Cover Sheet
July 2012 Internal Review Draft

Title of Environmental Review: Environmental Assessment to Analyze Impacts of a NOAA's National Marine Fisheries Service Issuance of a Permit for the Hatchery Genetic Management Plans Submitted by the Washington Department of Fish and Wildlife and the Nez Perce Tribe Under Section 10 of the Endangered Species Act.

Evolutionarily Significant Units: Snake River Spring/Summer-run Chinook salmon, Snake River Fall Chinook Salmon, Snake River Sockeye Salmon, and Snake River Basin Steelhead

Responsible Agency and Official: Barry Thom
Deputy Regional Administrator
National Marine Fisheries Service
Northwest Region
7600 Sand Point Way N.E., Building 1
Seattle, WA 98115

Contacts: Brett Farman
Salmon Management Division
National Marine Fisheries Service
Northwest Region
1201 NE Lloyd Blvd, Suite 1100
Portland, OR 97232

Legal Mandate: Endangered Species Act (ESA) of 1973, as amended and implemented – 50 CFR Part 223

Location of Proposed Activities: Snake River Basin and Tributaries Throughout Idaho State

Activity Considered: ESA Section 10 Permit Issuance for two Hatchery Genetic Management Plans for the Management of Snake River Fall Chinook Salmon.

1. PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.1. Background

NOAA's National Marine Fisheries Service (NMFS) is the lead agency responsible for administering the Endangered Species Act (ESA) for salmon and steelhead. Actions that may affect ESA-listed species are reviewed by NMFS under section 7, section 10, or section 4(d). The Secretary of Commerce (through the Northwest Regional Administrator for NMFS) may permit actions otherwise prohibited by section 9 to enhance the propagation or survival of the affected species under section 10(a)(1)(A) of the ESA.

On May 11, 2011, NMFS received two section 10(a)(1)(A) permit applications for hatchery programs that produce Snake River fall Chinook salmon (Table 1).

Table 1. Permit applications for Snake River fall Chinook salmon hatchery programs.

Hatchery Program	Applicant	Funding Entity
Nez Perce Tribal Hatchery Fall Chinook salmon Hatchery Program	Nez Perce Tribe	Bonneville Power Administration
Lyons Ferry Fall Chinook salmon Hatchery Programs	Washington Department of Fish and Wildlife (WDFW) and Idaho Department of Fish and Game (IDFG)	Lower Snake River Compensation Plan[1], Bonneville Power Administration, and Idaho Power Company

Each permit application includes a Hatchery and Genetic Management Plan (HGMP), and a single addendum that applies to both HGMPs. The addendum was developed jointly by WDFW and the Nez Perce Tribe in response to NMFS's early review and comments on the HGMPs. The addendum includes a proposal for additional monitoring and evaluation that is needed to resolve uncertainties regarding the long-term effects of Snake River fall Chinook salmon hatchery programs.

In review of the proposed hatchery programs, NMFS must consider whether the hatchery programs "are not likely to appreciably reduce the likelihood of survival and recovery" (65 FR 42422) of listed fall Chinook salmon. If the HGMPs meet the criteria of ESA section 10(a)(1)(A), NMFS can issue the permits. NMFS's issuance of permits to the applicants constitutes the Federal action that is subject to analysis as required by the National Environmental Policy Act (NEPA).

NMFS seeks to consider, through NEPA analysis, how its pending action may affect the natural and physical environment and the relationship of people with that environment. NMFS is also required to review compliance of ESA actions with other applicable laws and regulations. The

[1] Congress authorized the Lower Snake River Compensation Plan in the Water Resources Development Act of 1976 (PL 94-587) to offset losses (mitigate) caused by the construction and operation of the four Lower Snake River dam and navigation lock projects. The Lower Snake River Compensation Plan program is a U.S. Fish and Wildlife Service program funded by Bonneville Power Administration.

NEPA analysis provides an opportunity to consider, for example, how the action may affect conservation of non-listed species and socioeconomic objectives that seek to balance conservation with wise use of affected resources and other legal and policy mandates.

NMFS will evaluate the two permit applications collectively in one Environmental Assessment (EA) because they are managed jointly, address the overall production of Snake River fall Chinook salmon, overlap in geography, and rely on a common approach based upon a production agreement developed through the *U.S. v. Oregon* Management Agreement[2] process.

1.2. Description of the Proposed Action

The proposed Federal action is issuance of two research/enhancement permits, pursuant to section 10(a)(1)(A) of the ESA, for Snake River fall Chinook salmon hatchery programs as proposed in two HGMPs and an addendum. The HGMPs collectively describe the management of Snake River fall Chinook salmon at two hatcheries (Lyons Ferry Hatchery and Nez Perce Tribal Hatchery) and several satellite facilities associated with the hatchery programs. The proposed permits would expire on December 30, 2017.

Three alternatives are considered in this EA: (1) The Secretary of Commerce would not issue Section 10(a)(1)(A) permits to the applicants, (2) the Secretary of Commerce would issue Section 10(a)(1)(A) permits for the implementation of both of the HGMPs and the associated addendum, and (3) the Secretary of Commerce would issue Section 10(a)(1)(A) permits for the implementation of both of the HGMPs without the addendum.

1.3. Purpose of and Need for the Action

The purpose of the Proposed Action is (1) for the applicants to receive section 10(a)(1)(A) permits to continue to operate fall Chinook salmon hatchery programs that supplement natural-origin populations and support tribal, recreational, and commercial fisheries[3] in the Columbia River basin (including the Snake River), and (2) for NMFS to ensure that the ongoing and proposed activities described by the applicants in the HGMPs and joint addendum comply with the requirements of the ESA. The goals of the proposed program are as follows:

- Increase the natural spawning population of fall Chinook salmon upstream of Lower Granite Dam

[2] The most current *U.S. v. Oregon* Management Agreement (Management Agreement) was adopted by Federal court in 2008 and will be in place for 10 years. The Management Agreement was cooperatively negotiated by Federal and state governments and involved treaty Indian tribes under the continuing jurisdiction of the Federal court to ensure implementation of the tribes' fishing rights. The agreement includes substantive commitments related to hatchery production that are "intended to ensure that Columbia River fish runs continue to provide a broad range of benefits in perpetuity." The Management Agreement also includes provisions to "facilitate cooperative action by the Parties with regard to fishing regulation, policy issues or disputes, and the coordination of the management of fisheries on Columbia River runs and production and harvest measures."

[3] It should be noted that the proposed action pertains to hatchery operations and not the authorization of any fisheries. To the extent tribal fisheries referenced in this document are the subject of treaty rights, NMFS notes that the United States' treaties with Indian tribes are the supreme law of the land, and thus NMFS cannot make judicially binding determinations regarding the nature and extent of tribal treaty rights. Such determinations are the province of Federal courts.

- Sustain the long-term preservation and genetic integrity of the fall Chinook salmon population(s)
- Assist in the recovery and delisting of the Snake River fall Chinook salmon Evolutionarily Significant Unit (ESU)
- Provide harvest opportunities for tribal and non-tribal anglers while complying with Lower Snake River Compensation Plan mitigation requirements[4], *U.S. v. Oregon* Management Agreement production goals, and the ESA
- Provide information to reduce the uncertainty about impacts of the Snake River fall Chinook salmon hatchery programs on the natural-origin population

The need for the Proposed Action is for the continuation of ongoing and proposed hatchery programs that would supplement the natural spawning population, while conserving natural-origin populations, and support both tribal and non-tribal harvest opportunities. The Federal need is to conserve to the extent practicable the ability of Snake River fall Chinook salmon to recover to the point at which further protections are not required under the ESA for the species. In fulfilling the purpose and need, the Proposed Action would provide hatchery fish production for meeting mitigation responsibilities under the Lower Snake River Compensation Plan related to impacts from development of the four lower Snake River dams in Washington.

1.4. Action Area

The action area includes all areas where Snake River fall Chinook salmon may spawn, including the entire mainstem Snake River from the mouth upstream to Hells Canyon Dam, as well as all major tributaries of the Snake River where spawning may occur (Figure **1**). The action area includes river stretches within the states of Oregon, Washington, and Idaho.
In addition, the action area includes hatchery and satellite facilities where fish are spawned, incubated, reared, and/or acclimated. The following facilities would be used by the Lyons Ferry or Nez Perce Snake River fall Chinook salmon hatchery programs:

- Lyons Ferry Hatchery (located on the Snake River, directly below the confluence with Palouse River)
- Irrigon Hatchery (located on the Columbia River, near Irrigon, Oregon)
- Nez Perce Tribal Hatchery (located on the Clearwater River, 20 miles east of Lewiston, Idaho)
- Oxbow Hatchery (located on the Snake River near Oxbow, Idaho)
- Lower Granite Dam (located on the Snake River at river mile 110 near Pullman, Washington)
- Pittsburg Landing Acclimation Facility (located on the Snake River near Whitebird, Idaho)
- Big Canyon Acclimation Facility (located on the Lower Clearwater River near Peck, Idaho)

[4] As mitigation for four lower Snake River dam and lock projects, the Lower Snake River Compensation Plan program is designed to provide 54,900 adult fall Chinook salmon for commercial harvest and 18,300 adult fall Chinook salmon for recreational harvest throughout the Columbia River basin. In addition, the program has a goal to return 18,300 returning adult fall Chinook salmon to the area above Ice Harbor Dam.

- Captain John Rapids Acclimation Facility (located on the Snake River between Asotin, Washington and the mouth of the Grande Ronde River)
- Hells Canyon Dam (located on the Snake River at river mile 247 west of Pinehurst, Idaho)
- Luke's Gulch Acclimation Facility (located on the South Fork Clearwater River, south of Stites, Idaho)
- Saltwater Springs Satellite Facility (located on a tributary of Lapwai Creek just south of Lewiston, Idaho)
- Cedar Flats Acclimation Facility (located on the Lower Selway River, 5 miles east of its confluence with the Lochsa River)
- North Lapwai Valley Acclimation Facility (located on Lapwai Creek, just north of its confluence with the Clearwater River)

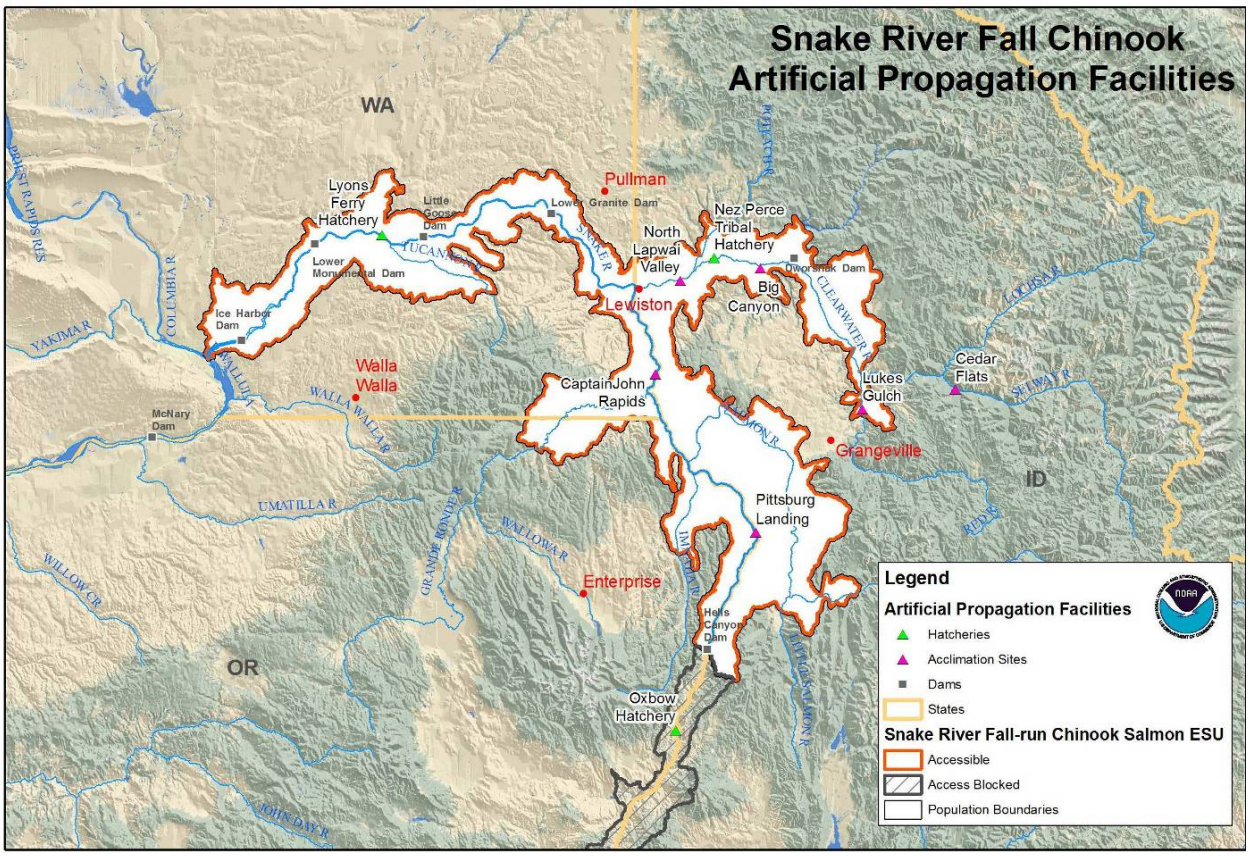

Figure 1. Snake River fall Chinook salmon hatchery facilities.

1.5. Scope

The scope of the action considered in this EA includes ESA permits for the operation of Snake River fall Chinook salmon hatchery programs as well as for research and monitoring of the species throughout the Snake River Basin as described in the Nez Perce Tribal Hatchery HGMP, Lyons Ferry HGMP, and the joint addendum to the Snake River fall Chinook salmon HGMPs. The review addresses potential effects in the entire action area. The HGMPs are limited in time

to match the current agreements in the *U.S. v. Oregon* Management Agreement; the permits would be in effect from the issuance of the permits through December 31, 2017. The operations will be monitored annually and adaptively managed as described in the HGMPs.

1.6. Relationship to Other Plans and Policies

This EA was prepared pursuant to regulations implementing NEPA (42 USC 4321), in compliance with Federal regulations for preparing an EA (40 CFR 1502), and consistent with recovery plans being developed pursuant to section 4 of the ESA by NMFS in conjunction with interested stakeholder groups.

The Proposed Action analyzed in this EA relates to ESA recovery planning throughout the Pacific Northwest, and particularly within the Columbia Basin, especially in the Snake River. After listing 27 Pacific salmon ESUs as threatened or endangered under the ESA, NMFS initiated a coastwide process to develop recovery plans for these species. The draft recovery plan for the Snake River Fall Chinook salmon ESU is being developed by NMFS in coordination with a team representing staff from tribes and relevant agencies and organizations. In general, the team is comprised of the same state, tribal, and Federal agencies that co-manage the fall Chinook salmon hatchery production. All factors that have been identified as leading to the decline of Snake River fall Chinook salmon are being addressed in the draft recovery plan. These factors include hydroelectric operations, harvest, habitat use, and hatchery production. Information from the draft recovery plan was used to prepare analyses in this EA.

In 2008, NMFS concluded multiple ESA consultations for several large scale Federal actions by issuing three biological opinions (Federal Columbia River Power System Biological Opinion, Upper Snake Biological Opinion, and *U.S. v. Oregon* Harvest Management Agreement Biological Opinion) that occur simultaneously affecting the same listed species of Columbia River Basin salmon and steelhead (NMFS 2008a, 2008b, 2008c). NMFS prepared a Supplemental Comprehensive Analysis to capture the best available data and analysis contemporaneous with its issuance of its biological opinions in 2008 (NMFS 2008a). NMFS's Supplemental Comprehensive Analysis builds on the Federal Columbia River Power System Action Agencies' Comprehensive Analysis, incorporating by reference the information relevant to NMFS's analysis on the Federal Columbia River Power System; that analysis includes information relevant to the consideration of fishery harvest in the Columbia and Snake Basins (NMFS 2008a). The Supplemental Comprehensive Analysis did not include an analysis of individual hatchery programs. Instead, it indicated that future ESA compliance would occur through consultation on the operations of the individual hatchery programs. The HGMPs describe the fall Chinook salmon hatchery programs for the purposes of ESA compliance.

The *U.S. v. Oregon* Management Agreement includes commitments for hatchery production for fall Chinook salmon between 2008 and 2017. The production tables from the *U.S. v Oregon* Management Agreement were included in the HGMPs. Though the agreement set forth a production strategy, the parties acknowledged that review under the ESA, continued evaluation, or both may trigger consideration of a modification of Snake River fall Chinook salmon program production.

Within the Snake River Basin, a total of almost 30 million hatchery-origin salmon and steelhead are released from other programs. The current release of around six million fall Chinook salmon accounts for about 20 percent of all hatchery production (FPC 2012b).

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

Three alternatives are considered in this EA: (1) The Secretary of Commerce would not issue Section 10(a)(1)(A) permits to the applicants, (2) the Secretary of Commerce would issue Section 10(a)(1)(A) permits for the implementation of both of the HGMPs and the associated addendum, and (3) the Secretary of Commerce would issue Section 10(a)(1)(A) permits for the implementation of both of the HGMPs without the addendum. No other alternatives that would meet the purpose and need were identified that were appreciably different from the three alternatives described below.

2.1. Alternative 1 (No Action) – Not Issue Section 10(a)(1)(A) Permits to the Applicants

Under this alternative, the Secretary of Commerce would not approve the HGMPs and, therefore, not issue section 10(a)(1)(A) permits to the applicants, in which case activities conducted under the HGMPs would not be exempted from section 9 take prohibitions. Consequently, the proposed hatchery programs described in the HGMPs would not have ESA coverage.

For the analysis of this alternative, NMFS assumes that the No-action Alternative would result in the termination of the hatchery operations described in the HGMPs. In addition, the monitoring and evaluation measures identified in the joint addendum would not be implemented. Though there are a number of other potential outcomes that might result from this determination (different broodstock collection points, reduced broodstock collection, collection of only hatchery-origin broodstock), the most likely outcome would be the cessation of broodstock collection at Lower Granite Dam because of the lack of ESA authorization, and this would result in a substantial re-structuring or even termination of the programs currently described in the HGMPs.

This formulation of the No-action Alternative as termination of hatchery operations is considered a reasonable alternative approach because it is a potential outcome, and because it represents one end of the spectrum of potential effects. This definition of the No-action Alternative also provides a reasonable low end on the range of effects to evaluate and to compare to the Proposed Action and other alternatives.

2.2. Alternative 2 (Proposed Action) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs and the Associated Addendum

Under this alternative, the Secretary of Commerce would permit, under section 10(a)(1)(A) of the ESA, the proposed hatchery HGMPs as they are described in both of the HGMPs and the joint addendum. The hatchery programs and associated Best Management Practices[5] would be

[5] Best Management Practices are actions that further reduce impacts on listed species or the environment and vary by program and location. Some examples of these principles include managing hatchery broodstock to improve hatchery-origin fish reproductive success rates in nature; reducing or phasing-out hatchery supplementation as viability of the target population improves and the need for supplementation declines; isolating hatchery-origin fish from interactions with natural populations that are not the target of hatchery supplementation; acclimating hatchery fish to the watershed to improve homing and reduce straying; conducting monitoring to track program performance and to facilitate adjustments in hatchery programs.

implemented as described in the HGMPs and the joint addendum. Under Alternative 2, fall Chinook salmon would be produced as described in the proposed HGMPs.

Each HGMP includes a detailed description of the proposed hatchery programs, and they are generally described below:

- Up to 5,500 fall Chinook salmon adults would be collected for broodstock[6]. Up to 30 percent (1,650) of the adult fish collected for broodstock may be natural-origin fish, and the remainder (3,850) would be hatchery-origin. In most years, approximately 350 (7 percent) natural-origin adults would be collected as broodstock because of limited availability.
- Approximately 10 percent of the entire returning adult run of Snake River fall Chinook salmon would be trapped during broodstock collection at Lower Granite Dam., Lyons Ferry Hatchery, or Nez Perce Tribal Hatchery. A weir in the South Fork Clearwater River may also be used for collection. Trapping activities would begin on August 18 or when water temperatures are below 70°F and would end in late November or early December.
- Broodstock would be treated with erythromycin and oxytetracycline to reduce disease risk. Formalin would also be used to reduce the incidence of fungus. Adults would be anesthetized before spawning, and all carcasses would be buried (rather than eaten) because of the anesthetic used.
- Broodstock would be transported to the Lyons Ferry and/or Nez Perce Tribal Hatchery for spawning.[7]
- Egg incubation and juvenile rearing would occur at Lyons Ferry Hatchery, Irrigon Hatchery, Oxbow Hatchery, Nez Perce Tribal Hatchery, and Sweetwater Springs Satellite Facility. Umatilla Hatchery may be used as an emergency backup for juvenile rearing if needed.
- 47.9 percent of Snake River fall Chinook salmon hatchery-origin smolts would be marked or tagged, although not all tagging types would allow for visual identification of hatchery-origin adults.
- Hatchery facilities would be maintained, including maintaining buildings, grounds, water intake structures, equipment, and ponds.
- Up to 900,000 hatchery-origin yearling and 3,200,000 subyearling fall Chinook salmon from the Lyons Ferry hatchery programs would be acclimated and/or released from the Lyons Ferry Hatchery, Captain John Rapids Acclimation Facility, Pittsburg Landing Acclimation Facility, Big Canyon Acclimation Facility, Hells Canyon Dam, and into the Grande Ronde River (Table 2).
- Up to 1,400,000 hatchery-origin subyearling fall Chinook salmon from the Nez Perce Tribal Hatchery would acclimated and/or released from the Nez Perce Tribal Facility,

[6] Broodstock are adult fish that are collected to be used for spawning in a hatchery.

[7] Although the production table (Table 4 in the Lyons Ferry HGMP) indicates that fall Chinook salmon would also be reared at Dworshak National Fish Hatchery and released as part of a transportation study that evaluates the effectiveness of barging fish downriver to bypass all of the Snake and Columbia River dams, this study will conclude with releases in 2012.

Luke's Gulch Acclimation Facility, Cedar Flats Acclimation Facility, and North Lapwai Valley Acclimation Facility (Table 3).

- 80,000 outmigrating smolts would be trapped using screw traps, beach seines, fyke nets, trawling, purse seines, and minnow traps and 10,000 may be tagged for monitoring.
- Management of all programs would be coordinated amongst the resource managers through the *U.S. v. Oregon* Management Agreement process.

Table 2. Snake River fall Chinook salmon release targets for the Lyons Ferry hatchery programs.

Program	Rearing Facility	Release Number	Release Location	Life stage	Mark
Lyons Ferry	Lyons Ferry	450,000	On-station	yearling	225K CWT[2], AD[3] 225K CWT,
Lyons Ferry	Lyons Ferry	200,000	On-station	sub-yearling	200K CWT, AD
Lyons Ferry	Lyons Ferry	200,000	Direct stream evaluation Near Captain John Rapids	sub-yearling	200k CWT, AD
Lyons Ferry	Irrigon FH	400,000	Grande Ronde River	sub-yearling	200K CWT, AD 200K unmarked
Fall Chinook Salmon Acclimation	Lyons Ferry	150,000	Pittsburg Landing	yearling	70K CWT, AD 80K CWT
Fall Chinook Salmon Acclimation	Lyons Ferry	150,000	Big Canyon	yearling	70K CWT, AD 80K CWT
Fall Chinook Salmon Acclimation	Lyons Ferry	150,000	Captain John Rapids	yearling	70K CWT, AD 80K CWT
Fall Chinook Salmon Acclimation	Lyons Ferry	500,000	Captain John Rapids	sub-yearling	100K CWT, AD 100K CWT 300K Unmarked
Fall Chinook Salmon Acclimation	Lyons Ferry	500,000	Big Canyon	sub-yearling	100K CWT, AD 100K CWT 300K Unmarked
Fall Chinook Salmon Acclimation	Lyons Ferry	400,000	Pittsburg Landing	sub-yearling	100K CWT, AD 100K CWT 200K Unmarked
Idaho Power Company	Oxbow	200,000	Hells Canyon Dam	sub-yearling	200K CWT, AD
Idaho Power Company	Irrigon[1]	800,000	Hells Canyon Dam	sub-yearling	200K CWT 600K AD only
Total	Yearlings Sub-yearlings			900,000 3,200,000	

Source: Adapted from Table 4 from the Lyons Ferry Hatchery HGMP

[1] This 800,000 group was originally reared at Umatilla Hatchery.

[2] Coded Wire Tag (CWT)

[3] Adipose Fin-Clip (AD)

Table 3. Snake River fall Chinook salmon production for Nez Perce Tribal Hatchery for Brood Years 2008-2017 (subyearlings).

Number	Age	Life History	Release Location(s)	Marking
500,000	0+	Standard	On station	100K Ad[1]CWT[2] 200K CWT only 200K Unmarked
200,000	0+	Early-spawning	Luke's Gulch	100K AdCWT 100K CWT only
200,000	0+	Early-spawning	Cedar Flats	100K AdCWT 100K CWT only
500,000	0+	Standard	North Lapwai Valley	100K AdCWT 200K CWT only 200K Unmarked
Total	1,400,000			

Source: Adapted from Table 5 in the Nez Perce Tribal Hatchery HGMP
[1] Adipose Fin-Clip (Ad)
[2]Coded Wire Tag (CWT)

Research, monitoring, and evaluation activities would occur consistent with the joint addendum to address uncertainties regarding the status of the natural-origin population of Snake River fall Chinook salmon and potential impacts of the proposed hatchery programs. The addendum outlines a large collection of ideas and suggests several potential research, monitoring, and evaluation measures for resolving information gaps. However, because the addendum is not intended to be an implementation document, the measures discussed are not prioritized or evaluated for feasibility. Therefore, after the joint addendum was developed, additional meetings were held among NMFS, the resource managers, and the funding agencies to identify which measures would be implemented as part of the overall Proposed Action.

Based on these meetings, the following research, monitoring, and evaluation measures are included as part of the Proposed Action:

- Parental based tagging of all Snake River fall Chinook salmon adults used for broodstock, run reconstruction, or fall backs (as funding allows) so that fish managers can better determine the origin of future returning adults.
- Reexamine past estimates of the number of Snake River fall Chinook salmon passing Lower Granite Dam and improve methods for future estimates.
- Determine the number of fall Chinook salmon adults that reach Lower Granite Dam but do not pass (i.e., fallback).
- Determine the level of spawning-site fidelity for Snake River fall Chinook salmon.
- Determine where Snake River fall Chinook salmon spawn, rear, and overwinter.
- Model Snake River fall Chinook salmon juvenile life cycle.
- Study Snake River fall Chinook salmon genetics to determine any trends in subpopulation structure over time.
- Collect, synthesize, and review all new information from these research, monitoring, and evaluation measures.

The information gathered from implementing these measures would reduce uncertainties and guide future adaptive management of the Snake River fall Chinook salmon hatchery programs. Because of current agreements and data collection and analysis timelines, changes would not occur until after the expiration of the permits considered in this EA. Possible changes may be analyzed in a separate NEPA review at that time.

The Proposed Action would not include any new construction, new access, or any modification of existing structures. A new temporary picket weir would be installed by Nez Perce Tribal staff on the South Fork Clearwater River to collect broodstock. However, installation of the weir would not require new construction, because of the annual, temporary nature of the materials. The weir would be installed annually around October 1 and disassembled around December 1. The weir would be a standard temporary picket weir that extends across the entire river channel with panels supported by angle iron tripods. The weir would have two separate trap boxes that would be modified to accommodate the size of fall Chinook salmon. The weir will be checked daily, and fish will be passed upstream or downstream according to their direction of travel within 24 hours.

2.3. Alternative 3 (HGMPs Without Addendum) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs Without the Addendum

Under this alternative, the Secretary of Commerce would permit the proposed hatchery programs and associated monitoring measures as they are described in the submitted HGMPs, but without any additional research, monitoring, and evaluation measures as described in the joint addendum. Though the implementation of the hatchery programs would initially be identical to Alternative 2 (Proposed Action) in terms of fish produced, the action would not be informed by the additional monitoring and evaluation identified in the joint addendum. As a result, the action is less likely to be adjusted from current levels to adapt to new information, and therefore this alternative would have different long-term impacts from those under Alternative 2. The addendum is designed to enable refinement of understanding of uncertainties regarding effects of the hatchery programs on Snake River fall Chinook salmon. Without the measures described in the addendum, these uncertainties would not be addressed, and, therefore, future management of the hatchery programs would be uninformed, and may increase the uncertainty of whether recovery would be possible.

2.4. Alternatives Considered but not Analyzed in Detail

2.4.1. Proposed Action for a Shorter Duration (until 2013)

The rationale for this alternative would be to coordinate the Proposed Action with the new Federal Columbia River Power System timeline (Section 1.6, Relationship to Other Plans and Policies). The Federal Columbia River Power System Biological Opinion is currently on court remand and is only in place in its current form until 2013. In February 2010, the Federal District Court of Oregon encouraged NMFS to revisit the Biological Opinion under a voluntary remand to review new scientific information and reexamination of the conclusions in the original 2008 opinion and to formally integrate the Adaptive Management Implementation Plan developed in fall of 2009 into the Biological Opinion and its Reasonable and Prudent Alternative.

In 2010, NMFS issued a Supplemental Biological Opinion that summarized and assessed the relevant new information. This information led NMFS (together with the Federal Columbia River Power System Action Agencies) to develop six new actions to further identify and protect against the uncertainties caused by climate change, toxics, invasive species, and hatchery-origin fish.

