Draft Environmental Assessment for the Sockeye Salmon Hatchery Program in the Salmon River Basin

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Lead Agency: National Marine Fisheries Service, West Coast Region
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1 INTRODUCTION

National Marine Fisheries Service (NMFS) is considering issuance of Section 10(a)(1)(A) permits to Idaho Fish and Game (IDFG) and NMFS's Northwest Fisheries Science Center (NWFSC) for the continued operation and maintenance (O&M) of the Snake River sockeye salmon (*Oncorhynchus nerka*) hatchery program as described in the Hatchery and Genetic Management Plans (HGMPs) (IDFG 2022). This program includes the collection, holding, and spawning of adult salmon, incubation of eggs, and rearing and release of juveniles as described in the HGMP (IDFG 2022) that has been submitted to NMFS as part of the application for ESA consultation to obtain permits for the hatchery.

The ESA Section 10(a)(1)(A) applications submitted to NMFS by IDFG, and NMFS's NWFSC include an HGMP that outlines the rearing and release of sockeye salmon using existing facilities. NMFS' issuance of a Section 10(a)(1)(A) constitutes a Federal action that is subject to analysis as required by the National Environmental Policy Act (NEPA) and is the topic of this environmental assessment (EA).

The following activities are included in the permit application and HGMPs and will be described in more detail in Subsection (2.2.1).

- Broodstock collection, including methods and facility operations
- Identification, holding, and spawning of adult fish
- Egg incubation and rearing
- Marking of hatchery-origin juveniles
- Juvenile releases
- Adult releases
- Raising fish to adulthood
- Adult management of returning hatchery-origin fish
- Research, monitoring, and evaluation (RM&E) to assess program performance

This EA is being prepared using the 2020 CEQ NEPA Regulations as modified by the Phase I 2022 revisions. The effective date of the 2022 revisions was May 20, 2022 and reviews begun after this date are required to apply the 2020 regulations as modified by the Phase I revisions unless there is a clear and fundamental conflict with an applicable statute. This EA began May 2023 and accordingly proceeds under the 2020 regulations as modified by the Phase I.

1.1 Purpose and Need

NMFS proposes to issue the Endangered Species Act (ESA) Section 10(a)(1)(A) enhancement permits to the IDFG and NMFS NWFSC. As provided in ESA Section 10(a)(1)(A), the purpose for such a permit is for scientific purposes or to enhance the propagation or survival of the affected species, which is the Snake River sockeye salmon for this permit application.

NMFS' need for the Proposed Action is to respond to the co-managers' permit applicants under Section 10(a)(1)(A); to ensure the recovery of ESA-listed Snake River sockeye salmon by conserving their productivity, abundance, diversity and distribution; and to ensure NMFS meets its tribal trust responsibilities. The proposed hatchery program within this EA releases fish listed as endangered. Under the ESA, NMFS will ensure it (1) is consistent with tribal treaty rights and the Federal government's trust and fiduciary responsibilities and (2) works collaboratively with co-managers (IDFG, SBT, and ODFW) to protect and conserve ESA-listed species.

The co-managers' objectives in developing and submitting the HGMPs for the salmon and steelhead hatchery programs in the Snake River Basin under Section 10(a)(1)(A) include operation of their hatchery

facilities to meet resource management and protection goals with the assurance that any harm, death, or injury to fish within a listed evolutionarily significant unit (ESU) or distinct population segment (DPS) does not appreciably reduce the likelihood of a species' survival and recovery and is not in the category of prohibited take under Section 10(a)(1)(A). Further, IDFG, NWFSC, SBT, and ODFW strive to protect, restore, and enhance the productivity, abundance, and diversity of Snake River sockeye salmon and their ecosystems to sustain treaty ceremonial and subsistence fisheries and non-treaty recreational fisheries, non-consumptive fish benefits, and other cultural and ecological values.

1.2 Project Area and Analysis Area

The "action area" means all areas to be affected directly or indirectly by the Proposed Action, in which the effects of the action can be meaningfully detected measured, and evaluated (50 CFR 402.02). The action area for analysis of effects will focus primarily on the Sawtooth Valley area of the upper Salmon River Basin, which is where the proposed hatchery program would release sockeye salmon. The action area includes (1) Redfish Lake, Pettit Lake, and Alturas Lake; (2) the migration corridor between the lakes and the mainstem Salmon River; and (3) the mainstem Salmon River down to its confluence with the Valley Creek near the town of Stanley, Idaho (Figure 1). ESA-listed species in the Sawtooth Valley include Snake River sockeye salmon, Snake River steelhead, and Snake River spring/summer Chinook salmon.

NMFS considered whether the mainstem Snake River, mainstem Columbia River, the estuary, and the ocean should be included in the action area. The potential concern is a relationship between hatchery production and density dependent interactions affecting salmon growth and survival. However, NMFS has determined that, based on best available science, it is not possible to establish any meaningful causal connection between hatchery production on the scale anticipated in the Proposed Action and any such effects.

The operation of hatchery facilities has the potential to affect ESA-listed salmon and steelhead in streams adjacent to hatchery facilities through the diversion of surface water or the maintenance of instream structures (e.g., the water intake and discharge structures). The proposed hatchery program would use seven hatchery facilities to spawn, incubate, rear, and release sockeye salmon.

- Sawtooth Hatchery, on the Salmon River near Stanley, Idaho
- Burley Creek Hatchery, in Kitsap County near Port Orchard, Washington
- Manchester Research Station, on the Puget Sound near Port Orchard, Washington
- Eagle Fish Hatchery, in Ada County near the town of Eagle, Idaho
- Springfield Hatchery, in Bingham County near the town of Springfield, Idaho
- Oxbow Hatchery, in Hood River County near the town of Cascade Locks, Oregon
- Bonneville Hatchery, on the Columbia River in Bonneville, Oregon

Adult sockeye salmon may be removed at Lower Granite Dam, when conditions warrant (temperature is a major concern), and transported to the Stanley Basin to avoid mortality during their upstream migration through the Snake and Salmon rivers. Conditions that would warrant the transport of sockeye salmon from the trap at Lower Granite Dam to the Stanley Basin include adverse migration conditions in the Snake and Salmon Rivers, for example high temperature conditions, and recruitment failures resulting in low adult returns. Operation of the Lower Granite Dam trap during the time that sockeye are present is permitted under the FCRPS Biological Opinion (NMFS 2008c), (NMFS 2020), and it is, therefore, not included in this EA.

