result of competition for space in refugia and rearing habitat in the main stem and tributaries. The potential for adverse effects on natural coho salmon populations is highest in late spring when lower flows and higher water temperatures may increase competition for suitable rearing habitat (Joint Hatchery Review Committee 2001). Because the release of HOR yearling from the hatchery coincides with the migration of NOR coho, Chinook, and steelhead, there is the potential for competition in areas where there is limited rearing or migratory habitat (such as the Lower Klamath). There is not expected to be competition between adult HOR coho salmon and NOR adult salmon for spawning habitat. This is because of low salmon abundances on the spawning grounds and adequate spawning habitat in the Klamath River basin. Competition between IGH juveniles and NOR juveniles is also expected to be low given the short residence time (< 22 days) of HOR yearling in the river and the low number of IGH coho yearling released (75,000).

Disease –Currently, CDFW certifies the health and disease status of coho salmon prior to release and disease has not been an issue for coho salmon at IGH. Under Alternative 1, as under the current hatchery program, there are not expected to be disease effects on NOR salmon from the direct release of juvenile coho.

Interbreeding – Spawning by IGH hatchery coho salmon is not controlled on the spawning grounds of the Klamath River. If the IGH coho salmon program were to continue under Alternative 1 as it does currently, this would not change and interbreeding between HOR coho from IGH and NOR coho salmon is likely to continue in the Upper Klamath, Scott, and Shasta populations. Other populations are known to experience negligible coho straying from IGH. When hatchery fish stray into natural populations they transfer genes from hatchery populations into naturally spawning populations (Pearse et *al*. 2007). This is thought to be problematic because hatchery programs alter the genetic composition (Reisenbichler and Rubin 1999, Ford 2002), phenotypic traits (Hard et *al*. 2000, Kostow 2004), and behavior (Berejikian et *al*. 1996, Jonsson 1997) of natural populations. These genetic interactions between hatchery and naturally produced stocks decrease the amount of genetic and phenotypic diversity of a species by homogenizing once disparate traits of hatchery and natural fish. The result has been progeny with lower survival (McGinnity et *al*. 2003, Kostow 2004) and ultimately, a reduction in the fitness of the natural stock (Reisenbichler and McIntyre 1977, Chilcote, 2003, Araki et *al*. 2007) and outbreeding depression (Reisenbichler and Rubin 1999, HSRG 2009).

It is expected that there would remain a low proportion of natural influence in the hatchery brood stock if the hatchery coho salmon program would continue as it does currently. However, as discussed above, it is unclear whether, without take authorization under ESA Section 10(a)(1)(A), collection and handling of listed coho salmon would continue, and other sources of hatchery broodstock may need to be identified. The Proportionate Natural Influence (PNI) measures gene flow between HOR and NOR fish, and is calculated by determining the proportion of NOR fish in the hatchery brood stock (pNOB) and dividing this by the proportion of natural spawners in the stream comprised of HOR fish (pHOS) plus the percent NOR fish in the hatchery brood stock (pNOB) (HSRG, 2009). In the analysis of the current coho salmon program, HOR adults on the spawning grounds were found to make up anywhere between 10 and 47 percent of the total spawning population. Under current conditions, pNOB would be 10 percent, as this is the current target for the IGH program. The large proportion of hatchery fish on the spawning grounds results in a PNI of ~0.17. This value is far below the HSRG recommended value of 0.67 for biologically important populations (HSRG 2009). In short, the combined natural and hatchery population genetics are being driven more by the hatchery than the natural environment, thereby reducing population fitness to 0.50 (0.5, lowest score possible). A summary of biological metrics for the current hatchery program are provided in Table 1[9].

Table 1. Summary escapement, harvest, broodstock and HSRG performance indicators of PNI and pHOS (productivity and capacity of 2.3 and 800) if the IGH coho salmon program were to continue under Alternative 1 (No Action) as it does currently (This table is reproduced from the HGMP: Table A-3).

		Max	Min	Ave
Escapement (adults)		734	71	228
HOR Total Escapement (plus strays)		289	50	94
HOS Effective Escapement		231	40	76
Total Natural Escapement (& All HOS)		1,023	130	322
Hatchery Broodstock		212*	212	212
Excess at Hatchery		2,731	308	759
Total Run-size		4,219	685	1,376
PNI		0.17		
pHOS		25%		
Population Fitness (range 0.5 to 1)		0.50		

* Assumes that the program collected more eggs than required to meet juvenile release targets. Excess eggs are culled at the eyed egg life-stage.

Although risks from hatchery interbreeding would be expected, there could also be benefits from maintaining hatchery production. If natural populations are too small without the input of hatchery spawners they can experience depensation, or the negative genetic impacts of small population size (e.g., inability to find mates, inbreeding). It is expected that, if the IGH coho salmon program were to continue under Alternative 1 as it does currently, Upper Klamath and Shasta populations could benefit through the contribution of strays. These two populations currently fall below the depensation thresholds set by Williams et *al.* (2008). At these abundances they are experiencing depensation. The coho salmon program at IGH contributes approximately 10-50 percent of the spawners to these populations depending on the return year. The benefits from spawning contributions are at least partially offset by the negative characteristics of hatchery spawners discussed above but the influx of spawners to these populations is a net benefit to these populations given their low natural abundance.

4.1.2.2. Anadromous Salmonid Habitat

4.1.2.2.1. Juvenile Summer and Winter Rearing Areas

[9] Under Alternative 1, if collection and handling of listed coho salmon were not authorized, one potential result is that out-of-basin coho salmon would be used as broodstock for a hatchery coho salmon program to continue. In this instance, the hatchery coho program would be a segregated program, and the pNOB would be 0, resulting in a PNI of 0. This would be inconsistent with HSRG recommendations.

If the IGH coho salmon program were to continue under Alternative 1 (No Action) as it does currently, effects on juvenile summer and winter rearing area could occur from the presence of hatchery fish. The amount of food in some areas could be limited at certain times of the year by hatchery fish. Space for rearing juveniles and fry could be limited by hatchery fish, particularly during low-flow periods in late summer.

4.1.2.2.2. Juvenile Migration Corridor

If the IGH coho salmon program were to continue under Alternative 1 (No Action) as it does currently, effects on juvenile migration corridor habitats could occur from the presence of hatchery fish. Food, space, and cover could be limited in certain months and in certain areas (such as thermal refugia) due the presence of hatchery juveniles. The function of important habitat in the juvenile migration corridor could continue to be limited due to reductions in food and space resulting from the presence of juvenile hatchery fish from March to May.

4.1.2.2.3. Adult Migration Corridor

There are expected to be little, if any, impacts to the adult migration corridor if the IGH coho salmon program were to continue under Alternative 1 as it does currently. At the time when adult hatchery coho return to the hatchery and spawning grounds, there is adequate migratory habitat to support salmon. There is therefore little if any competition between HOR coho and NOR salmon for migratory habitat.

4.1.2.2.4. Spawning Areas

There are expected to be little, if any, impacts to spawning habitat if the IGH coho salmon program were to continue under Alternative 1 as it does currently. There is expected to be adequate habitat to support HOR and NOR salmon on spawning grounds. None of the spawning areas where IGH coho stray are at, or near, carrying capacity. There is therefore little, if any, impact of HOR coho on natural spawning grounds.

4.1.2.3. Other Fish Species

4.1.2.3.1. Eulachon

Eulachon abundance in the Klamath River has decreased to the point where detecting them in the Klamath River has become difficult. In the Klamath River, adults rarely migrate more than 8 miles inland (NRC 2004). Yurok Tribal fisheries biologists surveyed for eulachon in the lower Klamath River and found only two eulachon in early 2011 and 40 in 2012 (Yurok Tribal Fisheries Program 2011, 2012). Yurok tribal fishermen also caught five eulachon in early 2011 (Yurok Tribal Fisheries Program 2011). In winter, eulachon enter the Klamath River to spawn, but do not migrate beyond the estuarine habitat within the lower several miles of the Klamath River. Spawning appears to be related to river water temperature and the occurrence of high tides (Ricker et al.1954, Smith and Saalfeld 1955, Spangler 2002), generally occurring in January, February, and March. Shortly after hatching, the larvae are carried downstream and dispersed by estuarine, tidal, and ocean currents. After the yolk sac is depleted, eulachon feed on pelagic plankton.

Predation by hatchery coho salmon smolts on newly hatched juvenile eulachon may occur if migration timing of hatchery salmonid juveniles overlaps with larvae and fry eulachon presence in the lower Klamath River and estuary. Most hatchery coho salmon smolts are anticipated to enter the lower Klamath River and estuary between the mid-April and late May. However, some coho salmon smolts may stop migrating entirely for short periods of time if factors such as water temperature inhibit migration. Sampling indicates coho salmon smolts are largely absent from the lower Klamath River and estuary by July (NRC 2004). Therefore, there is a potential for both coho salmon smolts and fry eulachon to be present in the lower Klamath River and estuary for a brief period of time. Since IGH coho salmon smolts will not be present in the Rogue River, there is no opportunity for interactions between larvae and fry eulachon to occur with IGH coho salmon smolts. Because of the overlap in the lower Klamath River and estuary between the emergence of fry eulachon and migration timing of coho salmon smolts in the spring, there would be a potential for predation on and competition with eulachon by hatchery coho salmon smolts. Presently, specific information regarding the predation on juvenile eulachon by juvenile salmonids is non-existent.

Fry eulachon occur in the water column and move downstream with the prevailing currents into pelagic areas where they begin to feed on small plankton (e.g., copepods and euphausiids). Fry eulachon are semitransparent and very small making them more difficult to spot in the water column. Coho salmon are generally present along shorelines in areas with abundant cover. Juvenile and smolt coho salmon typically feed during the day and prefer aquatic insects at the surface of a stream, such as mayflies, caddis flies, and stoneflies, while juvenile eulachon are plankton-feeders, chiefly eating crustaceans such as copepods and euphausiids in pelagic and open water habitats. Differences in habitat selection and in the diets of the two species, along with the abundance of alternative prey items available to juvenile coho salmon in the Klamath River, greatly reduce the likelihood that these two species would use similar habitat types within the lower Klamath River and estuary. Therefore, if the IGH coho salmon program were to continue under the No Action alternative as it does currently, predation on and competition with eulachon by hatchery juvenile and smolt coho salmon is unlikely to occur and it is not expected to result in significant impacts to eulachon.

Adult coho salmon may prey on eulachon in the marine and estuarine environments (NMFS 2006). Therefore, adult coho produced by the program may consume some eulachon during their ocean migration. However, given the number of hatchery adults produced by the program (less than 1,500 on average) and the large prey base of other species available for coho salmon to consume in the ocean, if the IGH coho salmon program were to continue under the No Action alternative as it does currently, it is not expected to result in significantly impacts to eulachon.

Because IGH is located far upstream of critical habitat designated for the Southern DPS of Pacific eulachon, and the No Action alternative is not likely to adversely affect any prey resources or migration corridors utilized by Pacific eulachon, NMFS does not anticipate that the No Action alternative will have any effect on essential features of critical habitat for the southern DPS of Pacific eulachon. Therefore, the No Action alternative is not likely to adversely affect critical habitat of the southern DPS of Pacific eulachon.

4.1.2.3.2. Green Sturgeon

Northern DPS green sturgeon (Species of Concern) enter the Klamath River between March and July to spawn and some adults remain in river until the first fall freshets trigger emigration downstream. Green sturgeon are not thought to ascend the lower Klamath River beyond Ishi Pishi Falls at RM 66 (NMFS 2005) which is about 125 miles downstream of IGH. IGH operations are not expected to significantly affect the physical, chemical and biological conditions within the lower Klamath River. Additionally, the Biological Review Team (BRT) noted that current threats to Klamath River green sturgeon are increased river temperatures, reduced oxygen concentrations, and the alteration of the river flow regime (NMFS 2005). Salmon hatchery operations or production were not listed as a threat to green sturgeon in any river examined by the BRT.

The Southern DPS of North American green sturgeon is listed as a threatened species, and includes all green sturgeon spawning populations south of the Eel River, with the only known spawning population being in the Sacramento River (71 FR 17757; April 7, 2006). Sub-adult and adult Southern DPS of North American green sturgeon enter coastal bays and estuaries north of San Francisco Bay, CA, during the summer months to forage (Lindley et al. 2008). In the Klamath River, the occurrence of Southern DPS green sturgeon is limited to the lower Klamath River and the estuary. In the Rogue River, the occurrence of southern DPS green sturgeon individuals is likely limited to the estuary in areas that are tidally influenced. Sub-adult and adult life stages of Southern DPS green sturgeon likely only occur in these areas during the summer and fall. Because of the upriver IGH location, and recognition by the BRT that hatchery production does not pose a threat to green sturgeon in the lower Klamath River, the No Action alternative is not likely to significantly affect green sturgeon. Critical habitat for the southern DPS of North American green sturgeon is not designated in the Klamath River or Rogue River (74 FR 52300; October 9, 2009), and NMFS does not anticipate that the No Action alternative will have an effect on waters offshore from the Klamath River or Rogue River estuaries, where critical habitat for the southern DPS does occur.

4.1.2.3.3. Pacific Lamprey

Adult Pacific lamprey enter the Klamath River at all times of the year to spawn, but cease feeding and die shortly after spawning. The No Action alternative is not expected to affect the physical, chemical and biological conditions for Pacific lamprey spawners within the Klamath River. However, coho salmon juveniles produced by IGH under the No Action alternative could prey on larval lamprey, which hatch within several weeks of spawning activity and drift downstream to backwater areas where they burrow into the substrate and commence feeding as ammocoetes (Kostow 2002). Pfeiffer and Pletcher (1964) observed that coho salmon fry prey on emergent larval lamprey. However, due to the small number of hatchery smolts released (75,000) if the IGH coho salmon program were to continue under the No Action alternative as it does currently, predation by coho salmon under the No Action alternative is not likely to significantly affect juvenile Pacific lamprey due to the diversity of other prey items utilized by coho salmon juveniles and the relatively high fecundity of larvae produced by Pacific lamprey spawners.

In addition, coho salmon are prey for adult Pacific lamprey. The coho salmon adults produced by the hatchery program provide a food source for Pacific lamprey in both the marine and freshwater periods of their life-cycle. Therefore, the No Action alternative will not negatively affect Pacific lamprey adults, unless hatchery production of coho salmon is eliminated. However, even if that occurred, due to the small number of hatchery adult coho salmon that are produced (generally less than 1,500) and the availability of other more abundant and desirable food sources (Chinook salmon), elimination of hatchery production of coho salmon at IGH is not expected to result in significant impacts to Pacific lamprey adults.

4.1.2.4. Fish-Eating Birds

If the IGH coho salmon program were to continue under the No Action alternative as it does currently, IGH production likely would continue to benefit overall foraging opportunities for fish-eating birds by increasing the numbers of coho salmon. In any event under the No Action alternative, IGH production likely would continue to benefit overall foraging opportunities for fish-eating birds by increasing the numbers of Chinook salmon and steelhead. However, this benefit could be offset to the extent that IGH production adversely affects natural populations of salmon and steelhead through behavioral differences that result in diminished fitness and survival of naturally-produced fish. If hatchery production of coho salmon were eliminated under the No Action alternative, due to the small number of hatchery smolts currently released (75,000) and the availability of other food sources, elimination of hatchery production of coho salmon at IGH is not expected to result in significant impacts to fish-eating birds.

4.1.3. Effects on Cultural Resources, Socioeconomics, and Environmental Justice

4.1.3.1. Cultural Resources and Socioeconomic Environment

Under Alternative 1 (No Action), no effects on cultural resources are expected. As discussed above in section 3.3.1, no prehistoric or archaeological resources are known to occur within the IGH area, and no activities would occur under Alternative 1 (No Action) that could cause disturbance to other known sites in the vicinity.

Under Alternative 1 (No Action), no significant effects on population or employment are expected. As discussed above in section 3.3.2, IGH employs seven permanent positions, so the impact of Alternative 1 on regional employment and income is small.