The Federal Columbia River Power System encompasses the operations of 14 major dams and reservoirs on the Columbia and Snake Rivers. These dams and reservoirs are operated as a coordinated system that provides hydroelectric power, flood control, and commercial navigation as far inland as Idaho. The 2008 Federal Columbia River Power System Biological Opinion included Reasonable and Prudent Alternative (RPA) actions (actions are RPA 39, 64, and 65) that addressed hatchery actions that would avoid jeopardy. Modification of these RPA actions could affect how NMFS reviews HGMPs (including the Proposed Action) in the future.

Though the RPA actions 39, 64, and 65 were not specifically mentioned by the Federal District Court of Oregon during the remand process, NMFS does not know if they are likely to change as a result of the remand during the length of the current hatchery Proposed Action. Determining if the Proposed Action would be compliant with an updated Federal Columbia River Power System Biological Opinion after 2013 would require speculation on whether RPA actions would remain the same or be modified and NMFS does not have the ability to predict how or if these RPA actions would change. Except for the shorter permit duration (until 2013), the activities considered under this alternative would be identical to the Proposed Action (Alternative 2); the only change would be the retrospective determination of compliance with a future speculative Federal Columbia River Power System Biological Opinion that may be updated through the remand process. If the Federal Columbia River Power System Biological Opinion changes substantially in relation to this action, it is likely that another hatchery action would be proposed (and evaluated) at that time. As a result, NMFS did not analyze this alternative in detail.

2.4.2. Greater Levels of Hatchery Production than under Proposed Action

NMFS could have considered issuing permits for production levels greater than proposed in the HGMPs. However, higher production levels could exceed the capacity of the production facilities and could potentially reduce the survival of the hatchery produced fish because of crowding, stress, and increased disease risk. Higher production levels could also result in large numbers of hatchery-origin fish in natural spawning areas, contributing to increased competition for rearing and spawning resources and increased disease risk. Reduced survival and fitness of juveniles would likely translate into reduced adult returns that would not meet mitigation goals, and could produce increased risk to natural-origin fish, and therefore not meet the purpose and need.

2.4.3. Lower Levels of Hatchery Production than under Proposed Action

NMFS could have considered issuing permits for production levels lower than proposed in the HGMPs; however, no clear intermediate level of production is apparent. Because NMFS has tribal trust responsibilities to provide for harvest for tribes, reductions in production would likely need to focus primarily on reductions in non-tribal benefit only. Reductions in non-tribal benefits would be unlikely to meet mitigation goals and would be inconsistent with *U.S. v.*

Oregon Management Agreement production agreements (Section 1.6, Relationship to Other Plans and Policies). Additionally, because the *U.S. v. Oregon* Management Agreement also includes harvest sharing agreements that proportionally allocate harvest shares according to total returns, reduced harvest would reduce benefit to both tribal and non-tribal parties. In short, reduced production is unlikely to meet the purpose and need for Lower Snake River Compensation Plan mitigation or harvest benefit.

Furthermore, any additional alternatives that might look at production levels that are more than zero, but less than the Proposed Action, would fall within the range of impacts considered under the No-action Alternative (Alternative 1)) and the Proposed Action (Alternative 2) and are unlikely to be sufficiently different from the Proposed Action (Alternative 2) to provide opportunity for meaningful analysis.

3. AFFECTED ENVIRONMENT

3.1. Introduction

Section 3 describes baseline conditions for 10 resources that may be affected by implementation of the EA alternatives: groundwater and hydrology, water quality, listed fish, non-listed fish, instream fish habitat, wildlife, socioeconomics, tourism and recreation, environmental justice, and cultural resources. No other resources were identified during internal scoping that would potentially be impacted by the Proposed Action or alternatives. Baseline conditions include the operation of the proposed Snake River fall Chinook salmon hatchery programs. Section 4 (Environmental Consequences) analyzes effects on these resources from implementing the EA alternatives.

3.2. Groundwater and Hydrology

Hatchery programs can affect groundwater and hydrology when they take water from a well (groundwater) or a neighboring tributary streams (surface water) for use in the hatchery facility. All water, minus evaporation, that is diverted from a river or taken from a well is discharged to an adjacent river after it circulates through the hatchery facility. When hatchery programs use groundwater, they may reduce the amount of water for other users in the same aquifer. When hatchery programs use surface water, they may lead to dewatering of the stream between the water intake and discharge structures. Generally, water intake and discharge structures are located as close together as possible to minimize the area of the stream that may be impacted by a water withdrawal.

Eleven hatchery facilities are currently used in the Snake River fall Chinook salmon hatchery programs (Subsection 1.4, Action Area). Two of the facilities use groundwater exclusively (Lyons Ferry Hatchery and Irrigon Hatchery), five of the acclimation facilities use surface water exclusively (Pittsburg Landing, Big Canyon, Captain John Rapids, Sweetwater Springs Satellite, and Cedar Flats Acclimation Facilities), and four facilities use both groundwater and surface water (Nez Perce Tribal Hatchery, Oxbow Hatchery, Lukes Gulch Acclimation Facility, and North Lapwai Valley Acclimation Facility) (Table 4). All hatchery facilities have current permits/water rights (WDOE 2012, IDWR 2012, OWR 2012).

Most of the surface water that is used by the hatchery facilities is taken from the Columbia, Snake, and Clearwater Rivers, which have minimum flows of more than10,000 cubic feet per second (cfs) (USGS 2012a). However, four acclimation facilities are located on creeks and rivers with lower flows than the mainstem Columbia, Snake, or Clearwater Rivers. For example, North Lapwai Valley Acclimation Facility is located on Lapwai Creek, which has a mean flow of 103 cfs. Lukes Gulch Acclimation Facility is located on the South Fork Clearwater River, which has a mean flow of 585 cfs or greater in the action area (USGS 2012a). Cedar Flats Acclimation Facility is located on the Selway River, which over the last 10 years has maintained a minimum flow of 3,813 cfs in the action area (USGS 2012a). Saltwater Springs Acclimation Facility uses a spring that originates from West Fork Sweetwater Creek, which flows between 0.45 cfs and 8.9 cfs seasonally.

A water permit is required for groundwater withdrawal within Washington, Idaho, and Oregon, and all hatchery wells used by hatchery facilities supporting the Snake River fall Chinook salmon hatchery programs are permitted by the states (WDOE 2012; IDWR 2012; OWR 2012). With the exception of Irrigon Hatchery, none of the facilities use groundwater in areas identified as Critical Groundwater Areas by the states (OWR 2012; OWR 2003; IDWR 2012; WDOE 2012). Critical Groundwater Areas do not have sufficient groundwater to provide a reasonably safe supply for irrigation or other uses at current or projected rates of withdrawal. Consequently, in these areas, the states will not approve new applications for water use except when sufficient water supply is available and other prior water rights will not be injured.

Table 4. Water source and use by hatchery facility.

Hatchery Facility	Total Facility Water Use (cfs)	Surface Water Used[1] (cfs)	Ground-water Used (cfs)	Water Source	Amount Used for Fall Chinook (cfs)	Proportion Used for Fall Chinook (%)	Discharge Location
Lyons Ferry Hatchery	118.1	0	118	Ground-water	28	24	Snake River
Nez Perce Tribal Hatchery	12.1	10	2.1	Ground-water and Clearwater River	4.5	37	Clearwater River
Oxbow Hatchery	19.1	17.9	1.2	Ground-water and Snake River	4.4	25	Snake River
Irrigon Hatchery	47	0	47	Ground-water	5	10	Columbia River
Pittsburgh Landing Acclimation Facility	4.5	4.5	0	Snake River	4.5	100	Snake River
Big Canyon Acclimation Facility	4.5	4.5	0	Snake River	4.5	100	Snake River
Captain John Rapids Acclimation Facility	5.6	5.6	0	Snake River	5.6	100	Snake River
Lukes Gulch Acclimation Facility	2.8	2.2	0.6	Ground-water and South Fork Clearwater River	2.8	100	South Fork Clearwater River
Sweetwater Springs Satellite Facility	2.2	2.2	0	Upland spring	2.2	100	West Fork Sweetwater Creek
Cedar Flats Acclimation Facility	2.2	2.2	0	Selway River	2.2	100	Selway River
North Lapwai Valley Acclimation Facility	5	1.4	3.6	Ground-water and Lapwai Creek	5	100	Lapwai Creek

3.3. Water Quality

Hatchery programs could affect several water quality parameters in the aquatic system. Concentrating large numbers of fish within hatcheries could produce effluent with elevated temperature, ammonia, organic nitrogen, total phosphorus, biological oxygen demand, pH, and suspended solids levels (Sparrow 1981; WDOE 1989; Kendra 1991; Cripps 1995; Bergheim and Åsgård 1996; Michael 2003). Chemical use within hatcheries could result in the release of antibiotics (a therapeutic), fungicides, and disinfectants into receiving waters (Boxall et al. 2004; Pouliquen et al. 2008; Martinez-Bueno et al. 2009). Other chemicals and organisms that could potentially be released by hatchery operations are polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT) and its metabolites (Missildine 2005; HSRG 2009), pathogens (HSRG 2005; HSRG 2009), steroid hormones (Kolodziej et al. 2004), anesthetics, pesticides, and herbicides.

The direct discharge of hatchery facility effluent is regulated by the Environmental Protection Agency (EPA) under the Clean Water Act through National Pollutant Discharge Elimination System (NPDES) permits. For discharges from hatcheries not located on Federal or tribal lands within Oregon and Washington, the EPA has delegated its regulatory oversight to the states. Oregon (Oregon Department of Environmental Quality) and Washington Department of Ecology are responsible for issuing and enforcing NPDES permits. In Idaho, the EPA is responsible for issuing and enforcing NPDES permits. The EPA administers NPDES permits for all projects on Federal and tribal lands; however, Native American tribes may adopt their own water quality standards for permits on tribal lands. None of the Nez Perce Tribal facilities (Nez Perce Tribal Hatchery, North Lapwai Valley Acclimation Facility, Lukes Gulch Acclimation Facility, Cedar Flats Acclimation Facility, and Sweetwater Springs Acclimation Facility) require NPDES permits, though a waste management plan was developed for all facilities (NPT 2011).

Fish hatcheries are approved by several Federal agencies to use a broad spectrum of commercial antibiotics, fungicides, and disinfectants to control bacterial and fungal disease agents associated with fish aquaculture. The use of these federally regulated products requires hatchery personnel to follow manufacturer-identified conditions under which the product could be expected to be effective and safe. Labels for approved products describe uses allowed by law. Any departure from the directions and conditions on the product label or on special state labels could be a legal violation. The use of hatchery treatment chemicals is closely regulated by the EPA, and each hatchery operation has reporting requirements concerning their use.

As part of administering elements of the Clean Water Act, Washington, Oregon, and Idaho are required to assess water quality in streams, rivers, and lakes. These assessments are published in what are referred to as the 305(d) report and the 303(d) list (the numbers referring to the relevant sections of the original Clean Water Act text). The 305(d) report reviews the quality of all waters of the state, while the 303(d) list identifies specific water bodies considered impaired (based on a specific number of exceedances of state water quality criteria in a specific segment of a water body). The EPA reviewed and approved Idaho's 2010 303(d) list on September 29, 2011. The EPA reviewed and approved Washington's 2008 303(d) list on January 29, 2009.

Within the action area, the Snake and Columbia Rivers are on the 303 (d) lists (IDEQ 2011, ODEQ 2012). Activities within the action area that contribute to the degradation of water quality

include agriculture and industry. The City of Lewiston, Idaho is downstream of the Nez Perce Reservation and is situated at the confluence of the Clearwater and Snake Rivers. There are several industries and municipalities in Lewiston along the Clearwater River. The Clearwater Corporation is a large lumber and paper mill, and has an NPDES permit for effluent that is piped to the Snake River (NPT 2009).

Table 5. Water source and use by hatchery facility.

Hatchery Facility	Compliant with NPDES Permit	Discharges Effluent into a 303(d) Listed Water Body
Lyons Ferry Hatchery	Yes	Yes
Nez Perce Tribal Hatchery	N/A	No
Oxbow Hatchery	N/A	Yes
Irrigon Hatchery	Yes	Yes
Pittsburgh Landing Acclimation	N/A	Yes
Big Canyon Acclimation	N/A	No
Captain John Rapids Acclimation	N/A	Yes
Lukes Gulch Acclimation	N/A	No
Sweetwater Springs Satellite	N/A	No
Cedar Flats Satellite	N/A	No
North Lapwai Valley Satellite	N/A	No

N/A = Not applicable because an NPDES permit is not required.

3.4. Fish Listed under the ESA

Since 1991, NMFS has identified a total of 13 salmon ESUs and steelhead DPSs throughout the Columbia River basin as requiring protection under the ESA. Four of the listed anadromous salmonid species occur in the Snake River Basin (Table 6) and in the action area. Baseline conditions for listed species in the action area are described below.

Table 6. Federal Register notices (publication date and citation) for final rules that list endangered and threatened species, designate critical habitats, or apply protective regulations to listed species considered in this assessment.

Species	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon (*Oncorhynchus tshawytscha*)			
Snake River Fall Chinook salmon	threatened (June 28, 2005; 70 FR 37160)	October 25, 1999; 64 FR 57399	June 28, 2005; 70 FR 37160
Snake River Spring/Summer Chinook salmon	threatened (June 28, 2005; 70 FR 37160)	December 28, 1993; 58 FR 68543	June 28, 2005; 70 FR 37160
Steelhead (*Oncorhynchus mykiss*)			
Snake River Basin Steelhead	threatened (January 5, 2006; 71 FR 834)	September 2, 2005; 70 FR 52630	June 28, 2005; 70 FR 37160
Sockeye Salmon *(Oncorhynchus nerka)*			
Snake River Sockeye Salmon	endangered (June 28, 2005; 70 FR 37160)	December 28, 1993; 58 FR 68543	Not Applicable (protections automatically applied)

3.4.1. General Hatchery Effects on Listed Species

Impacts of hatchery programs on the listed species can include direct impacts on individual fish that are used for broodstock collection, as well as indirect effects including genetic risks, hatchery facility risks, effects, disease, ecological interactions (e.g., competition and predation), nutrient cycling, and fisheries that target hatchery-origin adults. Hatchery programs can also increase the abundance of listed salmon and steelhead populations.

3.4.1.1. Hatchery Facility Risks

Potential risks to natural-origin salmon and steelhead associated with the operation of hatchery facilities include the following:

- Hatchery facility failure (power or water loss leading to catastrophic fish losses)
- Hatchery facility water intake effects (stream de-watering and fish entrainment)
- Hatchery facility effluent discharge effects (deterioration of downstream water quality)
- Weir effects (e.g., migration delays, isolation, impingement, increased predation rates)

3.4.1.2. Benefits of Nutrient Cycling

The flow of energy and biomass from productive marine environments to relatively unproductive terrestrial environments supports high productivity where the two ecosystems meet (Polis and

Hurd 1996). Salmon and steelhead are a major vector for transporting marine nutrients across ecosystem boundaries (i.e., from marine to freshwater and terrestrial ecosystems). Because of the long migrations of some stocks of Pacific salmon, the link between marine and terrestrial production may be extended hundreds of miles inland. Nutrients and biomass extracted from the milt, eggs, and decomposing carcasses of spawning salmon stimulate growth and restore the nutrients of aquatic ecosystems. Experiments have shown that carcasses of hatchery-produced salmon can be an important source of nutrients for juvenile salmon rearing in streams (Bilby et al. 1998).

3.4.1.3. Risks Associated with Disease Transfer

Interactions between hatchery-origin fish and natural-origin fish in the environment may result in the transmission of pathogens, if either the hatchery-origin or the natural-origin fish are harboring fish disease (Table 7). This impact may occur in tributary areas where hatchery-origin fish are released and throughout the migration corridor where hatchery-origin and natural-origin fish may interact. As the pathogens responsible for fish diseases are present in both hatchery-origin and natural-origin populations, there is some uncertainty associated with determining the source of the pathogen (Williams and Amend 1976; Hastein and Lindstad 1991). Hatchery-origin fish may have an increased risk of carrying fish disease pathogens because of relatively high rearing densities that increase stress and can lead to greater manifestation and spread of disease within the hatchery-origin population. Consequently, it is possible that the release of hatchery-origin salmon and steelhead may lead to an increase of disease in natural-origin salmon and steelhead populations.

Table 7. Some common fish pathogens found in Columbia River hatchery facilities.

Pathogen	Disease	Species Affected
Renibacterium salmoninarum	Bacterial Kidney Disease (BKD)	Chinook salmon, chum salmon, coho salmon, steelhead and sockeye salmon
Ceratomyxa shasta	Ceratomyxosis	Chinook salmon, steelhead, coho salmon and chum salmon
Flavobacterium psychrophilum	Coldwater Disease	Chinook salmon, chum salmon, coho salmon, steelhead and sockeye salmon
Flavobacterium columnare	Columnaris	Chinook salmon, chum salmon, coho salmon, steelhead and sockeye salmon
Yersinia ruckeri	Enteric Redmouth	Chinook salmon, chum salmon, steelhead and sockeye salmon
Aermonas salmonicida	Furunculosis	Chinook salmon, chum salmon, coho salmon, steelhead and sockeye salmon
Infectious hematopoetic necrosis	IHN	Chinook salmon, steelhead, chum salmon sockeye salmon
Saprolegnia parasitica	Saprolegniasis	Chinook salmon, coho salmon, steelhead, chum salmon, sockeye salmon
Vibrio anguillarum	Vibriosis	Chinook salmon, coho salmon and chum salmon

Sources: IHN database http://gis.nacse.org/ihnv/ ;
http://www.nwr.noaa.gov/Salmon-HarvestHatcheries/Hatcheries/Hatchery-Genetic-Mngmnt-Plans.cfm.

Bacterial gill disease and bacterial kidney disease have occurred in some of the Snake River fall Chinook salmon hatchery facilities (Lyons Ferry and Nez Perce Tribal Hatchery). As a result, hatchery managers have implemented mitigation measures such as culling eggs from females with high prevalence of bacterial kidney disease, using pathogen free water, using antibiotics, and using lower rearing densities. Consequently, Snake River fall Chinook salmon hatcheries have a relative disease-free status and low mortality during rearing.

3.4.1.4. Genetic Risks

Salmon and steelhead often differ genetically from population to population because of their strong tendency to return to spawn in their home stream. Because hatchery environments are always different from natural environments, domestication can be expected to occur in any hatchery program. To determine what risk it poses, three factors must be considered: (1) selection pressures in the hatchery environment that differ from those in the natural environment, causing the fish produced by the hatchery to be different genetically from what they would have been without the influence of the hatchery; (2) transmission of these differences, which is determined by the amount of interbreeding between hatchery-origin and natural-origin fish, both in the hatchery and on the spawning grounds (Lynch and O'Hely 2001, Ford 2002); and (3) the number of generations that the hatchery program has been in operation.

With regard to the first factor above, hatchery programs vary widely in approach and in thus in perceived domesticating environment they present (Busack et al.2005). This behavior allows the forces of natural selection, mutation, and random genetic drift to operate in relative isolation in different streams or subbasins, resulting in genetic differences. In many instances, these differences are adaptive, allowing a local population to have a greater ability to survive and persist in that environment than would another population (Taylor 1991; McElhany et al. 2000).

The biological mechanisms controlling genetic change in hatchery-origin fish are the same as those that cause change in natural-origin populations (i.e., selection, drift, mutation, and gene flow), but the hatchery environment and the manner in which hatchery operations are conducted can cause these mechanisms to have effects that differ in magnitude or direction from their operation in the natural environment. Therefore, local adaptation can be disrupted, and unique patterns of genetic diversity can be lost if the natural-origin population interbreeds with hatchery-origin fish. The three important elements determining the severity of this effect are (1) the extent of genetic dissimilarity between the hatchery-origin fish and the receiving natural-origin population, (2) the difference between the hatchery and natural environments, and (3) the relative amount of genetic material from hatchery-origin fish that enters the natural-origin population and vice versa.

The degree to which natural-origin fish differ genetically from natural-origin fish can depend a great deal on the way the hatchery program is operated. Choice of hatchery broodstock can be very important, because it can result in gene flow that changes the genetic character of the population. Some level of gene flow between populations, expressed as "stray" fish, is natural; in a hatchery operation, however, large numbers of fish from a totally different population can be released by a hatchery program and return to spawn with the native fish. The greater the geographic separation between the source and recipient population, the greater the likelihood of

genetic differences between the two populations (ICTRT 2007) and the greater the risk to the genetic character of the recipient population.

Berejikian and Ford (2004) summarize evidence from many studies that hatchery-origin fish do not reproduce as well under natural conditions as natural-origin fish. The magnitude of this difference is quite large when the hatchery-origin fish are of a non-local source, with reproductive rates from 2 percent to 37 percent of what was observed for natural-origin fish under the same conditions. Evidence that the presence of hatchery-origin fish can have a depressing impact on the productivity (progeny produced per parent) of natural-origin populations has been demonstrated in steelhead (Chilcote 2003), coho salmon (Nickelson 2003; Buhle et al. 2009), and Chinook salmon (Hoekstra et al. 2007). However, it is not clear, in most cases, how much of this poor reproductive performance might have been the product of non-genetic factors (Berejikian and Ford 2004). Nickelson (2003) suggests that the effect he measured was largely due to ecological interactions between hatchery-origin and natural-origin smolts during their seaward migration. Other scientists suggest hatchery-origin fish may learn behaviors in the hatchery facility that impair their future performance as spawners (Fleming et al. 1997; Berejikian et al. 1997).

In contrast to the study findings described above, there is some evidence that differences between hatchery-origin and natural-origin fish may not that large, especially when the source of the hatchery broodstock was from a local natural-origin population. For example, Berejikian et al. (2009) found that the reproductive success of naturally spawning hatchery-origin chum salmon was 83 percent of that for their natural-origin counterparts. Araki et al. (2007) found that the natural reproductive success of first generation hatchery-origin steelhead whose parents were natural-origin fish was 70 percent to 88 percent of that for natural-origin fish spawning in the same basin.

In summary, the bulk of the evidence suggests that hatchery-origin fish likely differ genetically from natural-origin fish in ways that can result in differences in reproductive performance when they spawn in the natural environment. When hatchery-origin fish interbreed with natural-origin fish, the productivity of the naturally spawning population may be reduced.

3.4.1.5. Broodstock Collection Risks

Removal of fish for broodstock may alter the effective size of the population when large numbers of adults are removed or the progeny of the fish used for broodstock are disproportionally represented in the population. By removal of fish from the population so that they can be used in the hatchery, the hatchery becomes responsible for that portion of the effective size. If the hatchery successfully provides new fish for the population, this capture of natural-origin fish for the hatchery can actually increase the effective size of the population. Should the operation fail, however, the effective size of the population will be reduced. For a population to maintain genetic diversity reasonably well, the effective size should be in the hundreds, and diversity loss can be severe if population effective size drops to a few dozen (Busack and Currens 1995).

In addition, adult fish removed for broodstock are not available to spawn naturally. Genetic diversity and subpopulation structure may be altered by the physical removal of adults from the population.

3.4.1.6. Competition and Predation Risks

Although competition and predation are treated as separate effects in this document, they are related to each other and, as a consequence, are frequently lumped together and described in the scientific literature as "ecological" effects. Competition is an interaction among members of the same species or different species utilizing a limited resource (e.g., food or space).. Competition between hatchery-origin and natural-origin fish may result from direct interactions, in which hatchery-origin fish interfere with access to limited resources by natural-origin fish, or indirect interactions, as when utilization of a limited resource by hatchery-origin fish reduces the amount available for natural-origin fish (SIWG 1984). Specific types of competition include competition for food, competition for territory among stream rearing juveniles, competition for mates, and competition for spawning sites.

For adult salmon and steelhead, effects from competition between hatchery-origin and natural-origin fish are assumed to be greatest in the spawning areas where competition for mates and spawning habitat occurs (USFWS 1994). Hatchery-origin females compete with natural-origin females for spawning sites and hatchery-origin males compete with natural-origin males for female mates. Although there is evidence that natural-origin fish have a competitive advantage over hatchery-origin fish in these situations (Fleming and Gross 1993; Berejikian et al. 1997), it is likely that the cost of this interaction, in terms of lower survival of spawners and deposited eggs, will be higher when hatchery-origin fish are present in substantial numbers.

Juvenile hatchery-origin fish released into the natural environment may compete with natural-origin fish for resources as they migrate downstream. Steelhead, coho salmon, and spring Chinook salmon typically will migrate downstream rapidly once they make a complete physiological transition to the smolt life history stage. Therefore, the hatchery programs posing the least risk from competition are those that consistently produce full-term, rapidly migrating smolts that use river corridors as a "highway" to the ocean with minimal foraging and competition with natural-origin fish along the way. This ideal is difficult to achieve. Not all individuals in a population will undergo the smolt transformation at the same time. Evidence suggests that the timing of smoltification can vary by 45 or more days within a single population (Quinn 2005). Most hatchery programs, however, release fish over a shorter period (e.g., 2 weeks). Such releases will include fish that have not yet smolted, as well as fish for which the peak smolt condition has passed. Juveniles released too early or too late with respect to smoltification are likely to migrate slowly, if at all. Because of their prolonged period in freshwater, such fish have a much greater opportunity to compete with natural-origin fish for food and space. Competition is heightened if hatchery-origin fish are more numerous and are of equal or greater size. Although non-migratory, hatchery-origin juveniles (residuals) may eventually die, there will be a period when there may be significant competition with natural-origin fish.

Migrant juvenile chum salmon and fall Chinook salmon spend an extended period in the estuarine environment feeding and growing before they move into marine waters (Quinn 2005). Hatchery programs that release sub-yearling juveniles are thus more likely to create a competitive environment for natural-origin fall Chinook salmon and chum salmon. This situation may be particularly acute in the Columbia River, where the estuary has suffered a major loss of

shallow water rearing habitat in the past century (Bottom et al. 2005). These habitat losses are likely to have reduced the capacity of these areas to support juvenile salmon, therefore exacerbating competition between hatchery-origin and natural-origin fish for the remaining habitat. There are roughly 126 million juvenile salmon and steelhead emigrating through the estuary (NMFS 2010). Fall Chinook salmon spend an extended period in the estuary before moving to marine waters, so effects on this species may be greater than for others species. Approximately 5.5 million fall Chinook salmon are released in the Snake River Basin (NPT 2011, WDFW 2011).

Fall Chinook salmon released from the program spend 1 to 5 years in the ocean prior to returning to the Snake River Basin to spawn (NPT 2011; WDFW 2011). This results in adults returning to spawn 1 to 6 years after being released, with 3 and 4 year old adults being most common (NPT 2011; WDFW 2011). Hatchery-origin adults from the program may compete with or spawn with natural-origin adults when they return. Connor et al. 2012 suggested that spawning capacity (the total available area available for Snake River fall Chinook salmon spawning) has not been reached even with high hatchery-origin returns.

Competition may also occur within stream habitats when young, pre-migratory fish are released, regardless of the species involved. Release of large numbers of fry or pre-smolts in a small area has great potential for competitive effects because interactions can occur for long periods, up to three years in the case of steelhead. The potential effect of competition on the behavior, and hence survival, of natural-origin fish depends on the degree of spatial and temporal overlap, relative sizes, and relative abundance of the two groups (Steward and Bjornn 1990). Effects would also depend on the degree of dietary overlap, food availability, size-related differences in prey selection, foraging tactics, and differences in microhabitat use (Steward and Bjornn 1990). The same situations that lead to competition between hatchery-origin and natural-origin juveniles can cause predation risk. Direct predation occurs when hatchery-origin fish eat natural-origin fish; indirect predation occurs when predation from other sources increases as a result of the increased abundance of juvenile salmon and steelhead.

In direct predation, released smolts may prey on natural-origin fry and fingerlings they encounter during downstream migration. Hatchery-origin smolts, sub-adults, and adults may also prey on natural-origin fish of susceptible sizes and life stages (smolt through sub-adult) in estuarine and marine areas. In general, natural-origin salmon and steelhead populations will be most vulnerable to predation when (1) natural-origin populations are depressed and predator abundance is high, (2) in small streams, (3) where migration distances are long, and (4) when environmental conditions favor high visibility. Some reports suggest that hatchery-origin fish can prey on fish that are one half their length (Pearsons and Fritts 1999), but other studies have concluded that hatchery-origin predators prefer fish one third or less their length (Horner 1978; Hillman and Mullan 1989; Beauchamp 1990; Cannamela 1992; CBFWA 1996). Because chum salmon and most fall Chinook salmon migrate to the ocean as sub-yearlings, they are much smaller than and more vulnerable to predation by hatchery-origin fish when they mix in the mainstem Columbia River. This vulnerability to predation by hatchery-origin fish in the mainstem Columbia is lower for the other species (coho salmon, steelhead, and spring Chinook salmon) because juveniles rear longer in freshwater and pass through the mainstem Columbia River en route to the ocean as older and larger fish.

In indirect predation, large concentrations of migrating fish may attract other predators (e.g., birds, fish, and seals). There are two types of predator response: (1) numerical, in which the predators increase in abundance and (2) functional, in which they switch preferred prey types. Hatchery-origin releases, by increasing the size of an outmigration event (often multifold), may consequently cause increased predation pressure on natural-origin outmigrants (Steward and Bjornn 1990). Nickelson (2003) concluded that large releases of coho salmon smolts thus increased predation on natural-origin coho salmon and likely caused reduced productivity in several populations. Large numbers of hatchery-origin fish may also alter natural-origin salmon behavioral patterns, potentially influencing their vulnerability and susceptibility to predation (Hillman and Mullan 1989; USFWS 1994). Hatchery-origin salmon and steelhead released into natural-origin salmon and steelhead production areas, or into migration areas during natural-origin salmon and steelhead emigration periods, may, therefore, pose an elevated, indirect predation risk to natural-origin salmon and steelhead. On the other hand, a mass of hatchery-origin salmon and steelhead migrating through an area may overwhelm established predator populations, providing a beneficial, protective effect to co-occurring natural-origin salmon and steelhead.