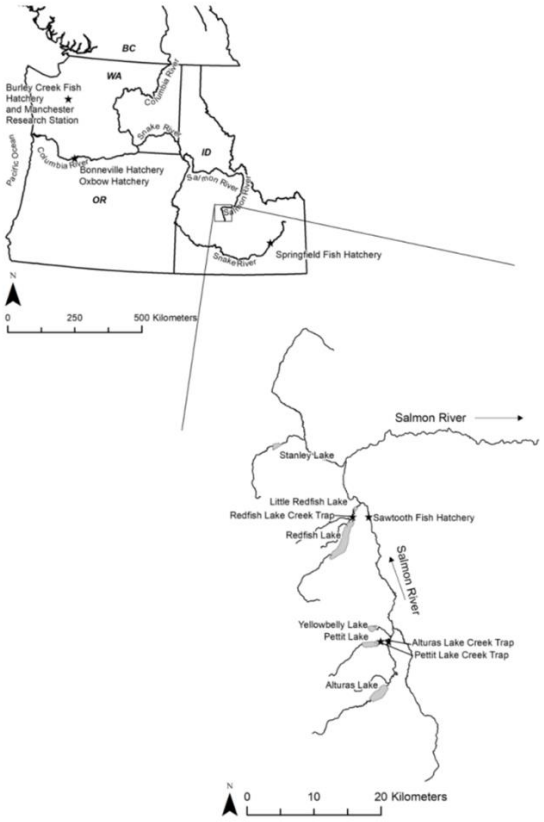

Figure 1. Location of Snake River Sockeye Salmon Hatchery Program in the Upper Salmon River Basin. The icon representing Oxbow Fish Hatchery also identifies the location of the Bonneville Fish Hatchery (9 km distance between hatcheries).

2 ALTERNATIVES

There are two alternatives being considered in this EA (Table 1):

- Alternative 1 (No Action/Current Program): NMFS would not issue the ESA section 10(a)(1)(A) for the Snake River sockeye salmon. The hatchery program would continue to operate as they are currently.
- Alternative 2 (Proposed Action): Under the Proposed Action, NMFS would issue the ESA section 10(a)(1)(A) permit for the Snake River sockeye salmon hatchery program submitted by the co-managers.

Table 1. Comparison of the two Alternatives.

Activity	Alternative 1 – Current Condition	Alternative 2 - Proposed Action
Broodstock collection	Broodstock would be collected in the basin and reared at Eagle Fish Hatchery, Burley Creek Hatchery and Manchester Research Station. For Eagle Fish Hatchery, Sockeye will be collected at Redfish Lake Creek trap and Sawtooth Fish Hatchery trap. At Sawtooth Hatchery, anadromous Sockeye adults are collected at a permanent weir that spans the Salmon River. When adult Sockeye salmon are reluctant to enter the Sawtooth Fish Hatchery ladder and trap, adults are collected using a large seine in shallow water along the shoreline. Springfield Fish Hatchery, Manchester Research Station, Burley Creek Fish Hatchery, and Oxbow Fish Hatchery do not collect Broodstock.	Same as Alternative 1.
Incubation	Eggs for Broodstock will be incubated at Eagle Fish Hatchery and Burley Creek Hatchery. Eggs for Smolt releases will be incubated at Springfield Hatchery.	Eggs for Broodstock will be incubated at Eagle Fish Hatchery and Burley Creek Hatchery. Eggs for Smolt releases will be incubated at Springfield Hatchery and Oxbow Fish Hatchery.
Rearing	Fish will be reared at Eagle Fish Hatchery, Springfield Hatchery, Burley Creek Hatchery, and Manchester Research Station.	Fish will be reared at Eagle Fish Hatchery, Springfield Hatchery, Burley Creek Hatchery, Manchester Research Station and Oxbow Fish Hatchery.
Release (acclimation)	Mature adults are transferred from Burley Creek Hatchery and Manchester Research Station to be released into Redfish or Pettit lakes (no additional acclimation period). Sawtooth Fish Hatchery no longer rears Sockeye juvenile for release to Sawtooth Valley waters. Sawtooth Fish Hatchery does currently acclimate Sockeye yearlings for one to two weeks before release into Redfish Lake Creek. Springfield hatchery smolts are acclimated at Sawtooth Fish Hatchery for one to two weeks prior to release into Redfish Lake Creek. No releases occur at Eagle Fish Hatchery.	Mature adults are transferred from Burley Creek Hatchery and Manchester Research Station to be released into Redfish or Pettit lakes (no additional acclimation period). Sawtooth Fish Hatchery does currently acclimate Sockeye yearlings for one to two weeks before release into Redfish Lake Creek. Springfield hatchery smolts are acclimated at Sawtooth Fish Hatchery for one to two weeks prior to release into Redfish Lake Creek. Oxbow reared smolts will be transferred to Bonneville Hatchery for final rearing and at least two weeks of acclimation before release into Tanner Creek.
Transplant hatchery-origin adults	N/A	Adult fish that return to Tanner Creek, are transported to Eagle Fish Hatchery for processing, and released to spawn upstream.

Table 2 lists the number of juvenile salmon and steelhead and the type of juveniles to be released under the two alternatives analyzed in this EA.

Table 2. Number and life stage of sockeye salmon that would be released for each of the alternatives analyzed in this EA.

Species	Alternative 1	Alternative 2
Sockeye salmon	Release 1,000,000 yearlings into Redfish Lake Creek	Release 1,000,000 yearlings into Redfish Lake Creek. Bonneville Hatchery will release ~40,000 Snake River sockeye salmon yearlings into Tanner Creek.

2.1 Alternative 1 (No Action/Current Program): NMFS would not issue the ESA Section 10(a)(1)(A) for the Snake River sockeye salmon hatchery program.

Under this alternative, NMFS would not issue the ESA Section 10(a)(1)(A). For analysis purposes, NMFS has defined the No Action/Current Program Alternative as the future conditions if the Proposed Action is not implemented. For the most part, this would result in the applicants continuing to operate those portions of the programs that are currently operating (Table 2), including RM&E (Research Monitoring, and Evaluation) and O&M (Operation, Maintenance, and Construction of hatchery facilities).

2.2 Alternative 2 (Proposed Action): Under the Proposed Action, NMFS would issue the ESA section 10(a)(1)(A) for the Snake River Sockeye Salmon Hatchery Program submitted by the co-managers.

Under the Proposed Action, NMFS would issue the ESA section 10(a)(1)(A) for the sockeye salmon hatchery program submitted by the co-managers. The sockeye salmon hatchery program in the Snake River Basin would be implemented as described in the submitted HGMP. The release goals, life stage, marking and release location of the proposed hatchery program can be found in Table 3.

Table 3. Snake River sockeye salmon hatchery program release information.