Under Alternative 1 (No Action), PacifiCorp would continue funding 100 percent of hatchery operations and maintenance costs pursuant to the KHSA. These costs will be borne by PacifiCorp customers in the six western states, but would constitute only a minute fraction of overall costs to customers.

Effects on the tribes under Alternative 1 may include reduced cultural benefits to tribal communities in the region as a result of continued, reduced coho salmon abundance. Effects on tribal fishing are discussed further below in section 4.1.3.3.

4.1.3.2. Recreation

Under Alternative 1 (No Action), no significant effects on recreational resources are expected including boating (standard and whitewater), camping, and day use. No activities would occur under Alternative 1 (No Action) that could cause disturbance to recreational facilities that occur within the IGH area, and elsewhere in the vicinity.

Under Alternative 1 (No Action), beneficial effects on recreational sport fishing (private and commercial) would continue similar to beneficial effects that currently occur from operation of the salmon and steelhead production program at IGH. Even if hatchery production of coho salmon were eliminated under the No Action alternative, directed fishing for listed coho salmon is currently prohibited, and hatchery production of Chinook salmon and steelhead would continue. Production from Iron Gate Hatchery contributes to recreational fisheries (as well as tribal fisheries) in the Klamath River Basin and the Pacific Ocean. In the mixed-stock coastal fisheries of the Pacific Ocean, the presence of hatchery fish allows for higher harvest levels than if there were no hatchery stocks in the fishery. Under Alternative 1, IGH would continue to produce fish that would provide support to these fisheries. However, because wild fish are harvested along with hatchery fish in coastal recreational fisheries, an increase in allowable harvest may also affect the escapement of wild stocks when these fish are harvested along with hatchery fish.

Under Alternative 1, IGH production would also continue to benefit recreational fisheries by increasing the numbers of salmon and steelhead. However, IGH production may also have an adverse effect on natural populations of salmon and steelhead through behavioral differences that result in diminished fitness and survival of HOR relative to NOR fish, and increased competition with and predation on NOR populations.

4.1.3.3. Commercial and Tribal Fishing

Production from IGH contributes to commercial and tribal fisheries in the Klamath River Basin and the Pacific Ocean. Under Alternative 1 (No Action), commercial and tribal fishing would continue to benefit from operation of the salmon production program at IGH because hatchery-produced salmon supplement these fisheries. Under Alternative 1, it is assumed IGH would continue to produce Chinook salmon and steelhead at historical production levels that would provide support to these fisheries. However, it is uncertain whether the coho salmon program at Iron Gate Hatchery would continue in its current form under Alternative 1.

4.1.3.4 Land Ownership and Land Use

Under Alternative 1 (No Action), no significant effects on land ownership and land use are expected. No activities would occur under Alternative 1 (No Action) that could cause changes in the current patterns of land ownership and land use in the IGH area.

4.2. Effects from Alternative 2 (Proposed Action)

Under Alternative 2, NMFS would issue an ESA section 10(a)(1)(A) permit for a term of 10 years authorizing the take of listed coho salmon at IGH pursuant to the conservation actions identified in the HGMP.

The primary purpose of the HGMP is to provide a single, comprehensive source of information regarding anadromous salmonid hatchery programs. NMFS will use this information in its ESA processes to assess impacts on listed anadromous fish. The elements of implementation of the HGMP that will have greatest environmental impact are as follows: (1) Capture of approximately 27-68 unmarked adult coho to use as broodstock (the goal is for 20 to 50 percent of broodstock to be of natural origin (NOR); and (2) Volitional release of 75,000 yearling coho into the Upper Klamath River between March 1 and April 15th.

4.2.1. Effects on Water Resources

4.2.1.1. Hydrology

No significant effects on hydrologic conditions and resources are expected under Alternative 2 (Proposed Action). The potential hydrology effects under Alternative 2 (Proposed Action) would be the same as described for Alternative 1 (No Action) in Section 4.1.1.1 because there is no appreciable difference in terms of water use between the two alternatives. The current level of water use at IGH would continue. No appreciable consumption of water will occur under Alternative 2 since water diverted to IGH from Iron Gate Reservoir would be returned to the river. Also, the amount diverted would be small relative to the total river flow (less than 1 percent), and cause no effects on other water uses in the short reach (about 0.5 miles) of the Klamath River between the IGH water intake in the deeper waters of Iron Gate Reservoir and the return discharge to the river from IGH. Improvements to hatchery-related facilities (e.g., Bogus Creek weir) are not expected to have any perceptible effect on water availability or use.

4.2.1.2. Water Quality

No significant effects on water quality are expected under Alternative 2 (Proposed Action). The potential water quality effects under Alternative 2 (Proposed Action) would be the same as described for Alternative 1 (No Action) in Section 4.1.1.2 because there is no appreciable difference between the two alternatives in terms of activities that can affect water quality. Alternative 2 includes improvements to the Bogus Creek Fish Counting Facility, including installation of taller weir panels and installation of an adult trap. Installation of these structures will not disturb existing riparian vegetation, requires no disturbance to soils of the stream bank, and will result in negligible disturbance to the streambed and negligible increases in suspended sediment.

Under Alternative 2 (Proposed Action), water discharged from IGH into the Klamath River would continue to contribute minor amounts of nutrient and organic matter loading to the river due to IGH operations, but these small loads are not expected to result in significant impacts to nutrients and algae in the Klamath River. The characteristics of the IGH discharge with regard to other water quality constituents also would likely be unchanged from current conditions. CDFW would continue to operate the IGH pursuant to an NPDES permit that establishes conditions for the IGH discharge to maintain compliance with the Clean Water Act. Therefore, Alternative 2 is not expected to result in significant impacts to other water quality constituents in the Klamath River for the same reasons as described for Alternative 1 (No Action) in section 4.1.1.2.

4.2.2. Effects on Biological Resources

4.2.2.1. Anadromous Salmonid Species

Under Alternative 2 (Proposed Action), effects on coho salmon would occur from continued operation of the coho salmon program at IGH and implementation of the HGMP. Hatchery propagation of coho salmon under Alternative 2 would require the lethal take of adult coho salmon for broodstock and the loss of individuals during incubation, rearing, and marking. Activities authorized under Alternative 2 would include collection of a minimum of 135 and maximum of 270 adult spawners (up to 50 percent of which may be NOR adults) in order to meet the IGH's goal of producing 75,000 yearling coho each year. In contrast, past hatchery operations have required the lethal take of approximately 270 fish each year to meet production objectives. Adults may enter the facility and not be used for broodstock. Excess adult fish may be returned back to the river or placed in tributary streams for supplementation. If fish abundance targets have been met in Bogus Creek, hatchery-origin broodstock may be euthanized if additional hatchery fish on the spawning grounds would exceed targets (pHOS) necessary to achieve a PNI > 0.5. The disposition of excess adults will be coordinated with NMFS on an annual basis. The handling and release of these adult coho back to the river may result in injury or mortality. It is expected that less than 1 percent of the fish collected and released will suffer injury sufficient to result in mortality (Keith Pomeroy, Hatchery Manager II, pers. comm. 2012). The actions proposed in the HGMP (and that would be implemented under Alternative 2) would be expected to reduce or eliminate factors such as low fertilization rates, egg and juvenile culling for genetic reasons, and bird predation in raceways, so that fewer adults are needed for broodstock over time. Thus, take of coho salmon from IGH activities would be reduced under Alternative 2 compared to Alternative 1 (No Action) if the IGH coho salmon program were to continue under the No Action alternative as it does currently. The overall reduction in take of listed coho salmon, along with the improved genetic makeup of the broodstock and improved rearing survival, would be expected to result in an overall beneficial effect on anadromous salmonid species and would not be expected to result in a significant adverse effect to anadromous salmonid species.

Inbreeding – Certain components of the current management scheme (small program size, the avoidance of jacks (grilse) in the broodstock, and the lack of a genetic broodstock management program at the hatchery) are anticipated to produce progeny with decreased survival rates due to lower fitness caused by inbreeding and divergence between brood years. Alternative 2 would be expected to decrease the degree of inbreeding and divergence in the hatchery population based on HGMP activities, such as the incorporation of jacks into the broodstock, the incorporation of NOR adults into the broodstock (20 to 50 percent of total broodstock), and the avoidance of HOR and sibling crosses in mating as resulting from the implementation of a genetically based spawning matrix.

Similar to the discussion under Alternative 1 (No Action), if the IGH coho salmon program were to continue under the No Action alternative as it does currently, under Alternative 2 the potential for indirect impacts to naturally-spawned juvenile salmon would likely result from competitive and predatory interactions, disease transfer, and interbreeding between HOR and NOR individuals in the Klamath River. Interactions would occur between HOR coho salmon and NOR coho salmon, Chinook, and steelhead. These interactions are an indirect impact of the coho salmon program at IGH and result in both positive and negative effects on salmon populations.

Predation – Based on the time and size at release, hatchery coho salmon yearlings may prey on naturally-produced coho, steelhead, and Chinook fry. With regard to coho, there is no specific data on the impact HOR coho predation may be having on NOR coho populations in the Klamath River basin. Modeling results presented in the HGMP indicate that hatchery coho induced mortality to natural coho from predation, competition and disease is less than 6 percent. Alternative 2 does not change the number of yearlings produced annually – it incorporates measures to improve survival from one life stage to the next so that the IGH can, pursuant to an adaptive management program, reduce the number of NOR and HOR broodstock collected as egg fertilization and juvenile survival rates improve. If successful, there may be a corresponding increase in the number of NOR coho in the river. Under Alternative 2, the impacts of this predation on NOR coho are expected to be relatively minor given the small number of fry in the main stem at the time when yearling HOR coho would be migrating, the relatively low number of HOR coho released from IGH, and implementation of the smolt indices so that HOR smolts released from IGH are ready for migration to the estuary and ocean environments, and will be less likely to residualize, compete, and predate on NOR coho salmon in the system. The impacts on Chinook and steelhead are expected to be similarly minor due to the large population sizes of both species in the Klamath[10]. In sum, NMFS does not anticipate any significant effect on predatory interactions under Alternative 2 due to implementation of the HGMP.

Competition – Similar to the impacts of predation, there is potential under Alternative 2 for impacts related to competition between HOR coho salmon and NOR coho, Chinook and steelhead for space in refugia and rearing habitat in the main stem Klamath River and tributaries. The potential for adverse effects on natural coho salmon populations is highest in late spring when lower flows and higher water temperatures may increase competition for suitable rearing habitat (Joint Hatchery Review Committee 2001). Because the release of HOR yearling from the hatchery coincides with the migration of NOR coho, Chinook, and steelhead, there is the potential for competition in areas where there is limited rearing or migratory habitat (such as the Lower Klamath). Actions under Alternative 2 would not change from existing conditions the number of coho yearlings produced per year. Competition between IGH juveniles and NOR juveniles is also expected to be low given the short residence time (22 days) of HOR yearling in the river, the low number (75,000) of IGH coho yearlings released, and implementation of the smolt indices so that HOR smolts released from IGH are ready for migration to the estuary and ocean environments, and will be less likely to residualize, compete, and predate on NOR coho salmon in the system. Under Alternative 2, there is not expected to be competition between adult HOR coho salmon and NOR adult salmon for spawning habitat because the abundances of spawners on the spawning grounds in the Klamath River are expected to remain low.

Disease –Currently, CDFW certifies the health and disease status of coho salmon prior to release and disease has not been an issue for coho salmon at IGH. Under Alternative 1, as under the current hatchery program, there are not expected to be disease effects on NOR salmon from the direct release of juvenile coho. However, because hatchery coho are susceptible to infection by the myxosporean *Ceratomyxa shasta*, returning adult coho that spawn naturally may increase the prevalence of this organism and increase disease load in the basin. This would not significantly change under Alternative 2,

[10] Modeling in the HGMP indicated for example that hatchery coho induced mortality on natural Chinook populations was less than 0.001.

so there are not expected to be significant disease effects on NOR salmon associated with implementation of the HGMP.

Interbreeding –Under Alternative 2, spawning by IGH hatchery coho salmon would be reduced in Bogus Creek and likely other tributaries with the implementation of this alternative. The HGMP calls for achieving the HSRG and CHSRG recommended PNI value greater than 0.5. The achievement of these objectives is expected to increase population fitness, abundance and productivity.

Although there are risks from hatchery fish interbreeding with natural origin coho there can also be benefits. If natural populations are too small without the input of hatchery spawners they can experience depensation, or the negative genetic impacts of small population size (e.g., inability to find mates, inbreeding). As discussed above regarding Alternative 1, it is expected that Alternative 2 could benefit the Upper Klamath and Shasta populations through the contribution of strays. These two populations currently fall below the depensation thresholds set by Williams e*t al.* (2008). At these abundances they are experiencing depensation. The coho program at IGH contributes approximately 10-50 percent to these populations depending on the year and under Alternative 2 this level of straying would likely continue. The benefits from spawning contributions are at least partially offset by the negative characteristics of hatchery spawners discussed above but the influx of spawners to these populations is a net benefit to these populations given their low natural abundance.

Under Alternative 2 (Proposed Action), human disturbance to returning coho salmon spawners may be increased slightly during the fall and winter periods. Boat surveys, foot surveys, and other actions directed at coho salmon would be increased as a result of HGMP research, monitoring, and evaluation activities, but would be confined to discrete times during the year, and to tributary areas, when and where the fish are present. Human presence in areas to conduct survey activities would be of low intensity and not constant, limited to a few individuals and a few days per week during the season. Potential noise and visual disturbance to coho salmon spawners resulting from these activities are therefore not expected to be significant.

4.2.2.2. Anadromous Salmonid Habitat

The potential effects on fish habitat under Alternative 2 (Proposed Action) would be similar to those described for Alternative 1 (No Action) in Section 4.1.2.2 if the IGH coho salmon program were to continue under the No Action alternative as it does currently, because there is no appreciable difference between the two alternatives in terms of activities that can affect fish habitat. Under Alternative 2, no significant adverse effects are expected on anadromous salmonid habitat. Although there is expected to be competition under Alternative 2 between HOR coho salmon and NOR coho, Chinook and steelhead in refugia and rearing habitat in the mainstem Klamath River and tributaries, this competition is not expected to result in significant adverse effects to anadromous salmonid habitat for the same reasons as discussed in Section 4.2.2.1 under Competition. In addition, Alternative 2 does not contain any habitat restoration components. Alternative 2 includes improvements to the Bogus Creek Fish Counting Facility, including installation of taller weir panels and installation of an adult trap. Installation of these structures will not disturb existing riparian vegetation, requires no disturbance to soils of the stream bank, and will result in negligible disturbance to the streambed and negligible increases in suspended sediment. Thus, Alternative 2 does not involve any in-river or on the ground disturbance activities that will significantly affect habitat in the area.

4.2.2.2.1. Juvenile Summer and Winter Rearing Areas

Under Alternative 2 (Proposed Action), effects on juvenile summer and winter rearing area could occur from the presence of hatchery fish. The amount of food in some areas could be limited at certain times of the year by hatchery fish. Space for rearing juveniles and fry could be limited by hatchery fish, particularly during low-flow periods in late summer.

4.2.2.2.2. Juvenile Migration Corridor

Under Alternative 2 (Proposed Action), effects on juvenile migration corridor habitats could occur from the presence of hatchery fish. Food, space, and cover could be limited in certain months and in certain areas (such as thermal refugia) due to the presence of hatchery juveniles. The presence of hatchery juveniles produced under Alternative 2 could limit the function of important habitat in the juvenile migration corridor from March to May due to reductions in food and space resulting from encroachment by these juveniles.

4.2.2.2.3. Adult Migration Corridor

There are expected to be little, if any, impacts to the adult migration corridor as a result of Alternative 2 (Proposed Action). At the time when adult hatchery coho return to the hatchery and spawning grounds, there is adequate migratory habitat to support salmon. Therefore, little, if any, competition would be expected between HOR coho and NOR salmon for migratory habitat.

4.2.2.2.4. Spawning Areas

There are expected to be little, if any, impacts to spawning habitat as a result of Alternative 2. There is expected to be adequate habitat to support HOR and NOR salmon on the spawning grounds. None of the spawning areas where IGH coho stray are at, or near, carrying capacity. Therefore, there would be little, if any, impact of HOR coho on natural spawning grounds.