Estuaries are important for providing rearing habitat for growth, serving as a refuge from predation, and providing a physiological transition before fish emigrate to higher saline waters in the marine environment (Quinn 2005; Thorpe 1994). In the case of the Columbia River basin, this is especially the case for fall Chinook salmon and chum salmon because their life history strategies require a longer period of estuarine resident than other species such as coho salmon, steelhead, and spring Chinook salmon (Bottom et al. 2005). Therefore, chum salmon and fall Chinook salmon are more vulnerable to predation in the estuary than coho salmon, steelhead, and spring Chinook salmon.

3.4.1.7. Harvest Risks

Salmon fisheries, even when they target hatchery-origin fish, can have a large impact on survival and persistence of natural-origin salmon and steelhead populations (Flagg et al. 1995; Myers et al. 1998). Efforts to focus the fishing effort on harvest of hatchery-origin fish can lead to the incidental harvest of natural-origin fish in excess of levels compatible with their survival and recovery (NRC 1996). In recent years, harvest management has undergone reform, and some concerns have been addressed. These actions have benefited the status of the species. Fishing Agreements such as the *U.S. v. Oregon* Management Agreement identify total (direct and/or indirect) allowable harvest rates for many Columbia River salmon species, including Snake River fall Chinook salmon, spring/summer Chinook salmon, and steelhead.

3.4.1.8. Research, Monitoring, and Evaluation Risks and Benefits

Research, monitoring, and evaluation programs for hatchery programs are not only necessary for adaptive management purposes but it helps ensure that hatchery programs do not limit the recovery of listed populations. Monitoring and evaluation of hatchery programs are necessary to determine if management actions are adequate to reduce or minimize the impacts of the general effects discussed previously, and to determine if the hatchery is meeting its performance goals. Monitoring and evaluation within a hatchery can include measurements to evaluate hatchery

programs (e.g., survival, nutrition, size at age, condition, disease prevention, genetic makeup, total released, percent smolted).

Monitoring and evaluation to determine impacts on listed fish from hatchery programs can themselves have potential adverse impacts on listed fish in the hatchery through injuries incurred during sampling and marking. Sampling within the hatchery can include direct mortalities (e.g., genetic analysis, disease pathology, smolt condition) and incidental take (e.g., sorting, marking, transfers). Marking of hatchery fish prior to release is required for all programs to monitor and evaluate hatchery effects (positive and negative). Marking is necessary to evaluate a number of objectives including selecting broodstock, determining hatchery stray rates and hatchery contributions to fisheries, and for the implementation of selective fisheries that target hatchery fish.

Sampling methods can include the use of weirs, electro-fishing, rotary screw traps, seines, hand nets, spawning ground surveys, snorkeling, radio tagging, and carcass recovery. Each sampling method can be used to collect a variety of information. Sample methods, like tagging methods, can adversely impact listed fish, both those targeted for data collection and those taken incidentally to the data collection.

3.4.2. Snake River Fall Chinook salmon

The Snake River Fall-run Chinook salmon ESU includes fish spawning in the lower mainstem of the Snake River and the lower reaches of several of the associated major tributaries, including the Tucannon, Grande Ronde, Clearwater, Salmon, and Imnaha Rivers. This ESU was originally listed under the ESA in 1992, and its listing status was reaffirmed in 2005 (70 FR 37160, June 28, 2005).

The Snake River Fall-run Chinook salmon ESU does not meet the ESU-level viability criteria (the non-negligible risk of extinction over 100-year time period), based on current abundance and productivity information, but recent numbers are approaching the delisting criteria (Ford 2011). The overall adult abundance has been increasing substantially beginning in 2000, though this trend has been largely driven by hatchery-origin returns (Figure 2). The 10-year average (2001 to 2010) over Lower Granite Dam has risen to 16,354, higher than the previous decade (1991 to 2001) average of 2,289. Similarly, the 10-year average (2001 to 2010) for natural-origin fish over Lower Granite Dam has risen to 2,588, several times that of the previous decade (1990 to 1999) average of 509. Fall Chinook salmon redd counts have risen from only 46 redds counted in 1991 to modern-day record counts of 2,994 in 2010 for the mainstem Snake River between Asotin, Washington, and Hells Canyon Dam (Arnsberg et al 2011).

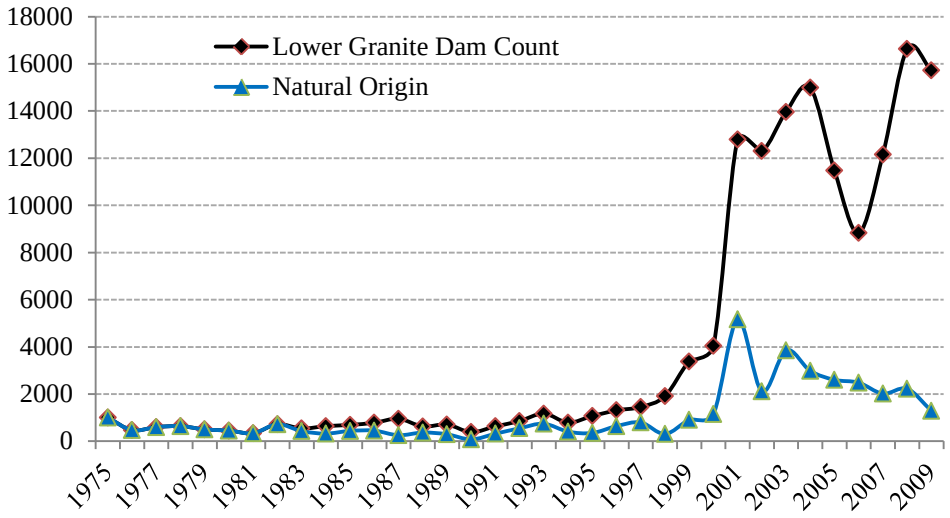

Figure 2. Numbers of fall Chinook salmon, natural-origin and natural- and hatchery-origin combined, crossing Lower Granite Dam from 1975 to 2009 (data from FPC 2012).

While both hatchery- and natural-origin returns have increased in recent years, a relatively high proportion of the estimated spawners are of hatchery origin (78 percent for the most recent 5-year cycle) (Ford 2011). Therefore, Ford (2011) suggests that the potential for longer-term risk of reduced productivity of the natural-origin population as a result of continued hatchery operations should be considered. A maximum of 30 percent of the broodstock would be natural-origin fish, but would typically be closer to 5 percent based on recent broodstock collections (NPT 2011; WDFW 2011). Removal of up to 30 percent of the available natural-origin fall Chinook salmon for broodstock still leaves sufficient adults in the wild to spawn naturally. Additionally, the hatchery program has been successful in returning adult fall Chinook salmon to the population. Additionally, only about 7 percent of the hatchery broodstock are of natural-origin (Subsection 2.2, Proposed Action), which is likely not sufficient to ameliorate the effect of the high proportion of hatchery-origin influence on the spawning grounds (Mobrand et al. 2005; Paquet et al. 2011).

Snake River fall Chinook salmon are caught in Columbia River fisheries under the *U.S. v. Oregon* Management Agreement targeting all fall Chinook salmon as they migrate upstream, returning throughout the Columbia River basin. Currently, fall Chinook salmon are not targeted for harvest in the action area. Any fall Chinook salmon that are harvested within the action area are taken incidental to steelhead fisheries, which coincide with adult fall Chinook salmon returns. Up to approximately 10 percent of the total adult fall Chinook salmon run in any year may be encountered during the steelhead fishery (IDFG 2011). Of those, up to 10 percent may die from hook-and-release mortality, meaning a maximum of 1 percent of the total population (hatchery and natural) may die as the result of fisheries in the action area (IDFG 2011). In 2010, approximately 1,000 hatchery-origin fall Chinook salmon were retained, and 900 hatchery-origin fall Chinook salmon were released. In addition, an estimated 4,000 unmarked fish were caught and released (IDFG 2012).

Because of their ESA listing status, fall Chinook salmon are captured, handled, weighed, measured, sampled, and adipose fin-clipped or tagged for monitoring and evaluation at relatively high rates (Subsection 2.2, Alternative 1). In general, handling mortalities are very low. The majority of fish used for monitoring and evaluation are hatchery-origin fish because they are more numerous, and are already being handled during routine hatchery operations. Although some of the monitoring is conducted for the purpose of evaluating the hatchery program, fall Chinook salmon are also handled for status monitoring. Adults are handled at Lower Granite Dam.

3.4.3. Snake River Spring/Summer Chinook salmon

The Snake River Spring/Summer Chinook salmon ESU includes all naturally spawned populations of spring/summer-run Chinook salmon in the mainstem Snake River and the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins, as well as fifteen hatchery propagation programs (70 FR 37160, June 28, 2005). The ESU was first listed under the ESA in 1992, and the listing was reaffirmed in 2005. Naturally produced spring Chinook salmon from the Clearwater River are not included in this ESU and are not listed under the ESA.

Abundance has been stable or increasing on average over the last 20 years (Figure 3) (NMFS 2008a). In 2010, 122,981 Snake River Spring/Summer Chinook salmon passed over Lower Granite Dam.

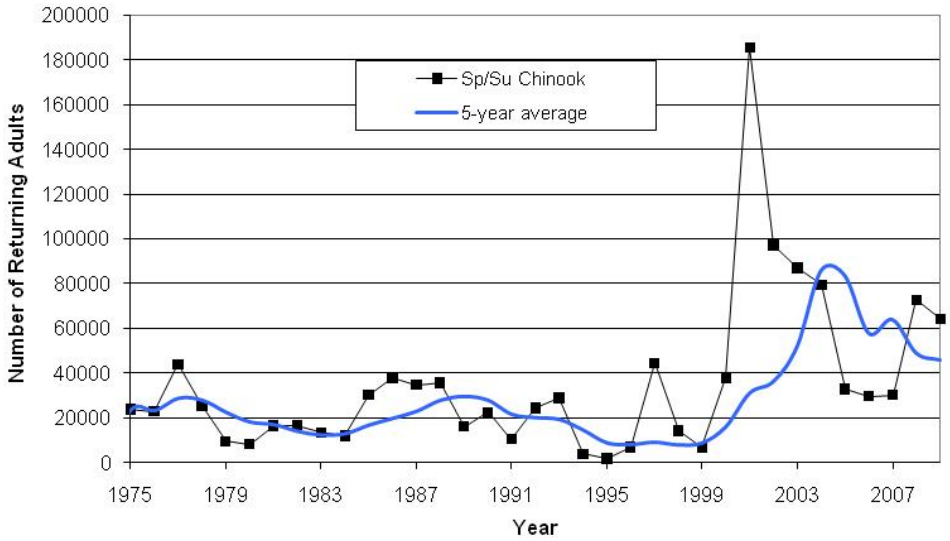

Figure 3. Number of spring/summer Chinook salmon crossing Lower Granite Dam from 1975 to 2009, annually and moving 5-year average (data from FPC 2012).

Both state and tribal fisheries on Snake River spring/summer Chinook salmon occur annually within the action area under exiting permits or authorizations. Fisheries occur in June and July and are curtailed prior to the arrival of fall Chinook salmon in the action area.

Because of their ESA listing status, spring/summer Chinook salmon are captured, handled, weighed, measured, sampled, and adipose fin-clipped or tagged for monitoring and evaluation at relatively high rates. Status monitoring occurs annually under existing permits. In general, handling mortalities are very low. The majority of fish used for monitoring and evaluation are hatchery-origin fish because they are more numerous, and are already being handled during routine hatchery operations. Although some of the monitoring is conducted for the purpose of evaluating the hatchery program, spring/summer Chinook salmon are also handled for status monitoring. Adults are handled at Lower Granite Dam, but very few concurrently with fall Chinook salmon because of their earlier migration timing (FPC 2012).

Within the action area, Snake River spring/summer Chinook salmon generally use the mainstem Snake and Clearwater Rivers as migration corridors. Adult migration timing and spawning locations are separate from those of fall Chinook salmon. In addition, spring /summer Chinook salmon do not rear in the areas where fall Chinook salmon rear or are released/collected by the Snake River fall Chinook salmon hatchery programs. However, the timing of outmigrating smolts may overlap in the spring, when both species head to the ocean.

3.4.4. Snake River Steelhead

Snake River basin steelhead were listed as threatened on August 18, 1997 (62 FR 43937). The listing was revised on January 5, 2006 (71 FR 834), after a review of the relationship between wild steelhead, hatchery steelhead, and resident *O. mykiss*. The revised Snake River Basin Steelhead Distinct Population Segment (DPS) includes all natural-origin populations of steelhead in the Snake River basin of southeast Washington, northeast Oregon, and Idaho, and six hatchery programs. Abundance has been stable or increasing on average over the last 30 years (Figure 4).

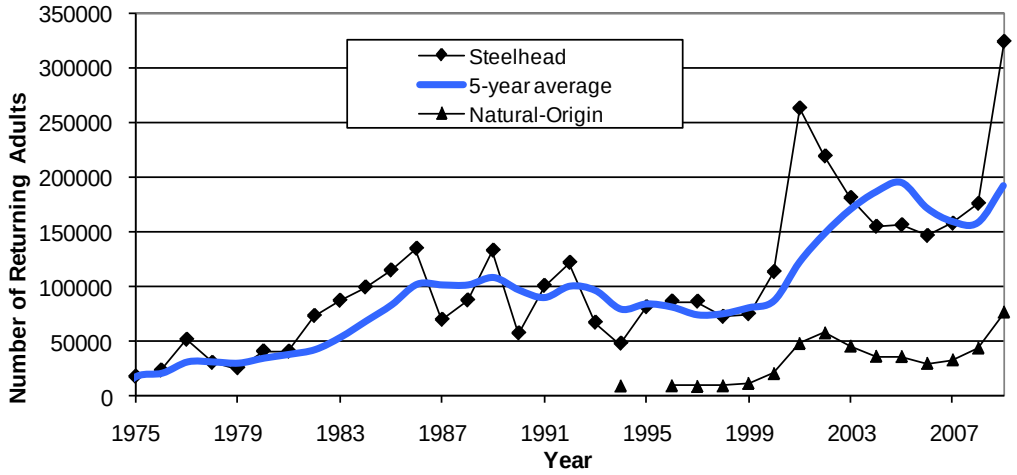

Figure 4. Snake River Basin Steelhead DPS abundance (natural-origin and all steelhead combined) and 5-year average at Lower Granite Dam (data from FPC 2012).

Both state and tribal fisheries on Snake River steelhead occur annually within the action area under exiting permits or authorizations specific to steelhead. Allowable harvest is set annually based on the projected natural-origin steelhead return to the entire Snake River Basin; therefore,

the number of fish harvested varies annually with the size of the projected run. Because only 10 percent of the total adult fall Chinook salmon may be encountered during the steelhead fishery (IDFG 2011), and a maximum of 1 percent of the total population (hatchery and natural) may die as the result of fisheries in the action area (IDFG 2011), steelhead fisheries may be curtailed when this limit is reached. Steelhead fisheries have not been curtailed because of fall Chinook salmon encounters in recent years (IDFG 2012). The incidental mortality to natural-origin steelhead is based on encounter rates, and in recent years has been estimated at up to 1,500 natural-origin steelhead salmon killed annually (IDFG 2012). Additionally, the fishery harvests up to 70,000 hatchery-origin steelhead annually in the action area (IDFG 2012).

Because of their ESA listing status, up to 25,000 adult steelhead are handled in the adult trap in Lower Granite Dam annually, and about 2,500 of these are sampled. This sampling occurs opportunistically while the trap is being operated for fall Chinook salmon broodstock collection and run reconstruction, and is used to monitor the status of steelhead. Previous authorizations have allowed up to 25 adult steelhead to die as a result of handling; however, no adult steelhead are killed during operation of the trap in most years (WDFW 2011).

Steelhead do not spawn or rear in the areas where Snake River fall Chinook salmon spawn, rear, or are released/collected in the Snake River fall Chinook salmon hatchery programs. The action area is predominantly migration corridors for steelhead.

The natural-origin abundance in the South Fork Clearwater River is unknown, but the ICTRT minimum abundance threshold is 1,000 (Ford 2011). The Nez Perce Tribe would anticipate handling up to 400 natural-origin steelhead at the weir (NPT 2012).

3.4.5. Snake River Sockeye Salmon

The Snake River Sockeye Salmon ESU is listed as endangered under the ESA. The Snake River Sockeye Salmon ESU includes all anadromous and residual sockeye salmon from the Snake River Basin, as well as sockeye salmon from the Redfish Lake hatchery program. The Snake River Sockeye Salmon ESU was listed as endangered in 1991, and reaffirmed as endangered in 2005 (NMFS 2005).

Snake River sockeye salmon have a very high risk of extinction. Abundance over the last 30 years has generally remained low (Figure 5). However, the count over Lower Granite Dam for 2010 was 2,201, which is the largest return in the last 25 years (FPC 2011). There are no fisheries that target Snake River sockeye.

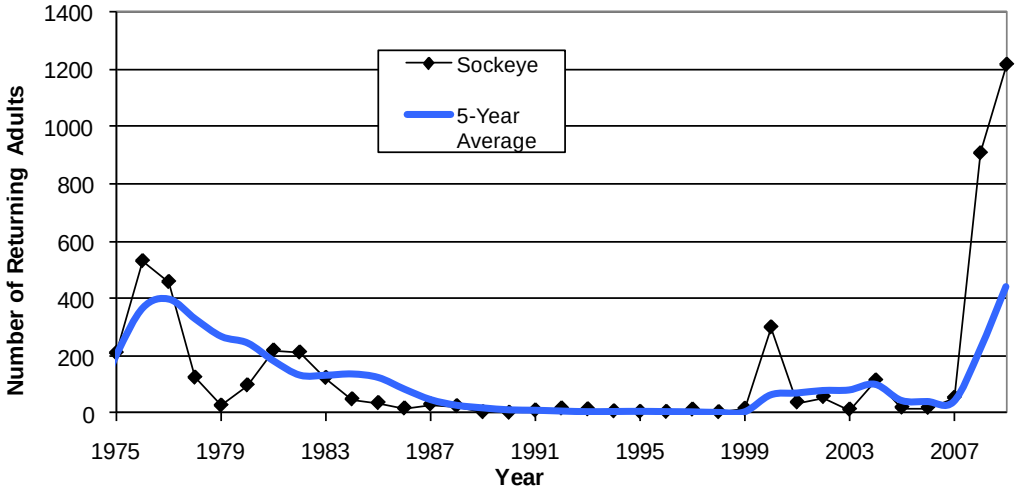

Figure 5. Numbers of sockeye salmon crossing Lower Granite Dam from 1975 to 2009 (data from FPC 2012).

Snake River sockeye salmon do not spawn or rear in the action area (Subsection 1.4, Action Area), and the action area is predominantly migration corridors for sockeye salmon. However, approximately 100,000 juvenile sockeye salmon outmigrate in the spring, passing downstream through the lower Snake River between April and June (FPC 2012). Snake River sockeye salmon may interact with Snake River fall Chinook salmon during their outmigration.

A few (fewer than 10) sockeye salmon are encountered annually in the Lower Granite Dam trap during August when fall Chinook salmon collections begin. These fish are released or retained for broodstock pursuant to their own HGMP/permit for hatchery programs. No mortalities have occurred in the trap in the past 5 years (WDFW 2011). Consistent with run timing and trap handling, no sockeye salmon have been incidentally caught in fisheries after they pass over Lower Granite dam in the last 20 years (IDFG 2011).

3.4.6. Bull Trout

Bull trout occur in the action area. Bull trout are listed as threatened under the ESA in the lower 48 states as a single DPS (USFWS 1998). There are over 50 core populations of bull trout upstream of Lower Granite Dam, which generally have stable or unknown population trends (USFWS 2005).

Bull trout, salmon, and steelhead can occur in similar aquatic habitat types; however, bull trout are more sensitive than salmon and steelhead to increased water temperatures, poor water quality, habitat conditions, and low flow conditions; thus, they more often occur in higher elevations with less disturbed habitats. Bull trout also require colder water temperatures than other salmon and trout; therefore, bull trout are more likely to occur in headwater streams (where a stream begins – its origin) where temperatures tend to be cooler. Because bull trout feed primarily on fish (referred to as piscivorous) as subadults and adults, they can be a substantial predator of young salmon and steelhead. Juvenile bull trout feed on similar prey as salmon and steelhead (USFWS 2002, 2008, 2010).

Bull trout may occasionally migrate through the Lower Granite Dam trap; however, most bull trout are not within the action area during operation of the trap for fall Chinook salmon because of warmer water temperatures. Only five bull trout have been encountered at the trap since 1998, all five of which were measured and released unharmed (FPC 2012; WDFW 2011).

Bull trout are present in the Clearwater River, and the abundance of bull trout in the South Fork Clearwater River is between 1,000 and 2,500 individuals (USFWS 2005). The bull trout in the South Fork Clearwater are less likely to migrate to the mouth of the South Fork Clearwater River because the life history types present do not migrate extensively (USFWS 2008). Only 17 percent of the South Fork Clearwater is considered a key area (USFWS 2005).

3.5. Non-listed Fish

This section includes Columbia River basin fish species that have a relationship with salmon and steelhead either as prey, predators, or competitors (Table 8). Generally, impacts would occur through competition for space or food used by both fall Chinook salmon and non-listed fish in the action area, or if either fall Chinook salmon or non-listed species are prey for the other. This section also discusses non-listed fish species that may be intercepted at the Lower Granite Trap during broodstock collection or monitoring activities related to the Snake River fall Chinook salmon hatchery programs.

Fall Chinook salmon in the action area are rarely piscivorous (fish-eaters), and feed predominantly on amphipods, dipterans, and various terrestrial insect orders including Coleoptera, Homoptera, Hymenoptera, and Thysanoptera (Muir and Coley 1996). However, they may prey on leopard dace, pygmy whitefish, and Umatilla Dace outside of the action area (Table 8).

Fall Chinook salmon may become prey of other species such as northern pikeminnow, smallmouth bass, walleye, trout, and channel catfish in the Columbia and Snake Rivers, but none of these species feed exclusively on salmon (Ward et al 1995, Keefer and Peery 2008). Lamprey are known to feed on salmon species (Beamish 1980; Setter et al 2004; Clemens et al 2010), though salmon are not the only host species for lamprey.

Within the action area, fall Chinook salmon compete for food with white sturgeon. No other non-listed fish are believed to compete with fall Chinook salmon for food or space within the action area (Table 8).

Very few of the species identified are incidentally captured in the adult trap at Lower Granite Dam regularly. In 2011, only 17 rainbow trout (which could be mistaken for redband or cutthroat trout) were handled at the trap (FPC 2012). Only eight lamprey were handled (FPC 2012). Though 87 sculpin were handled, that number incorporates all sculpin species (FPC 2012). Also in 2011, 755 suckers were handled, but it is unknown whether any were mountain sucker (FPC 2012). All incidentally captured species are released, and mortalities are low.

Several species are identified by the IDFG as “species of greatest conservation need” within the action area (Pacific lamprey, white sturgeon, westslope cutthroat trout, and inland redband trout)

(IDFG 2005). Pacific lamprey are also a "species of concern" as identified by the USFWS and are present in the Snake River basin. WDFW also describes several fish species as species of concern, including leopard dace, margined sculpin, mountain sucker, Paiute sculpin, pygmy whitefish, reticulated sculpin, riffle sculpin, river lamprey, and Umatilla dace (WDFW 2012).

Table 8. Range and status of other fish species that may interact with Snake River fall Chinoook salmon**.**

Species	Range in Columbia River Basin	Federal/State Listing Status	Type of Interaction with Fall Chinook salmon
Pacific, river, and brook lamprey	All accessible reaches in the Columbia River basin	Not listed. Pacific lamprey and river lamprey are Federal species of concern, river lamprey is a Washington State candidate species, Pacific lamprey is an Oregon State sensitive species and an Idaho State imperiled species	Freshwater predator species of fall Chinook salmon
White sturgeon	All accessible reaches in the Columbia River basin	Not federally listed, Idaho species of greatest conservation need.	May compete with fall Chinook salmon for food
Margined, reticulated, and riffle sculpin	All accessible reaches in the Columbia River basin	WDFW species of concern	Predators of salmon egg and fry
Leopard dace	Columbia River basin	Not federally listed, Washington State candidate species	Freshwater prey of fall Chinook salmon and but not within the action area
Mountain sucker	Middle-Columbia and Upper Columbia River watersheds	Not federally listed, Washington State species of concern	Occurs in similar freshwater habitats, but is a bottom feeder and has a different ecological niche
Northern pikeminnow	Throughout the Columbia River basin	Not listed	Freshwater predator species
Smallmouth bass	Throughout the Columbia River basin	Not listed	Freshwater predator species
Walleye	Throughout the Columbia River basin	Not listed	Freshwater predator species
Channel catfish	Throughout the Columbia River basin	Not listed	Freshwater predator species
Pygmy whitefish	Cle Elum and Kachess Lakes in Yakima basin; Priest Lake	Federal species of concern, Washington State sensitive	Freshwater prey of fall Chinook salmon but not within the action area
Inland redband trout	Throughout the Columbia River basin	Not listed	May feed on fall Chinook salmon
Umatilla dace	Columbia, Kootenay, Slocan, and Snake Rivers	Not federally listed, Washington State species of concern	Freshwater prey of salmon and steelhead but not within the action area
Westslope cutthroat trout	Upper Columbia River basin and Snake River	Federal species of concern, Idaho State vulnerable species	May feed on fall Chinook salmon.

Sources: Finger 1982; Horner 1978; IDFG 2005; Krohn 1968; Maret et al 1997; Polacek et al 2006; Ward et al 1995; WDFW 2012.

3.6. Instream Fish Habitat

Impacts on instream fish habitat from operating hatchery programs may occur from (1) reduction in available fish habitat from water withdrawals, (2) operation of instream structures (e.g., water intake structures and fish ladders), or (3) maintenance of instream structures (e.g., protecting banks from erosion or clearing debris from water intake structures).

Water withdrawals may affect instream fish habitat if they reduce the amount of water in a river between the hatchery's water intake and discharge structures. A full discussion of the effects of water withdrawal can be found in Subsection 3.1, Groundwater and Hydrology. In summary, the Snake River fall Chinook salmon hatchery programs remove water from Lapwai Creek, the South Fork Clearwater River, the Selway River, the Snake River, and the Clearwater River. After circulating the water through the hatchery facility, they discharge it (minus evaporation) a short distance (less than 300 feet) downstream from the water intake structure. In general, the amount of water diverted from the river is proportionally small compared to the flow in these rivers at the time that the water is being diverted. Sweetwater Springs uses proportionally more water from the West Fork of Sweetwater Creek than the other facilities; however, it is withdrawn from an area that does not provide fish habitat (NPT 2011).

The Snake River fall Chinook salmon hatchery programs use hatchery facilities that have several instream structures such as water intakes and fish ladders. Currently, the Snake River fall Chinook salmon hatchery programs do not use any weirs. All hatchery intakes on salmon and steelhead streams are screened to prevent fish injury from impingement or permanent removal from streams. The screening criteria for water withdrawal devices (NMFS 2011c) set forth conservative standards that help minimize the risk of harming naturally produced salmonids and other aquatic fauna. Oxbow Hatchery, which is not located on a stream supporting salmon or steelhead, is not screened. Because there is not a screen on the water intake structure, there may impingement or permanent removal of some non-salmonid fish at Oxbow Hatchery.

Instream maintenance may include clearing of debris and bedload from hatchery intake screens or protecting banks from erosion. Instream maintenance such as clearing of debris and bedload from hatchery intake screens or protecting banks from erosion may prevent vegetation growth, increase stream sedimentation, or disrupt some aquatic organisms, but maintenance activities are usually small in scale and duration, and return conditions to what they were when structures were first constructed. .

3.7. Wildlife

Within Idaho in the action area, several species either are listed under the ESA or are candidates for listing. Listed animals include the gray wolf, Canada lynx, grizzly bear, Northern Idaho ground squirrel, and the Selkirk mountain caribou (IDFG 2005). Candidate species in Idaho include the Columbia spotted frog, greater sage grouse, yellow-billed cuckoo, Southern Idaho ground squirrel, and wolverine (IDFG 2005). None of these species are known to occupy areas directly around the facilities.

Because the gray wolf, grizzly bear, and wolverine are carnivorous and scavenge, they may eat carcasses of adult fall Chinook salmon that return to the basin. Fish are not the only component

of the diets of these species, though salmonids may represent a somewhat larger proportion of the diet during the relatively short period of the year that adult salmon return to the action area. Because of the habitat in which fall Chinook salmon spawn in mainstem rivers with deep water, their carcasses are not readily accessible by most land mammals.

Idaho and Washington States also identify sensitive birds that may be present or migrate through the area (IDFG 2005; WDFW 2012). Some of these birds may eat juvenile salmon or adult salmon carcasses as a portion of their diet. Fish are not the only component of the diets of these species.

Steller sea lions and California sea lions are also known to feed on returning adult salmon in the Columbia River basin (USACE 2012). Sea lions feed on salmon downstream of Bonneville Dam (outside of the action area), where Snake River fall Chinook salmon adults (both hatchery- and natural-origin) migrate; however, the run timing of Snake River fall Chinook salmon does not coincide with the presence of either sea lion (NMFS 2008d), and they would not be eaten by Steller sea lions or California sea lions.

Southern resident killer whales' diet consists of a high percentage of Chinook salmon, with an overall average of 82 percent Chinook salmon (Hanson et al. 2010). Hanson et al. (2010) suggest that Chinook salmon stocks would be consumed at least roughly proportional to their local abundance. Southern resident killer whales reside predominantly in Puget Sound (outside of the action area), and would only rarely encounter Snake River fall Chinook salmon either as fall Chinook salmon migrate north up the coast, or killer whales migrate south down the coast. Snake River fall Chinook salmon would have very limited time of interaction with southern resident killer whales, and few are likely to be eaten.