Program	Release			Marking and Tagging	Rearing, Acclimation Site?	Release Location	Volitional Release?	Release time
	Goal (#)	Life Stage	Size (fpp)					
Snake River Sockeye Salmon Captive Broodstock	1,000,000	Yearlings	8-20	AD (1 rep. is PIT tagged)	Springfield Fish Hatchery	Redfish Lake Subbasin	No	Spring
	250	Adults	.35	AD + PIT	Eagle Fish Hatchery/NOAA	Redfish Lake	No	Fall
	100	Adults	.35	AD + PIT	Eagle Fish Hatchery /NOAA	Pettit Lake	N/A	Fall
	TBD	Adults	.35	AD + PIT	Alturas Naturals	Alturas Lake	N/A	Fall
	40,000	Yearlings	8-20	AD + CWT	Oxbow Hatchery Bonneville Hatchery	Tanner Creek	N/A	Spring

Following is a description of the proposed salmon and steelhead hatchery programs (including a description of the facilities used, broodstock collection, juvenile release sites, adult management, facility operation, and research, monitoring and evaluation activities).

2.2.1 Proposed Hatchery Program

"Action" means all activities, of any kind, authorized, funded, or carried out, in whole or in part, by Federal agencies. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

NMFS describes a hatchery program as a group of fish that have a separate purpose and that may have independent spawning, rearing, marking and release strategies (NMFS 2008b). The operation and management of every hatchery program is unique in time, and specific to an identifiable stock and its native habitat (Flagg et al. 2004). In this specific case, the Proposed Action is NMFS's issuance of section 10(a)(1)(A) permits to IDFG and NMFS's NWFSC for the Snake River Sockeye Salmon Hatchery Program as described in the November 29, 2022, HGMP (IDFG 2022).

The captive broodstock portion of the program was founded in 1991 by the IDFG and NMFS to prevent the extinction of the Snake River Sockeye Salmon ESU. The ESU was listed as an endangered on November 20, 1991 (56 FR 58619). Since then, the program has used captive broodstock to produce eggs, juveniles, and adults for reintroduction into the Sawtooth Valley lakes. To guard against catastrophic loss at any one brood facility, the captive broodstock components of the program are duplicated at facilities in Idaho (Eagle Fish Hatchery) and Washington (Manchester Research Station and Burley Creek Fish Hatchery). Eggs produced from annual spawning events at Eagle Fish Hatchery and at the Burley Creek Fish Hatchery are transferred to Springfield Hatchery in Idaho for continued culture.

A small number of eggs (50k) are sent to Oxbow Hatchery in Oregon for continued culture. After further rearing, the fish are transferred to Bonneville Fish Hatchery (Oregon) for final rearing, acclimation and release into Tanner Creek.

NMFS has developed draft viability criteria for the Snake River Sockeye Salmon ESU (Table 4). To help meet these criteria, the proposed hatchery program is using a three-phase approach with the following objectives – Only the current status (Phase 2) is fully addressed in the HGMP, and so Phase 3 is not addressed in the proposed permits:

- Phase 1: increase genetic resources and the number of adult sockeye salmon returns (captive brood phase)
- Phase 2: incorporate more natural-origin returns into hatchery spawning designs and increase natural spawning escapement (population re-colonization phase)
- Phase 3: move towards the development of an integrated program that meets proportionate natural influence (PNI) goals established by the Columbia River Hatchery Scientific Review Group (HSRG) (local adaptation phase). During Phase 3, captive broodstock will be phased out, and only anadromous-origin fish returning to Sawtooth valley Lakes will be used.

Table 4. Viable Salmonid Population (VSP) parameters and proposed biological viability criteria for Snake River sockeye salmon (NMFS 2015).

Viable Salmonid Population Parameter	Proposed Criteria
Abundance	Minimum spawning abundance threshold: 1,000 natural-origin fish each for Redfish Lake and Alturas Lake populations (intermediate size category)

	Minimum spawning abundance threshold: 500 natural-origin fish for populations in the smaller historical size category (Pettit, Stanley, or Yellowbelly Lakes)
Productivity	Population growth rate is stable or increasing
Spatial structure and diversity	Very low to low-risk rating for a highly viable Population Moderate risk rating for a viable population

In the 2008 FCRPS opinion, NMFS established a juvenile sockeye salmon production target for this hatchery program of 1,000,000 smolts (NMFS 2008c). These smolts would be released into Redfish Lake Creek with the option of emergency release directly into the Salmon River. Additionally, adults would be released into both Redfish and/or Pettit Lake consistent with the Snake River sockeye salmon recovery plan (NMFS 2015) recommendations. Eyed-eggs and pre-smolt releases into Pettit and Redfish Lakes were phased out, but some eyed-egg and pre-smolt releases into Pettit and Redfish Lake may occur to reduce inventory at Springfield Fish Hatchery

In 2013, IDFG purchased an abandoned trout hatchery, the Springfield Hatchery, and renovated it to make it suitable to accommodate increased production targets. With the creation of Springfield Hatchery, smolt production at Oxbow Hatchery and Sawtooth Hatchery was phased out. However, in 2022, 50,000 eyed-eggs were sent to Oxbow Hatchery for rearing. Springfield Hatchery is used to incubate and rear most eggs from spawning events at the IDFG Eagle Fish Hatchery and NMFS Burley Creek Hatchery. Springfield Hatchery is able to accommodate up to 1,000,000 smolts to meet the program targets. Captive brood operations at the Manchester Research Station and Burley Creek Hatchery may be terminated when the 5-year geometric mean of the total anadromous sockeye salmon run exceeds 1,000 (natural-origin and hatchery-origin combined). The Eagle Hatchery's captive brood operation may be terminated when the 5-year geometric mean of the total anadromous sockeye salmon run exceeds 2,150 (natural-origin and hatchery-origin combined). However, captive brood efforts may continue beyond trigger dates if captive broods are needed as a genetic safety net or to culture fish from Alturas or other lakes.