4.2.2.3. Other Fish Species

The potential effects on eulachon (including critical habitat for the southern DPS of Pacific eulachon), green sturgeon (including critical habitat for the southern DPS of North American green sturgeon), and Pacific lamprey under Alternative 2 (Proposed Action) would be the same as described for Alternative 1 (No Action) in Section 4.1.2.3 if the IGH coho salmon program were to continue under the No Action alternative as it does currently, because there is no appreciable difference between the two alternatives in terms of activities that can affect eulachon, green sturgeon, and Pacific lamprey.

4.2.2.4. Fish-Eating Birds

Under Alternative 2 (Proposed Action), IGH production likely would continue to benefit overall foraging opportunities for fish-eating birds by increasing the numbers of salmon and steelhead. However, this benefit could be offset to the extent that IGH production adversely affects natural populations of salmon and steelhead through behavioral differences that result in diminished fitness and survival of naturally-produced fish.

4.2.3. Effects on Cultural Resources, Socioeconomics, and Environmental Justice

4.2.3.1. Cultural Resources

Under Alternative 2 (Proposed Action), no significant effects on cultural resources are expected. As discussed above in section 3.3.1, no prehistoric or archaeological resources are known to occur within the IGH area, and no activities would occur under Alternative 2 (Proposed Action) that could cause disturbance to other known sites in the vicinity.

4.2.3.2. Socioeconomic Environment

Under Alternative 2 (Proposed Action), no significant effects on regional population and employment are expected. As discussed above in section 3.3.2, IGH employs seven permanent positions. Alternative

2 has the potential to result in the employment of more people in order to carry out activities required by the HGMP (such as spawning surveys, smolt trapping, broodstock genetic analysis, etc.) as compared to Alternative 1. However, the impact of Alternative 2 (Proposed Action) on regional employment is expected to remain relatively small.

Under Alternative 2 (Proposed Action), the IGH's contribution to the social and economic value of tribal, recreational, and commercial salmon fisheries in the Klamath River Basin could be enhanced by HGMP actions. Economic benefits to the region from these fisheries include: revenue generated through fish sales; jobs provided through commercial fishing and fish processing occupations; purchase of boats, boat repair services, equipment and fuel from local businesses; and the purchase of food and lodging at local motels and restaurants. However, the current ESA-listing status of coho salmon limits the ability of the region to fully benefit from salmon fisheries by limiting the opportunity to harvest excess unlisted salmon intermingled with listed coho salmon in traditional harvest areas. Improvements in the prospects for recovery of the listed coho salmon through HGMP hatchery and monitoring and evaluation activities, and complementary habitat and harvest management actions, are expected to provide benefits to the regional salmon fisheries. Effects on recreational, commercial, and tribal fisheries are discussed further below in sections 4.2.3.3 and 4.2.3.4.

Under Alternative 2 (Proposed Action), PacifiCorp would continue funding 100 percent of hatchery operations and maintenance costs pursuant to the KHSA. These costs will be borne by PacifiCorp customers in the six western states in which PacifiCorp operates, but would constitute only a minute fraction of overall costs to customers.

4.2.3.3. Recreation

Under Alternative 2 (Proposed Action), no significant effects on recreational resources are expected, including boating (standard and whitewater), camping, and day use. No activities would occur under Alternative 2 (Proposed Action) that could cause disturbance to recreational facilities that occur within the IGH area, and elsewhere in the vicinity.

Under Alternative 2 (Proposed Action), implementation of the HGMP is expected to improve prospects for the resumption of recreational coho sport fishing (private and commercial) in the Klamath River basin and coastal fisheries. Under Alternative 2 (Proposed Action), the total annual number of returning NOR and HOR adult coho salmon produced in the upper Klamath River would be expected to increase as a result of: (1) increased fitness and survival of hatchery fish; (2) reduction in the number of hatchery fish spawning naturally (reduced genetic effects on natural populations); (3) release of high quality smolts that migrate rapidly out of the system; and (4) the release of hatchery coho at a size similar to wild fish that migrate quickly out of the river system (reduces competition, predation and disease effects).

Monitoring and evaluation of information gathered through programs proposed in the HGMP are expected to improve the likelihood for effective application of management measures addressing human-caused factors for decline of the listed coho salmon population. Application of these measures should help protect and increase coho abundance and productivity in the Klamath Basin. Increases in coho salmon abundance and productivity are more likely outcomes under Alternative 2 (Proposed Action), potentially leading to timely recovery of the population, and subsequent resumption of conservation-based fisheries when viable, self-sustaining coho salmon returns are re-established.

4.2.3.4. Commercial and Tribal Fishing

Implementation of the HGMP under Alternative 2 (Proposed Action) is expected to improve prospects for the future resumption of fisheries relative to the No Action alternative. Under Alternative 2 (Proposed Action), the total annual number of returning NOR and HOR adult coho salmon produced in the upper Klamath River would be expected to increase as a result of increased fitness and survival of hatchery fish, reduction in the number of hatchery fish spawning naturally (reduced genetic effects on natural populations), release of high quality smolts that migrate rapidly out of the system and the release of hatchery coho at a size similar to wild fish that migrate quickly out of the river system (reduces competition, predation and disease effects). Monitoring and evaluation of information gathered through programs proposed in the HGMP is expected to improve the likelihood for effective application of management measures addressing human-caused factors for decline of the listed coho salmon population. Application of these measures should help protect and increase coho abundance and productivity in the Basin. Increases in coho salmon abundance and productivity are more likely outcomes under Alternative 2 (Proposed Action), potentially leading to timely recovery of the population, and subsequent resumption of conservation-based fisheries when viable, self-sustaining coho salmon returns are re-established.

Implementation of Alternative 2 (Proposed Action) is expected to improve the prospect for future resumption of commercial and tribal fisheries by conserving the listed species, and contributing to species recovery. However, the effects of Alternative 2 (Proposed Action) on fishing are not significant because such fisheries are unlikely to resume for some time, until coho salmon populations sufficiently recover to support directed commercial and tribal fisheries.

4.2.3.5. Land Ownership and Land Use

Under Alternative 2 (Proposed Action), no significant effects on land ownership and land use are expected. No activities would occur under Alternative 2 (Proposed Action) that would result in changes in the current patterns of land ownership and land use in the IGH area.

5.CUMULATIVE IMPACTS

This chapter describes what NMFS believes are cumulative impacts occurring in the Klamath River basin. Cumulative impacts are the impact on the environment which results from the incremental impact of the action, as previously described above in section 4.0, when added to other past, present, and foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions.

5.1. Water Resources

As described above in sections 4.1.1 and 4.2.1, neither Alternative 1 (No Action) nor Alternative 2 (Proposed Action) are expected to have significant effects on hydrology and water use in the Klamath River. As such, neither Alternative 1 (No Action) nor Alternative 2 (Proposed Action) would contribute to any significant adverse cumulative impacts to hydrology and water use in the Klamath River. The Klamath River's hydrology would continue to be dominated by the Klamath Basin's natural hydrologic character and upstream management of flow volumes from Upper Klamath Lake and releases from Iron Gate 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. At present, 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'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 May 2013, the NMFS and USFWS issued their final joint biological opinions (BiOp) on the effects of Reclamation's proposed Klamath Project operations on five federally listed threatened and endangered species for the period 2013-2023 (NMFS and USFWS 2013). That BiOp, as well as NMFS' 2012 BiOp on proposed issuance of an incidental take permit to PacifiCorp under ESA section 10(a)(1)(B) and implementation of a Habitat Conservation Plan for interim operations of PacifiCorp's Klamath Hydroelectric Project (NMFS 2012b), contemplate PacifiCorp's interrelated operations of Link River dam and Iron Gate dam and cover PacifiCorp's coordination with Reclamation over implementation of certain Reclamation operations. The BiOp on Reclamation's operation of its Klamath Project also identifies how Reclamation will operate the Klamath Project to maintain Upper Klamath Lake levels and river flow releases in a way that will avoid jeopardizing the continued existence of listed species and adverse modification of designated critical habitat.

Inflows to the Klamath River (at Link River dam) originate from 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 (ODEQ 2010). Upper Klamath Lake is nutrient-enriched (hypereutrophic), and experiences large, recurring algae blooms (ODEQ 2010). As a result the quality of the water flowing from Upper Klamath Lake is the "driver" that dictates water quality throughout the Klamath River (NCRWQCB 2010, ODEQ 2010). The influence of Upper Klamath Lake's highly variable and seasonal discharges of large quantities of algae, nutrients, and organic matter on downstream river reaches can be dramatic, especially related to algal production and associated effects on DO, pH, and alkalinity (NCRWQCB 2010, ODEQ 2010, FERC 2007, NRC 2004). The impact of upstream reaches diminishes with distance downstream of Iron Gate dam, but even with 190 miles of free flowing river and multiple tributaries, the large loads of nutrients and organic matter out of Upper Klamath Lake and the upper basin play a role in the water quality of the Klamath River downstream to the Pacific Ocean.

The Klamath River TMDL in California (NCRWQCB 2010) includes water temperature, dissolved oxygen, and nutrient-related numeric targets and waste load allocations for the hatchery as well as other Klamath River sources. With implementation of measures as required by NCRWQCB (2010) to achieve these water quality targets it is expected that hatchery operations will not contribute to any significant adverse cumulative impacts to water quality in the Klamath River.

5.2. Biological Resources

5.2.1. Fish Species

Alternative 1 (No Action) could cause an increased risk of extinction for the SONCC coho salmon ESU when added to other past, present, and reasonably forecast future actions if measures identified in the HGMP are not fully implemented. With implementation of the HMGP, biologically-based hatchery management strategies would be implemented that are expected to contribute to the conservation and recovery of the species. As described above in section 4.2.2, full implementation of the HGMP under Alternative 2 (Proposed Action) would increase egg-to-yearling survival and decrease the genetic and demographic risks of inbreeding (at the hatchery) and hatchery and natural interbreeding (on the spawning grounds) further aiding recovery of the SONCC coho salmon ESU. Accordingly, although there are still risks from predation, competitive interactions, and interbreeding the conservation benefits of Alternative 2 outweigh the risks associated with Alternative 2. Implementation of the HGMP under Alternative 2 (Proposed Action) would support recovery of the Upper Klamath and Shasta population units that might otherwise continue to decline irreversibly. The overall reduction in take, improved genetic makeup of the broodstock, and improved rearing survival are expected to result in an overall beneficial effect on anadromous salmonid species and are not expected to result in significant adverse effects to anadromous salmonid species. Based on these factors, Alternative 2 is not expected to contribute to any significant adverse cumulative impacts on fish species.

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 gold mining, timber harvest and grazing impacts, 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 about 350 miles of habitat upstream of Upper Klamath Lake and about 55 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 Weitchpec 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.

5.2.2. Fish-Eating Birds

As described above in sections 4.1.2.4 and 4.2.2.4, Alternative 1 (No Action) would maintain the current or similar contribution that IGH production has on forage for fish-eating birds, and Alternative 2 (Proposed Action) would likely increase the contribution that IGH production currently has on forage for fish-eating birds. The contribution of IGH production to forage for fish-eating birds, when added to other past, present, and foreseeable future actions, will result in beneficial cumulative effects on these birds.

Bald eagle and osprey have made a strong comeback from the mid 1960s and '70s 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.

5.3. Cultural Resources, Socioeconomics and Environmental Justice

As described above in sections 4.1.3 and 4.2.3, neither Alternative 1 (No Action) nor Alternative 2 (Proposed Action) are likely to impact identified historic or cultural resources. As such, neither

Alternative 1 (No Action) nor Alternative 2 (Proposed Action) would contribute to any significant cumulative impacts to these resources.

Human population growth in the 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. Employment has grown consistently in the 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.

Production from IGH contributes to commercial, tribal, and recreational fisheries in the Klamath River Basin and the Pacific Ocean. Under Alternative 1 (No Action), commercial, tribal, and recreational fishing would continue to benefit from operation of the salmon production program at IGH because hatchery-produced salmon supplement these fisheries. However, it is uncertain whether the coho salmon program could continue in its current form under Alternative 1. Under Alternative 2 (Proposed Action), further increases in coho salmon abundance and productivity are more likely to occur, contributing to the conservation and recovery of the species, and subsequent resumption of directed fisheries.

Historically, communities along the coast were dependent on commercial and recreational sportfishing. Along with commercial fishing, the coastal communities also depend 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 1980s has adversely 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 area experience 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 deterioration of water quality and habitat as a result of a variety of anthropogenic actions in the Klamath Basin have contributed to that loss.

5.4. Land Ownership and Land Use

Under either Alternative 1 (No Action) or Alternative 2 (Proposed Action), no significant effects on land ownership and land use are expected. No activities would occur under either alternative that would result in changes in the current patterns of land ownership and land use in the IGH area.

NMFS anticipates land use will not change 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 altered the natural environment including the Klamath River watershed.

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 large woody debris 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.

Agricultural activities in the area include grazing, dairy farming, and the cultivation of crops. Impacts on water quality are expected to be regulated under applicable laws. The impacts of this use on aquatic species are 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.

5.5. Climate Change

Under either Alternative 1 (No Action) or Alternative 2 (Proposed Action), no significant effects to climate change are expected. No activities would occur under either alternative that would result in changes to greenhouse gas emissions or other pollutants that are likely to significantly contribute to environmental conditions associated with climate change.

Climate change poses a high threat to salmonids within the area, particularly coho salmon. 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 may 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.

Although long-term trends in climate change are likely to place additional stress on the conservation and recovery of the SONCC coho salmon ESU, NMFS does not expect that climate change will be significant enough to have a noticeable effect on coho in the Klamath River basin during the 10-year permit period. The current climate in the 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°C in the summer and by 1°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 in response to changes in temperature and precipitation (California Natural Resources Agency 2009). Beneficial effects of Alternative 2 to SONCC coho salmon in the Klamath River basin, which are discussed in section 4.2.2.1, will help to maintain and improve the current spatial structure and may help to increase spatial distribution over the long term while long-term trends in climate change are likely to place additional stress on the conservation and recovery of the SONCC coho salmon ESU.

6.LIST OF AGENCIES/PERSONS CONSULTED

The following parties were consulted during the development of this EA: CDFW, PacifiCorp, the Klamath Tribes, the Karuk Tribe, the Yurok Tribe, and the Hoopa Valley Tribe. Written comments from the Karuk Tribe and Yurok Tribe were received during development of the HGMP, and responses to these comments were incorporated into the final HGMP. Copies of the comments are appended to the application materials.

7.REFERENCES

Ackerman, N.K., B. Pyper, I. Courter, and S. Cramer. 2006. Estimation Of Returns Of Naturally Produced Coho to the Klamath River – Review Draft. Technical Memorandum #1 of 8. Klamath Coho Integrated Modeling Framework Technical Memorandum Series. Submitted to the U.S. Bureau of Reclamation Klamath Basin Area Office on November 2, 2006.

Allee, B.J. 1981. The role of interspecific competition in the distribution of salmonids in streams. Pages 111-122 in E.L. Brannon and E.O. Salo, editors. Proceedings of the salmon and trout migratory behavior symposium. University of Washington Press, Seattle.

Anderson, E. 2003. Habitat and hydraulics: An overview of the impacts of dams, diversions and flow manipulation on Klamath River salmonids." Ecology and Geomorphology of the Lower Klamath Basin and its Tributaries. Eds. J. Mount, P. Moyle and S. Yarnell. Davis, CA.

Araki, H., B. Cooper, and M. S. Blouin. 2007. Genetic Effects of Captive Breeding Cause a Rapid, Cumulative Fitness Decline in the Wild. Science 318(5847): 100.

Basdekas, L., and M.L. Deas. 2007. Temperature and flow dynamics of the Klamath River – Review Draft. Technical Memorandum 7 of 8 of the Klamath Coho Integrated Modeling Framework Technical Memorandum Series. Submitted to the U.S. Bureau of Reclamation. April 20.

Beamish, R. J., C. Mahnken, and C. M. Neville. 1997. Hatchery and wild production of Pacific salmon in relation to large-scale, natural shifts in the productivity of the marine environment. ICES Journal of Marine Science. 54: 1200-1215.