Habitat disruption may occur from physical damage or disruption of riparian vegetation from angler access as well as physical disruption of streambed material by wading or motorized boat use. There is some potential for these activities to displace wildlife that may be in the area. Habitat impacts of fishing activities are usually localized and short-lived and are currently occurring related to ongoing steelhead fisheries in the action area. Additionally, fishery access points, roads, boat launches, and campsites are already present in the action area.

3.8. Socioeconomics

Socioeconomics is defined as the study of the relationship between economics and social interactions with affected regions, communities, and user groups. In addition to providing fish for harvest, hatchery programs directly affect socioeconomic conditions in the economic impact regions where the hatchery facilities operate. Hatchery facilities generate economic activity (personal income and jobs) by providing employment opportunities and through local procurement of goods and services for hatchery operations.

Currently, fisheries do not target hatchery-origin Snake River fall Chinook salmon, and these fish are only encountered incidentally during already ongoing steelhead fisheries. The non-tribal steelhead fishery draws some people from other states outside of the action area and would add some revenue to the region, and it is possible that a few additional anglers are drawn by the potential to encounter returning fall Chinook salmon. These fisheries contribute to economies

through the purchase of supplies such as fishing gear, camping equipment, consumables, and fuel at local businesses. All of these expenditures would be expected to support local businesses but it is unknown how dependent these businesses are on fishing related expenditures. Anglers would also be expected to contribute to the economy through outfitter/guide/charter fees.

The action area includes five counties in Washington (Asotin, Columbia, Franklin, Garfield, and Walla Walla), four in Idaho (Clearwater, Idaho, Lewis, and Nez Perce), and two in Oregon (Morrow and Wallowa) (Table 2).

Table 9. Demographic information regarding counties in the action area (USCB 2012).

County, State	Population (2010)	Proportion of total state population (percent)	Percent Hispanic Origin (percent)	Percent Native American (percent)	Median Income ($)
Asotin, WA	21,623	0.3	3.0	1.4	41,665
Columbia, WA	4,078	0.01	6.2	1.4	43,611
Franklin, WA	78,163	1.1	51.2	0.7	47,749
Garfield, WA	2,266	0.003	4.0	0.3	42,269
Walla Walla, WA	58,781	0.8	19.7	1.0	45,575
Clearwater, ID	8,761	0.5	3.1	2.2	41,835
Idaho, ID	16,267	1.0	2.6	3.0	34,536
Lewis, ID	3,821	0.2	3.3	4.7	35,808
Nez Perce, ID	39,265	2.5	2.8	5.6	44,395
Morrow, OR	11,173	0.3	31.3	1.2	43,902
Wallowa, OR	7,008	0.2	2.2	0.6	41,116

The median family income in each of these counties is lower than the median income for their respective states ($57,244 in Washington, $46,423 in Idaho, and 49,260 in Oregon)(USCB 2012). The total population for the combined counties affected in Washington (164,911) is 2.4 percent of the total population in the state of Washington (USCB 2012). The total population for the combined counties affected in Idaho (68,114) is 4.3 percent of the total population in the state of Idaho (USCB 2012). The total population for the combined counties affected in Oregon (18,181) is 0.5 percent of the total population in the state of Oregon (USCB 2012).

As compared to the Washington State revenue for 2006 ($289 billion) (U.S. Census Bureau 2012), total fishing expenditures in Washington accounted for less than 0.2 percent ($534 million) of the total state revenue, and salmon and steelhead angling only accounted for only a portion of that. No similar study was found for Idaho or Oregon, but fishing could be expected to contribute to a similar proportion of the total state economy based on similarities between industries found in the three states.

NMFS (2010) found that Columbia River Basin hatchery operations contributed over $22 million and 452 jobs to regional economies in the Snake River basin as a result of operating salmon and steelhead hatchery facilities. The same study found the Columbia River Basin hatchery operations contributed over $10.5 million and 414.5 jobs to regional economies in the Snake River basin from harvest-related effects. These jobs are typically Federal, state, or tribal positions. The Nez Perce Tribal Hatchery employs 15 permanent staff members (NPT 2011). The Lyons Ferry portion of the program employs 13 permanent staff members, and 9 seasonal staff members (NPT 2011).

Tribal fisheries also occur within the action area, using traditional fishing equipment created by local tribal craftsman. The availability of local fish reduces tribal reliance on other consumer goods, or travel costs to obtain other consumer goods.

3.9. Tourism and Recreation

Tourism and recreation in the action area are generally focused on outdoor activities such as camping, hiking, sightseeing, fishing, and hunting. Hatchery programs contribute to tourism and recreation in the action area by increasing fishing opportunity or providing tours of their hatchery facilities. However, fishing only accounts for about 3 percent of all tourism and recreation trips in Idaho (Travel USA 2008 ASA 2008, Felder 2007). Although specific data are not available on the proportion of fishing trips when compared to all tourism and recreational trips in Oregon and Washington, similar proportions are expected because Oregon and Washington have similar outdoor activities to Idaho. The regions affected also have similar populations, industry, and access to outdoor activities through public land. Therefore, it is assumed that fishing would be similarly represented in these areas.

3.10. Environmental Justice

This section was prepared in compliance with Presidential Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (EO 12898), dated February 11, 1994, and Title VI of the Civil Rights Act of 1964.

Executive Order 12898 (59 FR 7629) states that Federal agencies shall identify and address, as appropriate "…disproportionately high and adverse human health or environmental effects of [their] programs, policies and activities on minority populations and low-income populations…." While there are many economic, social, and cultural elements that influence the viability and location of such populations and their communities, certainly the development, implementation and enforcement of environmental laws, regulations and policies can have impacts. Therefore, Federal agencies, including NMFS, must ensure fair treatment, equal protection, and meaningful involvement for minority populations and low-income populations as they develop and apply the laws under their jurisdiction.

Both EO 12898 and Title VI address persons belonging to the following target populations:

- Minority – all people of the following origins: Black, Asian, American Indian and Alaskan Native, Native Hawaiian or Other Pacific Islander, and Hispanic[8]
- Low income – persons whose household income is at or below the U.S. Department of Health and Human Services poverty guidelines.

Definitions of minority and low income areas were established on the basis of the Council on Environmental Quality's (CEQ's) *Environmental Justice Guidance Under the Environmental Policy Act* of December 10, 1997. CEQ's *Guidance* states that "minority populations should be identified where either (a) the minority population of the affected area exceeds 50 percent or (b) the population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographical analysis." The CEQ further adds that "The selection of the appropriate unit of geographical analysis may be a governing body's jurisdiction, a neighborhood, a census tract, or other similar unit that is chosen so as not to artificially dilute or inflate the affected minority population."

The CEQ guidelines do not specifically state the percentage considered meaningful in the case of low income populations. For this study, the assumptions set forth in the CEQ guidelines for identifying and evaluating impacts on minority populations are used to identify and evaluate impacts on low income populations. More specifically, potential environmental justice impacts are assumed to occur in an area if the percentage of minority, Hispanic, and low income populations are meaningfully greater than the percentage of minority, Hispanic, and low income populations in the general population.

Within the action area, all tribal communities and seven of the 11 affected counties were identified as environmental justice communities of concern in NMFS 2010. The three tribes identified as environmental justice communities of concern in the action area are: the Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation, and the Shoshone-Bannock Tribes. The seven counties identified as environmental justice communities of concern are: Umatilla County Oregon; Franklin and Walla Walla Counties in Washington; and Clearwater, Idaho, Lewis, and Nez Perce Counties in Idaho.

3.11. Cultural Resources

Impacts on cultural resources typically occur when an action disrupts or destroys cultural artifacts, disrupts cultural use of natural resources, or would disrupt cultural practices. Within the action area, it is possible that some cultural artifacts are present around facilities because of the historical use of these areas by local tribes. The Lewis and Clark Trail follows the Clearwater and Snake Rivers and intersects much of the action area, but no cultural sites are designated on or near the hatchery facilities. A historical marker is located at Lyons Ferry State Park (Drewyers River Heritage Marker) (Lewis and Clark Trail LLC 2012).

The early history of non-Indian use of fishery resources in the Columbia River Basin is described in Craig and Hacker (1940). Prior to contact with European settlers, native peoples harvested fish from the Snake and Columbia Rivers and hunted elk, deer, bear, and waterfowl. Salmon are

[8] Hispanic is an ethnic and cultural identity and is not the same as race.

culturally, economically, and symbolically important to the Pacific Northwest. Historically, natural resources have been the mainstay of the economies of the Native Americans in the Columbia Basin. Salmon were an important aspect of the cultural life and subsistence of the Indian tribes that occupied the Columbia Basin. Hunting, fishing, and gathering have been important to tribes for thousands of years. These activities continue to be important today for subsistence and ceremonial purposes[9].

Salmon represent an important cultural resource to regional tribes within the action area. Within the action area, natural fish resources are used as a food source and for cultural practices (subsistence fishing). Fisheries in the larger tributaries are implemented by both states and tribes, but shift primarily to tribal fisheries in upstream, small tributaries. Tribal fisheries in the action area primarily target spring/summer Chinook salmon. Some fall Chinook salmon are still harvested, though, because of the cultural significance of fall Chinook salmon to tribes, often using traditional fishing equipment created by local tribal craftsman. Tribal fishing occurs inside the action area, and provides a local food source consistent with historical harvest methods and ceremonies that are culturally important to tribes.

4. ENVIRONMENTAL CONSEQUENCES

4.1. Introduction

The three alternatives being evaluated in this EA are described in Section 2, Alternatives Including the Proposed Action. The baseline conditions for the 10 resources (groundwater and hydrology, water quality, listed fish, non-listed fish, instream fish habitat, wildlife, socioeconomics, tourism and recreation, environmental justice, and cultural resources) that may be affected by the Proposed Action and alternatives are described in Chapter 3, Affected Environment. This chapter provides an analysis of the direct and indirect environmental effects associated with the alternatives on these 10 resources. Cumulative effects are presented in Chapter 5, Cumulative Effects.

4.2. Effects on Groundwater and Hydrology

4.2.1. Alternative 1 (No Action) – Do not Approve the HGMPs under ESA Section 10(a)(1)(A)

Under Alternative 1 (No Action), the Snake River fall Chinook salmon hatchery programs would be terminated, and less water would be used than under baseline conditions for broodstock holding, egg incubation, juvenile rearing, and juvenile acclimation (Table 10). Because less water would be used, there would be no change in compliance with water permits or water rights at any of the hatchery facilities (Subsection 3.2, Groundwater and Hydrology). A more detailed assessment of (1) groundwater effects and/or (2) surface water effects by hatchery facility can be found below.

[9] See also U.S. Department of the Interior, Secretarial Order No. 3206 (1997).

Lyons Ferry Hatchery

The Lyons Ferry Hatchery uses groundwater, but it is not within a State Critical Groundwater Area (Subsection 3.2, Groundwater and Hydrology). Under Alternative 1, Snake River fall Chinook salmon program production at Lyons Ferry Hatchery would be terminated, reducing groundwater use from 118 cfs to 90 cfs compared to baseline conditions (Table 10). However, reducing groundwater by 28 cfs relative to baseline conditions in an area that has sufficient groundwater supply for irrigation and other uses is expected to have a negligible effect on groundwater and hydrology.

Irrigon Hatchery

The Irrigon Hatchery also uses groundwater exclusively, but, unlike Lyons Ferry Hatchery, it is located within a State Critical Groundwater Area, which means there is not sufficient groundwater to provide a reasonably safe supply for irrigation or other uses at current or projected rates of withdrawal within the area (Subsection 3.2, Groundwater and Hydrology). Under Alternative 1, the Snake River fall Chinook salmon hatchery programs would no longer use Irrigon Hatchery, but other fish would continue to be raised at the hatchery. There would be a small reduction in water use relative to baseline conditions (4.2 cfs) (Table 10) (Subsection 3.2, Groundwater and Hydrology), but this reduction would not be expected to change baseline conditions for groundwater and hydrology.

Pittsburg Landing, Big Canyon, and Captain John Rapids Acclimation Facilities

Pittsburg Landing, Big Canyon, and Captain John Rapids Acclimation Facilities use surface water exclusively (Section 3.2, Groundwater and Hydrology). These acclimation facilities would be closed under Alternative 1 and would stop using surface water from adjacent rivers or streams (Table 10). Under baseline conditions, Pittsburg Landing, Big Canyon, and Captain John Rapids Acclimation Facilities take between 4.5 and 5.6 cfs of surface water from the mainstem Snake or Clearwater Rivers, which have minimum flows of 10,000 cfs (Subsection 3.2, Groundwater and Hydrology). All water diverted from these rivers (minus evaporation) is returned after it circulates through the facility, so the only segment of the river that may be impacted under baseline operations would be the area between the water intake and discharge structures (Subsection 3.2, Groundwater and Hydrology). Because (1) the distance between the water intake and discharge structures is small, and (2) the water used by the hatchery facility is just a small percentage of the total water in the river, there would be a negligible effect on groundwater and hydrology from terminating acclimation at Pittsburg Landing, Big Canyon, and Captain John Rapids under Alternative 1.

Sweetwater Springs Satellite and Cedar Flats Acclimation Facility

Sweetwater Springs Satellite Facility uses a spring that originates from West Fork Sweetwater Creek with a flow of between 0.45 cfs and 8.9 cfs seasonally (Subsection 3.2, Groundwater and Hydrology). All of the water currently diverted from the spring (minus evaporation) is returned to the West Fork Sweetwater Creek after circulating through the facility, so the only segment of the river that may be impacted under baseline operations would be the area between the water intake and discharge structures (Subsection 3.2, Groundwater and Hydrology). Under

Alternative 1, water use would be reduced from 2.2 cfs to 0 cfs (Table 10), but because the distance between the water intake and discharge structures is small (less than 300 feet) (BPA 1997), reducing use to 0 cfs would not result in an in-river hydrologic change. Therefore, effects on groundwater and hydrology from terminating the fall Chinook salmon program production at Sweetwater Springs Satellite Facility under Alternative 1 would be negligible or relative to baseline conditions.

The Cedar Flats Acclimation Facility uses water from the Selway River, which has a mean flow of 3,813 cfs (Subsection 3.2, Groundwater and Hydrology). All of the water currently diverted from the Selway River (minus evaporation) is returned after circulating through the facility, so the only segment of the river that may be impacted under baseline operations would be the area between the water intake and discharge structures (Subsection 3.2, Groundwater and Hydrology). Under Alternative 1, water use would be reduced from 2.2 cfs to 0 cfs (Table 10). However, because (1) the Cedar Flats Acclimation Facility currently uses less than 0.1 percent of the water in the Selway River, (2)the distance between the water intake and discharge structures is small, effects on groundwater and hydrology from terminating the fall Chinook salmon program production at Cedar Flats Acclimation Facility under Alternative 1 would be negligible relative to baseline conditions.

Nez Perce Tribal Hatchery, Oxbow Hatchery, Lukes Gulch Acclimation Facility, and North Lapwai Valley Acclimation Facility

Four facilities use both groundwater and surface water (Nez Perce Tribal Hatchery, Oxbow Hatchery, Lukes Gulch Acclimation Facility, and North Lapwai Valley Acclimation Facility) (Subsection 3.2, Groundwater and Hydrology). These facilities use between 0.3 cfs and 3.6 cfs of groundwater and between 1.4 cfs and 4.1 cfs of surface water to raise Snake River fall Chinook salmon under baseline conditions (Subsection 3.2, Groundwater and Hydrology). All surface water that is diverted from rivers (minus evaporation) is returned after circulating through the facility, so the only segment of the river that may be impacted by baseline operations would be the area between the water intake and discharge structures (Subsection 3.2, Groundwater and Hydrology). Under Alternative 1, the facilities would not produce Snake River fall Chinook salmon and would reduce their water use relative to baseline conditions (Table 10). However, because (1) these facilities take only a small proportion of the total flow from adjacent streams, (2) the distance between water intake and discharge is small (less than 300 feet) (BPA 1997), and (3) none of these facilities are located in State Critical Groundwater Areas (i.e., there is sufficient water in the aquifer for irrigation and other uses), effects on groundwater and hydrology from terminating the fall Chinook salmon program production at Nez Perce Tribal Hatchery, Oxbow Hatchery, Lukes Gold Acclimation Facility, and North Lapwai Valley Acclimation Facility under Alternative 1 would be negligible relative to baseline conditions.

Table 10. Water use by hatchery facility and alternative.

Hatchery Facility	Water Use for Fall Chinook Salmon Alternatives (cfs)							
	Baseline Conditions		Alternative 1 (No Action)		Alternative 2		Alternative 3	
	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground
Lyons Ferry Hatchery	0	118	0	90	0	118	0	118
Nez Perce Tribal Hatchery	10	2.1	6.3	1.3	10	2.1	10	2.1
Oxbow Hatchery	17.9	1.2	13.8	0.9	17.9	1.2	17.9	1.2
Irrigon Hatchery	0	47	0	42.8	0	47	0	47
Pittsburgh Landing Acclimation Facility	4.5	0	0	0	4.5	0	4.5	0
Big Canyon Acclimation Facility	4.5	0	0	0	4.5	0	4.5	0
Captain John Rapids Acclimation Facility	5.6	0	0	0	5.6	0	5.6	0
Lukes Gulch Acclimation Facility	2.2	0.6	0	0	2.2	0.6	2.2	0.6
Sweetwater Springs Satellite Facility	2.2	0	0	0	2.2	0	2.2	0
Cedar Flats Acclimation Facility	2.2	0	0	0	2.2	0	2.2	0
North Lapwai Valley Acclimation Facility	1.4	3.6	0	0	1.4	3.6	1.4	3.6

4.2.2. Alternative 2 (Proposed Action) – Approve the HGMPs Including the Joint Addendum under ESA Section 10(a)(1)(A)

Under Alternative 2, the Snake River fall Chinook salmon hatchery programs would continue to operate similar to baseline conditions. Relative to Alternative 1, more groundwater and surface water would be used under Alternative 2 (Table 10), but all surface water (minus evaporation) would be returned to adjacent water and streams after circulating through the hatchery facilities, and none of the facilities (except Irrigon Hatchery) is located in a State Critical Groundwater Area. As under Alternative 1, all hatchery facilities would operate compliant with water permits or water rights (Subsection 3.2, Groundwater and Hydrology). A more detailed assessment of (1) groundwater effects and/or (2) surface water effects by hatchery facility can be found below.

Lyons Ferry Hatchery

Under Alternative 2, Snake River fall Chinook salmon would be raised at Lyons Ferry Hatchery and would increase water use from 90 cfs to 118 cfs relative to Alternative 1 (Table 10). However, the Lyons Ferry Hatchery uses groundwater, and increasing groundwater by 28 cfs relative to Alternative 1 in an area that has sufficient groundwater supply for irrigation and other uses is expected to have negligible effects on groundwater and hydrology.

Irrigon Hatchery

The Irrigon Hatchery uses groundwater exclusively (Subsection 3.2, Groundwater and Hydrology). The Irrigon Hatchery is located in a State Critical Groundwater Area, which means there is not sufficient groundwater to provide a reasonably safe supply for irrigation or other uses at current or projected rates of withdrawal within the area (Subsection 3.2, Groundwater and Hydrology). Under Alternative 2, there would be a small increase (4.2 cfs) in water use relative to Alternative 1 (Table 10). However, this small increase would have a negligible effect relative to Alternative 1.

Pittsburg Landing, Big Canyon, and Captain John Rapids Acclimation Facilities

Pittsburg Landing, Big Canyon, and Captain John Rapids Acclimation Facilities use surface water exclusively (Section 3.2, Groundwater and Hydrology). Under Alternative 2, these facilities would each use between 4.4 cfs and 5.6 cfs more water than under Alternative 1 (Table 10). All water would be diverted from mainstem Snake or Clearwater Rivers, which have minimum flows of 10,000 cfs (Subsection 3.2, Groundwater and Hydrology). All water diverted from these rivers (minus evaporation) would be returned after it circulating through the facility, so the only segment of the river that may be impacted under Alternative 2 would be the area between the water intake and discharge structures (Subsection 3.2, Groundwater and Hydrology). Because (1) the distance between the water intake and discharge structures is small, and (2) the water used by the hatchery facility is just a small percentage of the total water in the river, there would be a negligible effect on groundwater and hydrology under Alternative 2 relative to Alternative 1.

Sweetwater Springs Satellite and Cedar Flats Acclimation Facility

Sweetwater Springs Satellite Facility uses a spring that originates from West Fork Sweetwater Creek with a flow of between 0.45 cfs and 8.9 cfs seasonally (Subsection 3.2, Groundwater and Hydrology). All of the water diverted from the spring (minus evaporation) would be returned to the West Fork Sweetwater Creek after circulating through the facility, so the only segment of the creek that may be impacted under Alternative 2 would be the area between the water intake and discharge structures (Subsection 3.2, Groundwater and Hydrology). Under Alternative 2, water use would increase from 0 cfs to 2.2 cfs (Table 10), but because the distance between the water intake and discharge structures is small (less than 200 feet) (BPA 1997), increasing water use by 2.2 cfs would not result in an in-river hydrologic change. Therefore, effects on groundwater and hydrology from fall Chinook salmon program production at Sweetwater Springs Satellite Facility under Alternative 2 would be negligible relative to Alternative 1.

The Cedar Flats Acclimation Facility uses water from the Selway River, which has a mean flow of 3,813 cfs (Subsection 3.2, Groundwater and Hydrology). All of the water diverted from the Selway River (minus evaporation) would be returned after circulating through the facility, so the only segment of the river that may be impacted under baseline operations would be the area between the water intake and discharge structures (Subsection 3.2, Groundwater and Hydrology). Under Alternative 2, water use would be increased from 0 cfs to 2.2 cfs (Table 10). However, as under Alternative 1, the Cedar Flats Acclimation Facility would use less than 0.1 percent of the water in the Selway River, and all water (minus evaporation) would be returned to the Selway River after circulating through the acclimation facility. Consequently, effects on groundwater and hydrology from producing fall Chinook salmon at Cedar Flats Acclimation Facility under Alternative 2 would be the same as those described under Alternative 1.

Nez Perce Tribal Hatchery, Oxbow Hatchery, Lukes Gulch Acclimation Facility, and North Lapwai Valley Acclimation Facility

Nez Perce Tribal Hatchery, Oxbow Hatchery, Lukes Gulch Acclimation Facility, and North Lapwai Valley Acclimation Facility use both groundwater and surface water (Subsection 3.2, Groundwater and Hydrology). All surface water that is diverted from rivers (minus evaporation) is returned after circulating through the facility, so the only segment of the river that may be impacted under Alternative 2 would be the area between the water intake and discharge structures (Subsection 3.2, Groundwater and Hydrology). Under Alternative 2, water use would be increased relative to Alternative 1 (Table 10). However, because (1) these facilities take only a small proportion of the total flow from adjacent streams, (2) the distance between water intake and discharge structures is small (less than 300 feet) (BPA 1997), and (3) none of these facilities are located in State Critical Groundwater Areas (i.e., there is sufficient water in the aquifer for irrigation and other uses), effects on groundwater and hydrology from the fall Chinook salmon program production at Nez Perce Tribal Hatchery, Oxbow Hatchery, Lukes Gold Acclimation Facility, and North Lapwai Valley Acclimation Facility under Alternative 2 would be negligible relative to Alternative 1.

4.2.3. Alternative 3 (HGMPs without Addendum) – Approve the HGMPs under ESA Section 10(a)(1)(A), Without Including the Joint Addendum

Unlike Alternative 2, hatchery programs would not be adaptively managed by information gained through monitoring and evaluation from the joint addendum under Alternative 3. Under both alternatives, 5.5 million more juvenile fall Chinook salmon would be released into the action area than under Alternative 1. This release would occur for the 5-year period of the permit (2012 to 2017). The benefit of monitoring and evaluation information under Alternative 2 would be realized after the 5-year permit has expired (after 2017). It is anticipated that the applicants would request approval of new HGMPs in 2017 for programs in this action area, and would use the monitoring and evaluation information gathered between 2012 and 2017 under Alternative 2 to inform management under the newly submitted plans. This benefit would not occur under Alternative 3 because 5-year monitoring and evaluation results would not be available to inform the new plans and, therefore, HGMPs submitted in 2017 may not include changes in response to changes in Snake River fall Chinook salmon status. As a result, the Snake River fall Chinook salmon hatchery programs may not be as likely to meet the stated goals of (1)

providing harvest opportunity for tribal anglers, and (2) sustaining the long-term preservation and genetic integrity of Snake River fall Chinook salmon (Subsection 1.3, Purpose and Need for the Action) if information is lacking to guide future management. However, Alternative 3 would not have direct or indirect impacts on groundwater and hydrology relative to Alternative 2 during the 5-year permit of the Proposed Action if this monitoring and evaluation component did not occur.

4.3. Effects on Water Quality

4.3.1. Alternative 1 (No Action) – Not Issue Section 10(a)(1)(A) Permits to the Applicants

Under Alternative 1 (No Action), the Snake River fall Chinook salmon hatchery programs would be terminated, which may lead to small improvements in water quality relative to baseline conditions through reductions in temperature, ammonia, nutrients (e.g., nitrogen), biological oxygen demand, pH, suspended solids levels, antibiotics, fungicides, disinfectants, steroid hormones, pathogens, anesthetics, pesticides, and herbicides (Subsection 3.3, Water Quality). These reductions may decrease the contribution of hatchery facilities to the impairment of 303(d) waters relative to baseline conditions (Subsection 3.3, Water Quality). However, terminating the Snake River fall Chinook salmon hatchery programs would not be expected to change any of the 303(d) lists because the contribution of substances from these programs is very small relative to the contribution of these substances from activities such as agriculture and industry (Subsection 3.3, Water Quality). Because water quality would be expected to improve under Alternative 1 relative to baseline conditions, there would be no change in compliance with applicable NPDES permits or tribal wastewater plans relative to baseline conditions (Subsection 3.3, Water Quality).

4.3.2. Alternative 2 (Proposed Action) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs and the Associated Addendum

Under Alternative 2 hatchery-origin salmon would increase relative to Alternative 1 and may degrade water quality relative to Alternative 1 by increasing temperature, ammonia, nutrients (e.g., nitrogen), biological oxygen demand, pH, sediment levels, antibiotics, fungicides, disinfectants, steroid hormones, pathogens, anesthetics, pesticides, and herbicides (Subsection 3.3, Water Quality). An increase in in these substances and biological parameters would increase the contribution of hatchery facilities to the impairment of 303(d)-listed waters relative to Alternative 1. However, operating the Snake River fall Chinook salmon hatchery programs would not be expected to change the 303(d) list relative to Alternative 1 because the contribution of substances from these programs would be small relative to the contribution of these substances from activities such as agriculture and industry (Subsection 3.3, Water Quality). Although water quality may be slightly degraded under Alternative 2 relative to Alternative 1, there would be no expected change in compliance with applicable NPDES permits or tribal wastewater plans relative to Alternative 1 because the hatchery facilities would comply with all applicable NPDES permits and tribal wastewater plans under Alternative 2.

4.3.3. Alternative 3 (HGMPs without Addendum) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs Without the Addendum

Unlike Alternative 2, hatchery programs would not be adaptively managed by information gained through monitoring and evaluation from the joint addendum under Alternative 3. Under both alternatives, 5.5 million more juvenile fall Chinook salmon would be released into the action area than under Alternative 1. This release would occur for the 5-year period of the permit (2012 to 2017). The benefit of monitoring and evaluation information under Alternative 2 would be realized after the 5-year permit has expired (after 2017). It is anticipated that the applicants would request approval of new HGMPs in 2017 for programs in this action area, and would use the monitoring and evaluation information gathered between 2012 and 2017 under Alternative 2 to inform management under the newly submitted plans. This benefit would not occur under Alternative 3 because 5-year monitoring and evaluation results would not be available to inform the new plans and, therefore, HGMPs submitted in 2017 may not include changes in response to changes in Snake River fall Chinook salmon status. As a result, the Snake River fall Chinook salmon hatchery programs may not be as likely to meet the stated goals of (1) providing harvest opportunity for tribal anglers, and (2) sustaining the long-term preservation and genetic integrity of Snake River fall Chinook salmon (Subsection 1.3, Purpose and Need for the Action) if information is lacking to guide future management. However, Alternative 3 would not have direct or indirect impacts on water quality relative to Alternative 2 during the 5-year permit of the Proposed Action if this monitoring and evaluation component did not occur.

4.4. Effects on Fish Listed under the ESA

Some effects of the alternatives would be similar among species and are discussed in a subsection on general effects on listed species. These include facility effects, benefits of nutrient cycling, and risk of disease transfer.

Genetic effects as described in Subsection 3.4.1.4, Genetic Effects, only affect the species that it is being propagated in a hatchery program; for this Proposed Action, that species is Snake River fall Chinook salmon. Consequently, genetic effects are only discussed in Subsection 4.4.1.2, Snake River Fall Chinook salmon. No other species would experience genetic effects as a result of the EA alternatives.

Harvest effects are only discussed for species that are regularly taken in fisheries within the action area. For this Proposed Action, species regularly taken in fisheries within the action area include Snake River fall Chinook salmon, Snake River spring/summer Chinook salmon, and Snake River steelhead. Harvest effects are not discussed for Snake River sockeye salmon or bull trout because they are not affected by fisheries in the action area related to the Proposed Action. The analyses for each species includes a discussion of broodstock collection effects, competition and predation effects, and research/monitoring/evaluation effects (Table **1**).

Table 1. Hatchery risk categories and corresponding analyses in this EA.