The proposed permits would only cover activities in Phase 2 of the hatchery program. Phase 1 has been completed and Phase 3 triggers are not expected to be met during the 3-year permit period. The submitted HGMP does not include enough details on Phase 3 activities for them to be evaluated in this opinion (i.e., NMFS would need an adult management plan to fully evaluate the effects of Phase 3 activities). Therefore, Phase 3 activities are not covered under the proposed permits. Activities that would be permitted by the proposed permits include:

- Annual operation of a permanent weir and fish trap on Redfish Lake Creek for broodstock collection
- Annual operation of the Sawtooth Hatchery's permanent weir and fish trap
- Annual operation of permanent weir and fish trap on Pettit Lake Creek for tagging anadromous adults migrating to Pettit Lake.
- Collection of anadromous-origin adults returning to the Bonneville Hatchery. These fish are transported to Eagle Fish hatchery for processing and released into Sawtooth valley Lakes. These fish are not incorporated into the captive broodstock.
- Removal of sockeye salmon from the Lower Granite Dam trap when low-flow or temperature conditions are expected to limit adult survival to spawning grounds
- Biological sampling of sockeye salmon at the Lower Granite Dam trap
- Transfer of fish between fish traps, hatchery facilities, and release locations
- Holding, spawning, and incubating fish at Eagle Fish Hatchery, Burley Creek Hatchery, Bonneville Hatchery, and Manchester Research Station.
- Rearing fish at Eagle Hatchery, Springfield Hatchery, Oxbow Hatchery, Burley Creek Hatchery, and Manchester Research Station

- Internal and external marking of hatchery-origin fish (e.g., adipose clips and tags)
- Tagging of natural-origin sockeye for monitoring purposes.
- Observing, handling, anesthetizing, weighing, measuring, examining, medicating, autopsying, tagging, and genetic sampling of sockeye salmon while in the hatchery facilities
- Culling of diseased sockeye salmon eggs
- Release of hatchery-origin juvenile sockeye salmon into Redfish Lake, Redfish Lake Creek, Pettit Lake, the Salmon River, and Tanner Creek.
- Release of Alturas-origin sockeye salmon adults into Alturas Lake
- Maintenance of the following facilities as needed to support the proposed hatchery program: Springfield Hatchery (IDFG), Eagle Hatchery (IDFG), Oxbow Hatchery (ODFW), Sawtooth Hatchery (IDFG), Burley Creek Hatchery (NMFS), Manchester Research Station (NMFS) and Bonneville Fish hatchery (ODFW).
- Operation of juvenile traps on Redfish, Pettit and Alturas Lake to monitor juvenile sockeye salmon
- Genetic sampling of juvenile sockeye salmon encountered in juvenile traps

Additional RM&E is permitted through permits 1124-7R to IDFG and 1341-6R to the Shoshone Bannock Tribes. These activities include use of mid-water trawls and screw traps to monitor the status of the sockeye salmon ESU.

Fisheries would not be permitted as part of the Proposed Action, and there are no fisheries that exist because of the proposed hatchery program, i.e., the "but for" test does not apply, and, therefore, there are no interrelated and interdependent fishery actions. Although one of the long-term goals of this hatchery program is to provide tribal and non-tribal harvest opportunity, these fisheries are not currently being proposed. There are existing fisheries that incidentally catch Snake River sockeye salmon, but these fisheries would exist with or without the proposed hatchery program (and have previously been evaluated in a separate biological opinion (NMFS 2008d).

Broodstock collection

Broodstock origin and number: Captive brood exist at the IDFG Eagle Fish Hatchery and at NMFS NWFSC facilities in Washington State. In the near-term, broodstock from both the IDFG and NMFS's NWFSC facilities would be used to produce eggs for annual release. Currently (Phase 2), 1,640 captive broodstock spawners are required to meet the production goal of one million smolts (approx. 1,115,000 eyed eggs). As hatchery production levels increase, the broodstock would eventually come from sockeye salmon returns collected at weirs in the Sawtooth Valley, and IDFG expects to phase out the use of captive broodstock in annual spawning events. With the change towards more anadromous broodstock, the total number needed to achieve release targets is estimated to be 1,150 adults Table 5.

Table 5. Broodstock collection information for the Snake River sockeye salmon hatchery program.

Program	Local source	Collection Location(s)	Collection Method	Collection/ Holding Target (adults)	Egg Take goal	Collection Duration
Snake River Sockeye Salmon	Redfish Lake Creek and Salmon River	Redfish Lake Creek, Sawtooth Fish Hatchery	Weir	1,150	1,115,000	July - October

Proportion of natural-origin fish in the broodstock (pNOB): The broodstock would be a minimum of 10 percent natural-origin adults in Phase 2 (population re-colonization phase). Until NORs reach numbers sufficient to meet this criterion, returning anadromous hatchery adults will be used along with naturally produced adults to achieve the 10% threshold. As the hatchery program transitions into Phase 3 (local

adaptation phase), an increasing number of natural-origin adults would be incorporated into the broodstock (35 percent minimum). Concurrently during Phase 3, the proportion of hatchery-origin anadromous adults released to spawn naturally will be limited (<16% of total adults released to Redfish Lake). However, Phase 3 activities are not covered under the proposed permits because Phase 3 triggers are not expected to be reached within the proposed 3-year permit period.

Broodstock selection: Sockeye salmon returning to RFLC/SAW that may be incorporated into the broodstock would be collected daily and transferred to Eagle Fish Hatchery for sorting. Sockeye salmon that are not incorporated into the broodstock program are held until early September before being released to spawn naturally. Adults collected in excess of projected brood need may be directly released into Sawtooth Valley waters. All sockeye salmon captured at Pettit Lake Creek Weir are sampled and released directly upstream to continue migration into Pettit Lake. Additional sockeye salmon may be collected from the Lower Granite trap or through seines or dip nets in some years. Returning adults captured at Bonneville Hatchery will be transported to Eagle Fish Hatchery for PBT evaluation before being released into Sawtooth Valley lakes. These fish would not be incorporated into the captive broodstock program. Genetic samples would be taken from all fish and, based on the results, a spawning design would be developed that represents the genetic diversity of the entire run, and that equalizes sex ratios and family contribution. The SBSTOC would review and approve the plan annually, and determine when random broodstock selection and random mating would be implemented.

Method and location for collecting broodstock: Broodstock would typically be collected at the Redfish Lake Creek trap (approximately 1 mile below the mouth of Redfish Lake), and Sawtooth Hatchery trap (Figure 1). If fish do not enter traps voluntarily, seines and dip nets may be used. In years where instream conditions of the mainstem Snake River are a concern for fish survival (e.g., high temperatures and low flow), fish may be collected at the Lower Granite Dam trap and transported to the Stanley Basin.

Duration of collection: Adults would be collected at the Redfish Lake trap and Sawtooth Hatchery trap from the start of June through the end of October.[1]

Encounters, sorting and handling, with ESA listed adults: Sockeye salmon encountered at the Redfish Lake Creek (RFLC) trap or Sawtooth Fish Hatchery (SAW) trap that may be incorporated into the broodstock and all Snake River sockeye collected at the Bonneville Hatchery ladder will be transported and temporarily held at Eagle Fish Hatchery. Sockeye salmon collected at RFLC, SAW, and the Pettit Lake weir in excess of brood need may be directly released into Sawtooth Basin waters. Additionally, sockeye salmon that are not incorporated into the broodstock would be held until early September before being released to spawn naturally.