Bell, M. 1991. Fisheries Handbook of Engineering Requirements and Biological Criteria. U.S. Army corps of Engineers, North Pacific Division, Portland.

Bell, E. and W.G. Duffy. 2007. Previously undocumented two-year freshwater residency of juvenile coho salmon in Prairie Creek, California. Transactions of the American Fisheries Society 136: 966-970.

Berejikian, B. A., Mathews, S. B. & Quinn, T. P. 1996. Effects of hatchery reared and wild ancestry on the development of agonistic behaviour in steelhead trout (Oncorhynchus mykiss) fry. Canadian Journal of Fisheries and Aquatic Sciences 53, 2004–2014.

Bjornn, T. C. and D. W. Reiser. 1991. Habitat requirements of salmonids in streams. In: W. R. Meehan (ed.), Influences of forest and rangeland management on salmonid fishes and their habitats, p. 83-138. Am. Fish. Soc. S. Pub. 19. Bethesda, Maryland. 751 p.

Brown, L. R., P. B. Moyle, and R. M. Yoshiyama. 1994. Historical Decline and Current Status of Coho Salmon in California. North American Journal of Fisheries Management 14(2): 237-261.

California Department of Fish and Wildlife (CDFW). 2002. Status review of California coho salmon north of San Francisco. Report to the California Fish and Game Commission, April 2002. Candidate Species Status Review Report 2002-3. Sacramento.

California Department of Fish and Wildlife (CDFW). 2003. Department of Fish and Game Annual Report: Shasta and Shasta River Juvenile Salmonid Outmigration Study, 2003. Northern California, North Coast Region.

California Department of Fish and Wildlife (CDFW). 2011. Appendix A: Hatchery and Genetic Management Plan for Iron Gate Hatchery Coho Salmon. Prepared for the National Oceanic Atmospheric Association National Marine Fisheries Service, Version 7, December 2011. 152 pp.

California Department of Fish and Wildlife (CDFW). 2011a. Klamath River basin fall Chinook salmon spawner escapement, in-river harvest and run-size estimates, 1978–2010. Available from W. Sinnen, CDFW, 5341 Ericson Way, Arcata, CA 95521.

California Department of Fish and Wildlife (CDFW). 2014. Klamath River Basin Fall Chinook Spawner Escapement, In-River Harvest and Run-size Estimates, 1978-2013. California Department of Fish and Wildlife, Northern Region, Klamath-Trinity Project Supervisor, Arcata CA. 95521. 15 pp.

California Hatchery Scientific Review Group (CHSRG). 2012. California Hatchery Review Report. Prepared for the US Fish and Wildlife Service and Pacific States Marine Fisheries Commission. June 2012. 100 p.

California Natural Resources Agency. 2009. California Adaption Strategy Discussion Draft: A Report to the Governor of the State of California in Response to Executive Order S-13-2008.]

Chesney, D. and M. Knechtle. 2014. Recovery of Fall-Run Chinook and Coho Salmon at Iron Gate Hatchery, October 8, 2013 to January 21, 2014. California Department of Fish and Wildlife, Klamath River Project, 1625 South Main Street, Yreka, CA. 21 pp.

Chilcote, M. W. 2003. Relationship between natural productivity and the frequency of wild fish in mixed spawning populations of wild and hatchery steelhead (Oncorhynchus mykiss). Can. J. Fish. Aquat. Sci. 60: 1057–1067.

Cole, J. 2000. Coastal sea surface temperature and coho salmon production off the north-west United States. Fish. Oceanogr. 9:1-16.

Federal Energy Regulatory Commission (FERC). 2006. Draft Environmental Impact Statement for Hydropower License, Klamath Hydroelectric Project, FERC Project No. 2082-027, Oregon and California. Office of Energy Projects, Division of Hydropower Licensing, 888 First Street, N.E., Washington, D.C. 20426. September 25.

Federal Energy Regulatory Commission (FERC). 2007. Final Environmental Impact Statement for Hydropower License, Klamath Hydroelectric Project, FERC Project No. 2082-027, Oregon and California. Office of Energy Projects, Division of Hydropower Licensing, 888 First Street, N.E., Washington, D.C. 20426. November.

Feely, R.A., C.L. Sabine, J.M. Hernandez-Ayon, D. Lanson, and B. Hales. 2008. Evidence for upwelling of corrosive “acidified” water onto the continental shelf. Science express. May 22, 2008. 10.1126/science.1155676.

Flagg, T. A., B. A. Berejikian, J. E. Colt, W. W. Dickhoff, L. W. Harrell, D. J. Maynard, C. E. NRCh, M. E. Strom, R. N. Iwamoto, and C. V. W. Mahnken. 2000. Ecological and behavioral impacts of artificial production strategies on the abundance of wild salmon populations pp. 92. NOAA Technical Memorandum NMFS-NWFSC-41. Seattle, WA: Northwest Fisheries Science Center.

Ford, M. J. 2002. Selection in captivity during supportive breeding may reduce fitness in the wild. Conservation Biology 16:815-825.

Fry, D.H, Jr. 1979. Anadromous fishes of California. California Department of Fish and Wildlife, Sacramento.

Good, T. P., R. S. Waples, and P. Adams (editors). 2005. Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-NWFSC-66. 597 p.

Hamilton, J. B., G. L. Curtis, S. M. Snedaker, and D. K. White. 2005. Distribution of Anadromous Fishes in the Upper Klamath River Watershed Prior to Hydropower Dams—A Synthesis of the Historical Evidence. Fisheries 30: 10-20.

Hard, J.J., Berejikian, B.A., Tezak, E.P., Schroder, S.L., Knudsen, C.M., and Parker, L.T. 2000. Evidence for morphometric differ- entiation of wild an captively reared adult coho salmon: a geometric analysis. Environ. Biol. Fishes, 58: 61–73.

Hardy, T.B. and R.C. Addley. 2001. Evaluation of interim instream flow needs in the Klamath River: Phase II - Volume I. DRAFT - Subject to Revision. April 9. 148 pages.

Hatchery Scientific Review Group (HSRG). 2004. Hatchery Reform: Principles and Recommendations of the HSRG. Long Live the Kings, Seattle, WA. April 2004.

Hatchery Scientific Review Group (HSRG). 2009. Columbia River hatchery reform system-wide report. Bonneville Power Administration and NOAA Fisheries. February 2009. http://hatcheryreform.us/hrp/uploads/C1EKAOMVHURK/01_HSRG%20Final%20Systemwide%20Report.pdf

Hay, D.E. and P.B. McCarter. 2000. Status of the eulachon Thaleichthys pacificus, in Canada. Canadian Science Advisory Secretariat. Research Advisory Document 200-145. Fisheries and Oceans Canada, Nanaimo, B.C.

Hicks, M. 2000. Evaluating standards for protecting aquatic life in Washington's surface water quality standards. Draft discussion paper and literature summary. Washington State Department of Ecology, Olympia, WA.

Hopelain, J.S. 1998. Age, Growth, and Life History of Klamath River Basin Steelhead Trout (*Oncorhynchus mykiss irideus*) as determined from scale analysis. Inland Fisheries Administration Report 98-3. California Department of Fish and Wildlife, Sacramento, CA. 19 pp. Accessed from http://www.krisweb.com/biblio/klamath_CDFW_hopelain_1998.pdf, on December 29, 2005.

ICF Jones & Stokes. 2010. Hatchery and Stocking Program Environmental Impact Report/Environmental Impact Statement. Final. January 2010. Prepared for the California Department of Fish and Wildlife and U.S. Fish and Wildlife Service, Sacramento, CA.

Johnson, S. L. 1988. The effect of the 1983 El Niño on Oregon's coho (Oncorhynchus kisutch) and chinook (O. tshawytscha) salmon. Fish. Res. (Amst.) 6:105-123.

Joint Hatchery Review Committee. 2001. Final report on anadromous salmonid fish hatcheries in California: December 2001.

Jonsson, B. 1997. A review of ecological and behavioural interac- tions between cultured and wild Atlantic salmon. ICES Journal of Marine Science, 54: 1031-1039.

Klamath Hydroelectric Settlement Agreement (KHSA). 2010. February 18, 2010. Available at http://216.119.96.156/Klamath/Klamath%20Hydroelectric%20Settlement%20Agreement%202-18-10signed.pdf

Klamath River Basin Fisheries Task Force (KRBFTF). 1991. The Long Range Plan for the Klamath River Basin Conservation Area Fishery Restoration Program. U.S. Fish and Wildlife Service, Klamath River Fishery Resource Office. Yreka, California.

Knechtle, M. and D. Chesney. 2014. Bogus Creek Salmon Studies 2013. California Department of Fish and Wildlife, Northern Region, Klamath River Project, 1625 South Main Street, Yreka, CA. 22 pp.

Koslow, J. A., A. J. Hobday, G.W. Boehlert. 2002. Climate variability and marine survival of coho salmon (Oncorhynchus kisutch) in the Oregon production area. Fisheries Oceanography 11(2): 65-77.

Kostow, K. 2002. Oregon Lampreys: Natural History, Status, and Analysis of Management Issues. Oregon Department of Fish and Wildlife. 111 pp.

Kostow, K.E. 2004. Differences in juvenile phenotypes and survival between hatchery stocks and a natural population provide evidence for modified selection due to captive breeding. Canadian Journal of Fisheries and Aquatic Sciences 61:577–589.

Lane and Lane Associates. 1981. The Copco Dams and the fisheries of the Klamath Tribe. U.S. Department of the Interior, Bureau of Indian Affairs, Portland, OR.

Larkin, P. A. 1956. Interspecific competition and population control in freshwater fish. Journal of the Fisheries Board of Canada 13:327-342.

Larson, Z. S., and M. R. Belchik. 1998. A preliminary status review of eulachon and Pacific lamprey in the Klamath River Basin. Yurok Tribal Fisheries Program, Klamath, CA.

Levin, P. S., R. W. Zabel and J. G. Williams. 2001. The road to extinction is paved with good intentions: negative association of fish hatcheries with threatened salmon. Proc. R. Soc. Lond. B. 268: 1153–1158.

Lewis, A. F. J., M. D. McGurk, and M. G. Galesloot. 2002. Alcan's Kemano River eulachon (Thaleichthys pacificus) monitoring program 1988-1998. Consultant's report prepared by Ecofish Research Ltd. for Alcan Primary Metal Ltd., Kitimat, B.C.

Lindley, S. T., M. L. Moser, D. L. Erickson, M. Belchik, D. W. Welch, E. Rechisky, J. T. Kelly, J. C. Heublein, and A. P. Klimley. 2008. Marine migration of North American green sturgeon. Transactions of the American Fisheries Society 137:182–194.

Ly, J. and Z. Ruddy. 2011. 5-Year Review: Summary and Evaluation of Southern Oregon/Northern California Coast Coho Salmon ESU. National Marine Fisheries Service, Southwest Region.

Mantua, N.J., S.R. Hare, Y. Zhang, J.M. Wallace, and R.C. Francis. 1997. A Pacific decadal climate oscillation with impacts on salmon. Bulletin of the American Meteorological Society, Vol. 78, pp. 1069-1079.

Mayfield, R.B. 2002. Temperature Effects on Green Sturgeon (Acipenser medirostris Ayres) Bioenergetics: An Experimental Lab Study. M.S. Thesis, University of California, Davis, CA. 41 pp.

McCullough, D., S. Spalding, D. Sturdevant, M. Hicks. 2001. Issue Paper 5. Summary of technical literature examining the physiological effects of temperature on salmonids. Prepared as part of U.S. EPA Region 10 Temperature Water Quality Criteria Guidance Development Project. EPA-910-D-01-005.

McGinnity, P., P. Prodöhl, A. Ferguson, R. Hynes, N. Ó Maoiléidigh, N. Baker, D. Cotter, B. O'Hea, D. Cooke, G. Rogan, J. Taggart, and T. Cross. 2003. Fitness reduction and potential extinction of wild populations of Atlantic salmon, Salmo salar, as a result of interactions with escaped farm salmon. Proc. Roy. Soc. Lond. B [Online DOI 10.1098/ rspb.2003.2520].

McMichael, G.A., C. S. Sharpe and T.N. Pearsons. 1997. Effects of Residual Hatchery-Reared Steelhead on Growth of Wild Rainbow Trout and Spring Chinook Salmon. Transactions of the American Fisheries Society 126(2): 230–239.

Moyle, P. B. 2002. Inland Fishes of California. Revised and Expanded. Univ. Calif. Press, Berkeley and Los Angeles, CA.

Naman, S.W. 2008. Predation by hatchery steelhead on natural salmon fry in the Upper-Trinity River, California. Masters Thesis, Humboldt State University. December 2008. Naman2008_PREDATION BY HATCHERY STEELHEAD ON NATURAL SALMON FRY IN THE UPPER-TRINITY RIVER, CALIFORNIA.pdf

National Marine Fisheries Service (NMFS). 2001. Status review update for coho salmon (Oncorhynchus kisutch) from the Central California Coast and the California Portion of the Southern Oregon/Northern California Coast Evolutionarily Significant Units. Southwest Fisheries Science Center, Santa Cruz, California. April 12. 43 p.

National Marine Fisheries Service. 2002. Biological Opinion: Klamath Project Operations. National Marine Fisheries Service, Southwest Region, Long Beach, California. May 31.

National Marine Fisheries Service (NMFS). 2005. Green Sturgeon Status Review Update. Biological Review Team, Santa Cruz Laboratory, SWFSC, NOAA Fisheries, February 2005.

National Marine Fisheries Service (NMFS). 2006. Eulachon: A Review of Biology and Annotated Bibliography.

National Marine Fisheries Service (NMFS). 2007. Endangered Species Act - Section 7 Consultation. Biological Opinion. Klamath Hydroelectric Project License (FERC No. 2082-027). Action Agency: Federal Energy Regulatory Commission (FERC). Consultation Conducted By: National Marine Fisheries Service, Southwest Region. File Number: 15 1422SWR2003AR8914. Date Issued: December 21, 2007.

National Marine Fisheries Service (NMFS) and United States Fish and Wildlife Service (USFWS). 2013. Biological Opinions on the Effects of Proposed Klamath Project Operations from May 31, 2013 through March 31, 2023, on Five Federally Listed Threatened and Endangered Species. NMFS File Number: SWR-2012-9372. FWS File Number 08EKLA00-2013-F-0014.

National Marine Fisheries Service (NMFS). 2012a. Final 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, Arcata CA. February 2012.

National Marine Fisheries Service (NMFS). 2012b. Final Biological Opinion on the Proposed Issuance of an Incidental Take Permit to PacifiCorp Energy 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, Southwest Region. February 2012.

National Research Council (NRC). 2004. Endangered and Threatened Fishes in the Klamath River Basin: Causes of Decline and Strategies for Recovery. Prepared for the National Academy of Science by the National Research Council, Division on Earth and Life Studies, Board on Environmental Studies and Toxicology, Committee on Endangered and Threatened Fishes in the Klamath River Basin. Washington, D.C. 358 p.

Nickelson, T. E., J.W. Nicholas, A. M. McGie, R. B. Lindsay, D. L. Bottom, R. J. Kaiser, and S. E. Jacobs. 1992. Status of anadromous salmonids in Oregon coastal basins. Unpublished manuscript. Oregon Department of Fish and Wildlife, Research and Development Section, Corvallis, and Ocean Salmon Management, Newport, Oregon. 83 p.

National Resource Council (NRC). 2003. Endangered and Threatened Fishes of the Klamath River Basin; Causes of the Decline and Strategies for Recovery NRC Press, October 2003.

North Coast Regional Water Quality Control Board (NCRWQB). 2010. Implementation of the Action Plan for the Klamath River TMDLs Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in the Klamath River in California and Lower Lost River Implementation Plan.

Oregon Department of Environmental Quality (ODEQ) 2010. Oregon's 2010 Integrated 303(d) Report. URL: http://www.deq.state.or.us/wq/assessment/2010Report.htm.

Pacific Fishery Management Council. 1999. Amendment 14 to the Pacific coast salmon plan (1997). Portland Oregon. 133 p.