	General Effects on Listed Species	**Snake River Fall Chinook salmon**	**Snake River Spring/Summer Chinook salmon**	**Snake River Steelhead**	**Snake River Sockeye Salmon**	**Bull Trout**
Hatchery facility effects	X					
Nutrient cycling effects	X					
Disease transfer effects	X					
Genetic effects		X				
Broodstock collection effects		X	X	X	X	X
Competition and predation effects		X	X	X	X	X
Harvest effects		X	X	X		
Research, monitoring, and evaluation effects		X	X	X	X	X

4.4.1 Alternative 1 (No Action) – Not Issue Section 10(a)(1)(A) Permits to the Applicants

Under Alternative 1 (No Action), all Snake River fall Chinook salmon hatchery programs would be terminated. As a result, the acclimation facilities used by these programs would cease to operate (Subsection 1.4, Action Area). However, the primary hatchery facilities that support the Snake River fall Chinook salmon hatchery programs (i.e., Lyons Ferry Hatchery and Nez Perce Tribal Hatchery) would continue to operate because they also raise other species of fish (Subsection 1.4, Action Area).

4.4.1.1. General Effects on Listed Species

Most effects on listed fish under Alternative 1 would result from releasing 5.5 million fewer hatchery-origin salmon in the action area relative to baseline conditions (Table 2 and Table 3). Releasing fewer hatchery-origin fish may affect genetics, disease, ecological interactions, nutrient cycling, and harvest (Subsection 3.4.1, Hatchery Effects on Listed Species). Terminating the Snake River hatchery programs would also have an impact on the number of fall Chinook salmon collected as adults for broodstock and the number of fall Chinook salmon that would return to the action area as adults (Subsection 3.4.1, Hatchery Effects on Listed Species).

Hatchery Facility Effects

Hatchery facility risks include hatchery facility failure (and associated catastrophic fish loss of any listed fish in the hatchery facility), facility water intake effects (stream de-watering and fish entrainment), effluent discharge effects, and weir effects (Subsection 3.4.1.1, Hatchery Facility Risks). Because listed Snake River fall Chinook salmon would not be used as broodstock under Alternative 1, there would be a reduced risk of losing listed fish through hatchery facility failures relative to baseline conditions.

Hatchery facility water intake structures may lead to stream de-watering or entrainment of fish (Subsection 3.4.1.1, Hatchery Facility Risks). Risks associated with stream dewatering are discussed in Subsection 4.2, Effects of Groundwater and Hydrology. Although some facilities would reduce or eliminate the amount of water taken from rivers and streams, effects on hydrology are expected to be negligible relative to baseline conditions. Consequently, the reduced risk of impacting fish through diminished stream flows would be negligible relative to baseline conditions. Water intakes that are not properly screened may injure fish through impingement, entrainment, or death (Subsection 3.4.1.1, Hatchery Facility Risks).

Alternative 1 may improve water quality slightly relative to baseline conditions by reducing temperature, ammonia, nutrients (e.g., nitrogen), biological oxygen demand, pH, sediment levels, antibiotics, fungicides, disinfectants, steroid hormones, and pathogens (Subsection 4.3, Effects on Water Quality). However, all hatchery facilities are either operated compliant with NPDES permits under baseline conditions or do not require an NPDES permit because their impacts on water quality are already expected to be small based on current operating conditions. NPDES permits are intended to protect aquatic life. Consequently, Alternative 1 would have negligible benefits relative to baseline conditions on fish through changes in water quality.

There would be no difference in weir effects between Alternative 1 and baseline conditions because weirs do not currently operate, nor would they be operated under Alternative 1.

Nutrient Cycling Effects

Alternative 1 would eliminate the ongoing annual release of juvenile fall Chinook salmon into the Snake and Clearwater River systems, reducing the abundance of adult Snake River fall Chinook salmon. Consequently, benefits of nutrient cycling to all species through the availability of hatchery-origin carcasses would be reduced under Alternative 1 when compared to baseline conditions (Subsection 3.4.1.2, Benefits of Nutrient Cycling).

Disease Transfer Effects

The Snake River fall Chinook salmon hatchery facilities implement mitigation measures to minimize the potential for disease transfer (culling diseased fish, using low rearing densities, using antibiotics, and using pathogen-free water) (Subsection 3.4.1.3, Risks Associated with Disease Transfer). Therefore, although Alternative 1 would reduce the number of hatchery-origin fish interacting with and potentially transferring diseases such as bacterial kidney disease or bacterial gill disease to natural-origin fish, these changes would have a negligible effect on Snake River Fall Chinook salmon.

4.4.1.2. Snake River Fall Chinook Salmon

Genetic Effects

Under Alternative 1, the short-term effects on genetic risk to Snake River fall Chinook salmon would be similar to under baseline conditions because hatchery-origin adults would continue to return to the Snake River basin for up to 6 years (Subsection 3.4.1.6, Competition and Predation Risks) and potentially interbreed with natural-origin adults (Subsection 3.4.1.4, Genetic Risks). However, the over the long-term, Alternative 1 may reduce genetic risks to Snake River fall Chinook salmon relative to baseline conditions by reducing interbreeding between hatchery-origin and natural-origin fish unless population size is reduced to a level where inbreeding and genetic drift occur (Subsection 3.4.1.4, Genetic Risks and Subsection 3.4.2, Snake River Fall Chinook salmon). If Alternative 1 reduces population size to a level where inbreeding and genetic drift occur, then genetic risks would be greater under Alternative 1 relative to baseline conditions. However, this is unlikely since the number of natural-origin fish returning in recent years has been well over 100 individuals (Subsection 3.4.1.5, Broodstock Collection Risks).

Broodstock Collection Effects

Under Alternative 1, impacts of fish removal activities would be eliminated because adult fall Chinook salmon would not be collected for broodstock (Subsection 3.4.1.5, Broodstock Collection Risks). In the short-term, up to 5,500 additional adult fall Chinook salmon would spawn naturally (Subsection 2.2, Alternative 2). However, because the majority of the fish taken as broodstock would be hatchery-origin fish, the number of additional spawners under Alternative 1 relative to baseline conditions would decrease over time since the hatchery program would no longer be producing fish. The number of addition natural-origin spawners under Alternative 1 relative to baseline conditions would be between 350 and 1,650 adults annually. Therefore, Alternative 1 would initially result in an additional 5,500 adult spawners relative to baseline conditions, but over time would result in a maximum of 1,650 additional adult spawners relative to baseline conditions.

Competition and Predation Effects

Alternative 1 would eliminate competition and direct and indirect predation risks on natural-origin Snake River fall Chinook salmon in the action area from operating the Snake River fall Chinook salmon hatchery programs because Snake River fall Chinook salmon would no longer

be released into the Snake River basin to compete with natural-origin fall Chinook salmon for food and space (Subsection 3.4.1.6, Competition and Predation Risks). Competition and predation in the Columbia River estuary may be reduced slightly because there would be approximately 2 percent fewer salmonids rearing in estuary than under baseline conditions.

Harvest Effects

Under Alternative 1, no hatchery-origin Snake River fall Chinook salmon would be released from hatchery facilities, nor would they return to the Snake and Clearwater Rivers where they may be intercepted in fisheries. Currently, fall Chinook salmon are not targeted specifically for harvest within the action area. Around 1000 or fewer hatchery-origin fall Chinook salmon are caught incidentally in steelhead fisheries, which coincide with adult fall Chinook salmon returns (Subsection 3.4.2, Snake River Fall Chinook salmon). In the short-term, there would be no expected change to the number of Snake River fall Chinook salmon harvested in fisheries because hatchery-origin fall Chinook salmon would continue to return to the Snake River basin for years after terminating the hatchery program. Over the long-term (after 2017), fewer hatchery-origin Snake River fall Chinook salmon would be harvested than under baseline conditions.

Incidental harvest effects on the natural-origin Snake River fall Chinook salmon population are not expected to change under Alternative 1 relative to baseline conditions because the *U.S. v Oregon* Management Agreement identifies a total allowable harvest rate on Snake River fall Chinook salmon based on the abundance of natural-origin returns (Subsection 3.4.1.7, Harvest Risks). These sliding harvest rates ensure that harvest impacts on natural-origin fall Chinook salmon protect the status of the population.

Research, Monitoring, and Evaluation Effects

Under Alternative 1, some of the proposed research, monitoring, and evaluation activities under baseline conditions would be eliminated. Because uncertainties remain regarding the status of the natural-origin component of the Snake River Fall Chinook salmon ESU, monitoring may still occur in the absence of the proposed hatchery programs; however, funding for monitoring is largely linked to hatchery program impacts, so monitoring effort would likely be reduced relative to baseline conditions. As a result, impacts from research, monitoring, and evaluation activities would be expected to continue under Alternative 1, but at lower levels than under baseline conditions (Subsection 3.4.1.8, Research and Monitoring Risks and Benefits). Impacts from handling adults passing over Lower Granite Dam would likely continue under Alternative 1, though they may be at reduced levels relative to baseline conditions (Subsection 3.4.1.8., Research and Monitoring Risks and Benefits).

Summary

Under Alternative 1, hatchery facility effects, nutrient cycling effects, disease transfer effects, broodstock collection effects, competition and predation effects, and research/monitoring/evaluation effects would be reduced relative to baseline conditions (Subsection 3.4, Fish Listed under the ESA). Harvest effects on natural-origin fall Chinook salmon would remain similar as under baseline conditions. The number of Snake River fall

Chinook salmon that would be harvested in fisheries would be similar in the short-term but would be reduced if fewer hatchery-origin fish are available. Although the natural productivity of Snake River fall Chinook salmon may improve under Alternative 1, the total abundance of natural-origin fish may decline over time and then stabilize at a level that can be supported by the current condition of the habitat.

4.4.1.3. Snake River Spring/Summer Chinook Salmon

Broodstock Collection Effects

Under Alternative 1, fall Chinook salmon broodstock would not be collected at Lower Granite Dam, the hatchery facilities, or the South Fork Clearwater weir. As a result, incidental handling impacts on spring/summer Chinook salmon would be eliminated under Alternative 1 relative to baseline conditions.

By the time fall Chinook salmon broodstock are collected in the fall, almost all spring/summer Chinook salmon have already passed over Lower Granite Dam. Very few of the spring/summer Chinook salmon would be expected to be encountered at the trap in mid-August when broodstock collections begin. Additionally, the trap does not operate full time, and would only encounter around 10 percent of the small number of spring/summer Chinook salmon remaining in the river. Therefore, Alternative 1 may result in fewer spring/summer Chinook salmon harmed at the trap annually relative to baseline conditions, but the impact would be small and difficult to measure at the population scale.

Competition and Predation Effects

Snake River spring/summer Chinook salmon interact with fall Chinook salmon in the mainstem of the Snake and Clearwater Rivers when they outmigrate to the ocean each spring. Snake River spring/summer Chinook salmon do not rear in the same areas as fall Chinook salmon (Subsection 3.4.3, Snake River Spring/Summer Chinook salmon).

Alternative 1 would lead to a small reduction in predation and competition effects on natural-origin Snake River spring/summer Chinook salmon relative to baseline conditions because Snake River fall Chinook salmon would no longer be released into the Snake River basin and interact with spring/summer Chinook salmon in the migration corridor (Subsection 3.4.1.6, Competition and Predation Risks). Competition and predation in the Columbia River estuary may be reduced slightly because there would be approximately 2 percent fewer fish rearing in estuary than under baseline conditions.

Harvest Effects

Snake River spring Chinook salmon fisheries occur in June and July and are curtailed prior to the arrival of fall Chinook salmon to the action area (Subsection 3.4.3, Snake River Spring/Summer Chinook salmon). Consequently, Alternative 1 would not affect the number of Snake River spring/summer Chinook salmon harvested relative to baseline conditions.

Research, Monitoring, and Evaluation Effects

Under Alternative 1, some of the proposed monitoring and evaluation activities would be eliminated. Some monitoring may still occur in the absence of the proposed hatchery programs; however, funding for monitoring is largely linked to hatchery program impacts. Therefore, monitoring effort would likely be reduced relative to baseline conditions, thus reducing some handling impacts on spring/summer Chinook salmon. Very few adults would be encountered at the Lower Granite Dam trap concurrently with fall Chinook salmon (Subsection 3.4.3, Snake River Spring/Summer Chinook salmon). Status monitoring (Subsection 3.4.3, Snake River Spring/Summer Chinook salmon) would likely occur at similar rates.

Summary

Small reductions in impacts on Snake River spring/summer Chinook salmon may occur under Alternative 1 from small reductions in handling at broodstock collection points. Additionally, some reduction in competition impacts may occur under Alternative 1 relative to baseline conditions. Harvest impacts would likely remain about the same as under baseline conditions. In general, the reduction in impacts on Snake River spring/summer Chinook salmon under Alternative 1 would be small, and they would not be expected to change the ESU's abundance trend (Subsection 3.4.3, Snake River Spring/Summer Chinook salmon).

4.4.1.4. Snake River Steelhead

Broodstock Collection Effects

Under Alternative 1, fall Chinook salmon broodstock would not be collected at Lower Granite Dam or the hatchery facilities. Consequently, incidental impacts on steelhead from broodstock removal activities would be reduced under Alternative 1 relative to baseline conditions.

Impacts from trapping and handling activities at Lower Granite Dam would continue, but would likely be at reduced levels without fall Chinook salmon broodstock collection. Relative to baseline conditions, it is likely that fewer steelhead would be handled or killed annually under Alternative 1, but the reduction from baseline conditions would be small (fewer than 5 fish annually)(Subsection 3.4.4, Snake River Steelhead).

Competition and Predation Effects

Ecological interactions between hatchery and natural-origin fish in the action area due to direct and indirect predation and competition would be eliminated under Alternative 1 relative to baseline conditions. Though impacts on listed species from competition are assumed to occur from the release of large numbers of hatchery-origin fish into the action area, the level of impact from predation and competition by hatchery juveniles is uncertain. Alternative 1 would eliminate the release of hatchery-origin fall Chinook salmon. Current releases are in areas that are not spawning or rearing areas for natural-origin steelhead. Overall, there would be a reduction in ecological interactions under Alternative 1; however the reduction in interactions would likely be small relative to baseline conditions because of the limited overlap with spawning and rearing areas between the two species. Competition and predation in the

Columbia River estuary may be reduced slightly because there would be approximately 2 percent fewer fish rearing in estuary than under baseline conditions.

Harvest Effects

Adult steelhead returns coincide with adult fall Chinook salmon returns. Though it is possible that steelhead fisheries would be curtailed early if fall Chinook salmon impacts are reached (Subsection 3.4.1.7, Harvest Risks), this has not happened in recent years. The decrease in hatchery-origin fall Chinook salmon returns would not change the timing or implementation of ongoing steelhead fisheries under baseline conditions (Subsection 3.4.1.7, Harvest Risks).

Research, Monitoring, and Evaluation Effects

Under Alternative 1, some of the proposed monitoring and evaluation activities would be eliminated. Because uncertainties remain regarding the status of the natural-origin component of the Snake River salmon and steelhead ESU/DPS, monitoring may still occur in the absence of the proposed hatchery programs. However, funding for monitoring is largely linked to hatchery program impacts, so monitoring effort would likely be reduced. Previous authorizations have allowed up to 25 adult steelhead to die as a result of handling during trap operations, but no adult steelhead are killed during operation of the trap in most years (WDFW 2011). Therefore, Alternative 1 may result in a fewer steelhead being harmed at the trap annually relative to baseline conditions; but the impact would be small and difficult to measure at the population scale. The impact is expected to be small at the population or ESU scale for listed fish that are handled at the trap.

Summary

Small reductions in impacts on Snake River steelhead may occur from reduced handling at broodstock collection points. Additionally, some reduction in ecological impacts may occur under Alternative 1; however, the magnitude of that impact is unknown. Harvest and research, monitoring, and evaluation impacts would likely remain about the same under Alternative 1 as under baseline conditions. In general, the reduction in impacts under Alternative 1 to Snake River steelhead would be small relative to impacts under baseline conditions, and no change in the abundance trend would be expected (Subsection 3.4.4, Snake River Steelhead).

4.4.1.5. Snake River Sockeye Salmon

Broodstock Collection Effects

Under Alternative 1, fall Chinook salmon broodstock would not be collected at Lower Granite Dam or the hatchery facilities. Incidental impacts on sockeye salmon from broodstock removal activities would be reduced under Alternative 1 because adult fall Chinook salmon would not be collected for broodstock at these sites.

Impacts from trapping and handling activities at Lower Granite Dam would continue, but would likely be at reduced levels without fall Chinook salmon broodstock collection. Relative to baseline conditions, it is likely that fewer sockeye salmon would be handled annually under

Alternative 1, reducing even further any chance of sockeye salmon mortality at the trap. The reduction from baseline conditions would be small (no more than one fish annually)(Subsection 3.4.5, Snake River Sockeye).

Competition and Predation Effects

Ecological interactions between hatchery-origin fall Chinook salmon and sockeye salmon in the action area due to competition and direct and indirect predation would be eliminated under Alternative 1. Though impacts on listed species from competition are assumed to occur from the release of large numbers of hatchery-origin fish into the action area, the level of impact from competition and predation by hatchery juveniles is uncertain. Alternative 1 would eliminate releases of hatchery-origin fall Chinook salmon. Current releases are in areas that are not spawning or rearing areas for Snake River sockeye. Consequently, there would be a reduction in ecological interactions relative to baseline conditions. However the reduction in interactions would likely be small because of the limited overlap with spawning and rearing areas between the two species. Competition and predation in the Columbia River estuary may be reduced slightly because there would be approximately 2 percent fewer fish rearing in estuary than under baseline conditions.

Research, Monitoring, and Evaluation Effects

Under Alternative 1, some of the proposed monitoring and evaluation activities would be eliminated. Because uncertainties remain regarding the status of the natural-origin component of the Snake River salmon and steelhead ESU/DPS, monitoring may still occur in the absence of the proposed hatchery programs; however, funding for monitoring is largely linked to hatchery program impacts, so monitoring effort would likely be reduced. In some years, a few (less than 10) adult sockeye salmon are handled in the trap as they ascend the ladder. These fish are released or retained for broodstock pursuant to their own HGMP/permit for hatchery programs. The impact is expected to be small at the population or ESU scale for sockeye salmon that are handled at the trap.

Summary

Small reductions in impacts on Snake River sockeye may occur from reduced handling at broodstock collection points. Additionally, some reduction in competition and predation risks may occur under Alternative 1; however, the magnitude of that impact is unknown. Research, monitoring, and evaluation impacts would likely remain about the same as under Alternative 1. In general, the reduction in impacts on Snake River sockeye would be small and would not be expected to affect abundance trends or status (Subsection 3.4.5, Snake River Sockeye Salmon).

4.4.1.6. Bull Trout

Broodstock Collection Effects

Under Alternative 1, fall Chinook salmon broodstock would not be collected at Lower Granite Dam or the hatchery facilities. Incidental impacts on bull trout from broodstock removal

activities would be reduced under Alternative 1 because adult fall Chinook salmon would not be collected at these sites.

Impacts from trapping and handling activities at Lower Granite Dam would continue, but would likely be at reduced levels without fall Chinook salmon broodstock collection. Under baseline conditions, only five bull trout have been encountered at the trap since 1998; however, Alternative 1 would reduce the potential for bull trout to be handled annually, reducing even further any chance of bull trout mortality at the trap. The reduction from baseline conditions would be small (no more than one fish annually) (Subsection 3.4.6 Bull Trout).

Competition and Predation Effects

Ecological interactions between hatchery-origin fall Chinook salmon and bull trout due to competition direct and indirect predation would be eliminated under Alternative 1. Though impacts on listed species from competition are assumed to occur from the release of large numbers of hatchery-origin fish into the action area, the level of impact from competition and predation by hatchery juveniles is uncertain. In the case of bull trout, hatchery-origin fall Chinook salmon are more likely to be prey for bull trout than predators. Hatchery-origin fall Chinook salmon are currently being released, and Alternative 1 would eliminate those releases. This may reduce some of the available prey for bull trout. However, current releases are in areas that are not spawning or rearing areas for bull trout. There would be a reduction in ecological interactions; however the reduction in interactions would likely be small because of the limited overlap with spawning and rearing areas between the two species.

Research, Monitoring, and Evaluation Effects

Under Alternative 1, some of the proposed monitoring and evaluation activities would be eliminated. Because uncertainties remain regarding the status of the natural-origin component of the Snake River salmon and steelhead ESU/DPS, monitoring may still occur in the absence of the proposed hatchery programs; however, funding for monitoring is largely linked to hatchery program impacts, so monitoring effort would likely be reduced. During trapping activities at Lower Granite Dam, only five bull trout have been encountered in the trap since 1998 (FPC 2012). These fish were released after capture, and no mortalities have been reported. Overall, the impact is expected to be small at the population or DPS scale for listed fish that are handled at the trap.

Summary

Small reductions in impacts on bull trout may occur from reduced handling at broodstock collection points. Additionally, some reduction in competition and predation risks may occur under Alternative 1; however, the magnitude of that impact is unknown. Research, monitoring, and evaluation impacts would likely remain about the same as under Alternative 1. In general, the reduction in impacts on bull trout would be small and would not be expected to affect abundance trends (Subsection 3.4.6, Bull Trout).

4.4.2. Alternative 2 (Proposed Action) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs and the Associated Addendum

4.4.2.1. General Effects on Listed Species

Most effects on listed fish under Alternative 2 would result from releasing 5.5 million more hatchery-origin salmon in the action area relative to Alternative 1. Releasing more hatchery-origin fish may affect genetics, disease, ecological interactions, nutrient cycling, and harvest (Subsection 3.4.1, Hatchery Effects on Listed Species). Alternative 2 would also have an impact on the number of fall Chinook salmon collected as adults for broodstock and the number of fall Chinook salmon that would return to the action area as adults relative to Alternative 1 (Subsection 3.4.1, Hatchery Effects on Listed Species).

Hatchery Facility Effects

Although some facilities would remove water from rivers and streams under Alternative 2, it would be returned to the river or stream (minus evaporation) a short distance from the water intake structure. As under Alternative 1, all hatchery facilities would operate compliant with water permits or water rights (Subsection 3.2, Groundwater and Hydrology). All water diverted from these rivers (minus evaporation) is returned after it circulates through the facility, so the only segment of the river that may be impacted under baseline operations would be the area between the water intake and discharge structures (Subsection 3.2, Groundwater and Hydrology). Because (1) the distance between the water intake and discharge structures is small, and (2) the water used by the hatchery facility is just a small percentage of the total water in the river. Consequently, the increased risk of affecting fish through diminished stream flows under Alternative 2 would be negligible relative to Alternative 1.

Alternative 2 may degrade downstream water quality slightly relative to Alternative 1 by increasing temperature, ammonia, nutrients (e.g., nitrogen), biological oxygen demand, pH, sediment levels, antibiotics, fungicides, disinfectants, steroid hormones, and pathogens (Subsection 4.3, Effects on Water Quality). However, all hatchery facilities would either be operated compliant with NPDES permits or tribal wastewater plans, or do not require an NPDES permit because their impacts on water quality are already expected to be small based on current operating conditions. NPDES permits and tribal wastewater plans are intended to protect aquatic life. Consequently, Alternative 2 would have negligible impacts on fish relative to Alternative 1 through changes in water quality.

Under Alternative 2, a weir would be used to collect broodstock in the South Fork Clearwater River. Consequently, Alternative 2 may increase risk to fish relative to Alternative 1 if fish are delayed in their migration, isolated, impinged, or subjected to greater predation rates (Subsection 3.4.1.1, Hatchery Facility Effects). The South Fork Clearwater weir would only be operated for 3months out of the year, and it would be monitored to minimize unintentional weir effects. Consequently, increased weir risk would be low under Alternative 2, but increased relative to Alternative 1.

Nutrient Cycling Effects

Alternative 2 would result in the annual release of 5.5 million juvenile fall Chinook salmon into the Snake and Clearwater River systems, increasing the abundance of adult Snake River fall Chinook salmon relative to Alternative 1. Consequently, benefits of nutrient cycling as described in Subsection 3.4.1.2, Benefits of Nutrient Cycling, would be increased for all species through the availability of more hatchery-origin carcasses as compared to Alternative 1(Subsection 3.4.1.2, Benefits of Nutrient Cycling).

Disease Transfer Effects

The annual release of 5.5 million juvenile fall Chinook salmon into the Snake and Clearwater River systems may increase risks associate with disease transfer relative to Alternative 1 for all species because there would be more hatchery-origin fish interacting with natural-origin fish, which may result in the increased risk of transmission of pathogens (Subsection 3.4.1.3., Risks Associated with Disease Transfer). However, hatchery facilities would implement mitigation measures to minimize the potential for disease transfer. These measures would include using culling diseased fish, using low rearing densities, using antibiotics, and using pathogen-free water (Subsection 3.4.1.3, Risks Associated with Disease Transfer). Therefore, although there may be some increased risk of disease transfer under Alternative 2 relative to Alternative 1, the increased risk would be low because of mitigation measures.

4.4.2.2. Snake River Fall Chinook salmon

Genetic Effects

Alternative 2 may increase genetic risk relative to Alternative 1 by increasing domestication risk by allowing a high number of hatchery-origin fall Chinook salmon to spawn naturally. Hatchery-origin fish are subjected to selective pressures in the hatcheries, which may be transferred to the naturally-spawning populations through interbreeding (Subsection 3.4.1.4, Genetic Risks). Under Alternative 2, the proportion of hatchery-origin fall Chinook salmon on the spawning grounds would be well above 50 percent (Subsection 3.4.2, Snake River Fall Chinook salmon). Additionally, only about 7 percent of the hatchery broodstock are of natural-origin (Subsection 2.2, Proposed Action), which is likely not sufficient to ameliorate the effect of the high proportion of hatchery-origin influence on the spawning grounds (Subsection 3.4.2, Fall Chinook salmon). A maximum 30 percent of the hatchery broodstock would be of natural-origin, which would likely not sufficient to ameliorate the effect of the high proportion of hatchery-origin on the spawning grounds (Subsection 2.2, Alternative 2; Subsection 3.4.2, Snake River Fall Chinook salmon). However, the genetic influence of the hatchery programs relative to Alternative 1 may be lower than suggested by the proportion of hatchery-origin fish on the spawning grounds and the proportion of natural-origin fish in the broodstock because the reproductive success of the hatchery-origin fish in the natural environment may be lower than that of natural-origin fish. Nonetheless, Alternative 2 would likely increase the risk of fitness depression due to domestication relative to Alternative 1.

The addendum includes a proposal for additional monitoring and evaluation that is needed to resolve uncertainties regarding the long-term effects of Snake River fall Chinook salmon

hatchery programs (Subsection 2.2, Proposed Action). The information gathered from implementing these mitigation measures would reduce uncertainties and guide future adaptive management of the Snake River fall Chinook salmon hatchery programs to reduce the risk of genetic effects over time.

Broodstock Collection Effects

Under Alternative 2, up to 1,650 natural-origin fall Chinook salmon may be used as broodstock and unable to spawn naturally (Subsection 2.2, Proposed Action). However, Alternative 2 would increase the total number of fall Chinook salmon on the spawning grounds because the hatchery program would be increasing the number hatchery-origin spawns by more than 1,650. As a result, Alternative 2 would be expected to increase abundance relative to Alternative 1, but may also reduce the effective size of the population based on broodstock spawning protocols relative to Alternative 1.

Competition and Predation Effects

Under Alternative 2, hatchery-origin fall Chinook salmon would be reared in hatchery facilities and released into the Snake and Clearwater Rivers. Consequently, competition with juvenile Snake River fall Chinook salmon would increase relative to Alternative 1 (Subsection 4.4.1.1, General Effects on Listed Species).

Hatchery-origin fall Chinook salmon would be released into areas where natural-origin fall Chinook salmon may spawn, rear, and migrate through. Juvenile competition for space and food between hatchery- and natural-origin fall Chinook salmon would increase relative to Alternative 1 in the migration corridors and Columbia River estuary. Approximately, 2 percent more salmonids would be rearing in the estuary relative to Alternative 1.

Alternative 2 would not change predation risk on natural-origin fall Chinook salmon because the hatchery-origin fall Chinook salmon released under Alternative 2 would not eat natural-origin fall Chinook salmon of a similar size.

Adult competition for suitable spawning locations and mate selection between hatchery- and natural-origin fall Chinook salmon would also increase under Alternative 2 relative to Alternative 1. The total available area available for Snake River fall Chinook salmon spawning has not been reached even with high hatchery-origin returns (Subsection 3.4.1.6, Competition and Predation Risks).

Harvest Effects

Under Alternative 2, hatchery-origin Snake River fall Chinook salmon would be released from hatchery facilities, and would they return to the Snake and Clearwater Rivers where they may be intercepted in fisheries. Currently, fall Chinook salmon are not targeted specifically for harvest within the action area, but are harvested incidentally in the steelhead fisheries. Under Alternative 2, there would be no change in the number of fall Chinook salmon harvested in the short-term. Over the long-term (after 2017), harvest of Snake River fall Chinook salmon would

likely increase compared to Alternative 1 because more hatchery-origin fish would be returning to the Snake River Basin.

Incidental harvest effects on the natural-origin Snake River fall Chinook salmon population are not expected to change under Alternative 2 relative to Alternative 1 because the *U.S. v. Oregon* Management Agreement identifies a total allowable harvest rate on Snake River fall Chinook salmon based on the abundance of natural-origin returns (Subsection 3.4.1.7, Harvest Risks). These sliding harvest rates ensure that harvest impacts on natural-origin fall Chinook salmon protect the status of the population.

Research, Monitoring, and Evaluation Effects

Under Alternative 2, the monitoring and evaluation activities proposed in the joint addendum would be implemented. Monitoring and evaluation programs would be necessary to determine the performance of hatchery programs.