There would be no steelhead intercepted at any trap during operations for adult sockeye collection, because steelhead do not migrate past the Sawtooth Hatchery or into Redfish Lake Creek after April, and broodstock collection for the sockeye hatchery program usually does not start until mid-July. The Redfish Lake Creek trap may incidentally intercept some adult spring/summer Chinook salmon. Spring/summer Chinook salmon intercepted at the Redfish Lake Creek trap would be passed upstream to spawn naturally

[1] As discussed above, in some years, fish would be collected at the Lower Granite trap between late June and late August and transported to the Sawtooth Basin. However, operation of the Lower Granite trap would not be covered by the proposed permits. In most years, sockeye salmon would be collected from the Redfish Lake Creek and Sawtooth Hatchery traps between mid-July and mid-October. However, in some years, collection at the Redfish Lake Creek trap and Sawtooth Hatchery traps may occur early if sockeye begin returning to the traps earlier.

or transported to Sawtooth Hatchery to be used as broodstock for the Sawtooth spring Chinook salmon hatchery program. The Sawtooth Hatchery trap is operated primarily for the purpose of collecting spring Chinook salmon broodstock for the Sawtooth spring Chinook salmon hatchery program, and most, if not all, sockeye salmon collection occurs during that operation. Spring Chinook salmon intercepted at Sawtooth Fish Hatchery would be incorporated into the broodstock or passed upstream to spawn naturally. All Snake River sockeye returning to Bonneville are transported to Eagle Fish Hatchery. These fish are not incorporated into the broodstock program and are released to spawn naturally.

Proposed mating protocols

Genetic samples would be taken from all returning anadromous sockeye salmon. A spawning design would then be developed that incorporates a portion of the returning anadromous sockeye. No back-up males or pooled samples would be used in spawning. A spawning matrix would be used with eggs from a single female split into two equal subfamilies. Each subfamily would be spawned with a randomly selected unique male. Full and half-sibling are identified and crosses between these individuals are not made. The SBSTOC would review and approve the plan annually and determine when one-to-one crosses should occur.

Proposed protocols for each release group (annually)

- Life stage: eyed-eggs; pre-smolts at 60-80 fish per pound; smolts at 8-20 fish per pound; and adults at 0.35 fish per pound.
- Acclimation (Y/N) and duration of acclimation: Eggs: No; Pre-smolts: Yes. Approximately 7 days when possible, but depends on raceway availability at Sawtooth Hatchery; Smolts: Yes, 7-14 days. All stages of acclimation occur at Sawtooth hatchery immediately prior to release into Redfish Lake Creek.
- Volitional release (Y/N): No. Fish will be forced out of transport vehicles.
- External mark(s): All pre-smolts, smolts, and adults would have clipped adipose fins. Adipose clipping will be the preferred alternative. However, RM&E actions (e.g., growth trials) may prevent fish from attaining sufficient size prior to the marking window. Additionally, marking trailer availability may be limited. In those instances, Chinook salmon and steelhead trout marking would be prioritized, due to mark-selective fisheries on those stocks. The SBTOC would review and approve the plan annually and determine how adipose intact sockeye salmon returning to the Sawtooth Fish Hatchery weir would be handled (e.g., returned to Eagle Fish Hatchery for genetic analyses or passed for continued migration to Pettit or Alturas lakes).
- Internal marks/tags: Currently, all captive adults from Eagle and Manchester have passive integrated transponder (PIT) tags and a representative sample of smolts from Springfield Hatchery have PIT tags. Smolts released from Oxbow Hatchery receive coded-wire tags in place of PIT tags. All hatchery reared sockeye salmon are genetically tagged through parental-based tagging (PBT).

Maximum number released/release locations

- Target program: 1,000,000 smolts would be planted at the outlet of Redfish Lake, and A minimum of 250 full-term hatchery adults would be released into Redfish Lake, and 100 full-term hatchery adults would be released in Pettit Lake. In addition, approximately 40,000 smolts will be released into Tanner Creek. The number of fish released into Alturas Lake each year will be determined based on the Snake River Sockeye Recovery Plan (NMFS 2015).
- Time of release: November/December (eggs); October (pre-smolts); April/May (smolts); August/September/October (adults).

- Fish health certification: Certification of fish health would be conducted prior to release (major bacterial, viral, and parasitic pathogens). IDFG and NMFS fish health professionals' sample and certify all release and/or transfer groups.

Proposed adult management

- Anticipated number or range in hatchery fish returns originating from this program: An average of 389 hatchery-origin sockeye have returned annually to Redfish Lake over the last eleven years (2010-2021). It was expected that these numbers would increase in Phase 2 of the Snake River Sockeye Salmon Hatchery Program, however due to various external factors the number of returns decreased.
- Removal of hatchery-origin fish and the anticipated number of natural-origin fish encountered: An average of 94 natural-origin sockeye have returned annually to Redfish Lake over the last eleven years (2010-2021). Hatchery-origin fish are not removed during Phase 2 of the hatchery program. Although hatchery-origin sockeye salmon would be removed under Phase 3 to meet PNI goals, Phase 3 activities are not covered under the proposed permits because Phase 3 triggers are not expected to be reached within the proposed 3-year permit period. Additionally, the submitted HGMP does not include enough details on Phase 3 activities for them to be evaluated in this opinion (i.e., NMFS would need an adult management plan to fully evaluate the effects of Phase 3 activities).
- Appropriate uses for hatchery fish that are removed: Not applicable.
- Are hatchery fish intended to spawn naturally (Y/N): Yes.
- Performance standard for pHOS (proportion of naturally spawning fish that are of hatchery-origin): There is not a pHOS standard during Phase 2 (population re-colonization phase). The pHOS would likely be limited to less than 16 percent in Redfish Lake during Phase 3 (local adaptation phase). However, Phase 3 activities are not covered under the proposed permits.
- Performance standard for stray rates into natural spawning areas: The straying rate of hatchery-origin Snake River sockeye salmon straying into the natural-spawning areas of other sockeye salmon (listed or un-listed) is expected to be less than 1%. In 2022, 300 sockeye of Springfield origin, were detected straying into the Columbia River, but were not seen in the Okanagan or Wenatchee River basins.