Pacific Fishery Management Council. 2008. Assessment of factors affecting natural area escapement shortfall of Klamath River fall Chinook salmon in 2004-2006. (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

Pacific Fishery Management Council (PFMC). 2011. Review of 2010 Ocean Salmon Fisheries. Available online at: http://www.pcouncil.org/salmon/stock-assessment-and- fishery-evaluation-safe-documents/review-of-2010-ocean-salmon-fisheries/

Pacific Fishery Management Council (PFMC). 2012. Preseason Report III: Council Adopted Management Measures and Environmental Assessment Part 3 for 2012 Ocean Salmon Fishery Regulations. Portland, OR. 41 pp.

Pacific Fishery Management Council (PFMC). 2014a. Preseaon Report III: Council Adopted Management Measures and Environmental Assessment Part 3 for 2014 Ocean Salmon Fishery Regulations. Portland, OR. 49 pp.

Pacific Fishery Management Council (PFMC). 2014b. Preseaon Report II: Proposed Alternatives and Environmental Assessment Part 2 for 2014 Ocean Salmon Fishery Regulations. Portland, OR. 73 pp.

Pacific Fishery Management Council (PFMC). 2014c. Review of 2013 Ocean Salmon Fisheries: Stock Assessment and Fishery Evaluation Document for the Pacific Coast Salmon Fishery Management Plan. (Document prepared for the Council and its advisory entities.) Pacific Fishery Management Council, 7700 NE Ambassador Place, Suite 101, Portland, Oregon 97220-1384.

PacifiCorp. 2006. Application for Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act for the Relicensing of the Klamath Hydroelectric Project (FERC 201 No. 2082) in Siskiyou County, California Klamath Hydroelectric Project (FERC Project No. 2082). Prepared for: State Water Resources Control Board Division of Water Quality Water Quality Certification Unit 1001 I Street, 15th Floor Sacramento, California 95814. Prepared by: PacifiCorp 825 N.E. Multnomah, Suite 1500, Portland, Oregon 97232.

PacifiCorp. 2008. Application for Water Quality Certification Pursuant to Section 401 of the Federal Clean Water Act for the Relicensing of the Klamath Hydroelectric Project (FERC No. 2082) in Siskiyou County, California Klamath Hydroelectric Project (FERC Project No. 2082). Prepared for: State Water Resources Control Board Division of Water Quality Water Quality Certification Unit 1001 I Street, 15th Floor Sacramento, California 95814. Prepared by: PacifiCorp 825 N.E. Multnomah, Suite 1500, Portland, Oregon 97232. March 2008.

PacifiCorp. 2012. PacifiCorp Klamath Hydroelectric Project Interim Operations Habitat Conservation Plan for Coho Salmon. Prepared by PacifiCorp Energy, Inc., Portland, OR. Submitted to the National Marine Fisheries Service, Arcata Area Office, Arcata, CA. February 16, 2012.

PacifiCorp. 2014. Klamath Hydroelectric Project Interim Operations Habitat Conservation Plan (HCP) Annual Report on HCP Activities During 2013. PacifiCorp, 825 N.E. Multnomah Street, Portland, OR 97232. April 30, 2014.

Pearse, D.E, Donohoe C.J, and Garza J.C. 2007. Population genetics of steelhead (Oncorhynchus mykiss) in the Klamath River. Environmental Biology of Fishes 80, 377-387.

Peterson, N.P. 1982. Immigration of Juvenile Coho Salmon (Oncorhynchus kisutch) Into Riverine Ponds. Canadian Journal of Fisheries and Aquatic Sciences 39(9): 1308 -1310.

Pfeiffer, W. and T. Pletcher. 1964. Club cells and granular cells in the skin of lampreys. Journal of the Fisheries Research Board of Canada 21:1083-1088

Platts, W. S. 1991. Livestock grazing. In: Influence of forest and rangeland management on Salmonid fishes and their habitats. American Fisheries Society, Special Publication 19:389-423.

Portner , H.O. and R. Knust. 2007. Climate change affects marine fishes through the oxygen limitation of thermal tolerance. Science 315:95–97.

Quinn, T.P. 2005. The behavior and ecology of Pacific salmon and trout. UBC Press, Vancouver

Reisenbichler, R.R. and McIntyre, J.D. 1977. Genetic differences in growth and survival of juvenile hatchery and wild steelhead trout, Salmo gairdneri. Can. J. Fish. Res. Board 34, 123–128.

Reisenbichler, R. R. and S. P. Rubin. 1999. Genetic changes from artificial propagation of Pacific salmon affect the productivity and viability of supplemented populations. ICES J. Mar. Sci. 56: 459-466.

Ricker, W. E., D. F. Manzer, and E. A. Neave. 1954. The Fraser River eulachon fishery, 1941-1953. Fisheries Research Board of Canada, Manuscript Report No. 583.

Riley, J. 1967. Annual Report for Iron Gate Salmon and Steelhead Hatchery, First Year of Operation, 1965-66. California Department of Fish and Wildlife, Inland Fisheries, Region 1, Redding, Calif.

Ryding, K. E. and J. R. Skalski. 1999. Multivariate regression relationships between ocean conditions and early marine survival of coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences 56: 2374-2384.

Ryman, N., and L. Laikre. 1991. Effects of supportive breeding on the genetically effective population size. Conservation Biology 5:325-329.

San Diego State University. 2011. Infodome webpage for American Indian Studies. Available online at: http://infoguides.sdsu.edu/sub.php?id=195.

Sandercock, F.K. 1991. Life History of Coho Salmon. Pp. 395–446 in Pacific Salmon Life Histories, C. Groot, and L. Margolis, eds. Vancouver: University of British Columbia Press.

Scheiff, A.J., J.S. Lang, and W.D. Pinnex. 2001. Juvenile salmonid monitoring on the Mainstem Klamath River at Big Bar and the Mainstem Trinity River at Willow Creek, U.S. Fish and Wildlife Service

Klamath River Fisheries Assessment Program, Arcata, CA. 114 pp. Available online at: http://www.krisweb.com/biblio/biblio_klamath.htm

Smith, W. E., and R. W. Saalfeld. 1955. Studies on Columbia River smelt Thaleichthys pacificus (Richardson). Washington Department of Fisheries, Fisheries Research Paper 1(3): 3-26.

Snyder, J.O. 1931. Salmon of the Klamath River, California. Division of Fish and Game, Bulletin No. 34.

Soto, T. 2007. Personal communication. Fishery Biologist. Karuk Tribe Fisheries Program, Orleans, California.

Spangler, E. A. K. 2002. The ecology of eulachon (Thaleichthys pacificus) in Twentymile River, Alaska. M.S. Thesis. University of Alaska, Fairbanks.

Spence, B. C., G. A. Lomnicky, R. M. Hughes, and R. P. Noviztki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, Oregon.

Sweeting, R. M., R. J. Beamish, D. J. Noakes and C. M. Neville. 2003. Replacement of wild coho salmon by hatchery-reared coho salmon in the Strait of Georgia over the past three decades. Trans. Am. Fish. Soc. 23: 492-502.

Sutton, R., M. Deas, R. Faux, R. A. Comm, T. Soto, M. Belch, J. E. Holt, B. W. McCovey Jr., and F. J. Myers. 2004. Klamath River Thermal Refugia Study, Summer 2003. Prepared for the Klamath Area Office, Bureau of Reclamation, Klamath Fall, Oregon. 147 pp.

Terres J.K. 1980. The Audubon Society encyclopedia of North American birds.

Trihey & Associates, Inc. 1996. Instream Flow Requirements for Tribal Trust Species in the Klamath River. Prepared for the Yurok Tribe. Concord, CA.

Tschaplinski, P.J. 1988. The use of estuaries as rearing habitats by juvenile coho salmon. In T.W. Chamberlain (ed.), Proceedings of a workshop: Applying 15 years of Carnation Creek results. (pp. 123-142). Nanaimo, BC: British Columbia Ministry of Environment, Lands, and Parks.

Tschaplinski, P.J. 1999. The effects of forest harvesting, fishing, climate variation, and ocean conditions on salmonid populations of Carnation Creek, Vancouver Island, British

Columbia. In: E.E. Knudsen et al., eds. Sustainable Fisheries Management: PacificSalmon. Lewis Publ., Boca Raton.

U.S Fish and Wildlife Service (USFWS). 1976. Taking of golden eagles: denial of depredation control order. Federal Register 4(221):50355-50356.

U.S. Fish and Wildlife Service (USFWS). 1995. Working paper on restoration needs: Habitat restoration actions to double natural production of anadromous fish in the Central Valley of California. Volume 2. May 9, 1995. Anadromous Fish Restoration Program Core Group. Stockton, CA.

U.S. Fish and Wildlife Service (USFWS). 1998. Klamath River (Iron Gate dam to Seiad Creek) Life Stage Periodicities for Chinook, Coho and Steelhead. U. S. Fish and Wildlife Service. Coastal California Fish and Wildlife Office, Arcata, California. 51p.

U.S Fish and Wildlife Service (USFWS). 2004. 90-day finding on a petition to list three species of lampreys as threatened or endangered. FR 69:77,158-77,167. December 27.

Williams, T. H., E. P. Bjorkstedt, W. G. Duffy, D. Hillemeier, G. Kautsky, T. E. Lisle, M. McCain, M. Rode, R. G. Szerlong, R. S. Schick, M. N. Goslin, and A. Agrawal. 2006. Historical Population Structure of Coho Salmon in the Southern Oregon/Northern California Coasts Evolutionarily Significant Unit. U.S. Department of Commerce, National Oceanic and Atmospheric Administration Tech. Memo. NOAA-TM-NMFS-SWFSC-390.

Williams, T. H., B. C. Spence, W. Duffy, D. Hillemeier, G. Kautsky, T. Lisle, M. McCain, T.Nickelson, G. Garman, E. Mora, and T. Pearson. 2008. Framework for assessing viability of threatened coho salmon in the Southern Oregon/Northern California Coast Evolutionarily Significant Unit. Oregon-California Technical Recovery Team external review draft. July 5. 88 p.

Yurok Tribal Fisheries Program. 2011. Yurok Tribe Studies of Eulachon Smelt in the Klamath River Basin, California. Progress report. November 1, 2010 to April 30, 2011.

Yurok Tribal Fisheries Program. 2012. Yurok Tribe Studies of Eulachon Smelt in the Klamath River Basin, California. Progress report. November 1, 2011 to April 30, 2012.

8. Appendix A: Summary of Alternatives Considered but Rejected from Detailed Analysis

Several alternatives were considered by NMFS during the development of the Environmental Assessment (EA) to determine the best approach for achieving both the Purpose and Need for the action. As provided in ESA section 10(a)(1)(A), the purpose of the permit is for scientific purposes or to enhance the propagation or survival of the affected species, which is the SONCC ESU of coho salmon for the permit application. The four additional alternatives considered include the following:

A. Eliminate Hatchery Production/Improve Habitat
B. Implement a Segregated program consistent with Hatchery Scientific Review Group (HSRG) guidelines
C. Implement an Integrated program consistent with HSRG guidelines
D. Reduced hatchery production

Alternatives were evaluated using the AHA (All H Analyzer) model developed by the HSRG (www.hatcheryreform.us). The AHA model estimates coho salmon population abundance and fitness out over 100 generations. The model also provides estimates of adult spawning escapement, the proportion of hatchery fish on the spawning grounds (pHOS), proportion of natural origin spawners needed for broodstock (pNOB) and the number of hatchery origin (HOR) and natural origin (NOR) adults caught in fisheries. Data produced by this model enabled NMFS to compare alternatives, and assess the likelihood a particular alternative would achieve conservation objectives. In addition, NMFS consulted with its co-managers regarding these issues. Each of the alternatives considered are described in more detail below.

A. Eliminate Hatchery Production/Improve Habitat

Under this alternative, the IGH coho salmon program would be eliminated and mitigation goals would focus on improving habitat in the basin. All potential negative impacts of the IGH coho salmon program to the natural population would be eliminated under this alternative; however, the effectiveness of habitat actions to improve coho salmon abundance and productivity may take a number of years before results are realized.

According to the AHA analysis, under this alternative the total average coho salmon population NOR abundance decreases from 1,376 to 563, and the minimum NOR population size decreases from 685 to 258. This reduction in NOR population size would increase extinction risks in the near term.

By evaluating results from the AHA model, NMFS determined that completely eliminating the coho salmon hatchery program would not achieve the objective to enhance the propagation or survival of the SONCC coho salmon ESU consistent with the Purpose and Need for the action and Section 10(a)(1)(A) of the ESA. Consequently, NMFS did not analyze this alternative in greater detail in the EA, except to the extent that elimination of the IGH coho salmon program may be a result of Alternative 1 (No Action).

B. Implement a Segregated Hatchery Program Consistent with Hatchery Scientific Review Group (HSRG) Guidelines

Under this alternative, the coho program would be changed to a segregated program designed to meet HSRG guidelines for such a program. The program would be operated as follows:

- No NOR adults would be incorporated into the broodstock. All NOR adult and jack coho salmon arriving at the hatchery would be released back to the river.
- In-hatchery survival rates would be increased by improving culture practices which includes reducing bird predation in raceways.
- The program would continue to target a release 75,000 yearling fish each year to achieve mitigation goals.
- A more robust weir would be constructed in Bogus Creek to insure that pHOS in this stream did not exceed the 5 percent value recommended by the HSRG (target would be set at 1 percent). This action would create conditions where 99 percent of the HOR adults returning to the basin would be collected or harvested.

According to the AHA analysis, under this alternative total run size would range from 850 to 5,334 adults (1,674 average). NOR escapement to the spawning grounds would average 512 adults, and would vary annually between 233 and 1,772 adults. Reducing the number of HOR adults spawning naturally may pose demographic (i.e., abundance) and life history diversity risks to the population. Consequently, there is a trade-off between improving population fitness by removing hatchery fish from the spawning grounds, and increasing demographic and diversity risks to the population from this same action. Over time, hatchery practices select for fish adapted to the hatchery environment rather than the natural environment. If the natural run were to become extinct, the remaining HOR component would have lower natural fitness and therefore be less suitable for a reintroduction effort.

By evaluating results from the AHA model, NMFS determined that implementing a segregated coho salmon hatchery program would not achieve the objective to enhance the propagation or survival of the SONCC coho salmon ESU consistent with the Purpose and Need for the action and Section 10(a)(1)(A) of the ESA. Consequently, NMFS did not analyze this alternative in detail in the EA.

C. Implement an Integrated Hatchery Program Consistent with HSRG Guidelines

This alternative would result in the immediate implementation of an integrated coho program at IGH consistent with guidelines for such programs established by the HSRG. The program would be designed to achieve the HSRG PNI criterion (0.67) for biologically important populations. This program would be implemented as follows:

- To achieve the PNI value of 0.67 or greater, the proportion of NOR adults used as broodstock would be increased to ~20% (i.e., 20% of all broodstock would be of natural origin). Achieving this PNI value would also require that the proportion of the natural coho spawning population consisting of hatchery fish be less than 10 percent.
- Hatchery production would be maintained at 75,000 yearling coho.
- Hatchery culture practices would be improved to increase egg-to-smolt survival rates. Facilities would be constructed to reduce bird predation in raceways.
- A more efficient weir would be installed in Bogus Creek to prevent HOR adults from spawning in this stream.

According to the AHA model, total run size under this alternative would range from 845 to 5,341 adults. NOR escapement to the spawning grounds averages 497 and varies annually between 213 and 1,763 coho adults. The well integrated (i.e., high fitness) hatchery program produces, on average, 1,100 adult coho returns. These fish act as a gene bank for the population (protecting species diversity), and ensure that enough fish return each year to reduce demographic risks associated with low natural production.

While this alternative possesses several benefits, it also presents several conservation risks. For example, achieving HSRG guidelines for an integrated program requires that sufficient natural production exist to both supply hatchery broodstock needs and maintain a viable coho natural population. Currently, natural coho abundance in the Upper Klamath River Population Unit, including Bogus Creek, is insufficient to achieve both objectives. In addition, until natural coho abundance levels increase it is important to allow excess hatchery adults to spawn naturally to decrease demographic and extinction risks.