Funding for monitoring is largely linked to hatchery program impacts, so monitoring effort would be slightly increased relative to Alternative 1. However, it is unknown how much monitoring would increase in comparison to Alternative 1 because some monitoring is used to track the status of the natural-origin component of fall Chinook salmon and would likely still occur under Alternative 1. Under Alternative 2, the trap would likely be used to monitor the status of natural-origin Snake River fall Chinook salmon. Impacts from handling of adults passing over Lower Granite Dam would likely increase slightly compared to Alternative 1, but because handling mortalities are very low, the impact would be expected to be small to negligible at the population or ESU scale.

Parental-based tagging was proposed in the addendum and if fully funded, all returning adults captured in the Lower Granite trap may be sampled to run genetic analysis for identification of individuals. It is not known exactly how many fish would be sampled annually. However it would likely include all broodstock (up to 5,500) as well as additional fish passing through the Lower Granite trap as funding allows (Subsection 2.2, Alternative 2). The sampling would be non-lethal, and conducted on fish being trapped for some other purpose. Therefore, the impact of parental-based tagging is expected to be negligible relative to Alternative 1.

For all tagging methods, mortality from marking or tagging of juveniles is typically less than 1 percent (Subsection 3.4.2, Fall Chinook salmon). In total, this would result in approximately 41,000 of 4.1 million hatchery-origin smolts dying from tagging injuries. In addition, the Nez Perce Tribe monitors outmigrating smolts using screw traps, beach seines, fyke nets, trawling, purse seines, and minnow traps. It is estimated that 80,000 smolts would be trapped, 10,000 of those would be tagged, and up to 450 smolts (0.6 percent) would die from trapping or tagging injuries (Subsection 3.4.2, Fall Chinook salmon).

Summary

Under Alternative 2, hatchery facility effects, nutrient cycling effects, disease transfer effects, broodstock collection effects, competition and predation effects, and research/monitoring/evaluation effects would be increase relative to Alternative 1 (Subsection

3.4, Fish Listed under the ESA). Harvest effects on natural-origin fall Chinook salmon would remain similar as under Alternative 1. The number of Snake River fall Chinook salmon that would be harvested in fisheries would be increased relative to Alternative 1. Although the natural productivity of Snake River fall Chinook salmon may be less under Alternative 2 relative to Alternative 1, the long-term abundance of natural-origin fish may be higher because of hatchery-origin fish spawning in the wild.

4.4.2.3. Snake River Spring/Summer Chinook salmon

Broodstock Collection Effects

Snake River spring/summer Chinook salmon would not encountered in the Lower Granite Dam trap during fall Chinook salmon broodstock collection because of their early migration timing. Therefore, collection of broodstock under Alternative 2 would have no impact on Snake River spring/summer Chinook salmon relative to Alternative 1.

Under Alternative 2, the South Fork Clearwater weir would be used for fall Chinook salmon broodstock collection. However, any spring/summer Chinook salmon that use the South Fork Clearwater River would have likely already passed the weir location by the time it is installed. Therefore, broodstock collection effects on Snake River spring/summer Chinook salmon would be similar under Alternative 2 and Alternative 1.

Competition and Predation Effects

Under Alternative 2, fall Chinook salmon would be reared in hatchery facilities and released into the Snake and Clearwater Rivers. Fall Chinook salmon from these programs would be released into or near mainstem sections of the Snake and Clearwater Rivers. These areas are predominantly migration corridors for spring/summer Chinook salmon (Subsection 3.4.3, Snake River Spring/Summer Chinook salmon), and therefore direct interactions in sensitive habitats would be limited. There would be approximately 2 percent more salmonids rearing in the estuary under Alternative 2 relative to Alternative 1, which may increase competition for food and space in the estuary. Because spring/summer Chinook salmon would be larger than fall Chinook salmon while in migration corridor and estuary (Subsection 3.4.1.6, Competition and Predation Risks), no changes in predation effects would be expected relative to Alternative 1.

Harvest Effects

Snake River spring Chinook salmon fisheries occur in June and July and are curtailed prior to the arrival of fall Chinook salmon to the action area (Subsection 3.4.3, Snake River Spring/Summer Chinook salmon). Consequently, Alternative 2 would not affect the number of Snake River spring/summer Chinook salmon harvested relative to Alternative 1.

Research, Monitoring, and Evaluation Effects

Under the Alternative 2, the monitoring and evaluation activities proposed in the joint addendum would be implemented. Funding for monitoring is largely linked to hatchery program impacts, so monitoring effort would be slightly increased under Alternative 2. Though monitoring effort

would increase relative to Alternative 1, spring/summer Chinook salmon would have passed above the Lower Granite Dam trap by the time the trap is operated for fall Chinook salmon broodstock collection and monitoring (Subsection 3.4.3, Snake River Spring/Summer Chinook salmon), and few, if any, would be encountered. As a result, few additional spring/summer Chinook salmon would be handled or trapped under Alternative 2 relative to Alternative 1. Additionally, because handling mortalities are very low, the impact would be expected to be negligible relative to Alternative 1.

Summary

Alternative 2 would increase impacts on Snake River spring/summer Chinook salmon relative to Alternative 1 due to increased competition effects, facility effects, and handling for broodstock collection and monitoring. In general the increase in impacts relative to Alternative 1 would be small and would not be expected to change the status or abundance trend relative to Alternative 1 (Subsection 3.4.3, Snake River Spring/Summer Chinook Salmon).

4.4.2.4. Snake River Steelhead

Broodstock Collection Effects

Under Alternative 2, the Lower Granite Dam trap and the South Fork Clearwater weir would be used for fall Chinook salmon broodstock collection. Snake River steelhead are routinely encountered in the Lower Granite Dam trap during fall Chinook salmon broodstock collection because of the overlap in migration timing. In some years, up to 25,000 adult Snake River steelhead are handled in the trap as they ascend the ladder (Subsection 3.4.4, Snake River Steelhead). Alternative 2 would increase the number of steelhead handled at Lower Granite Dam; however sampling would be expected to occur at a similar level to Alternative 1 for status monitoring (Subsection 3.4.4, Snake River Steelhead). The impact of Alternative 2 would be greater than Alternative 1; however the increase would be slight. Overall, the impact on the species would be small.

Under Alternative 2, the South Fork Clearwater weir would be used for fall Chinook salmon broodstock collection. Snake River steelhead are present in the Clearwater River and would be encountered at the weir. The natural-origin abundance in the South Fork Clearwater River is unknown but the ICTRT minimum abundance threshold is 1,000 (Subsection 3.4.4, Snake River Steelhead). The Nez Perce Tribe would anticipate handling up to 400 natural-origin steelhead at the weir (Subsection 3.4.4, Snake River Steelhead). All steelhead would be released within 24 hours (Subsection 2.2, Alternative 2). Therefore, Alternative 2 may delay these 400 steelhead slightly in their migration. However, all steelhead would be passed above the weir to continue their migration. The overall impact of the weir to Snake River steelhead would be expected to greater relative to Alternative 1; however the increase in impacts would be small.

Competition and Predation Effects

Under Alternative 2, fall Chinook salmon would be reared in hatchery facilities and released into the Snake and Clearwater Rivers. Fall Chinook salmon from these programs would be released into or near mainstem sections of the Snake and Clearwater Rivers where ecological interactions

with steelhead would be limited. These areas are predominantly migration corridors (Subsection 3.4.4, Snake River Steelhead), so there would only be a small increase in ecological interactions under Alternative 2 relative to Alternative 1.

Harvest Effects

Under Alternative 2, hatchery-origin fall Chinook salmon would be produced by the program, and would return to the Snake and Clearwater Rivers where they may be incidentally intercepted in steelhead fisheries. Because adult steelhead returns coincide with adult fall Chinook salmon returns, the increase in hatchery-origin fall Chinook salmon returns reduces the likelihood that steelhead fisheries would be curtailed early if fall Chinook salmon impacts are reached (Subsection 3.4.1.7, Harvest Risks). Therefore, Alternative 2 may increase the number of steelhead that can be harvested relative to Alternative 1.

Research, Monitoring, and Evaluation Effects

Under the Alternative 2, the monitoring and evaluation activities proposed in the joint addendum would be implemented. Funding for monitoring is largely linked to hatchery program impacts, so monitoring effort would be slightly increased relative to Alternative 1. Adult steelhead returns coincide with adult fall Chinook salmon returns, and monitoring efforts directed at fall Chinook salmon would impact steelhead passing Lower Granite Dam (Subsection 3.4.4, Snake River Steelhead). Though monitoring effort would increase, it is likely that some monitoring would occur to monitor the status of Snake River steelhead even without Alternative 2, though the level of monitoring is uncertain. At a maximum, the impact would include the handling of up to 25,000 adult steelhead, of which 25 may die. This morality level, although low, is expected to be slightly higher than under Alternative 1.

Summary

Alternative 2 would increase impacts on Snake River steelhead relative to Alternative 1 due to increased ecological interactions, facility effects, and handling for broodstock collection and monitoring. However effects on spring/summer Chinook salmon under Alternative 2 would be low. Consequently, Alternative 2 is not expected to change the status or abundance trend relative to Alternative 1 (Subsection 3.4.4, Snake River Steelhead).

4.4.2.5. Snake River Sockeye salmon

Broodstock Collection Effects

Under Alternative 2, the Lower Granite Dam trap and the South Fork Clearwater weir would be used for fall Chinook salmon broodstock collection. Snake River sockeye salmon are rarely encountered in the Lower Granite Dam trap during fall Chinook salmon broodstock collection because of their earlier migration timing. In some years, a few (less than 10) adult sockeye salmon are handled in the trap as they ascend the ladder. These fish are released or retained for broodstock pursuant to their own HGMP/permit for hatchery programs (Subsection 3.4.5, Snake River Sockeye Salmon). Snake River sockeye salmon are not present in the Clearwater River, and would not be encountered at the weir. The overall impact on Snake River sockeye salmon under Alternative 2 would be expected to be small relative to Alternative 1.

Competition and Predation Effects

Under Alternative 2, fall Chinook salmon would be reared in hatchery facilities and released into the Snake and Clearwater Rivers. These areas are predominantly migration corridors for sockeye salmon where limited interaction occur (Subsection 3.4.5, Snake River Sockeye Salmon). Therefore, Alternative 2 would have low effects on ecological interactions between Snake River fall Chinook and sockeye salmon relative to Alternative 1.

Research, Monitoring, and Evaluation Effects

Under the Alternative 2, the monitoring and evaluation activities proposed in the joint addendum would be implemented. Funding for monitoring is largely linked to hatchery program impacts, so monitoring effort would be slightly increased under Alternative 2 relative to Alternative 1. Though monitoring effort would increase, almost all of the Snake River sockeye salmon will have passed above the Lower Granite Dam trap by the time the trap is operated for fall Chinook salmon broodstock collection and monitoring. In some years, a few (less than 10) adult sockeye salmon are handled in the trap as they ascend the ladder (Section 3.4.5, Snake River Sockeye Salmon). These fish are released or retained for broodstock pursuant to their own HGMP/permit for hatchery programs. No mortalities have been reported during that time. Alternative 2 would not change the migration timing, and therefore would not affect the anticipated encounter rate. As a result, very few sockeye salmon would be handled or trapped as a result of Alternative 2.

Summary

Small impacts on Snake River sockeye salmon may occur under Alternative 2 relative to Alternative 1 through ecological interactions, facility effects, and handling for broodstock collection and monitoring. Alternative 2 would not be expected to change the abundance trends or status of Snake River sockeye salmon (Subsection 3.4.5, Snake River Sockeye Salmon).

4.4.2.6. Bull Trout

Broodstock Collection Effects

Under Alternative 2, the Lower Granite Dam trap and the South Fork Clearwater weir would be used for fall Chinook salmon broodstock collection. Bull trout are rarely encountered in the Lower Granite Dam trap during fall Chinook salmon broodstock collection because of their preference for cooler water (Subsection 3.4.6, Bull Trout). During trapping activities at Lower Granite Dam, only five bull trout have been encountered in the trap since 1998 (FPC 2012). All bull trout were released after capture, and no mortalities have been reported (Subsection 3.4.6, Bull Trout).

Bull trout are present in the Clearwater River, and would be encountered at the weir (Subsection 3.4.6, Bull Trout). The Nez Perce Tribe does not estimate the number of bull trout handled at the weir (NPT 2012); however, it is unlikely that all individuals in the population (between 1,000 and 2,500) would be handled at the weir because the life history forms present do not migrate extensively (Subsection 3.4.6, Bull Trout), and would be less likely to encounter the weir. Therefore, Alternative 2 may delay some bull trout in their migration. However, all bull trout

would be passed above or below the weir to continue their migration. The Alternative 2 impact on bull trout would be expected to be greater than Alternative 1, but small overall since few fish would be encountered, and all would be passed within 24 hours (Subsection 2.2, Proposed Action).

Competition and Predation Effects

Ecological interactions between hatchery-origin fall Chinook salmon and bull trout due to predation and competition would increase under Alternative 2 relative to Alternative 1 because hatchery-origin fall Chinook salmon would be released into the Snake River basin and may increase some of the available prey for bull trout. However, Alternative 2 would release fall Chinook salmon into areas that are not spawning or rearing areas for bull trout, so the increase in ecological interactions between fall Chinook salmon and bull trout would be approximately the same as under Alternative 1.

Research, Monitoring, and Evaluation Effects

Under the Alternative 2, the monitoring and evaluation activities proposed in the joint addendum would be implemented. Funding for monitoring is largely linked to hatchery program impacts, so monitoring effort would be slightly increased relative to Alternative 1. Though monitoring effort would increase, bull trout are rarely encountered at the Lower Granite Dam trap during the time the trap is operated for fall Chinook salmon broodstock collection and monitoring. Alternative 2 would not change the migration pattern of bull trout relative to Alternative 1, and therefore would not affect the anticipated encounter rate. Therefore, Alternative 2 would have low effects on research, monitoring, and evaluation impacts on bull trout similar to Alternative 1.

Summary

Small impacts on bull trout may occur under Alternative 2 through ecological interactions, facility effects, and handling for broodstock collection and monitoring. However, all of these impacts are expected to be low and similar to impacts under Alternative 1. As under Alternative 1, impacts under Alternative 2are not expected to change the overall abundance or status of bull trout (Subsection 3.4.6, Bull Trout).

4.4.3. Alternative 3 (HGMPs Without Addendum) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs Without the Addendum

Unlike Alternative 2, hatchery programs would not be adaptively managed by information gained through monitoring and evaluation from the joint addendum under Alternative 3. Under both alternatives, 5.5 million more juvenile fall Chinook salmon would be released into the action area than under Alternative 1. This release would occur for the 5-year period of the permit (2012 to 2017). The benefit of monitoring and evaluation information under Alternative 2 would be realized after the 5-year permit has expired (after 2017). It is anticipated that the applicants would request approval of new HGMPs in 2017 for programs in this action area, and would use the monitoring and evaluation information gathered between 2012 and 2017 under Alternative 2 to inform management under the newly submitted plans. This benefit would not occur under Alternative 3 because 5-year monitoring and evaluation results would not be

available to inform the new plans and, therefore, HGMPs submitted in 2017 may not include changes in response to changes in Snake River fall Chinook salmon status. As a result, the Snake River fall Chinook salmon hatchery programs may not be as likely to meet the stated goals of (1) providing harvest opportunity for tribal anglers, and (2) sustaining the long-term preservation and genetic integrity of Snake River fall Chinook salmon (Subsection 1.3, Purpose and Need for the Action) if information is lacking to guide future management. However, Alternative 3 would not have direct or indirect impacts on listed fish relative to Alternative 2 during the 5-year permit of the Proposed Action if this monitoring and evaluation component did not occur.

4.5. Effects on Non-listed Fish

4.5.1. Alternative 1 (No Action) – Not Issue Section 10(a)(1)(A) Permits to the Applicants

Fall Chinook salmon are generally not piscivorous (fish-eaters) while in the action area (Subsection 3.5, Non-listed Fish), so reductions to the number of fall Chinook salmon under Alternative 1 would be unlikely to change effects on non-listed fish within the action area relative to baseline conditions.

The absence of the Snake River fall Chinook salmon hatchery programs under Alternative 1 would reduce the amount of food available to salmon predators (e.g., Pacific lamprey, Northern pikeminnow, smallmouth bass, walleye trout, and channel catfish) (Subsection 3.5, Non-listed Fish) relative to baseline conditions. However, none of these fish depend exclusively on fall Chinook salmon as a food source (Subsection 3.5, Non-listed fish), so Alternative 1 would be expected to have a negligible effect on salmon predator species.

Generally, competition for space or food used by both fall Chinook salmon and non-listed fish in the action area, such as white sturgeon, would be reduced slightly under Alternative 1 relative to baseline conditions because there would be fewer fall Chinook salmon in the action area.

The absence of programs under Alternative 1 would eliminate the collection of broodstock at Lower Granite Dam. However, the trap would likely continue to operate at a similar level as under baseline conditions to monitor species status. Therefore, there would still be limited capture of non-listed fish species at the trap. Based on data from 2011, the trap has captured 17 rainbow trout, 8 lamprey, 87 sculpin, and 755 suckers (Subsection 3.5, Non-listed Fish). In all cases, the numbers trapped would likely be dependent upon relative abundance of each species, and the numbers trapped would be a small proportion of each species' abundance (Subsection 3.5, Non-listed Fish). All incidentally captured species would be released, and few, if any, mortalities would be expected.

Because Alternative 1 would not be expected to have more than a negligible effect on any non-listed fish in the action area relative to baseline conditions, Alternative 1 would not be expected to affect the Federal or State status of any non-listed fish relative to baseline conditions (Subsection 3.5, Non-listed Fish).

4.5.2. Alternative 2 (Proposed Action) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs and the Associated Addendum

Under Alternative 2, 5.5 million more juvenile fall Chinook salmon would be released into the action area than under Alternative 1. Fall Chinook salmon are generally not piscivorous while in the action area (Subsection 3.5, Non-listed Fish), so increases in the number of fall Chinook salmon under Alternative 2 would be unlikely to change effects on non-listed fish within the action area relative to Alternative 1.

The Snake River fall Chinook salmon hatchery programs under Alternative 2 would increase the amount of food available to salmon predators (e.g., Pacific lamprey, Northern pikeminnow, smallmouth bass, walleye trout, and channel catfish) (Subsection 3.5, Non-listed Fish) relative to Alternative 1. However, none of these fish depend exclusively on fall Chinook salmon as a food source (Subsection 3.5, Non-listed fish), so Alternative 2 would be expected to have a negligible beneficial effect on salmon predator species relative to Alternative 1.

Generally, competition for food used by both fall Chinook salmon and non-listed fish in the action area, including white sturgeon, would be increased slightly under Alternative 2 relative to Alternative 1 because there would be more fall Chinook salmon in the action area.

The hatchery programs under Alternative 2 would allow the collection of broodstock at Lower Granite Dam. However, the trap would likely continue to operate at a similar level as under Alternative 1 to monitor species status. Therefore, there would still be limited capture of non-listed fish species at the trap. Based on data from 2011, the trap has captured 17 rainbow trout, 8 lamprey, 87 sculpin, and 755 suckers (Subsection 3.5, Non-listed Fish). In all cases, the numbers trapped would likely be dependent upon relative abundance of each species, and the numbers trapped would be a small proportion of each species' abundance (Subsection 3.5, Non-listed Fish). All incidentally captured species would be released, and few, if any, mortalities would be expected. Therefore, Alternative 2 is likely to increase the incidence of capture of non-listed fish relative to Alternative 1. However, the impact would be low in comparison because non-listed fish would continue to be trapped under Alternative 1, and fish trapped under either alternative would be released and would have low mortality rates.

Because Alternative 2 would not be expected to have more than a negligible effect on any non-listed fish in the action area relative to Alternative 1, Alternative 2 would not be expected to affect the Federal or State status of any non-listed fish relative to Alternative 1 (Subsection 3.5, Non-listed Fish).

4.5.3. Alternative 3 (HGMPs without addendum) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs Without the Addendum

Unlike Alternative 2, hatchery programs would not be adaptively managed by information gained through monitoring and evaluation from the joint addendum under Alternative 3. Under both alternatives, 5.5 million more juvenile fall Chinook salmon would be released into the action area than under Alternative 1. This release would occur for the 5-year period of the permit (2012 to 2017). The benefit of monitoring and evaluation information under Alternative 2 would be realized after the 5-year permit has expired (after 2017). It is anticipated that the

applicants would request approval of new HGMPs in 2017 for programs in this action area, and would use the monitoring and evaluation information gathered between 2012 and 2017 under Alternative 2 to inform management under the newly submitted plans. This benefit would not occur under Alternative 3 because 5-year monitoring and evaluation results would not be available to inform the new plans and, therefore, HGMPs submitted in 2017 may not include changes in response to changes in Snake River fall Chinook salmon status. As a result, the Snake River fall Chinook salmon hatchery programs may not be as likely to meet the stated goals of (1) providing harvest opportunity for tribal anglers, and (2) sustaining the long-term preservation and genetic integrity of Snake River fall Chinook salmon (Subsection 1.3, Purpose and Need for the Action) if information is lacking to guide future management. However, Alternative 3 would not have direct or indirect impacts on non-listed fish relative to Alternative 2 during the 5-year permit of the Proposed Action if this monitoring and evaluation component did not occur.

4.6. Effects on Instream Fish Habitat

4.6.1. Alternative 1 (No Action) – Not Issue Section 10(a)(1)(A) Permits to the Applicants

Under Alternative 1, the Snake River fall Chinook salmon hatchery programs would be terminated, and several acclimation facilities would close. However, the primary facilities used to support the Snake River fall Chinook salmon hatchery programs would continue to operate and use instream structures because these facilities are used to produce other species of fish.

Alternative 1 would reduce the amount of water diverted from rivers for operation of the hatchery facilities relative to baseline conditions, but effects would be negligible relative to baseline conditions because the Snake River fall Chinook salmon hatchery programs divert a proportionally small amount of water relative to the total flows of their water source, and all diverted water (minus evaporation) is returned to the river a short distance from the water intake structure thus reducing the area of potential impact from water withdrawal (Subsection 4.2, Groundwater and Hydrology). Sweetwater Springs uses proportionally more water from the West Fork of Sweetwater Creek than the other facilities; however, it is not withdrawn from an area that provides fish habitat, therefore, no change in effects related to instream habitat near Sweetwater Springs would occur under Alternative 1 (Subsection 3.6, Instream Fish Habitat).

Under Alternative 1, there would be a low to negligible change in impacts on instream fish habitat from operating instream structures relative to baseline conditions (e.g., impingement or permanent removal of fish) because (1) all of the primary facilities would continue to operate instream structures as under baseline conditions, (2) the acclimation facilities would close but none of them have fish ladders or weirs, and they are all screened to minimize the risk of harming naturally produced salmonids and other aquatic fauna (Subsection 3.6, Instream Fish Habitat).

Under Alternative 1, there would be a small reduction in effects (e.g., sedimentation, disruption of aquatic organisms, or prevention of vegetative growth) from maintenance of instream structures relative to baseline conditions at hatchery facilities. Since the acclimation facilities would be closed, no debris or bedload clearing from water intakes or protection of banks from erosion would be needed at these sites. Consequently, short- or long-term instream habitat impacts would be reduced as a result of instream or nearshore maintenance.

4.6.2. Alternative 2 (Proposed Action) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs and the Associated Addendum

Alternative 2 would increase the amount of water diverted from rivers for operation of the hatchery facilities relative to Alternative 1, but impacts from increased water diversions would likely be negligible relative to Alternative 1 because (1) a proportionally small amount of water relative to the total flows of their water source would be diverted, leaving large amounts of water in the river, and (2) all diverted water (minus evaporation) would be returned to the river a short distance from the water intake structure thus reducing the area of potential impact from the water withdrawal (Subsection 4.2, Groundwater and Hydrology). As under current conditions, Sweetwater Springs would use proportionally more water from the West Fork of Sweetwater Creek than the other facilities; however, it is withdrawn from an area that does not provide fish habitat (Subsection 3.6, Instream Fish Habitat). Consequently, impacts on instream habitat near Sweetwater Springs would be the same under Alternative 2 as under Alternative 1.

Under Alternative 2, a new temporary picket weir would be installed by Nez Perce Tribal staff on the South Fork Clearwater River to collect broodstock. However, no permanent structures would be constructed or maintained within or adjacent to the stream. Weir installation could cause some minor disturbance to habitat availability as people enter the river to place weir panels. Substrate disturbance and sedimentation would be limited to the small amount disturbed by human feet during wading. The weir would be installed annually around October 1 and disassembled around December 1. The weir would be a standard temporary picket weir that extends across the entire river channel with panels supported by angle iron tripods, and would have two separate trap boxes that would be modified to accommodate the size of fall Chinook salmon (Subsection 2.2, Alternative 2). Free movement of fish that limits the accessible habitat would be delayed in the area because of the weir. Daily monitoring of the weir and passage of all non-target fish would limit this migration delay to 24-hours or less (Subsection 2.2, Alternative 2). Finally, the screening criteria for water withdrawal devices (NMFS 2011c) set forth conservative standards that help minimize the risk of harming naturally produced salmonids and other aquatic fauna. These criteria would continue to be implemented under Alternative 2. Because (1) there would be no permanent structures associated with the weir, (2) the weir would be monitored daily, (3) all non-target fish would be passed above the weir within 24 hours, and (4) screening criteria would be implemented, impacts on instream habitat from the weir would be low relative to Alternative 1.

Because the primary hatchery facilities would be operated almost identically as under Alternative 1, there would be no change in impacts from fish ladders or water intake structures relative to Alternative 1. Several acclimation facilities would be operated under Alternative 2, which would not be operated under Alternative 1. However, none of the acclimation facilities would use fish ladders or weirs, and all of the acclimation facilities would be screened to minimize the risk of harming naturally produced salmonids and other aquatic fauna. Therefore, levels of impingement or permanent removal of fish would be similar between Alternative 2 and Alternative 1 at the acclimation facilities.

Under Alternative 2, there would be a small increase in effects (e.g., sedimentation, disruption of aquatic organisms, or prevention of vegetative growth) relative to Alternative 1 from maintenance of instream structures since the acclimation facilities would operate under

Alternative 2. Debris and bedload would be cleared from water intakes and banks protected from erosion. Short-term, localized instream habitat effects would be expected, but no long-term, permanent habitat alterations would occur under Alternative 2 from these maintenance activities because the existing habitat conditions would be maintained.

4.6.3. Alternative 3 (HGMPs without addendum) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs

Unlike Alternative 2, hatchery programs would not be adaptively managed by information gained through monitoring and evaluation from the joint addendum under Alternative 3. Under both alternatives, 5.5 million more juvenile fall Chinook salmon would be released into the action area than under Alternative 1. This release would occur for the 5-year period of the permit (2012 to 2017). The benefit of monitoring and evaluation information under Alternative 2 would be realized after the 5-year permit has expired (after 2017). It is anticipated that the applicants would request approval of new HGMPs in 2017 for programs in this action area, and would use the monitoring and evaluation information gathered between 2012 and 2017 under Alternative 2 to inform management under the newly submitted plans. This benefit would not occur under Alternative 3 because 5-year monitoring and evaluation results would not be available to inform the new plans and, therefore, HGMPs submitted in 2017 may not include changes in response to changes in Snake River fall Chinook salmon status. As a result, the Snake River fall Chinook salmon hatchery programs may not be as likely to meet the stated goals of (1) providing harvest opportunity for tribal anglers, and (2) sustaining the long-term preservation and genetic integrity of Snake River fall Chinook salmon (Subsection 1.3, Purpose and Need for the Action) if information is lacking to guide future management. However, Alternative 3 would not have direct or indirect impacts on instream fish habitat relative to Alternative 2 during the 5-year permit of the Proposed Action if this monitoring and evaluation component did not occur.

4.7. Effects on Wildlife

4.7.1. Alternative 1 (No Action) – Not Issue Section 10(a)(1)(A) Permits to the Applicants

Under Alternative 1, the Snake River fall Chinook salmon hatchery programs would be eliminated. As a result, fewer fall Chinook salmon (juvenile and adult) would be available as a food source for predators and scavengers that use salmon as a food source relative to baseline conditions, including federally listed gray wolf and grizzly bear (Subsection 3.7, Wildlife). In recent years, over 30,000 hatchery-origin Snake River fall Chinook salmon have returned to the Snake River basin each year (FPC 2012) (Subsection 3.4.2, Snake River Fall Chinook salmon). Assuming an average weight of returning adult and jacks at 15 pounds, Alternative 1 could result in the loss of more than 450,000 pounds of salmon carcasses that would no longer be available for use by other species. Because of the habitat in which they spawn in mainstem rivers with deep water, carcasses are not readily accessible by most land mammals, and would be used primarily by other fish and aquatic invertebrates, which may then be eaten by terrestrial mammals. Additionally, none of the federally listed or candidate species found in Idaho are known to occupy areas directly around Idaho hatchery facilities (Subsection 3.7, Wildlife). Consequently, little or no adverse effects are anticipated to these species as a result of the decreased salmon food supply under Alternative 1.

Although fish are an important part of the diets for a variety of birds, including Idaho- and Washington State-listed sensitive bird species, none are wholly dependent on salmon and steelhead for survival. As a result, the decrease in salmon as a food source under Alternative 1, would have a low to moderate effect on bird species in the action area.

Steller sea lions and California sea lions are also known to feed on returning adult salmon in the Columbia River basin downstream of Bonneville Dam (Subsection 3.7, Wildlife). Snake River fall Chinook salmon adults currently represent approximately 10 percent of the total fall Chinook salmon return (Subsection 3.7, Wildlife), however their run timing does not coincide with steller sea lion presence (Subsection 3.7, Wildlife). Consequently, Alternative 1 would not be expected to reduce the number of salmon and steelhead available to stellar sea lions and California sea lions in the vicinity downstream of Bonneville Dam, because they target other fish stocks. Therefore, Alternative 1 would not lead to a change in sea lion diet or distribution relative to baseline conditions.