Proposed research, monitoring, and evaluation

- Adult sampling, purpose, methodology, location, and the number of ESA-listed fish handled: The proposed permits would authorize annual genetic monitoring of all adult Sockeye salmon captured at adult weirs and traps in the Snake River basin as well as those collected at Bonneville Fish Hatchery at the Eagle Fish Genetics Laboratory. This biological sampling reduces the genetic risks associated with artificial propagation by enabling pedigree based broodstock management and evaluation of supplementation releases. The proposed permits would also authorize biological sampling of adult sockeye salmon at Lower Granite Dam. This biological sampling would enable managers to determine which sockeye were surviving the migration from Lower Granite Dam to the Stanley Basin.
- Juvenile sampling, purpose, methodology, location, and the number of ESA-listed fish handled: Monitoring of the status of juvenile sockeye salmon populations in Alturas, Pettit and Redfish lakes would continue to be authorized under Research Permits 1124-7R and 1341-6R. Monitoring juvenile emigration from Alturas and Pettit lakes would continue to be authorized under Research Permit 1341-6R. These activities would not be included as part of the Proposed Action. However, information provided by research permitted under permits 1124-7R and 1341-

6R would be used to monitor the success of the Snake River sockeye salmon hatchery program. The Proposed Action would permit the capture, sampling, tagging, and release of juvenile sockeye salmon at juvenile traps in Redfish, Petit and Alturas lakes and Lower Granite Dam to determine sockeye abundance, productivity, and run timing.

Proposed operation, maintenance, and construction of hatchery facilities

- Water source(s) and quantity for hatchery facilities: The Proposed Action would not permit the construction of any hatchery facilities. The Proposed Action would permit the operation and maintenance of the Eagle Fish Hatchery, Springfield Hatchery, Oxbow Fish Hatchery, Sawtooth Fish Hatchery, Burley Creek Fish Hatchery, and Manchester Research Station as needed to implement the proposed Snake River sockeye salmon hatchery program. Table 6 summarizes the water source and use by hatchery facility.

Table 6. Fresh water source and use by hatchery facilities for the Snake River Sockeye Salmon Hatchery Program.

Hatchery Facility	Total Surface Water Use	Total Ground-water Use	Max use for Proposed Program (%)	Surface Water Source	Minimum Surface Water Flows	Max Surface Water Diverted for Proposed Program (%)	Discharge Location
Springfield Hatchery	0	50 cfs	100	N/A	N/A	N/A	Boom Cr., Snake River
Eagle Fish Hatchery	0	6.57 cfs	100	N/A	N/A	N/A	Boise River
Oxbow Fish Hatchery	8.5 cfs	0	10	Oxbow Springs	.66 cfs	10	Columbia River
Sawtooth Fish Hatchery	43 cfs	11.6 cfs	10	Salmon River	150 cfs	2	Salmon River
Burley Creek Fish Hatchery	0	2.14 cfs	100	N/A	N/A	N/A	Burley Cr.
Manchester Research Station[1]	NA	NA	NA	NA	N/A	N/A	Clam Bay, Puget Sound
Bonneville Hatchery	25.4 cfs	27.85 cfs	.02	Tanner Creek	11.14 cfs	.04	Tanner Creek, Columbia

[1] Manchester Research Station no longer uses surface water as a freshwater resource
N/A: not applicable; cfs: cubic feet per second;
Source: waterdata.usgs.gov, HGMPs, and hatchery managers.

- Water diversions meet NMFS screen criteria (Y/N): Yes. The water intakes at the Oxbow Fish Hatchery, the Sawtooth Fish Hatchery, Bonneville Fish Hatchery and the Manchester Research Station are screened in compliance with NMFS guidelines (NMFS 1994) to protect juvenile fishes.
- Permanent or temporary barriers to juvenile or adult fish passage (Y/N): Yes. Three permanent weirs in the Sawtooth Valley: a weir at the Sawtooth Fish Hatchery, a weir on Redfish Lake

Creek, and a weir on Pettit Lake and a rotary screw trap on Alturas Lake Creek. There are no other barriers to juvenile or adult passage.

- Instream structures (Y/N): Yes. There are water diversion structures at Oxbow Hatchery, and Sawtooth Hatchery. There is a fish ladder at Bonneville Hatchery to collect returning adults. There are water discharge structures at each hatchery facility used by the proposed hatchery program (Table 3).
- Streambank armoring or alterations (Y/N): Yes. Minor armoring would be maintained at diversion structures and at water discharge structures.
- Pollutant discharge and location(s) All hatchery facilities that support the Snake River sockeye salmon hatchery program operate consistent with their Idaho Pollutant Discharge Elimination System (IPDES) permits. Table 3 shows discharge locations for each hatchery facility.

2.3 Alternatives Considered but not Analyzed in Detail

The following alternatives were considered, but not analyzed in detail because they were described in the prior EA. For more detail on these alternatives, please see the Snake River sockeye salmon Hatchery Program EA completed by NMFS (2005b) and the recent amendment of the EA provided by BPA (BPA 2012).

2.3.1 Hatchery Programs with Increased Production Levels

Under this alternative, NMFS would issue an ESA section 10(a)(1)(A) permit for production levels associated with the hatchery program that are increased beyond the levels described in the HGMPs and in Section 2.2, Alternative 2, Proposed Action. This alternative is not analyzed in detail because broodstock and physical infrastructure would not be available for larger numbers than the maximum production described for Alternative 2.

2.3.2 Hatchery Programs with Decreased Production Levels

While NMFS often looks at decreased production levels as an alternative, it is utilized to provide additional information that cannot be ascertained from comparing the proposed program to a scenario without the program. In some other basins where natural-origin populations are more sensitive to the possibility of interactions with hatchery fish, it may be informative to size the program up and down to see how varying the intensity of those interactions affects risk to natural spawning populations. Here, however, the program is relatively small and removed from interactions with sensitive populations. Thus, an alternative that further reduces production is not analyzed because it is not likely to yield any significant insight beyond the analysis of the proposed action.

3 AFFECTED ENVIRONMENT

This chapter describes current conditions for nine resources that may be affected by implementation of the EA alternatives. The resources are:

- Water quantity—Section 3.1
- Water quality—Section 3.2
- Fish—Section 3.3
- Other fish species—3.4
- Wildlife—Section 3.5
- Marine and Freshwater Habitat-Section—3.6

- Socioeconomics—Section 3.7
- Cultural Resources—Section 3.8
- Environmental Justice—Section 3.9

Each resource's analysis area includes the Project Area as a minimum area, but may include locations beyond the Project Area if discernible effects of the EA's alternatives on that resource would be expected to occur outside the immediate area of the proposed activities (Section 1.2, Project Area and Analysis Area).

3.1 Water quantity

The analysis area for Water Quantity is discontinuous areas of the stream where the water is diverted from the stream for use at the hatchery facilities described in Chapter 2. The description of existing conditions for water quantity focuses on water resources associated with the Springfield Hatchery, Eagle Fish Hatchery, and Burley Creek Hatchery. Water use, as well as quality and effects of the facilities has already been consulted on in NMFS (2013) and will not be further discussed in this EA.

Table 7. Details for those facilities that divert water for hatchery operations; NA = not applicable.