By using the AHA model, NMFS determined that implementing this alternative would not achieve the objective to enhance the propagation or survival of the SONCC coho salmon ESU consistent with the Purpose and Need for the action and Section 10(a)(1)(A) of the ESA. Consequently, NMFS did not analyze this alternative in detail in the EA.

D. Reduced Hatchery Production

For this alternative, hatchery production would be reduced by 50 percent to 37,500 yearlings. The program would be operated consistent with HSRG guidelines for an integrated program (i.e. a PNI > 0.67). The program would be implemented as follows:

- To achieve the PNI value of 0.67 or greater, the proportion of NOR adults used as broodstock would be increased to ~20% (i.e., 20% of all broodstock would be of natural origin).
- Hatchery production would be reduced to 37,500 yearling coho.
- Hatchery culture practices would be improved to increase egg-to-smolt survival rates. Facilities would be constructed to reduce bird predation in raceways.
- A more efficient weir would be installed in Bogus Creek to prevent HOR adults from spawning in this stream.

Under this alternative total run size ranges from 552 to 3,650 (NOR and HOR) adults (1,120 average). NOR escapement to the spawning grounds averages 514 adults and varies annually between 229 and 1,802. This integrated program produces on average approximately 500 HOR fish with high fitness. These HOR fish act as a gene bank for the population (protecting species diversity), and ensure that enough fish return each year to reduce demographic risks associated with low natural production. The reduction in program size results in fewer HOR fish returning to the basin which reduces risks associated to natural populations from hatchery fish spawning naturally. A reduction in juvenile release numbers also decreases possible competition and predation impacts to NOR juveniles.

A major concern with this program is that the smaller number of fish used as broodstock (38) would increase the probability of inbreeding and Ryman-Laikre effects (i.e., gene swamping) occurring in the population (Ryman and Laikre 1991). Both effects can result in decreased effective population size and fitness.

It would also be difficult in a program of this size to collect broodstock (both at the hatchery and in the wild) that represent the full range of life history diversity present in the population. Fish must be collected for broodstock representatively over the full adult run-timing to ensure that population diversity is not lost (i.e. genetic drift does not occur). The fewer the number of fish collected, the more likely that hatchery operations will decrease diversity.

Finally, the smaller the number of fish released from a hatchery program, the higher the probability that random events may result in unexpected low adult returns. For example, the current hatchery program with a release size of 75,000 yearlings has seen adult returns to the hatchery of less than 70 fish (see Table 4 in the HGMP). Reducing the number of fish released from the hatchery increases the probability that an entire brood year may be lost due to random variation in post-release survival.

NMFS determined that implementing this alternative would not achieve the objective to enhance the propagation or survival of the SONCC coho salmon ESU consistent with the Purpose and Need for the action and Section 10(a)(1)(A) of the ESA. Consequently, NMFS did not analyze this alternative in detail in the EA.

Summary

None of the individual alternatives (A-D) would completely achieve the objective to enhance the propagation or survival of the SONCC coho salmon ESU consistent with the Purpose and Need for the action and Section 10(a)(1)(A) of the ESA. Consequently, elements of alternatives A and C were combined to produce Alternative 2 (Preferred Alternative or Proposed Action) that is analyzed in detail in the EA.

The Preferred Alternative accounts for the fact that current natural coho abundance is insufficient to immediately convert the existing hatchery program to an integrated program that achieves HSRG guidelines (Alternative C). The Preferred Alternative also recognizes that actions being implemented in the basin by multiple parties will result in increased habitat quality and NOR abundance over time. However, increases in coho abundance and fitness expected from HGMP implementation are not dependent on the effectiveness of ongoing habitat actions. As coho NOR abundance increases, the hatchery program is converted in phases to a properly integrated hatchery program. The phased implementation approach has lower demographic and extinction risks than all of the other alternatives identified above. As discussed in the EA, the Preferred Alternative would achieve the objective to enhance the propagation or survival of the SONCC coho salmon ESU consistent with the Purpose and Need for the action and Section 10(a)(1)(A) of the ESA.

Finding of No Significant Impact for Issuance of an Endangered Species Act Section 10(a)(1)(A) Permit to the California Department of Fish and Wildlife (CDFW) for Activities at the Iron Gate Fish Hatchery (IGH)

National Marine Fisheries Service
October 31, 2014

National Oceanic and Atmospheric Administration Administrative Order 216-6 (May 20, 1999) contains criteria for determining the significance of the impacts of a proposed action. In addition, the Council on Environmental Quality (CEQ) regulations at 40 C.F.R. 1508.27 state that the significance of an action should be analyzed both in terms of "context" and "intensity." Each criterion listed below is relevant to making a finding of no significant impact and has been considered individually, as well as in combination with all other criteria. The significance of this action is analyzed based on the NAO 216-6 criteria and CEQ's context and intensity criteria. These include:

1) Can the proposed action reasonably be expected to cause substantial damage to the ocean and coastal habitats and/or essential fish habitat as defined under the Magnuson-Stevens Act and identified in FMPs?

Response: Ocean, coastal, and/or essential fish habitat will not be substantially damaged under the proposed action. The Proposed Action is the National Marine Fisheries Service's (NMFS) proposed issuance of a permit under Endangered Species Act (ESA) Section 10(a)(1)(A) to the California Department of Fish and Wildlife (CDFW) for operation of the coho salmon program at Iron Gate Hatchery (IGH) under a proposed Hatchery and Genetic Management Plan (HGMP) for a period of 10 years if NMFS determines that the application submitted by the CDFW and PacifiCorp meets the ESA section 10(a)(1)(A) permit issuance criteria. As a result of permit issuance, CDFW would be authorized to take federally listed Southern Oregon/Northern California Coast (SONCC) evolutionarily significant unit (ESU) coho salmon resulting from implementation of the coho salmon program at IGH under a HGMP. NMFS completed an Essential Fish Habitat (EFH) consultation on the proposed action under the Magnuson-Stevens Fishery Conservation and Management Act and concluded that activities to be implemented under the proposed action are primarily biological, and will have limited adverse effects on salmon EFH (NMFS 2014). For each of the proposed action's adverse effects on EFH for salmon, the proposed action includes the best approaches to avoid or minimize those adverse effects. Therefore, NMFS did not propose additional conservation measures.

The primary purpose of the HGMP is to provide a single, comprehensive source of information regarding anadromous salmonid hatchery programs. NMFS uses this information in its ESA processes to assess impacts on listed anadromous fish. The elements of the HGMP that will have greatest impact include: (1) annual capture and directed mortality of approximately 135 to 270 adult coho salmon to use as broodstock (the goal is for 20 to 50 percent of broodstock to be natural origin [NOR]); and (2) volitional release of 75,000 yearling coho into the Upper Klamath

River based between March 1 and April 15. Neither of these elements will contribute to substantial ocean, coastal, or EFH effects.

In the Klamath Basin, EFH has been designated in the mainstem Klamath River and its tributaries from Iron Gate Dam to the mouth. EFH includes the water quantity and quality conditions necessary for successful adult migration and holding, spawning, egg-to-fry survival, fry rearing, smolt migration, and estuarine rearing of juvenile coho salmon and Chinook salmon. No adverse effects to estuarine habitat or marine habitat, including such habitat designated as EFH for coho or Chinook salmon, are expected from the proposed action because any adverse effects of the proposed action to habitat are expected to be ameliorated to an undetectable level before reaching any estuarine or marine habitat.

Potential effects on EFH from the proposed action would be similar to effects of the No-action Alternative. No significant effects on hydrologic conditions and resources are expected under the proposed action. The proposed action will have no significant impact on the quantity or consumption demand of water used for hatchery activities and the total amount of water diverted will remain small relative to the total volume of the river. Additionally, the total amount of water diverted into the hatchery is returned to the river below the hatchery. The water source for the hatchery is located in the Iron Gate Reservoir, which is not accessible to anadromous fish and is not designated as EFH. There will be no difference in the terms of water use, and the quantity of water will remain the same as currently used for hatchery practices (NMFS 2014a). Improvements to hatchery-related facilities (e.g., Bogus Creek weir) are not expected to have any perceptible effect on water availability or use.

The potential water quality effects from the proposed action will be the same as under the No-action Alternative because there is no appreciable difference between the current water quality conditions and proposed action's water quality conditions. CDFW will continue to operate the IGH pursuant to the existing National Pollutant Discharge Elimination System permit that establishes conditions for the IGH discharge to maintain compliance with the Clean Water Act. Water discharged from IGH into the Klamath River will continue to contribute minor amounts of nutrient and organic matter loading to the river, but these small loads are not expected to result in significant impacts to nutrients and algae in the Klamath River. The characteristics of the IGH discharge with regard to other water quality constituents will also likely be unchanged from current conditions (NMFS 2014a). The proposed action would include improvements to the Bogus Creek Fish Counting Facility, including installation of taller weir panels and installation of an adult trap. Installation of these structures will not disturb existing riparian vegetation, requires no disturbance to soils of the stream bank, and will result in negligible disturbance to the streambed and negligible increases in suspended sediment. Therefore, the proposed action is not expected to result in significant impacts to any water quality constituents in the Klamath River.

Under the proposed action, effects on juvenile summer and winter rearing area and juvenile migration corridor habitats could occur from the presence of hatchery fish. The amount of food in some areas could be limited at certain times of the year by hatchery fish. Space for rearing juveniles and fry could be limited by hatchery fish, particularly during low-flow periods in late summer. The presence of hatchery juveniles produced under the proposed action could limit the function of important habitat in the juvenile migration corridor from March to May due to reductions in food and space resulting from encroachment by these juveniles. Any adverse effects experienced from the presence of juvenile hatchery fish will be the same as those that currently occur, since production goals under the HGMP will remain the same, and therefore, no increases in demand are expected on rearing space or migratory habitats from the new program. Little, if any, impacts to the adult migration corridor are expected as a result of the proposed action. When adult hatchery coho salmon return to the hatchery and spawning grounds, there is adequate migratory habitat to support salmon. Therefore, little, if any, competition would be expected between adult hatchery origin return (HOR) coho and natural origin return (NOR) adult salmon for migratory habitat.

Similarly, little, if any, impacts to spawning habitat are expected as a result of the proposed action. There is expected to be adequate habitat to support HOR and NOR salmon on the spawning grounds. None of the spawning areas where IGH coho salmon stray are at, or near, carrying capacity. Therefore, there would be little, if any, impact of HOR coho salmon on natural spawning grounds as compared to current conditions.

Therefore, NMFS believes the proposed action will have no significant impact on ocean and coastal habitats and EFH because, as described above, the proposed action is primarily biologically based; contains minimal instream modification or habitat alteration; does not include increases in the quantity of water used for hatchery facilities or change the water quality of water released from hatchery facilities; and will not have significant adverse effects on spawning, rearing, or migratory habitat.

2) Can the proposed action be expected to have a substantial impact on biodiversity and/or ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)?

Response: Implementation of the proposed action will not result in significant impacts to the biodiversity or current ecosystem function because any adverse effects as a result of the proposed action will be similar to current conditions related to biodiversity, established flow regimes, sediment transport, predator/prey relationships, or other ecosystem functions. However, NMFS does anticipate an overall beneficial effect on ecosystem functions from the proposed action.

Salmonid populations in the Klamath Basin have been declining, and with these declines, ecosystem functions relying on these species have changed. Although production of hatchery origin coho salmon has helped to maintain a small population of coho salmon in the upper Klamath Basin, interactions between hatchery fish and natural spawners is likely negatively impacting the biodiversity of the remaining fish under the current coho salmon program. The HGMP contains biologically-based hatchery management strategies that are expected to contribute to the conservation of the SONCC coho salmon ESU. Implementation of the HGMP would increase egg-to-yearling survival and decrease the genetic and demographic risks of inbreeding (at the hatchery) and interbreeding between hatchery and natural origin coho salmon (on the spawning grounds), which would contribute to recovery of the SONCC coho salmon ESU. Accordingly, although there will be ongoing risks from predation, competitive interactions, and interbreeding, the conservation benefits of the HGMP outweigh the risks.

Implementation of the HGMP would support recovery of the Upper Klamath and Shasta populations of the SONCC coho salmon ESU. Implementation of the HGMP will promote management of hatchery broodstock to achieve: proper genetic integration with natural populations; local adaptation of natural and hatchery populations; minimization of adverse ecological interactions between hatchery- and natural-origin fish; and minimization of effects of hatchery facilities on the ecosystem. Achievement of these goals will benefit all of the salmonid populations in the Klamath River Basin, and will have a positive impact on biodiversity and ecosystem function.

3) Can the proposed action reasonably be expected to have a substantial adverse impact on public health or safety?

Response: The proposed hatchery program would not be expected to have a substantial adverse impact on public health or safely because there would be no change in the risk of exposure of hatchery workers to chemicals or pathogens. Likewise, there would be no change in the potential nutritional benefits of the hatchery programs to human health and no change in the risk of public exposure to toxic contaminants relative to current conditions.

4) Can the proposed action reasonably be expected to adversely affect endangered or threatened species, their critical habitat, marine mammals, or other non-target species?

Response: NMFS has reviewed the adverse effects of the proposed action on endangered and threatened species and their critical habitat through consultation under ESA section 7. This consultation resulted in a biological opinion, in which NMFS determined that the proposed action will have adverse project effects on the SONCC coho salmon ESU and its designated critical habitat to some degree, but the proposed action is not likely to jeopardize the continued existence of the SONCC coho salmon ESU and is not likely to result in the destruction or adverse modification of SONCC coho salmon ESU critical habitat (NMFS 2014). In addition, NMFS concluded that the proposed action is not likely to adversely affect the species and critical habitat with respect to the Southern Distinct Population Segment (DPS) of North American green sturgeon, Southern DPS of Pacific Eulachon, and Southern Resident killer whale DPS. The discussion in the Environmental Assessment (NMFS 2014a) regarding whether the proposed action can reasonably be expected to adversely affect endangered or threatened species, their critical habitat, marine mammals, or other non-target species is summarized below.

The proposed action would authorize take of SONCC ESU coho salmon that result from the IGH coho salmon program, while also minimizing take and adverse effects via implementation of the HGMP. Hatchery propagation of coho salmon under the HGMP will require the lethal take of adult coho salmon for broodstock and directed take from the handling and transport of adult and juvenile coho salmon. Activities authorized under the permit would include collection of 135 to 270 adult coho salmon spawners annually (up to 50 percent of which may be NOR adults) to meet the IGH's goal of producing 75,000 yearling coho salmon each year. Under current operations the egg to smolt survival is only about 30%, and as a result about 270 adult coho salmon broodstock are required to produce the target release goal of 75,000 smolts (CDFW and PacifiCorp 2014). Under the HGMP culture practices will be improved to increase egg-to-smolt survival rates. The increase in survival will be achieved by improving egg incubation conditions and covering raceways with netting to reduce bird predation on juveniles. Egg incubation conditions will be investigated to identify measures that will further improve survival. These actions may include 1) changes to incubation methods, 2) improvements in egg rearing water quality, 3) filtering organic matter from the water source, 4) using moist-air incubation, 5) decreasing egg density in incubation trays, and 6) modifying coho salmon spawning protocol when using spawning matrix to insure milt is viable. All of these actions are anticipated to improve egg to smolt survival to 60 percent which in turn will reduce the number of coho salmon broodstock required to meet smolt release goals from 270 to 135 as the benefits from these actions are realized (CDFW and PacifiCorp 2014).

In addition to adult coho salmon taken for broodstock purposes, up to 10,500 juvenile coho salmon may be handled, transported and marked at the Bogus Creek fish weir. Juvenile outmigrant trapping at Bogus Creek or upper mainstem Klamath River is expected to result in predation of up to 3.2 percent of the trapped coho salmon subyearlings (i.e., up to 335 subyearlings). Of the coho salmon not eaten, trapping is expected to result in an annual total mortality of up to 5.7 percent of captured subyearlings (i.e., up to 599 subyearlings) and up to 7.9 percent of captured yearlings and smolts (i.e., up to 830 yearlings and smolts) at the Bogus Creek trap. Actual mortality will likely be less since these estimates were derived from the maximum observed mortality rates. The incidental mortality rate for this activity does not represent a significant reduction to the ESU and conservation benefits derived through the implementation of the HGMP including operation of the monitoring and evaluation program outweigh potential adverse effects described under the biological opinion (NMFS 2014).