Southern resident killer whales also feed on adult salmon, and prefer Chinook salmon (Subsection 3.7, Wildlife). Southern resident killer whales reside predominantly in Puget Sound (outside of the action area), and would only rarely encounter Snake River fall Chinook salmon as either fall Chinook salmon migrate north up the coast or as killer whales migrate south down the coast. Under Alternative 1, the Snake River fall Chinook salmon hatchery programs would be terminated and fewer Chinook salmon would be migrating along the coast relative to baseline conditions. However, the effect is not expected to be substantial since killer whales rarely encounter this stock of fall Chinook salmon, and have other Chinook salmon prey sources within and around the Puget Sound.

Habitat disruption may occur from physical damage or disruption of riparian vegetation from angler access as well as physical disruption of streambed material by wading or motorized boat use (Subsection 3.7, Wildlife). There is some potential for these activities to displace wildlife that may be in the area. Habitat impacts of fishing activities are usually localized and short-lived and are currently occurring related to ongoing steelhead fisheries in the action area. Additionally, fishery access points, roads, boat launches, and campsites are already present in the action area (Subsection 3.7, Wildlife). Alternative 1 would not change the baseline conditions.

4.7.2. Alternative 2 (Proposed Action) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs and the Associated Addendum

Under Alternative 2, the hatcheries would release juvenile fall Chinook salmon into the action area and would provide more food (both juvenile and adults) to wildlife that eat salmon relative to Alternative 1. Although fish are an important part of the diets for a variety of wildlife species including birds and mammals, none are wholly dependent on Snake River fall Chinook salmon for survival. Because Snake River fall Chinook salmon account for 20 percent of hatchery production in the action area (Subsection 1.6, Relationship to Other Plans and Policies), other natural-origin salmon and steelhead as well as nearly 24 million hatchery-origin salmon and steelhead smolts and the adults that return from those releases would be available as prey to Stellar sea lions, California sea lions, southern resident killer whales, and other wildlife that prey on these salmon. However, the run timing of Snake River fall Chinook salmon does not coincide with steller sea lion or California sea lion presence in the action area (Subsection 3.7, Wildlife).

Consequently, the increase in Snake River fall Chinook salmon would not likely benefit these sea lions. Overall, changes in the availability of salmon as a food source under Alternative 2 would not be expected to change the abundance or status of any of the wildlife species relative to Alternative 1 (Subsection 3.7, Wildlife) because of the abundance of other hatchery-origin species available in addition to any natural-origin prey species.

Under Alternative 2, a new temporary picket weir would be installed by Nez Perce Tribal staff on the South Fork Clearwater River to collect broodstock (Subsection 2.2, Alternative 2). The weir may increase impacts on wildlife through incidental trapping and drowning or by disrupting migration. It is also possible that carcasses would collect on the weir and may also attract large mammals. The weir would be checked daily, and fish would be passed upstream, and carcasses allowed to move downstream. Because of the daily human activity and limited delays in movement of fish and carcasses, the weir would be unlikely to cause a noticeable change in local wildlife behavior or affect wildlife abundance or status compared to Alternative 1(Subsection 3.7, Wildlife).

Habitat disruption may occur from physical damage or disruption of riparian vegetation from angler access as well as physical disruption of streambed material by wading or motorized boat use (Subsection 3.3, Wildlife). There is some potential for these activities to displace wildlife that may be in the area. Habitat impacts of fishing activities are usually localized and short-lived and would occur under Alternative 2 due to ongoing steelhead fisheries in the action area. Additionally, fishery access points, roads, boat launches, and campsites are already present in the action area, so no change in effects to wildlife from these activities would occur under Alternative 2. Though some increase in fishing activity may occur under Alternative 2, there would not be an increase in habitat disruption relative to Alternative 1because there would be no new access points and no new fisheries.

4.7.3. Alternative 3 (HGMPs without addendum) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs Without the Addendum

Unlike Alternative 2, hatchery programs would not be adaptively managed by information gained through monitoring and evaluation from the joint addendum under Alternative 3. Under both alternatives, 5.5 million more juvenile fall Chinook salmon would be released into the action area than under Alternative 1. This release would occur for the 5-year period of the permit (2012 to 2017). The benefit of monitoring and evaluation information under Alternative 2 would be realized after the 5-year permit has expired (after 2017). It is anticipated that the applicants would request approval of new HGMPs in 2017 for programs in this action area, and would use the monitoring and evaluation information gathered between 2012 and 2017 under Alternative 2 to inform management under the newly submitted plans. This benefit would not occur under Alternative 3 because 5-year monitoring and evaluation results would not be available to inform the new plans and, therefore, HGMPs submitted in 2017 may not include changes in response to changes in Snake River fall Chinook salmon status. As a result, the Snake River fall Chinook salmon hatchery programs may not be as likely to meet the stated goals of (1) providing harvest opportunity for tribal anglers, and (2) sustaining the long-term preservation and genetic integrity of Snake River fall Chinook salmon (Subsection 1.3, Purpose and Need for the Action) if information is lacking to guide future management. However, Alternative 3 would

not have direct or indirect impacts on wildlife relative to Alternative 2 during the 5-year permit of the Proposed Action if this monitoring and evaluation component did not occur.

4.8. Effects on Socioeconomics

4.8.1. Alternative 1 (No Action) – Not Issue Section 10(a)(1)(A) Permits to the Applicants

Under Alternative 1 (No Action), all Snake River fall Chinook salmon hatchery programs would be terminated. Although Snake River fall Chinook salmon are not targeted in any fishery, these fish are encountered incidentally during non-tribal steelhead fishing, and it is possible that a few additional anglers are drawn to the steelhead fishery by the potential to encounter returning fall Chinook salmon (Subsection 3.8, Socioeconomics). Consequently, Alternative 1 may reduce the number of fishing trips taken relative to baseline conditions, which could reduce the purchase of supplies such as fishing gear, camping equipment, consumables, and fuel at local businesses. Under Alternative 1, there may also be a reduction in the number of charter/guided fishing trips taken compared to baseline conditions, which could negatively affect the revenue of the charter boat industry within the action area.

Because fishing accounts for less than 0.2 percent of the total state revenue in Washington, small changes in fishery-related revenue under Alternative 1 would not be expected to measurably affect total state revenue relative to baseline conditions. Although the contribution of fishing to total state revenue in Oregon and Washington is unknown, data shows fishing could be expected to contribute a similar proportion to the other states' revenue (Subsection 3.8, Socioeconomics). Snake River Basin hatcheries contribute of $10.5 million and 415.5 jobs to regional economies from harvest-related effects (Subsection 3.8, Socioeconomics). It is possible that the 15 staff positions at Nez Perce Tribal Hatchery and the 22 staff positions for the Lyons Ferry program (Subsection 3.8, Socioeconomics) may be terminated or reduced, which would slightly reduce the economic input locally. Revenue would be expected to decline and jobs lost as a result of terminating the Snake River fall Chinook salmon hatchery programs. Hatchery-origin fall Chinook salmon would not be available in the action area to harvest, so fishing trips and expenditures would decrease relative to baseline conditions. Additionally, without these programs other fisheries would reach their limit on incidental impacts on natural-origin Snake River fall Chinook salmon faster than they would if hatchery-origin fish were present to mitigate impacts. Therefore, fishing seasons may be shortened, and thus trips and expenditures curtailed.

There would also be a reduction in revenue and jobs associated with operating the hatchery facilities (Subsection 3.8, Socioeconomics). However, it is difficult to determine the amount of revenue and jobs that would be lost. Changes to median incomes for environmental justice counties would likely be negligible because of the small contribution of fishing to total revenue, and no changes in county populations would be expected under Alternative 1 (Section 3.8, Socioeconomics).

Under Alternative 1, traditional harvest methods, food use patterns, cultural knowledge transfer, and ceremonies related to Snake River fall Chinook salmon runs would not occur. For example, Alternative 1 would reduce the demand for traditional fishing equipment created by local tribal craftsman. Because less Snake River fall Chinook salmon would be produced in the action area, tribal fishing would likely occur outside of the action area resulting in an increase in travel costs

to tribal members. In addition, the absence of fish would result in increased tribal reliance on other consumer goods, which would cost more than the low cost of tribal fishing.

4.8.2. Alternative 2 (Proposed Action) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs and the Associated Addendum

Under Alternative 2, Snake River fall Chinook salmon hatchery programs would release juvenile fish into the Snake River Basin. Although Snake River fall Chinook salmon are not targeted in any fishery, these fish are encountered incidentally during steelhead fisheries, and it is possible that a few additional anglers would be drawn to the non-tribal steelhead fishery by the potential to encounter returning fall Chinook salmon (Subsection 3.8, Socioeconomics). Consequently, Alternative 2 may increase the number of fishing trips taken relative Alternative 1, which could increase the purchase of supplies such as fishing gear, camping equipment, consumables, and fuel at local businesses. Under Alternative 2, there may also be an increase in the number of charter/guided fishing trips taken compared to Alternative 1, which could positively affect the revenue of the charter boat industry within the action area.

Because fishing accounts for less than 0.2 percent of the total state revenue in Washington, small changes in fishery-related revenue under Alternative 2 would not be expected to measurably affect total state revenue relative to Alternative 1. Although the contribution of fishing to total state revenue in Oregon and Washington is unknown, data shows fishing could be expected to contribute a similar proportion to the other states' revenue (Subsection 3.8, Socioeconomics). Under baseline conditions, Snake River Basin hatcheries contribute of $10.5 million and 415.5 jobs to regional economies from harvest-related effects (Subsection 3.8, Socioeconomics). The Snake River Basin hatcheries contribute $22 million and 452 jobs to regional economies as a result of operating the hatchery facilities. It is likely that the 15 staff members employed at Nez Perce Tribal Hatchery, and the 22 staff members employed for the Lyons Ferry program (Subsection 3.8, Socioeconomics) would be retained under Alternative 2 and, therefore, slightly increase the economic input locally compared to Alternative 1. Under Alternative 2, fishing-related revenue would be expected to be similar to baseline conditions, which would be an increase in revenue and jobs when compared to Alternative 1.

No changes to medium income environmental justice counties or to populations would be expected under Alternative 2 when compared to Alternative 1 with the exception of beneficial effects on tribes in the action area.

Under Alternative 2, traditional harvest methods, food use patterns, cultural knowledge transfer, and ceremonies related to Snake River fall Chinook salmon runs would occur. Alternative 2 would increase the demand for traditional fishing equipment created by local tribal craftsman compared to Alternative 1. Tribal fishing would occur inside the action area resulting in reduced travel costs to tribal members. In addition, the availability of fish would result in decreased reliance on other consumer goods that cost more than the low cost of tribal fishing.

4.8.3. Alternative 3 (HGMPs Without Addendum) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs Without the Addendum

Unlike Alternative 2, hatchery programs would not be adaptively managed by information gained through monitoring and evaluation from the joint addendum under Alternative 3. Under both alternatives, 5.5 million more juvenile fall Chinook salmon would be released into the action area than under Alternative 1. This release would occur for the 5-year period of the permit (2012 to 2017). The benefit of monitoring and evaluation information under Alternative 2 would be realized after the 5-year permit has expired (after 2017). It is anticipated that the applicants would request approval of new HGMPs in 2017 for programs in this action area, and would use the monitoring and evaluation information gathered between 2012 and 2017 under Alternative 2 to inform management under the newly submitted plans. This benefit would not occur under Alternative 3 because 5-year monitoring and evaluation results would not be available to inform the new plans and, therefore, HGMPs submitted in 2017 may not include changes in response to changes in Snake River fall Chinook salmon status. As a result, the Snake River fall Chinook salmon hatchery programs may not be as likely to meet the stated goals of (1) providing harvest opportunity for tribal anglers, and (2) sustaining the long-term preservation and genetic integrity of Snake River fall Chinook salmon (Subsection 1.3, Purpose and Need for the Action) if information is lacking to guide future management. However, Alternative 3 would not have direct or indirect impacts on socioeconomics relative to Alternative 2 during the 5-year permit of the Proposed Action if this monitoring and evaluation component did not occur.

4.9. Effects on Tourism and Recreation

4.9.1. Alternative 1 (No Action) – Not Issue Section 10(a)(1)(A) Permits to the Applicants

Hatchery programs contribute to tourism and recreation in the action area by increasing fishing opportunity or providing tours of their hatchery facilities (Subsection 3.9, Tourism and Recreation). Under Alternative 1, all Snake River fall Chinook salmon hatchery programs would be terminated. Although Snake River fall Chinook salmon are not targeted in any fishery, these fish are encountered incidentally during steelhead fisheries, and it is possible that a few additional anglers are drawn to the steelhead fishery by the potential to encounter returning fall Chinook salmon (Subsection 3.8, Socioeconomics). Consequently, Alternative 1 may reduce the number of fishing trips taken relative to baseline conditions. However, this change would likely be negligible to the overall number of tourism and recreational trips taken within the states of Idaho, Washington, and Oregon because only 3 percent of the total tourism and recreational trips taken in those states are currently fishing-only trips (Travel USA 2008)(Subsection 3.9, Tourism and Recreation).

The acclimation facilities used by these programs would cease to operate under Alternative 1. However, the primary hatchery facilities that support the Snake River fall Chinook salmon hatchery programs (i.e., Lyons Ferry Hatchery and Nez Perce Tribal Hatchery) would continue to operate because they also raise other species of fish (Subsection 1.4, Action Area). Because there are no tours of acclimation facilities, no change in the number of hatchery tours would be expected under Alternative 1 relative to baseline conditions.

4.9.2. Alternative 2 (Proposed Action) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs and the Associated Addendum

The potential effects of Alternative 2 on tourism and recreation would be small, but positive relative to Alternative 1. There may be a small increase in the number of fishing trips or hatchery tours relative to Alternative 1, but this change would likely be negligible to the overall number of tourism and recreational trips taken within the states of Idaho, Washington, and Oregon because only 3 percent of the total tourism and recreational trips taken in those states are currently fishing-only trips (Travel USA 2008)(Subsection 3.9, Tourism and Recreation).

4.9.3. Alternative 3 (HGMPs Without Addendum) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs Without the Addendum

Unlike Alternative 2, hatchery programs would not be adaptively managed by information gained through monitoring and evaluation from the joint addendum under Alternative 3. Under both alternatives, 5.5 million more juvenile fall Chinook salmon would be released into the action area than under Alternative 1. This release would occur for the 5-year period of the permit (2012 to 2017). The benefit of monitoring and evaluation information under Alternative 2 would be realized after the 5-year permit has expired (after 2017). It is anticipated that the applicants would request approval of new HGMPs in 2017 for programs in this action area, and would use the monitoring and evaluation information gathered between 2012 and 2017 under Alternative 2 to inform management under the newly submitted plans. This benefit would not occur under Alternative 3 because 5-year monitoring and evaluation results would not be available to inform the new plans and, therefore, HGMPs submitted in 2017 may not include changes in response to changes in Snake River fall Chinook salmon status. As a result, the Snake River fall Chinook salmon hatchery programs may not be as likely to meet the stated goals of (1) providing harvest opportunity for tribal anglers, and (2) sustaining the long-term preservation and genetic integrity of Snake River fall Chinook salmon (Subsection 1.3, Purpose and Need for the Action) if information is lacking to guide future management. However, Alternative 3 would not have direct or indirect impacts on tourism and recreation relative to Alternative 2 during the 5-year permit of the Proposed Action if this monitoring and evaluation component did not occur.

4.10. Effects on Environmental Justice

4.10.1. Alternative 1 (No Action) – Not Issue Section 10(a)(1)(A) Permits to the Applicants

Under Alternative 1, all Snake River fall Chinook salmon hatchery programs would be terminated. Although Snake River fall Chinook salmon are not targeted by any fishery, they are taken incidentally in other fisheries (e.g., Snake River steelhead fishery). Eliminating the Snake River fall Chinook salmon hatchery programs may lead to reduced seasons in other fisheries because of an increased rate of incidental impact on natural-origin Snake River fall Chinook salmon.

In the action area, three tribal communities and seven counties were identified as environmental justice communities (Subsection 3.10, Environmental Justice). It is believed that all ethnic groups engage in recreational fishing. Harvest agreements are specifically designed to allow harvest by tribal members, while not limiting the participation of other United States citizens.

Any reduction in fishing opportunity under Alternative 1 would not result in a disproportionate negative impact on any minority or low income population group because the negative economic effect would be realized by all environmental justice and non-environmental justice communities in the action area (Section 3.10, Environmental Justice). The fisheries are activities that are equally available to all communities both within and outside of the action area. Additionally, hatchery facilities are generally open to the public. Because the lack of fishing opportunities would negatively impact all communities equally, no one environmental justice community would be disproportionately impacted by the lack of Snake River fall Chinook salmon hatchery programs.

4.10.2. Alternative 2 (Proposed Action) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs and the Associated Addendum

Most effects on environmental justice communities under Alternative 2 would result from releasing 5.5 million more hatchery-origin salmon in the action area relative to Alternative 1.

Alternative 2 would provide hatchery-origin fish that would support fishing opportunities to all population sectors equally. There are no data to suggest that any one population group enjoys a disproportionally greater benefit from fishing opportunities in the action area than any other group (Subsection 3.10, Environmental Justice). Because the fishing opportunities would positively benefit tribal communities and the overall tourism and recreation-based economic and employment segment in the action area, all environmental justice communities would potentially benefit under Alternative 2 relative to Alternative 1.

4.10.3. Alternative 3 (HGMPs Without Addendum) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs Without the Addendum

Unlike Alternative 2, hatchery programs would not be adaptively managed by information gained through monitoring and evaluation from the joint addendum under Alternative 3. Under both alternatives, 5.5 million more juvenile fall Chinook salmon would be released into the action area than under Alternative 1. This release would occur for the 5-year period of the permit (2012 to 2017). The benefit of monitoring and evaluation information under Alternative 2 would be realized after the 5-year permit has expired (after 2017). It is anticipated that the applicants would request approval of new HGMPs in 2017 for programs in this action area, and would use the monitoring and evaluation information gathered between 2012 and 2017 under Alternative 2 to inform management under the newly submitted plans. This benefit would not occur under Alternative 3 because 5-year monitoring and evaluation results would not be available to inform the new plans and, therefore, HGMPs submitted in 2017 may not include changes in response to changes in Snake River fall Chinook salmon status. As a result, the Snake River fall Chinook salmon hatchery programs may not be as likely to meet the stated goals of (1) providing harvest opportunity for tribal anglers, and (2) sustaining the long-term preservation and genetic integrity of Snake River fall Chinook salmon (Subsection 1.3, Purpose and Need for the Action) if information is lacking to guide future management. However, Alternative 3 would not have direct or indirect impacts on environmental justice communities relative to Alternative 2 during the 5-year permit of the Proposed Action if this monitoring and evaluation component did not occur.

4.11. Effects on Cultural Resources

4.11.1. Alternative 1 (No Action) – Not Issue Section 10(a)(1)(A) Permits to the Applicants

Under Alternative 1the acclimation facilities used by these current programs would cease to operate (Subsection 1.4, Action Area). However, the primary hatchery facilities that support the Snake River fall Chinook salmon hatchery programs (i.e., Lyons Ferry Hatchery and Nez Perce Tribal Hatchery) would continue to operate because they also raise other species of fish (Subsection 1.4, Action Area).

There may be some cultural artifacts present around hatchery facilities (Subsection 3.11, Cultural Resources). Under Alterative 1, there would be no change in the potential for cultural artifacts to be disrupted or destroyed at the primary hatchery facilities (i.e., Lyons Ferry Hatchery and Nez Perce Tribal Hatchery) relative to baseline conditions because these facilities would continue to operate. However, several acclimation facilities would close under Alternative 1, and consequently the potential for cultural artifacts to be disrupted or destroyed would be reduced under Alternative 1 relative to baseline conditions. The historical marker at Lyons Ferry State Park would not be affected by any alternative because no activity would occur in this area.

Most effects on cultural resources would result from releasing 5.5 million fewer hatchery-origin salmon in the action area relative to baseline conditions (Table 2 and Table 3). Salmon are an important cultural resource to tribes within the action area for subsistence and ceremonial purposes (Subsection 3.11, Cultural Resources), and eliminating the Snake River fall Chinook salmon hatchery program may reduce their availability for harvest by tribes. Fisheries in the large tributaries are implemented by both states and tribes, but shift primarily to tribal fisheries in upstream, small tributaries. As a result, tribal fisheries in the action area primarily target spring/summer Chinook salmon (Subsection 3.11, Cultural Resources) in upstream tributaries. However, fall Chinook salmon are harvested, because of the cultural significance of fall Chinook salmon to tribes. Therefore, a decrease in Snake River fall Chinook salmon available for subsistence and ceremonial purposes would be a negative impact on tribes compared to baseline conditions.

4.11.2. Alternative 2 (Proposed Action) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs and the Associated Addendum

Under Alternative 2, most effects on cultural resources would result from releasing 5.5 million more hatchery-origin salmon in the action area relative to Alternative 1.

There may be some cultural artifacts present around hatchery facilities (Subsection 3.11, Cultural Resources). Under Alterative 2, all hatchery facilities used to produce Snake River fall Chinook salmon would be operated. As a result, there may be an increase in the potential for cultural artifacts to be disrupted or destroyed at acclimation facilities relative to Alternative 1. However, there would be no change in the potential for cultural artifacts to be disrupted or destroyed at the primary hatchery facilities (i.e., Lyons Ferry Hatchery and Nez Perce Tribal Hatchery) relative to Alternative 1 because these facilities would be operated under both alternatives.

Salmon are an important cultural resource to tribes within the action area for subsistence and ceremonial purposes (Subsection 3.11, Cultural Resources), and hatchery-origin Snake River fall Chinook salmon contribute to this cultural resource and availability for harvest. Fisheries in the large tributaries are implemented by both states and tribes, but shift primarily to tribal fisheries in upstream, small tributaries. As a result, tribal fisheries in the action area primarily target spring/summer Chinook salmon (Subsection 3.11, Cultural Resources) in upstream tributaries. However, fall Chinook salmon are harvested, because of the cultural significance of fall Chinook salmon to tribes. Therefore, an increase in Snake River fall Chinook salmon available for subsistence and ceremonial purposes would be a beneficial impact on tribes compared to Alternative 1.

4.11.3. Alternative 3 (HGMPs Without Addendum) – Issue Section 10(a)(1)(A) Permits for the Implementation of Both of the HGMPs Without the Addendum

Unlike Alternative 2, hatchery programs would not be adaptively managed by information gained through monitoring and evaluation from the joint addendum under Alternative 3. Under both alternatives, 5.5 million more juvenile fall Chinook salmon would be released into the action area than under Alternative 1. This release would occur for the 5-year period of the permit (2012 to 2017). The benefit of monitoring and evaluation information under Alternative 2 would be realized after the 5-year permit has expired (after 2017). It is anticipated that the applicants would request approval of new HGMPs in 2017 for programs in this action area, and would use the monitoring and evaluation information gathered between 2012 and 2017 under Alternative 2 to inform management under the newly submitted plans. This benefit would not occur under Alternative 3 because 5-year monitoring and evaluation results would not be available to inform the new plans and, therefore, HGMPs submitted in 2017 may not include changes in response to changes in Snake River fall Chinook salmon status. As a result, the Snake River fall Chinook salmon hatchery programs may not be as likely to meet the stated goals of (1) providing harvest opportunity for tribal anglers (i.e. cultural resource benefits to tribes), and (2) sustaining the long-term preservation and genetic integrity of Snake River fall Chinook salmon (Subsection 1.3, Purpose and Need for the Action) if information is lacking to guide future management. However, Alternative 3 would not have direct or indirect impacts on cultural resources relative to Alternative 2 during the 5-year permit of the Proposed Action if this monitoring and evaluation component did not occur.

5. CUMULATIVE IMPACTS

This section discusses the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The purpose of this assessment is to describe the additional impact of the hatchery programs in light of all the other impacts on listed fish and their habitats.

5.1. Other Agency Programs, Plans, and Policies

Cumulative impacts of NMFS' Proposed Action under section 10(a)(1)(A) would be minor. Other Federal, tribal, and state actions are expected to occur within the action area, in Snake and Clearwater River tributaries outside the action area, and in the migration corridor between the Snake River and the Pacific Ocean that would affect the fish populations considered under the Proposed Action. State and tribal fisheries would still occur in other Snake and Clearwater River tributaries and in the mainstem Columbia River. Land management and water-use decisions that affect these populations are made inside and outside the Snake River Basin. There are overarching concerns and legal mandates for the recovery of listed salmon and steelhead populations in the Columbia River Basin; at the same time, there are social and cultural needs for sustainable fisheries and sustainable economic use of resources.

There are numerous initiatives by state, Federal, tribal, and private entities designed to restore salmon and steelhead populations, but it is not usually clear who would implement the initiatives, when they would be implemented, or how effective they would be. In part, this is due to the reduced effectiveness of individually and separately implemented actions at the local scale. An exception to this uncertainty, then, would come as a result of a more broad-scale implementation of different actions across larger portions of the watersheds – such a broad-scale approach exists in several scenarios currently playing out in the Columbia River Basin. In large part, these actions are coordinated through or in association with Federal ESA recovery plans either already developed or currently in development by NMFS. These plans are intended to provide a framework by which Federal, state, local, tribal, and private actions can be designed and implemented in a manner that would most effectively restore salmon and steelhead populations. State initiatives include legislative measures to facilitate the recovery of listed species and their habitats, as well as the overall health of watersheds and ecosystems. Regional programs are being developed that designate priority watersheds and facilitate development of watershed management plans. All of these regional efforts are expected to help increase salmon and steelhead populations in the action area (and elsewhere in the region) because of compatible goals and objectives.

The operation of the Snake River fall Chinook salmon hatchery programs as described in the proposed HGMPs are designed to be consistent with recovery efforts for populations of salmon and steelhead in the basin. The proposed hatchery operations, if successful, are expected to continue to contribute to the recovery of the natural-origin salmon and steelhead populations in the Snake River Basin. Monitoring and evaluation activities under the Proposed Action in combination with other monitoring activities will determine if the proposed hatchery programs

are consistent with recovery planning efforts for salmon and steelhead throughout the Snake River Basin.

5.2. Cumulative Effects

The hatchery programs and associated fisheries that may impact listed salmon and steelhead within the action area would be managed based on the impacts on ESA-listed fish that are returning to the Snake and Clearwater Rivers and their associated ESUs and DPSs. If the cumulative effects of other hatchery programs, fisheries, pinniped predation on salmonids, ocean conditions or conservation efforts do not allow sufficient escapement of returning adult salmon and steelhead to the action area to meet recovery goals while providing for the operation of the proposed hatchery programs, adjustments to fisheries and to the hatchery production levels would likely be proposed.

If the cumulative effects of salmon management efforts fail to provide for recovery of listed species, then impacts due to the hatchery programs and fishing in the action area would be substantially diminished. Therefore, the cumulative impacts of the Proposed Action on recovery actions are expected to be minor because of reporting and monitoring requirements that would ensure compatibility with recovery planning. Management of the hatchery programs and of fishing opportunity is only one element of a large suite of regulations and environmental factors that may influence the overall health of listed salmon and steelhead populations and their habitat. The proposed hatchery programs are coordinated with monitoring so that hatchery managers can respond to changes in the status of affected listed species. Monitoring and adaptive management would help ensure that the affected ESU and DPS are adequately protected and would help counter-balance any potential adverse cumulative impacts. Healthy and self-sustaining Snake River salmon and steelhead populations would be an important component in long-term recovery of each of the affected species as a whole.

5.3. Climate Change

The action area (Subsection 1.4, Action Area) is located in the Pacific Northwest. The climate is changing in the Pacific Northwest due to human activities, and this is affecting hydrologic patterns and water temperatures. Regionally averaged air temperature rose about 1.5°F over the past century (with some areas experiencing increases up to 4°F) and is projected to increase another 3°F to 10°F during this century. Increases in winter precipitation and decreases in summer precipitation are projected by many climate models, although these projections are less certain than those for temperature (USGCRP 2009).

Higher temperatures in the cool season (October through March) are likely to increase the percentage of precipitation falling as rain rather than snow, and to contribute to earlier snowmelt. The amount of snowpack measured on April 1, a key indicator of natural water storage available for the warm season, has already declined substantially throughout the region. The average decline in the Cascade Mountains, for example, was about 25 percent over the past 40 to 70 years, with most of this due to the 2.5°F increase in cool season temperatures over that period. Further declines in Northwest snowpack are likely due to additional warming this century, varying with latitude, elevation, and proximity to the coast. April 1 snowpack is likely to decline as much as 40 percent in the Cascades by the 2040s (USGCRP 2009).

High and base stream flows are likely to change with warming. Increasing winter rainfall is likely to increase winter flooding in relatively warm watersheds on the west side of the Cascade Mountains. Earlier snowmelt, and increased evaporation and water loss from vegetation, will increase stream flows during the warm season (April through September). On the western slopes of the Cascade Mountains, reductions in warm season runoff of 30 percent or more are likely by mid-century. In some sensitive watersheds, both increased flood risk in winter and increased drought risk in summer are likely due to warming of the climate (USGCRP 2009).

In areas where it snows, a warmer climate means major changes in the timing of runoff: increased stream flows during winter and early spring, and decreases in late spring, summer, and fall. Flow timing has shifted over the past 50 years, with the peak of spring runoff shifting from a few days earlier in some places to as much as 25 to 30 days earlier in others. This trend is likely to continue, with runoff shifting 20 to 40 days earlier within this century. Major shifts in the timing of runoff are not likely in areas dominated by rain rather than snow (ISAB 2007; USGCRP 2009).