Facilities	Water Source	Surface/Spring Water (cfs)	Ground Water (cfs)	Water Diversion Distance (km) Change to for proposed program (%)	Discharge Location	Meet NMFS Screening Criteria	IPDES Permit #	Water Right Permit #
Eagle Fish Hatchery	N/A	0	6.57	N/A	Boise River	N/A	N/A	21938 19805 63-132K 63-133L
Springfield Hatchery	N/A	0	50	N/A	Boom Cr., Snake River	Yes	IDG131020	35-4271A 36-8635A 35-8679 35-9068 35-11394
Oxbow Fish Hatchery	Oxbow Springs	8.5	0	10	Columbia River	N/A	OX-64520	OX-93421
Sawtooth Fish Hatchery	Salmon River	43	11.6	2	Salmon River	Yes	IDG131000	71-10934 71-10937 71-02088 71-07079
Burley Creek Fish Hatchery	N/A	0	2.14	N/A	Burley Creek	Yes	N/A	G1-25124 P
Manchester Research Station	N/A	N/A	N/A	N/A	Clam Bay, Puget Sound	Yes	N/A	N/A
Bonneville Hatchery	Tanner Creek	25.4	27.85	.04	Tanner Creek, Columbia River	Yes	BON-64425	BON-S1310

3.2 Water quality

The analysis area for Water Quality includes stream reaches downstream from where facilities are located up until the point where effluent effects are sufficiently diluted to have no effect. Water quality and effects of the facilities has already been consulted on in NMFS (2013) and will not be further discussed in this EA.

3.3 Fish

3.3.1 ESA-Listed Salmon and steelhead

NMFS has identified three salmon Evolutionarily Significant Units (ESUs) (Snake River Fall Chinook Salmon, Snake River Spring/Summer Chinook Salmon, and Snake River Sockeye Salmon) and one steelhead Distinct Population Segment (DPS) (Snake River Steelhead) in the Snake River Basin that are protected under the ESA. Snake River sockeye salmon were listed as an endangered species on November 20, 1991, Snake River spring/summer Chinook salmon and Snake River fall Chinook salmon were listed as threatened species on April 22, 1992, and the first hatchery consultation and opinion was completed on April 7, 1994 (NMFS 1994; 2008b). The 1994 opinion was superseded by "Endangered Species Act Section 7 Biological Opinion on 1995-1998 Hatchery Operations in the Columbia River Basin, Consultation Number 383" completed on April 5, 1995 (NMFS 1995a; 1995b). The Snake River Steelhead DPS was listed as threatened in Threatened on August 18, 1997 (62 FR 43937) and January 5, 2006 (71 FR 833); updated April 14, 2014 (79 FR 20802).

Snake River Steelhead

The Snake River Basin steelhead DPS includes all naturally spawned anadromous *O. mykiss* populations below natural and manmade impassable barriers in streams in the Snake River Basin of southeastern Washington, northeastern Oregon, and Idaho, as well as several hatchery programs. Steelhead from the Upper Salmon River Basin are part of the Salmon River MPG, which contains 12 extant populations. The best available information indicates that the Snake River Steelhead DPS is currently at a moderate risk of extinction (Ford 2022).

Snake River Fall Chinook Salmon

This ESU includes naturally spawned fall-run Chinook salmon originating from the mainstem Snake River below Hells Canyon Dam and from the Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River sub-basins. It also includes fall-run Chinook salmon from the following artificial propagation programs: the Lyons Ferry Fish Hatchery Program, the Fall Chinook Acclimation Project, the Nez Perce Tribal Hatchery Program, and the Idaho Power hatchery program. The Lower Snake River population is rated at "low risk", rather than "very low risk," for abundance and productivity (Ford 2022).

Snake River Spring/summer Chinook Salmon

The Snake River Spring/summer-run Chinook Salmon ESU includes all naturally spawned populations of spring/summer-run Chinook salmon in the mainstem Snake River and the Tucannon, Grande Ronde, Imnaha, and Salmon River sub-basins, as well as in fifteen artificial propagation programs.

Ford (2022) concluded that while there have been improvements in abundance/productivity in several populations relative to the time of listing, the majority of populations have experienced sharp declines in abundance in the recent five-year period, primarily due to variation in ocean survival. Overall, Ford (2022) concluded that at this time, the Snake River spring/summer-run Chinook salmon ESU continues to be at moderate-to-high risk.

Snake River Sockeye Salmon

The Snake River sockeye salmon ESU includes all naturally spawned anadromous and residual sockeye salmon originating from the Snake River Basin, as well as sockeye salmon from the Redfish Lake Captive Broodstock Program and the Snake River Sockeye Salmon Hatchery Program.

The Snake River sockeye salmon ESU remains at "extremely high risk," although there has been substantial progress on the first phase of the proposed recovery approach—developing a hatchery-based program to amplify and conserve the stock to facilitate reintroductions. Non-ESA-Listed Salmon

There are no non-ESA-listed salmon populations in the analysis area. Bull trout are also present, they are ESA-listed, and are described in Section 3.4, Other Fish Species.

3.3.2 Ongoing Effects of the Hatchery Programs

Hatchery fish that are released from the hatchery programs being evaluated in this EA currently interact with other salmon and steelhead within the analysis area once they are released, either as juveniles on their migration to the ocean, or adults as they return to spawn (Table 8)[2]. The current use of various facilities that will be analyzed in Chapter 4 also interact with salmon and steelhead within the analysis area. The extent of effects (adverse or beneficial) on salmon and steelhead and their habitat depends on the program design, the condition of the habitat, and the status of the species, among other factors.

Table 8. Potential effects of hatchery programs on natural-origin salmon and steelhead.

Effect	Description of Effect
Genetics	• Interbreeding with hatchery-origin fish can affect within- and among population genetic diversity • Hatchery-origin salmon and steelhead can act to preserve the genetic integrity and diversity of depleted natural populations • Interbreeding with hatchery-origin fish may affect the reproductive performance and viability (fitness) of the local populations. • Also see "Population Viability" effects
Masking	• Hatchery-origin fish can increase the difficulty in determining the status of the natural-origin component of a salmon population.
Competition and Predation	• Hatchery-origin fish can increase competition for food and space with natural-origin fish. • Hatchery-origin fish can prey on natural-origin fish. • Juvenile hatchery-origin fish can decrease predation on natural-origin salmon and steelhead by providing an alternative prey source.
Disease	• Concentrating salmon for rearing in a hatchery facility can lead to an increased risk of amplifying pathogens. When hatchery-origin fish are released from hatchery facilities, they may increase the disease risk to natural-origin salmon and steelhead through pathogen transmission.
Population Viability	• Abundance: Preserve, increase, or decrease the abundance of a natural-origin fish population. • Spatial Structure: Preserve, expand, or reduce the spatial structure of a natural-origin fish population • Genetic Diversity: Increase or decrease within-population genetic diversity of a natural-origin fish population • Productivity: Maintain, increase, or decrease the productivity of a natural-origin fish population.