The actions proposed in the HGMP are expected to reduce or eliminate factors such as low fertilization rates, juvenile culling for genetic reasons, and bird predation in raceways, further decreasing broodstock population needs so that fewer adults are needed over time. As egg to smolt survival rates improve over time the number of adult coho salmon required for broodstock will decrease from 270 to as few as 135. Thus, the adverse effect of take of coho salmon from IGH activities will be reduced under the HGMP as compared to the current hatchery program. Certain components of the current management scheme (small program size, the avoidance of jacks in the broodstock, and the lack of a genetic broodstock management program at the hatchery) have been shown to produce progeny with decreased survival rates due to lower fitness caused by inbreeding and divergence between brood years. Activities included in the HGMP that are expected to decrease these adverse effects include: development of a genetic spawning matrix to reduce sibling crosses, incorporation of jacks into the broodstock to reduce genetic divergence between brood years, incorporation of NOR adults into the broodstock (20 to 50 percent of total broodstock) to improve fitness, and adoption of a 2:1 male to female mating protocol.

Implementation of the HGMP will not change the number of yearlings produced annually. However, the HGMP incorporates measures to improve survival from one life stage to the next so that the IGH can reduce the number of NOR and HOR broodstock collected. Increasing in-hatchery survival and leaving more natural origin adult coho salmon on the natural spawning grounds is expected to increase the survival of juvenile coho salmon in the upper Klamath population unit.

Similar to current conditions, the potential for indirect adverse effects to naturally-spawned juvenile salmon will likely result from competitive and predatory interactions, disease transfer, and interbreeding between HOR and NOR coho salmon individuals in the Klamath River. Interactions will continue to occur between HOR coho salmon and NOR coho salmon, Chinook, and steelhead. Based on the time and size at release, hatchery coho salmon yearlings may prey on naturally-produced coho, steelhead, and Chinook fry. Modeling results indicate that hatchery coho salmon induced mortality rates upon natural coho salmon in the Upper Klamath River population unit via predation, competition, and disease is approximately 6 percent of juveniles that interact with hatchery juveniles (CDFW 2012). The impacts of this predation on NOR coho are expected to be relatively minor given the small number of fry in the main stem at the time when yearling HOR coho salmon would be migrating and the relatively low number of HOR coho salmon released from IGH. The impacts on Chinook and steelhead are expected to be similarly minor due to the large population sizes of both species in the Klamath River. Implementation of a smolt characteristic index to ensure "smolt ready" fish are released will decrease the temporal overlap between species, and decrease the potential for interactions between HOR and NOR fish in the natural environment. Physiological smolt characteristics (gill Na+, K+ and ATPase activity) are an indirect measure of seawater tolerance and migration speed. Under the HGMP, these characteristics will be monitored to determine the physiological condition of the hatchery smolts to be released relative to natural origin fish in the Upper Klamath River population unit. The collection of these data will help ensure that most or all released fish are physiologically ready to migrate rapidly to the ocean and successfully transition into saltwater.

Spawning by HOR coho salmon will be reduced in Bogus Creek and likely in other tributaries with the implementation of the HGMP. Once the immediate threat of demographic extinction is reduced, the HGMP calls for achieving a recommended proportion of natural influence (PNI) value greater than 0.5 in Bogus Creek and reducing hatchery strays to other streams over time. This would ensure that the natural environment, and not the hatchery, would be driving the larger population. The achievement of these objectives is expected to increase population fitness, abundance, and productivity.

Under the proposed action, there is potential for adverse effects related to competition between HOR coho salmon and NOR coho salmon, Chinook, and steelhead under the proposed action. Because the release of HOR smolts from the hatchery coincides with the migration of NOR coho salmon, Chinook salmon, and steelhead, there is the potential for competition in areas where there is limited migratory habitat. Given the low number of coho salmon in the Klamath River, it is anticipated that there will be adequate migratory habitat available for all species. Competition between IGH juveniles and NOR juveniles is expected to be low given the short residence time (average 22 days; Beeman et al. 2012) of HOR yearling in the Klamath River and the low number (75,000) of IGH coho salmon yearlings released, and implementation of the smolt indices so that HOR smolts released from IGH are ready for migration to the estuary and ocean environments, and will be less likely to residualize, compete, and predate on NOR coho salmon in the system. Competition between adult HOR coho salmon and NOR adult salmon for spawning habitat is not expected because the abundance of spawners on the spawning grounds in the Klamath River are expected to remain low.

Adverse disease effects on NOR adult salmon from the direct release of juvenile coho are not expected under the proposed action. However, because hatchery coho salmon are susceptible to infection by the myxosporean *Ceratomyxa shasta*, returning adult coho salmon that spawn naturally may increase the prevalence of this organism and increase disease load in the Klamath River Basin by increasing the quantity of fish on the natural spawning grounds and therefore, increasing the quantity of fish that can pass on the disease. This will not significantly change under the proposed action, so significant disease effects on NOR salmon associated with the proposed action are not anticipated.

Adverse effects on adult migration corridors as a result of the proposed action are not likely to occur. At the time when adult hatchery coho salmon return to the hatchery and spawning grounds, there is adequate migratory habitat to support salmon. Therefore, little, if any, competition would be expected between HOR coho and NOR salmon for migratory habitat. Similarly, adverse effects to spawning habitat are not likely to occur from the proposed action. There is expected to be adequate habitat to support HOR and NOR salmon on the spawning grounds. None of the spawning areas where IGH coho stray are at, or near, carrying capacity. Therefore, there would be little, if any, impact of HOR coho salmon on natural spawning grounds.

Effects to other threatened and endangered species, non-listed marine mammals and other non-target species under the proposed action will remain the same as under the No-action Alternative. There will be no changes in the quantity of hatchery Chinook salmon released from IGH, which will allow the quantity of available prey for marine mammals to remain relatively the same as under current conditions. Additionally, the HGMP will be implemented at IGH, which is approximately 190 miles upriver from the Klamath River estuary or any marine environments where marine mammals are found. There will also be no significant adverse effects to fish eating birds since the number of fish produced will remain the same as under current management practices.

Because of the overlap in the lower Klamath River and estuary between the emergence of fry eulachon and migration timing of coho salmon smolts in the spring, there would be a potential for predation on and competition with eulachon by hatchery coho salmon smolts. Fry eulachon occur in the water column and move downstream with the prevailing currents into pelagic areas where they begin to feed on small plankton (e.g., copepods and euphausiids). Fry eulachon are semitransparent and very small making them more difficult to spot in the water column. Coho salmon are generally present along shorelines in areas with abundant cover where they typically feed during the day and prefer aquatic insects at the surface of a stream, such as mayflies, caddis flies, and stoneflies. Juvenile eulachon are plankton-feeders, chiefly eating crustaceans such as copepods and euphausiids in pelagic and open water habitats. Differences in habitat selection and in the diets of the two species, along with the abundance of alternative prey items available to juvenile coho salmon in the Klamath River, greatly reduce the likelihood that these two species would use similar habitat types within the lower Klamath River and estuary. Therefore, predation on and competition with eulachon by hatchery juvenile and smolt coho salmon is unlikely to occur and is not expected to result in significant impacts to eulachon.

Adult coho salmon may prey on eulachon in the marine and estuarine environments (Gustafson et al. 2010). Therefore, adult coho salmon produced by the program may consume some eulachon during their ocean migration. However, given the number of hatchery adults produced by the program (less than 1,500 on average) and the large prey base of other species available for coho salmon to consume in the ocean, adult coho salmon produced by the program are unlikely to significantly affect eulachon. NMFS issued a final rule designating critical habitat for the Southern DPS of eulachon on October 20, 2011 (76 FR 65324). The designation includes the Klamath River from the mouth upstream to the confluence with Omogar Creek at about RM 8, but it excludes lands of the Resighini Rancheria and Yurok Tribe. Because IGH is located far upstream of critical habitat designated for the Southern DPS of Pacific eulachon, the proposed action will not result in any temporary or permanent disturbances to river substrate or banks in the lower Klamath River, and the proposed action is not likely to adversely affect any prey resources or migration corridors utilized by Pacific eulachon, NMFS does not anticipate that the proposed action is likely to adversely affect any essential features of critical habitat for the southern DPS of Pacific eulachon where it is designated. Therefore, the proposed action is not likely to adversely affect critical habitat of the southern DPS of Pacific eulachon.

Predation by coho salmon is not likely to significantly affect juvenile Pacific lamprey due to the small number of hatchery smolts released (75,000) under the proposed action, the diversity of other prey items utilized by coho salmon juveniles, and the relatively high fecundity of larvae produced by Pacific lamprey spawners. Coho salmon are prey for adult Pacific lamprey. The coho salmon adults produced by the hatchery program will provide a food source for Pacific lamprey in both the marine and freshwater periods of their life cycle. Therefore, the proposed action is not likely to significantly affect Pacific lamprey.

Northern DPS green sturgeon enter the Klamath River between March and July to spawn and some adults remain in river until the first fall freshets trigger emigration downstream. Northern DPS green sturgeon are not thought to ascend the lower Klamath River beyond Ishi Pishi Falls at river mile (RM) 66 (NMFS 2005), which is about 125 miles downstream of IGH. The Southern DPS of North American green sturgeon is listed as a threatened species, and includes all green sturgeon spawning populations south of the Eel River, with the only known spawning population being in the Sacramento River. Sub-adult and adult Southern DPS of green sturgeon enter coastal bays and estuaries north of San Francisco Bay, CA, during the summer months to forage (Lindley et al. 2008). In the Klamath River, the occurrence of Southern DPS green sturgeon is limited to the lower Klamath River and the estuary. IGH operations are not expected to significantly affect the physical, chemical, and biological conditions within the lower Klamath River. Additionally, the Biological Review Team (BRT) noted that current threats to Klamath River green sturgeon are increased river temperatures, reduced oxygen concentrations, and the alteration of the river flow regime (NMFS 2005). Salmon hatchery operations or production were not listed as a threat to green sturgeon in any river examined by the BRT. Because of the upriver IGH location and recognition by the BRT that hatchery production does not pose a threat to green sturgeon in the lower Klamath River, the proposed action is not likely to significantly affect green sturgeon. Critical habitat for the southern DPS of North American green sturgeon is not designated in the Klamath River or Rogue River and NMFS does not anticipate that the proposed action will have an effect on waters offshore from the Klamath River or Rogue River estuaries, where critical habitat for the southern DPS does occur.

Given an expected 1 percent smolt-to-adult survival ratio, NMFS expects continued IGH operations to result in approximately 60,000 adult Chinook salmon annually that may be available as prey resources for marine mammals, including the threatened Southern Resident killer whale DPS. Implementation of the HGMP for the coho salmon program will not change the quantity of available Chinook salmon and may increase the number of coho salmon, which could be utilized as prey for marine mammals. Therefore, the proposed action is not likely to significantly affect marine mammals, including the threatened Southern Resident killer whale DPS. Critical habitat for the Southern Resident killer whale DPS includes approximately 2,560 square miles of marine waters in three specific areas: 1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; 2) Puget Sound; and 3) the Strait of Juan de Fuca (71 FR 69054; November 29, 2006). Critical habitat designated for the threatened Southern Resident killer whale DPS is outside of the area that will be affected by the proposed action.

Critical habitat for the SONCC coho salmon ESU includes all accessible waterways, substrate, and adjacent riparian zones between the Mattole River in California, and the Elk River in Oregon, inclusive (64 Fed. Reg. 24049; May 5, 1999). Excluded are: (1) areas above specific dams identified in the Federal Register notice, (2) areas above longstanding natural impassible barriers (i.e., natural waterfalls), and (3) tribal lands.

The artificial propagation program will take place at the Iron Gate Hatchery, on the main stem Klamath River, approximately 190 miles upstream from coastal and ocean habitats. The proposed action does not contain any instream restoration or habitat related conservation measures. The proposed action includes improvements to the Bogus Creek Fish Counting Facility, including installation of taller weir panels and installation of an adult trap. Installation of these structures will not disturb existing riparian vegetation, requires no disturbance to soils of the stream bank, and will result in negligible disturbance to the streambed and negligible increases in suspended sediment. Under the proposed action, the total number of coho salmon smolts released will be more closely regulated as compared to past practices that allowed for the release of surplus smolts. Close regulation of releases will decrease the demand of HOR fish on essential habitat types associated with critical habitat designated for the SONCC coho salmon ESU, which will provide a small, beneficial effect.

Under the proposed action, effects on juvenile summer and winter rearing area and juvenile migration corridor habitats could occur from the presence of hatchery fish. The amount of food in some areas could be limited at certain times of the year by hatchery fish. Space for rearing juveniles and fry could be limited by hatchery fish, particularly during low-flow periods in late summer. The presence of hatchery juveniles produced under the proposed action could limit the function of important habitat in the juvenile migration corridor from March to May due to reductions in food and space resulting from encroachment by these juveniles. Although there is expected to be competition under the proposed action between HOR coho salmon and NOR coho, competition between IGH juveniles and NOR juveniles is also expected to be low given the short residence time (22 days) of HOR yearling in the river, the low number (75,000) of IGH coho yearlings released, and implementation of the smolt indices so that HOR smolts released from IGH are ready for migration to the estuary and ocean environments, and will be less likely to residualize and compete with NOR coho salmon in the system.

Little, if any, impacts to the adult migration corridor are expected as a result of the proposed action. At the time when adult hatchery coho salmon return to the hatchery and spawning grounds, there is adequate migratory habitat to support salmon. Therefore, little, if any, competition would be expected between adult HOR coho salmon and NOR adult salmon for migratory habitat.

Similarly, little, if any, impacts to spawning habitat are expected as a result of the proposed action. There is expected to be adequate habitat to support HOR and NOR salmon on the spawning grounds. None of the spawning areas where IGH coho stray are at, or near, carrying capacity. Therefore, there would be little, if any, impact of HOR coho on natural spawning grounds as compared to current conditions.

5) Are significant social or economic impacts interrelated with natural or physical environmental effects?

Response: No significant effects on regional population and employment are expected. IGH employs seven permanent positions. The proposed action has the potential to result in the employment of more personnel to carry out activities required by the HGMP (such as spawning surveys, smolt trapping, broodstock genetic analysis, etc.). The impact of implementation of the proposed action on regional employment is expected to remain relatively small.

The IGH's contribution to the social and economic value of tribal, recreational, and commercial salmon fisheries in the Klamath River Basin could be enhanced by HGMP actions. Economic benefits to the region from these fisheries include revenue generated through fish sales; jobs provided through commercial fishing and fish processing occupations; purchase of boats, boat repair services, equipment, and fuel from local businesses; and the purchase of food and lodging at local motels and restaurants. However, the current ESA-listing status of coho salmon limits the ability of the region to fully benefit from salmon fisheries by limiting the opportunity to harvest surplus unlisted salmon intermingled with listed coho salmon in traditional harvest areas.

Improvements in the prospects for recovery of the listed coho salmon through HGMP hatchery, research, and monitoring and evaluation activities, and complementary habitat and harvest management actions are expected to provide benefits to the regional salmon fisheries. Under the Proposed Action, PacifiCorp would continue funding 100 percent of hatchery operations and maintenance costs pursuant to the Klamath Hydroelectric Settlement Agreement (KHSA; KHSA 2010). These costs will be borne by PacifiCorp customers in the six western states in which PacifiCorp operates, but would constitute only a small fraction of overall costs to customers (NMFS 2012a).

6) Are the effects on the quality of the human environment likely to be highly controversial?