Fish habitat changes due to climate change are likely to create a variety of challenges for ESA-listed species of fish. Higher winter stream flows can scour streambeds, damaging spawning redds and washing away incubating eggs (USGCRP 2009). Earlier peak stream flows could flush young salmon and steelhead from rivers to estuaries before they are physically mature enough for the transition, increasing a variety of stresses and the risk of predation (USGCRP 2009). Lower summer stream flows and warmer water temperatures will degrade summer rearing conditions in many parts of the Pacific Northwest for a variety of salmon and steelhead species (USGCRP 2009), and are likely to reduce the survival of steelhead fry in streams with incubation in early summer. Other likely effects include alterations to migration patterns, accelerated embryo development, premature emergence of fry, and increased competition and predation risk from warm-water, non-native species (ISAB 2007). The increased prevalence and virulence of diseases and parasites that tend to tend to flourish in warmer water will further stress salmon and steelhead (USGCRP 2009). Overall, about one-third of the current habitat for the Pacific Northwest's coldwater fish may well no longer be suitable for them by the end of this century as key temperature thresholds are exceeded (USGCRP 2009).

Climate change is also likely to affect conditions in the Pacific Ocean. Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances (USGCRP 2009). It is likely that, as ocean conditions change, abundances of salmon and steelhead will continue to change accordingly, resulting in changes in abundance of adults returning to freshwater to spawn.

In the Snake River Basin impacts from climate change may be similar to those described above. The Snake River is fed largely by glaciers and snow melt if climate change reduces the snow pack then summer time flows may reduce the suitable habitat for salmon and steelhead yearling rearing, decreasing their abundance. Climate change may also increase the frequency of major flood events that can scour redds (especially for fall Chinook salmon) and for salmon and steelhead spawning and rearing in the Clearwater River and the lower Snake River tributaries.

Lower summer flows due to a reduced winter snow pack may increase water temperatures that may lead to an increase in the abundance of non-native warm water species that can compete and prey on listed salmon and steelhead. Warmer water temperatures may also increase the incidence of disease outbreaks and virulence in both the natural-origin and hatchery-origin juveniles.

If climate change contributes to a substantial decline in the abundance of listed salmon and steelhead populations in the Snake River Basin though impacts on habitat and from changes in ocean conditions the proposed hatchery programs may be used as a "safety net" program to maintain genetic resources. The proposed hatchery programs are somewhat protected from the possible increase in disease prevalence from warmer water temperatures because much of the rearing occurs using well water and the fish are tested at spawning, during rearing, and prior to release to limit disease transmission to the natural-origin populations.

While climate change may well have impacts on the abundance and/or distribution of ESA-listed salmonids that are considered under the Proposed Action, the proposed hatchery management described in the HGMPs and the associated monitoring provide the ability to evaluate hatchery program impacts as abundances change, leading to adjustments accordingly.

6. AGENCIES CONSULTED

National Marine Fisheries Service
Nez Perce Tribe
Bonneville Power Administration
Washington Department of Fish and Wildlife
Idaho Department of Fish and Game
Oregon Department of Fish and Wildlife

7. REFERENCES CITED

Arnsberg, B., A. Garcia, P. Groves, D. Milks, R Mueller. 2012. 2011 Snake River Fall Chinook Salmon Spawning Summary.

Araki, H., B. Cooper, and M.S. Blouin. 2007. Genetic effects of captive breeding cause a rapid, cumulative fitness decline in the wild. Science 318:100-103.

ASA (American Sportfishing Association) 2008. Southwick Associates. Sportfishing in America: An Economic Engine and Conservation Powerhouse. Produced for the American Sportfishing Association with funding from the Multistate Conservation Grant Program, 2007. Available at http://www.asafishing.org/images/statistics/resources/Sportfishing%20in%20America%20Rev.%207%2008.pdf (accessed May 11, 2012)

Beamish, R. J. 1980. Adult biology of the river lamprey (Lampetra ayresi) and the Pacific lamprey (Lampetra tridentata) from the Pacific coast of Canada. Canadian Journal of Fisheries and Aquatic Sciences 37: 1906-1923.

Beauchamp, D.A. 1990. Seasonal and diet food habits of rainbow trout stocked as juveniles in Lake, Washington. Trans. of the American Fish Society 119: pages 475 to 485.

Bergheim, Asbjørn and Torbjørn Åsgård. 1996. Chapter 3. Waste Production from Aquaculture. IN: Aquaculture and Water Resource Management, Donald J. Baird, et al. (eds). Blackwell Science, Ltd. Oxford, England. Pages 50 to 80

Berejikian, B. A., E.P. Tezak, et al. (1997). "Reproductive behavioral interactions between wild and captively reared coho salmon (Oncorhynchus kisutch)." ICES Journal of Marine Science 54: 1040-1050.

Berejikian, B. A. and M. J. Ford (2004). "Review of relative fitness of hatchery and natural salmon." NOAA Technical Memorandum NMFS-NWFSC-61, 28p.

Berejikian, B. A., D. M. Van Doornik, et al. (2009). "Reproductive behavior and relative reproductive success of natural- and hatchery-origin Hood Canal summer chum salmon (Oncorhynchus keta)." Canadian Journal of Fisheries and Aquatic Sciences 66: 781-789.

Bilby, R.E., B.R. Fransen, P.A. Bission, and J.K. Walter. 1998. Response of juvenile coho salmon (Oncorhynchus kisutch) and steelhead (Onchorhynchus mykiss) to the addition of salmon carcasses to two streams in southwestern Washington, U.S.A. Can. J. Fish. Aquat. Sci. 55: pages 1909 to 1918

Bottom, D.L., C.A. Simenstad, J. Burke, J., A.M. Bapista, D.A. Jay, K.K. Jones, E. Casillas, and M.H. Schiewe. 2005. Salmon at river's end: the role of the estuary in the decline and recovery of Columbia River salmon. U.S. Dept. Commer., NOAA Technical Memorandum. NMFS-NWFSC-68. 246 pages

Boxall AB, Fogg LA, Blackwell PA, Kay P, Pemberton EJ, Croxford A. 2004. Veterinary medicines in the environment. Rev Environ Contam Toxicol. 2004: pages 1 to 91.

BPA (Bonneville Power Administration) 1997. Final Environmental Impact Statement Nez Perce Tribal Hatchery Program. Bonneville Power Administration U.S. Department of Energy Bureau of Indian Affairs U.S. Department of the Interior Nez Perce Tribe. July 1997

Busack, C., K. P. Currens, et al. (2005). Tools for evaluating ecological and genetic risks in hatchery programs. Final Report for BPA Project 2003-058-00, Contract BPA00016399.

Cannamela, D. A. (1992). Potential impacts of releases of hatchery steelhead trout smolts on wild and natural juvenile chinook and sockeye salmon. White Paper. Appendix A.

CBFWA (Columbia Basin Fish and Wildlife Authority) (1996). Draft programmatic environmental impact statement. Impacts of artificial salmon and steelhead production strategies in the Columbia River basin. USFWS, NMFS, and Bonneville Power Administration. Portland, Oregon.

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)." Canadian Journal of Fisheries and Aquatic Sciences 60: 1057-1067.

Clemens, B. J., T. Binder, M. Docker, M. Moser, and S. Sower (2010): Similarities, Differences, and Unknowns in Biology and Management of Three Parasitic Lampreys of North America, Fisheries, 35:12, 580-594

Connor, William P., K.F. Tiffen. 2010 – Research, Monitoring, and Evaluation of Emerging Issues and Measures to Recover the Snake River Fall Chinook Salmon ESU. Annual Report 2008. Document ID #P118208. US Department of Energy, Bonneville Power Administration, Environment, Fish, and Wildlife Department. Portland, Oregon.

Connor, William P., K.F. Tiffen. 2012 – Research, Monitoring, and Evaluation of Emerging Issues and Measures to Recover the Snake River Fall Chinook Salmon ESU. Annual Report 2010. Document ID #P126080. US Department of Energy, Bonneville Power Administration, Environment, Fish, and Wildlife Department. Portland, Oregon.

Craig and Hacker. 1940. The history and development of the fisheries of the Columbia River. United States Bureau of Fisheries. Washington, [D.C.] : U.S. Govt. Print. Off., 1940

Cripps, Simon J. 1995. Serial particle size fractionation and characterization of an aquacultural effluent. Aquaculture, 133: pages 323 to 339.

Felder, T. 2007. Take Me Fishing in Idaho An Evaluation of the Idaho Department of Fish & Game's 2006 Angler Recruitment and Retention Program. Human Dimensions Consulting. April 2007. Available at

http://www.rbff.org/uploads/Research_section/Iowa/2006_Idaho_RR_Program_Final_Report.pdf (accessed May 22, 2012)

Finger, T.R. 1982. Interactive Segregation among Three Species of Sculpins (Cottus) Copeia, Vol. 1982, No. 3 (Aug. 10, 1982), pp. 680-694

FPC (Fish Passage Center) 2012a. Columbia Basin Fishery Agencies and Tribes Fish Passage Center online query page. Available at http://www.fpc.org/ (accessed May 13, 2012)

FPC (Fish Passage Center) 2012b. DRAFT Fish Passage Center 2011 Annual Report.Fish Passage Center of the Columbia Basin Fish & Wildlife Authority. June 2012 available at http://www.fpc.org/documents/annual_FPC_report/FPC2011_Annual_Report-DRAFT.pdf (accessed July 2, 2012)

Flagg, T. A., F. W. Waknitz, et al. (1995). "The effect of hatcheries on native coho salmon populations in the lower Columbia River." American Fisheries Society 15: 366-375.

Fleming, I. A. and M. R. Gross (1993). "Breeding success of hatchery and wild coho salmon (Oncorhynchus kisutch) in competition." Ecological Applications 3(2): 230-245.

Fleming, I. A. and S. Einum (1997). "Experimental tests of genetic divergence of farmed from wild Atlantic salmon due to domestication." ICES Journal of Marine Science 54: 1051-1063.

Ford, M. J. (2002). "Selection in captivity during supportive breeding may reduce fitness in the wild." Conservation Biology 16(3): 815-825.

Ford, M. J. e., T. Cooney, et al. (2011). Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-113, 281 p.

Hanson, M.B., R.W. Baird, J.K.B. Ford, J. Hempelmann-Halos, D.M. Van Doornik, J.R. Candy, C.K. Emmons, G.S. Schorr, B. Gisborne, K.L. Ayres, S.K. Wasser, K.C. Balcomb, K. Balcomb-Bartok, J.G. Snewa, M.J. Ford. 2010. Species and stock identification of prey consumed by endangered southern resident killer whales in their summer range. Endangered Species Research 11: 69-82.

Hastein, T. and T. Lindstad. 1991. Diseases in wild and cultured salmon: possible interaction. Aquaculture 98: pages 277 to 288.

Hillman, T.W. and J.W. Mullan. 1989. Effect of hatchery releases on the abundance of wild juvenile salmonids in Summer and Winter Ecology of Juvenile Chinook Salmon and Steelhead Trout in the Wenatchee River, Washington. Report to Chelan County PUD by D.W. Chapman Consultants, Inc. Boise, Idaho.

Hoekstra et al. 2007 Quantitative Threat Analysis for Management of Imperiled Species of Chinook Salmon (Oncorynchus tshawyscha) Ecological Applications 17:2061–2073. http://dx.doi.org/10.1890/06-1637.

Horner, N. J. (1978). Survival, densities and behavior of salmonid fry in stream in relation to fish predation. M.S. Thesis, University of Idaho, Moscow, Idaho. 115p.

HRSG (Hatchery Scientific Review Group). 2005. Hatchery reform in Washington State: principles and emerging issues. Fisheries 30(6): pages 1 to 23.

HSRG 2009. Columbia River hatchery reform system wide report. Available from, http://www.hatcheryreform.us/hrp/reports/system/welcome_show.action

ICTRT (Interior Columbia Technical Recovery Team). 2003. Independent populations of Chinook, steelhead, and sockeye for listed Evolutionarily Significant Units within the interior Columbia River domain. Working draft.

ICTRT. 2007. Viability criteria for application to interior Columbia basin Salmonid ESUs (review draft). U.S. Dept.Commerce, NOAA, National Marine Fisheries Service, Northwest Region. Portland, Oregon.

IDEQ (Idaho Department of Environmental Quality) 2011. Idaho Department of Environmental Quality Final 2010 Integrated Report. Boise, ID: Idaho Department of Environmental Quality.

IDEQ 2012. Idaho Department of Environmental Quality. Water Quality Division website available at http://www.deq.idaho.gov/water-quality.aspx (accessed July 02, 2012)

IDFG (Idaho Department of Fish and Game) 2005. Idaho Comprehensive Wildlife Conservation Strategy. Appendix B: Idaho Species of Greatest Conservation Need. Idaho Conservation Data Center, Idaho Department of Fish and Game, Boise, ID. Available at http://fishandgame.idaho.gov/public/wildlife/cwcs/ (accessed May 11, 2012)

IDFG 2007. Idaho Department of Fish and Game Fisheries Management Plan 2007 – 2012. Boise, ID. Available at http://fishandgame.idaho.gov/public/fish/planFisheries.pdf (accessed June 27, 2012)

IDFG 2011. Fisheries Management and Evaluation Plan Submitted Under ESA Section 4(d) for IDFG Recreational Fisheries for Spring/Summer Chinook Salmon. January 2011.

IDFG 2012. 2012 Annual Report to NOAA Fisheries Fishery Management and Evaluation Plans 4(d) Rule Limit 4 The Incidental Take of ESA Listed Salmon and Steelhead during Conduct of Recreational Fisheries in Idaho. April 2012.

IDWR (Idaho Department of Water Resources) 2012. Online well log search page - http://www.idwr.idaho.gov/apps/appswell/searchwc.asp (accessed May 4, 2012)

ISAB (Independent Scientific Advisory Board). 2007. Climate Change Impacts on Columbia River Basin Fish and Wildlife. Independent Scientific Advisory Board for the Northwest Power and Conservation Council; Portland, Oregon. Report ISAB 2007-2. May 11, 2007.

Keefer, M. L. and C. A. Peery (2008). A literature review relevant to juvenile fall Chinook salmon habitat use, migration behavior, and survival in the lower Snake River. Technical Report 2008-11. Task 2 for Contract #W912EF-08-D-0005.

Kendra, W. (1991). "Quality of salmonid hatchery effluents during a summer low-flow season." Transactions of the American Fisheries Society 120: 43-51.

Kolodziej EP, T Harter, DL Sedlak . 2004. Dairy wastewater, aquaculture, and spawning fish as sources of steroid hormones in the aquatic environment. Environ Sci Technol. 38: pages 6377 to 6384.

Krohn, D. C. 1968. Production of the reticulate sculpin (Cottus perplexus) and its predation on salmon fry in three Oregon streams. M. S. Thesis, Oregon St. Univ., Corvallis. 78 p

Lewis and Clark Trail LLC (LCT) 2012. LewisandClarkTrail.com website. http://www.lewisandclarktrail.com/section4/wacities/poindex.htm (accessed May 14, 2012)

Lynch, M. and M. O'Hely (2001). "Captive breeding and the genetic fitness of natural populations." Conservation Genetics 2: 363-378.

Maret, T. R., C. Robinson & G. Minshall (1997): Fish Assemblages and Environmental Correlates in Least-Disturbed Streams of the Upper Snake River Basin, Transactions of the American Fisheries Society, 126:2, 200-216

Martínez Bueno MJ, MD Hernando, A Agüera, AR Fernández-Alba. 2009. Application of passive sampling devices for screening of micro-pollutants in marine aquaculture using LC-MS/MS. Talanta. 77: pages 1518 to 1527.

McElhany, P., M. H. Rucklelshaus, et al. (2000). Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. of Commerce, NOAA Tech. Memo, NMFS-NWFSC-42

Michael, John H., Jr. 2003. Nutrients in salmon hatchery wastewater and its removal through the use of wetland constructed to treat off-line settling pond effluent. Aquaculture, 226: pages 213 to 225.

Missildine, B.R., R.J. Peters, G. Chin-Leo, and D. Houck. 2005. Polychlorinated biphenyl concentrations in adult Chinook salmon (Oncorhynchus tshawytscha) returning to coastal and Puget Sound hatcheries of Washington State. Environmental Science and Technology. 39: pages 6944 to 6951

Mobrand, L. E., J. Barr, et al. (2005). "Hatchery reform in Washington State." Fisheries 30(6): 11-23.+

Muir and Coley 1996. Diet of Yearling Chinook Salmon and Feeding Success During Downstream Migration in the Snake and Columbia Rivers. Northwest Science, Vol. 70, No.4, 1996

Myers, J. M., R. G. Kope, et al. (1998). Status review of Chinook salmon from Washington, Idaho, Oregon, and California, U.S. Dept. Commer., NOAA Tech Memo. NMFS-NWFSC-35, 443p.

Nickelson, T. (2003). "The influence of hatchery coho salmon (Oncorhynchus kisutch) on the productivity of wild coho salmon populations in Oregon coastal basins." Canadian Journal of Fisheries and Aquatic Sciences 60: 1050–1056.

NMFS (National Marine Fisheries Service). 1999. Designated critical habitat; revision of critical habitat for Snake River spring/summer Chinook salmon. Final rule. Federal Register 64:205(25 October 1999):57399-57403.

NMFS 2005. Endangered and threatened species; designation of critical habitat for 12 evolutionarily significant units of West Coast salmon and steelhead in Washington, Oregon, and California. Final rule. Federal Register 70:170(2 September 2005):52630-52858.

NMFS. 2008a. Supplemental Comprehensive Analysis of the Federal Columbia River Power System and Mainstem Effects of the Upper Snake and other Tributary Actions. May 5, 2008).

NMFS. 2008b. Biological Opinion: Impacts of U.S. v. Oregon Fisheries in the Columbia River in years 2008-2017 on ESA listed Species and Magnuson-Stevens Act Essential Fish Habitat. May 5, 2008.

NMFS. 2008c. Endangered Species Act – Section 7 Biological Opinion on the effects of the Pacific Coast Salmon Plan and U.S. Fraser Panel Fisheries on the lower Columbia River coho and lower Columbia River Chinook evolutionarily significant units listed under the Endangered Species Act and Magnuson-Stevens Act Essential Fish Habitat Consultation. NMFS, Portland, Oregon.

NMFS 2008d. Final Environmental Assessment for the Take of California Sea Lions at Bonneville Dam Pursuant to section 120 of the Marine Mammal Protection Act. March 12, 2008.

NMFS 2009. Operation of the Lower Granite Dam Adult Trap, 2008. Jerrel R. Harmon. Fish Ecology Division Northwest Fisheries Science Center National Marine Fisheries Service National Oceanic and Atmospheric Administration 2725 Montlake Boulevard East

NMFS 2010. Final Environmental Impact Statement to Inform Columbia River basin Hatchery Operations and the Funding of Mitchell Act Hatchery Programs.

NMFS. 2011a. Request for Concurrence. National Environmental Policy Act Compliance Work Group: Environmental Effects Scoping and Preliminary Determination on Permitting of two hatchery programs as described in the two Hatchery and Genetic Management Plans and joint addendum for the Nez Perce Tribal Hatchery Fall Chinook Salmon Program and the Washington Department of Fish and Wildlife Lyons Ferry Complex Fall Chinook Salmon Program under section 10(a)(1)(A) of the Endangered Species Act. National Marine Fisheries Service, Portland, OR

NMFS. 2011b. Effects of Hatchery Programs on Salmon and Steelhead Populations: Reference Document for NMFS ESA Hatchery Consultations. March 7, 2011. NMFS Northwest Regional Office, Salmon Management Division. Portland, Oregon. 50p.

NMFS 2011c. Anadromous Salmonid Passage Facility Design. National Marine Fisheries Service - Northwest Region. July 2011. http://www.nwr.noaa.gov/Salmon-Hydropower/FERC/upload/Fish-Passage-Design.pdf

NRC (National Research Council) (1996). Upstream: Salmon and Society in the Pacific Northwest. National Academy Press: Washington, D.C.

NPT 2002 – Lower Snake River Compensation Plan. Fall Chinook Acclimation Project Summary. – available at http://www.fws.gov/lsnakecomplan/Reports/HGMPs/NPT%20HGMP.pdf (accessed July 3, 2012)

NPT 2009 - Nez Perce Tribe Water Quality Assessment Clean Water Act Section 305(b) Report. Prepared by: Jenifer Harris, Nez Perce Tribe Water Resources Division. December 31, 2009

NPT 2011 – Snake River Stock Fall Chinook Nez Perce Tribal Hatchery Hatchery and Genetic Management Plan. Submitted Under ESA Section 10(a)(1)(A). May 11, 2011.

NPT and WDFW 2011. Addendum to Snake River Fall Chinook HGMPs for Lyons Ferry Hatchery Fall Chinook Acclimation Project Idaho Power Company, and Nez Perce Tribal Hatchery. Submitted Under ESA Section 10(a)(1)(A). May 11, 2011.

NPT 2012. Hesse, Jay and Becky Johnson. Nez Perce Tribe. May 21, 2012. Personal communication, letter to Craig Busack (NMFS) regarding South Fork Clearwater River Fall Chinook Salmon Broodstock Collection Facilities and Methods Clarification.

ODEQ (Oregon Department of Water Quality) 2012- Water Quality Assessment - Oregon's 2010 Integrated Report Assessment Database and 303(d) List. Available at http://www.deq.state.or.us/wq/assessment/rpt2010/search.asp (accessed July 3, 2012)

ODFW (Oregon Department of Fish and Wildlife) 2011. Irrigon Hatchery Operation Plan 2011. Available at http://www.dfw.state.or.us/fish/HOP/Irrigon%20HOP.pdf (accessed July 2, 2012)

OWR (Oregon Department of Water Resources) 2003. Ground Water Supplies in the Umatilla Basin. Oregon Water Resources Department Ground Water Section. April 3, 2003 Pendleton, Oregon. Available online at http://www.wrd.state.or.us/OWRD/GW/docs/UmatillaGWWkshpRptApril2003.pdf (accessed May 11, 2012)

OWR 2012. Online Water & Monitoring Well Standard Query page - http://apps.wrd.state.or.us/apps/gw/owmwds_well_query/ (accessed May 4, 2012)

Paquet, P. J., T. Flagg, et al. (2011). "Hatcheries, conservation, and sustainable fisheries - achieving multiple goals: results of the hatchery scientific review group's Columbia River Basin review." Fisheries 36(11): 547-561.

Pearcy, W.G. 1992. Ocean Ecology of North Pacific Salmonids. Washington Sea Grant Program. University of Washington Press. Seattle, Washington. 179 pages.

Pearsons, T. N. and A. L. Fritts (1999). "Maximum size of chinook salmon consumed by juvenile coho salmon." North American Journal of Fisheries Management 19: 165-170.

Polacek, M.C., C. M.Baldwin, and Knuttgen 2006. Status, Distribution, Diet, and Growth of Burbot in Lake Roosevelt, Washington. Northwest Science. Vol. 80. No. 3, 2006

Polis, G.A. and S.D. Hurd. 1996. Linking Marine and Terrestrial Food Webs: Allochthonous Input from the Ocean Supports High Productivity in Small Island and Coastal Land Communities. American Naturalist 173(3): pages 396 to 423.

Pouliquen H, Thorin C, Haury J, Larhantec-Verdier M, Morvan ML, Delépée R, Le Bris H. 2008. Comparison of water, sediment and plants for the monitoring of antibiotics: a case study on a river dedicated to fish farming. Environ Toxicol Chem. 2008 Nov 3:1.

Quinn, T. P. (2005). The behavior and ecology of Pacific salmon and trout. Seattle, WA, University of Washington Press.

Setter, A., B. Clemens, and R. Carmichael. 2004. Smolt monitoring activities at Little Goose Dam in 2003. Annual Technical Report to the Fish Passage Center.

SIWG (Species Interaction Work Group) (1984). Evaluation of potential interaction effects in the planning and selection of salmonid enhancement projects. J. Rensel, chairman and K. Fresh editor. Report prepared for the Enhancement Planning Team for implementation of the Salmon and Steelhead Conservation and Enhancement Act of 1980. Washington Dept. Fish and Wildlife. Olympia, Washington. 80p

Sparrow, R.A.H. 1981. Hatchery Effluent Water Quality in British Columbia. Bio-Engineering Symposium for Fish Culture (FCS Publ. 1): pages 162 to 166.

Steward, C. R. and T. C. Bjornn (1990). Supplementation of Salmon and Steelhead Stocks with Hatchery Fish: A Synthesis of Published Literature In Analysis of Salmon and Steelhead Supplementation, William H. Miller editor. Report to Bonneville Power Administration (BPA), Portland, Oregon. Project No. 88-100. 126p

Taylor, E. B. (1991). "A review of adaptation in Salmonidae, with particular reference to Pacific and Atlantic salmon." Aquaculture 98: 185-207.

Travel USA 2008. Longwoods International Who is the Idaho Traveler Visitor Report Idaho. April, 2008. Commissioned report available through Idaho Department of Commerce at http://commerce.idaho.gov/tourism-grants-and-resources/Research/ (accessed May 11, 2012)

Thorpe, J. E. (1994). "Significance of straying in salmonids and implications for ranching." Aquaculture and Fisheries Management 25, Supplement 2: 183-190.

USACE (US Army Corps of Engineers) 2012. Status Report – Pinniped Predation and Deterrent Activities at Bonneville Dam 2012. May 18, 2012. Robert Stansell, Bjorn van der Leeuw, and Karrie Gibbons - Fisheries Field Unit U.S. Army Corps of Engineers Bonneville Lock and Dam Cascade Locks, OR. Available at http://www.nwd-wc.usace.army.mil/tmt/documents/fish/2012/update20120518.pdf (accessed May 22, 2012)

USCB (United States Census Bureau). 2012. Online State and County QucikFacts. 2011 Census Data. Available at http://quickfacts.census.gov/qfd/index.html (accessed May 11, 2012)

USGCRP (U.S. Global Change Research Program). 2009. Global Climate Change Impacts in the United States. Cambridge University Press, New York. globalchange.gov/publications/reports/scientific-assessments/us-impacts

USFWS (U.S. Fish and Wildlife Service) 1994. Programmatic Biological Assessment of the Proposed 1995-99 LSRCP Program L. office. Boise, ID.

USFWS 1998. Determination of Threatened Status for the Klamath River and Columbia River Distinct Population Segments of Bull Trout. Final rule. Federal Register 63:111 (10 June 1998):31647-61674.

USFWS 2002. Bull Trout (*Salvelinus confluentus*) Draft Recovery Plan. Fish and Wildlife Service, Portland, Oregon Available at http://ecos.fws.gov/docs/recovery_plan/021129.pdf Accessed May 9, 2012.

USFWS 2005. Bull Trout Core Area Conservation Status Assesssment. U.S. Fish and Wildlife Service Portland, Oregon February - April, 2005

USFWS 2008. 5-Year Status Review: Summary and Assessment of Bull Trout (*Salvelinus confluentus*). Fish and Wildlife Service, Portland, Oregon Available at http://ecos.fws.gov/docs/five_year_review/doc1907.pdf Accessed May 9, 2012.

USFWS 2010. Flow-Habitat Relationships for Spring and Fall-Run Chinook salmon and Steelhead/Rainbow Trout Spawning in the Yuba River. U. S. Fish and Wildlife Service Energy Planning and Instream Flow Branch. Sacramento Fish and Wildlife Office. Available at http://www.fws.gov/stockton/afrp/documents/yubaspawn.pdf (Accessed May 18, 2012).

USGS 2012a. Current Water Data for the Nation online search page. http://waterdata.usgs.gov/nwis/rt (accessed May 4, 2012)

USGS 2012b. USGS Annual Water Data Report Mapper—Water Years 2006 to 2011. Online interactive map available at http://wdr.water.usgs.gov/adrgmap/index.html (accessed May 11, 2012)

USGS 2012c. USGS Groundwater Data for the Nation online search page. http://waterdata.usgs.gov/nwis/gw (accessed May 11, 2012)

US Travel Association 2009. The Impact of Travel on State Economies, 2009 Edition. Commissioned report available through Idaho Department of Commerce at http://commerce.idaho.gov/tourism-grants-and-resources/Research/ (accessed May 11, 2012)

Ward, D. L., J. H. Petersen, and J. J. Loch. 1995. Index of predation on juvenile salmonids by northern squawfish in the lower and middle Columbia River and in the lower Snake River. Transactions of the American Fisheries Society 124:321-334.

WDFW (Washington Department of Fish and Wildlife) 2009. Annual Report for the operation of Lower Granite Dam Trap under permit #1530.

WDFW 2011. Snake River Stock Fall Chinook Lyons Ferry Hatchery, Fall Chinook Acclimation Program, and Idaho Power Company Hatchery and Genetic Management Plan. Submitted Under ESA Section 10(a)(1)(A). May 11, 2011.

WDFW (Washington Department of Fish and Wildlife) 2012. List of Species of Concern in Washington State. Available at http://wdfw.wa.gov/conservation/endangered/All/ (accessed May 11, 2012)

WDOE (Washington Department of Ecology). 1989. Quality and Fate of Fish Hatchery Effluents during the Summer Low Flow Season. Publication No. 89-17. Prepared by Will Kendra, Washington Department of Ecology, Environmental Investigations and Laboratory

Services Program, Surface Water Investigations Section, Mail Stop PV-11, Olympia, Washington 98504. May 1989.

WDOE 2012. Online well log viewer. Available at http://apps.ecy.wa.gov/welllog/ (accessed May 4, 2012).

Williams, I.V. and D.F. Amend. 1976. A natural epizootic of Infectious Hematopoietic Necrosis in fry of sockeye salmon (Oncorhynchus nerka) at Chilko Lake, British Columbia. J. Fish. Res. Board Can. 33: pages 1564 to 1567.