Response: No. Although the proposed action is related to larger conservation issues in the Klamath River Basin that are controversial, for example the KHSA, the proposed action itself is not highly controversial. The effects of the proposed hatchery programs as described in the proposed HGMP are not highly controversial because their effects are consistent with implementation of other hatchery programs and are beneficial to the affected human communities. Under the proposed action, IGH will be operated to conserve the listed SONCC coho salmon ESU. The HGMP is built around the principles and recommendations of the Hatchery Scientific Review Group (2004) and more recently, the California Hatchery Scientific Review Group (2012) recommended that the draft HGMP for the coho program should be approved and implemented. These principles and recommendations represent the best science available for operating hatchery facilities consistent with the conservation of salmonid species.

No comments were received in response to the proposed action analyzed in the draft EA. This is an indication that the methodology and best available information used to analyze effects are not highly controversial to the public.

7) Can the proposed action reasonably be expected to result in substantial impacts to unique areas, such as historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, essential fish habitat, or ecologically critical areas?

Response: The proposed action would not adversely impact unique areas, cultural or historic resources, park land, prime farmlands, wetlands, wild and scenic rivers, essential fish habitat, or ecologically critical areas (see response to Question 1 regarding effects to essential fish habitat). The proposed action activities would not occur within any area designated or qualified as unique, park land, wetland, or prime farmland; therefore, no effects would occur to these areas either directly or indirectly. The Klamath River is designated as a Wild and Scenic River (WSR), and the proposed action is expected to improve the resources of this WSR compared to its current condition by improving fisheries resources. Improvements include increases in the abundance of native, wild salmonids; improvements in genetic and life history diversity; and decreases in the influence of HOR coho salmon in the Klamath Basin. Under the proposed action, no effects on cultural resources are expected because no prehistoric or archaeological resources are known to occur within the IGH area, and no activities would occur under the proposed action that could cause disturbance to other sites in the vicinity.

8) Are the effects on the human environment likely to be highly uncertain or involve unique or unknown risks?

Response: Effects on the human environment are fairly well-known (e.g., indirect impacts to wild fish through predation and competition, impacts to fishery resources indirectly affecting tribal resources, changes to genetics of salmon populations). Although there are some uncertainties involved in the on-going operation of hatchery programs, the risks are understood, and the proposed hatchery program includes explicit steps to monitor and evaluate these uncertainties in a manner that allows timely adjustments to minimize or avoid adverse impacts.

Improvements to the hatchery coho salmon program under the proposed action are intended to provide mitigation for the take of natural spawning coho salmon, and will provide improvements to the overall population through management of hatchery broodstock to achieve proper genetic integration with, or segregation from, natural populations; promotion of local adaptation of natural and hatchery populations; minimization of adverse ecological interactions between hatchery- and natural-origin fish; and minimization of effects of hatchery facilities on the ecosystem. Risks associated with activities under the proposed action are not unique or unknown; they have been assessed under prior permit approvals, and are similar to other ongoing HGMP programs outside of the action area.

9) Is the proposed action related to other actions with individually insignificant, but cumulatively significant impacts?

Response: Development of an ESA section 10(a)(1)(A) permit application and the development and implementation of an HGMP for the IGH coho salmon program is occurring within the larger context of national interest in the Klamath River, its fisheries, and restoration and the interests of tribal fisheries, tribal trust resources, hatchery interests, and listed species recovery. Hatchery operations, hatchery reform, and salmon recovery are also related to several larger, overarching plans, agreements, and regulatory requirements within which the proposed action operates. These related and foreseeable actions are not anticipated to have an adverse cumulative effect on the human environment because their goals and objectives are to assist with species conservation and recovery. Therefore, the addition of the proposed action to these related actions is not anticipated to cause an adverse cumulative impact on the human environment since the goal of this action is also to enhance the propagation and survival of the SONCC coho salmon and to improve HGMP practices in the action area.

As an example of the related actions between other ongoing plans and the proposed action, the permit term of 10 years includes the interim period prior to when mainstem Klamath River dams of the Klamath Hydroelectric Project (Federal Energy Regulatory Commission Project No. 2082) are anticipated to be removed pursuant to the KHSA if there is an affirmative determination by the Secretary of the Interior as described in the KHSA or fish passage facilities are constructed and operated at the Project facilities if dam removal does not occur under the KHSA and the Project is relicensed by FERC. This permit would authorize take associated with implementation of the coho salmon hatchery program under a proposed HGMP for IGH during that interim period. Revised hatchery management goals and strategies will be developed by CDFW and NMFS in response to reintroduction of coho salmon to habitat above Iron Gate Dam (KHSA 2010). At that time, a new HGMP would be developed for any new or revised programs at Iron Gate or other hatchery facilities in the area.

10) Is the proposed action likely to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural or historical resources?

Response: The proposed action would not affect any districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places. Similarly, the proposed action is not likely to cause any loss or destruction of scientific, cultural, or historical resources primarily because the proposed action covered activities will occur within active stream channels and within existing facilities (Iron Gate Dam and Iron Gate Fish Hatchery). Under the proposed action, no effects on cultural resources are expected because no prehistoric or archaeological resources are known to occur within the IGH area, and no activities would occur under the proposed action that could cause disturbance to other sites with prehistoric or archaeological resources in the vicinity.

11) Can the proposed action reasonably be expected to result in the introduction or spread of a nonindigenous species?

Response: The proposed action does not involve the introduction, removal, or movement of any non-indigenous species into or out of the action area. The species involved in the proposed restoration activities are native to the study region (coho salmon), and common handling and movement methods will be used where necessary, which are not known to introduce or lead to the spread of nonindigenous species. The HGMP would not introduce non-native species or expand their current range.

12) Is the proposed action likely to establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration?

Response: The proposed hatchery program is not likely to establish a precedent for future actions with significant effects or to represent a decision in principle about a future consideration because the proposed hatchery programs are similar in nature and scope to similar hatchery actions over the past several years. Other HGMPs involving captive breeding or supplementation in the Pacific Northwest (e.g., Snake River fall Chinook salmon and Hood Canal Summer Chum salmon hatchery programs) have been analyzed through similar ESA determinations and NEPA reviews.

Like other similar hatchery programs already reviewed, implementation monitoring is a key element of the proposed hatchery programs, which would improve information regarding the effects of the program. The proposed hatchery program would use and support precedence already set for monitoring and adaptive management, which is expected to reduce risk of significant effects occurring now or in the future.

Finally, the issuance of an ESA section 10(a)(1)(A) permit to CDFW is a singular action considered for the interim period until dam removal occurs or fish passage facilities are constructed and operated at dams on the Klamath River mainstem, which would result in changes to hatchery operations that cannot be determined at this time. This proposed action is specific to the IGH coho salmon propagation program for this interim period.

13) Can the proposed action reasonably be expected to threaten a violation of Federal, State, or local law or requirements imposed for the protection of the environment?

Response: The proposed action is not expected to result in violations of federal, state, or local requirements for protection of the environment. Issuance of an ESA section 10(a)(1)(A) permit to CDFW will be in compliance with all federal, state, or local laws or requirements imposed for the protection of the environment.

14) Can the proposed action reasonably be expected to result in cumulative adverse effects that could have a substantial effect on the target species or non-target species?

Response: The proposed action, as described in the HGMP (CDFW and PacifiCorp 2014), will improve hatchery broodstock collection, incubation, rearing, and release practices. NMFS believes that the HGMP will generally have a beneficial effect on relationships between the target species and the non-target species that they interact with by decreasing indirect effects caused by an abundance of hatchery fish. Decreasing the residence time of hatchery reared coho salmon, re-releasing unspawned adult coho salmon, and improving hatchery broodstock collection will decrease the indirect effects on Chinook salmon and steelhead that occupy the same habitat as hatchery reared fish by decreasing the interaction time, decreasing predation and competition, and increasing the proportion of natural spawners in the Upper Klamath Basin.

The proposed action will result in implementation of biologically-based hatchery management strategies that are expected to contribute to the conservation and recovery of SONCC coho salmon. Implementation of the HGMP under the proposed action would increase egg-to-yearling survival and decrease the genetic and demographic risks of inbreeding (at the hatchery) and hatchery and natural interbreeding (on the spawning grounds) further aiding recovery of the SONCC coho salmon ESU. Accordingly, although there are still risks from predation, competitive interactions, and interbreeding the conservation benefits of the proposed action outweigh the risks associated with proposed action. Implementation of the HGMP would support recovery of the Upper Klamath River and Shasta River population units that might otherwise continue to decline irreversibly. The overall reduction in take, improved genetic makeup of the broodstock, and improved rearing survival are expected to result in an overall beneficial effect on anadromous salmonid species and are not expected to result in significant adverse effects to anadromous salmonid species. Based on these factors, the proposed action is not expected to contribute to any significant adverse cumulative impacts on fish species.

Production from IGH contributes to commercial, tribal, and recreational fisheries in the Klamath River Basin and the Pacific Ocean. Under the proposed action commercial, tribal, and recreational fishing would continue to benefit from operation of the salmon production program at IGH because hatchery-produced salmon supplement these fisheries. Under the proposed further increases in coho salmon abundance and productivity are more likely to occur, contributing to the conservation and recovery of the species, and subsequent resumption of directed fisheries in the future. The proposed action is not expected to have significant effects on hydrology and water use in the Klamath River. As such, the proposed action would not contribute to any significant adverse cumulative impacts to hydrology and water use in the Klamath River. The Klamath River's hydrology would continue to be dominated by the Klamath Basin's natural hydrologic character and upstream management of flow volumes from Upper Klamath Lake and releases from Iron Gate dam. The Klamath River total maximum daily load (TMDL) in California (NCRWQCB 2010) includes water temperature, dissolved oxygen, and nutrient-related numeric targets and waste load allocations for the hatchery as well as other Klamath River sources. With implementation of measures as required by NCRWQCB (2010) to achieve these water quality targets it is expected that hatchery operations under the proposed action will not contribute to any significant adverse cumulative impacts to water quality in the Klamath River.

The proposed action alternative is not likely to impact identified historic or cultural resources. As such, the proposed action would not contribute to any significant cumulative impacts to these resources. Under both the no action and the proposed action alternatives, no significant effects on land ownership and land use are expected. No activities would occur under either alternative that would result in changes in the current patterns of land ownership and land use in the IGH area.

Climate change poses a high threat to salmonids within the area, particularly coho salmon. 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. No activities would occur under the proposed action that would result in changes to greenhouse gas emissions or other pollutants that are likely to significantly contribute to environmental conditions associated with climate change.

NMFS expects that impacts from the proposed action, in combination with other ongoing and planned actions in the action area, will be beneficial to the human environment as compared to the No-action Alternative.

DETERMINATION

In view of the information presented in this document, the analysis contained in the supporting Final Environmental Assessment (NMFS 2012) it is hereby determined that the issuance of a Section 10(a)(1)(A) permit to CDFW and PacifiCorp and implementation of the HGMP will not significantly impact the quality of the human environment as described above and in the Final Environmental Assessment. In addition, all beneficial and adverse impacts of the proposed action have been addressed to reach the conclusion of no significant impacts. Accordingly, preparation of an EIS for this action is not necessary.

William Stelle

10/31/14

Regional Administrator, West Coast Region, NMFS

Date

REFERENCES CITED

Barraclough,W. E. 1967. Number, size and food of larval and juvenile fish caught with an Isaacs-Kidd trawl in the surface waters of the Strait of Georgia. April 25-29, 1966. Fish. Res. Board Can. Rep. Ser. No. 926. 79 pp

Barraclough, W. E., and J. D. Fulton. 1967. Data record: Number, size, composition, and food of larval and juvenile fish caught with a two-boat surface trawl in the Strait of Georgia, July 4-8, 1966. Fish. Res. Board Can., Biol. Stn., Nanaimo, B.C. , Manuscr. Rep. Ser. 940, 82 p.

Beeman, J., Juhnke,S., Stutzer,G., and Wright,k. 2012. Effects of Iron Gate Dam discharge and other factors on the survival and migration of juvenile coho salmon in the lower Klamath River, northern California, 2006-09. U.S. Geological Survey Open File Report. 2012-1067. 96p

California Department of Fish and Wildlife (CDFW) and PacifiCorp. 2014. Hatchery and Genetic Management Plan for Iron Gate Hatchery Coho Salmon. Prepared for: National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Arcata, California. 114 pp.

California Hatchery Scientific Review Group (CHSRG). 2012. California Hatchery Review Report. Prepared for the US Fish and Wildlife Service and Pacific States Marine Fisheries Commission. June 2012. 100 pgs.

Chesney, D. and M. Knechtle. 2010. Shasta River Chinook and Coho Salmon Observations in 2009-2010 Siskiyou County, CA.

Chesney, D. and M. Knechtle. 2011. Shasta River Chinook and Coho Salmon Observations in 2010-2011 Siskiyou County, CA.

Chesney, D. and M. Knechtle. 2012. Shasta River Chinook and Coho Salmon Observations in 2011-2012 Siskiyou County, CA.

Gustafson, R.G., M.J. Ford, D. Teel, and J.S. Drake. 2010. Status review of eulachon (*Thaleichthys pacificus*) in Washington, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-105, 360 p.

Hatchery Scientific Review Group (HSRG)–L. Mobrand (chair), J. Barr, L. Blankenship, D. Campton, T. Evelyn, T. Flagg, C. Mahnken, R. Piper, P. Seidel, L. Seeb and B. Smoker. 2004. Hatchery Reform: Principles and Recommendations of the HSRG. Long Live the Kings, 1305 Fourth Avenue, Suite 810, Seattle, WA 98101 (available fromwww.hatcheryreform.org).

Klamath Hydroelectric Settlement Agreement (KHSA). 2010. February 18, 2010. Available at http://216.119.96.156/Klamath/Klamath%20Hydroelectric%20Settlement%20Agreement%202-18-10signed.pdf

Lindley, S. T., M. L. Moser, D. L. Erickson, M. Belchik, D. W. Welch, E. Rechisky, J. T. Kelly, J. C. Heublein, and A. P. Klimley. 2008. Marine migration of North American green sturgeon. Transactions of the American Fisheries Society 137:182–194.

Moffitt, S., Marston, B., and Miller, M. 2002. Summary of eulachon research in the Copper River delta, 1998-2002. Regional Information Report No. 2A02-34. Anchorage: Alaska Department of Fish and Game.

National Marine Fisheries Service (NMFS). 2005. Green sturgeon (*Acipenser medirostris*) status review update. NOAA Fisheries, Southwest Fisheries Science Center, Long Beach, CA. 31 pp.

National Marine Fisheries Service (NMFS). 2014. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation. Issuance of an Endangered Species Act (ESA) Section 10(a)(1)(A) Permit for Enhancement and Scientific Purposes to the California Department of Fish and Wildlife (CDFW) for Implementation of the Coho Salmon Program at the Iron Gate Hatchery (IGH) under a Hatchery and Genetic Management Plan (HGMP). West Coast Region. NMFS consultation number : SWR-201309615. October 2014.

National Marine Fisheries Service (NMFS). 2014a. Final Environmental Assessment for Issuance of an Endangered Species Act Section 10(a)(1)(A) Permit to the California Department of Fish and Wildlife for activities at the Iron Gate Fish Hatchery.

North Coast Regional Water Quality Control Board (NCRWQB). 2010. Implementation of the Action Plan for the Klamath River TMDLs Addressing Temperature, Dissolved Oxygen, Nutrient, and Microcystin Impairments in the Klamath River in California and Lower Lost River Implementation Plan.

Robinson, D. G., W. E. Barraclough, and J. D. Fulton. 1968a. Data record: Number, size composition, weight and food of larval and juvenile fish caught with a two-boat surface trawl in the Strait of Georgia, May 1-14, 1967. Fish. Res. Board Can., Biol. Stn., Nanaimo, B.C., Manuscr. Rep. Ser. 964: 1-105.

Robinson, D. G., W. E. Barraclough, and J. D. Fulton. 1968b. Data record: Number, size composition, weight and food of larval and juvenile fish caught with a two-boat surface trawl in the Strait of Georgia, June 5-9, 1967. Fish. Res. Board Can., ~iol. Stn., Nanaimo, B.C., Manuscr. Rep. Ser. 972: 1-109

Scott, W. B. & E. J. Crossman. 1973. Freshwater fishes of Canada. *Bulletin of the Fisheries Research Board of Canada* 184: 1-966