[2] The hatchery fish from the hatchery program being evaluated in this EA are not likely to have a discernible effect on fish in the ocean

Effect	Description of Effect
Nutrient Cycling	• Returning hatchery-origin adults can increase the amount of marine-derived nutrients in freshwater systems.
Facility Operations	• Hatchery facilities can reduce water quantity or quality in adjacent streams through water withdrawal and discharge. • Weirs for broodstock collection or to control the number of hatchery-origin fish on the spawning grounds can have the following unintentional consequences: ▪ Isolation of formerly connected populations ▪ Limiting or slowing movement of migrating fish species, which may enable poaching or increased predation ▪ Alteration of stream flow ▪ Alteration of streambed and riparian habitat ▪ Alteration of the distribution of spawning within a population ▪ Increased mortality or stress due to capture and handling ▪ Impingement of downstream migrating fish ▪ Forced downstream spawning by fish that do not pass through the weir • Increased straying due to either trapping adults that were not intending to spawn above the weir, or displacing adults into other tributaries
Research, Monitoring, and Evaluation (RM&E)	• Surveying and sampling to assess program objectives and goals may increase the risk of injury and mortality to steelhead that are the focus of the action, or that may be incidentally encountered. • RM&E will also provide information on the status of the natural population

Genetics

Hatchery-origin fish can affect natural population productivity and diversity when they interbreed with natural-origin fish. In determining genetic risk to natural-origin populations posed by hatchery programs, NMFS evaluates three major areas of effects: within-population diversity, among-population genetic diversity/outbreeding, and hatchery-influenced selection. Distilling the complex phenomenon of genetic change and its consequences into these three somewhat overlapping areas is a simplification done for practical reasons. NMFS' intent is to responsibly consider concerns that have arisen from published scientific papers addressing the genetic risk of hatchery-origin salmon and steelhead on natural-origin fish, and NMFS finds that evaluating hatchery programs on these three "axes" accomplishes that objective. For additional information regarding the effects of a hatchery program on genetics, please see general information on competition risks from salmon hatchery programs to natural-origin salmon and steelhead, and the qualitative evaluation tool are presented in NMFS (2019a).

Competition and Predation

Ecological interactions between natural- and hatchery-origin fish may occur during the adult and juvenile life-history stages. Hatchery yearlings, subyearlings, and fry released into habitats where natural-origin juvenile salmon rear may compete with or prey on natural-origin fish. Hatchery-origin adults may also compete with natural-origin salmon or steelhead for spawning and holding sites. The incidence of competition or predation between natural- and hatchery-origin fish under past and current hatchery operations has been influenced by a variety of factors including size of predators and prey, spatial and temporal overlap, and the number of fish released at any time.

Residualism of hatchery-origin juveniles

In addition, while a portion of hatchery-origin fish currently released may not emigrate and may stay in the stream (i.e., residualize) to compete with or prey upon natural-origin fish, there are no data indicating that residualism rates for hatchery-origin fish are higher than their natural counterparts. These non-migratory fish may directly compete for food and space with natural-origin juvenile salmonids of similar

age. They also may prey on younger, smaller-sized juvenile salmonids. Although this behavior has been studied and observed most frequently in the case of hatchery steelhead, residualism has been reported as a potential issue for hatchery Chinook salmon as well. Johnson et al. (2012) and Temple and Pearsons (2012) found very low rates of residualism (less than 0.1 percent) for hatchery spring Chinook salmon in the Yakima River.

Interactions between hatchery-origin juveniles and natural-origin juveniles

The Springfield Fish Hatchery Sockeye Salmon Hatchery Program produces up to 1 million smolts for release into Redfish Lake Creek. Smolts are released to Redfish Lake Creek in May. Release dates are based on historical out-migration timing and peak flow rates. All sockeye salmon smolt releases are forced releases from transport vehicles after acclimation at Sawtooth Fish Hatchery.

It is anticipated that the sockeye salmon smolts released will out-migrate soon after release. During these releases, rearing, and outmigration periods, some natural-origin salmon juveniles are lost to competition and predation from hatchery-origin juveniles particularly when there is overlap in time and space (NMFS 2018d; 2018c). The sockeye salmon hatchery manages fish size at release, release location, and release timing to minimize competition and predation from hatchery-origin juveniles.

Prey Enhancement

Upon release into the natural environment, hatchery-origin juveniles may become prey for natural-origin salmon and steelhead and provide an additional food source. Depending on the size, any resident adult fish can prey on hatchery-origin juveniles. Similarly, larger natural-origin juvenile fish can prey on hatchery-origin juveniles. Though the occurrence of predation by some species on hatchery-origin juveniles has likely been low because of fish size (Section 0, Competition and Predation), prey enhancement can occur for any fish species larger than the hatchery-origin juveniles. Sockeye salmon are not piscivorous and therefore do not prey on hatchery-origin fish.

Disease

Fish diseases and pathogens can be present in hatchery-origin and natural-origin salmon and steelhead, and interactions between groups of fish in the natural environment can result in transmission of pathogens from afflicted fish. Hatchery-origin fish released into the natural environment may pose an increased risk of transferring diseases to natural-origin salmon and steelhead if not released in a disease-free condition.

Pathogens are not unique to hatcheries. Hatchery-origin fish may have an increased risk of carrying fish disease pathogens because higher rearing densities of fish in the hatchery may stress fish and lower immune responses. Under certain conditions, hatchery effluent has the potential to transport fish pathogens out of the hatchery, where natural fish may be exposed. These impacts are currently addressed by rearing the hatchery fish at low densities, within widely recognized guidelines (Piper 1986), and by continuing well-developed monitoring, diagnostic, and treatment programs already in place. Table 9 lists the pathogens, the time period these were observed and the treatment that was applied, if any, for all facilities considered in this EA.

Table 9. Past disease occurrence at the facilities considered in this EA (2013 to present).

Facility	Species	Year	Pathogen-caused Disease	Comment
Eagle Fish Hatchery	Snake River Sockeye Captive Broodstock	Annual	*Saprolegnia*	1,667 ppm formalin 20-minute flow through for eggs (preventative treatment)
		Annual	*Saprolegnia*	167 ppm formalin, 1-hour static bath for anadromous adults (preventative treatment)
		Annual	*BKD*	Protocols in place for rearing eggs from Positive Females (anadromous adults)

Facility	Species	Year	Pathogen-caused Disease	Comment
		2016	*IHNv*	Fertilized eggs water hardened in 100 ppm Argentyne (anadromous adults); Outbreak
		Annual	*Parvicapsula sp Myxobolus sp*	Monitor for prevalence anadromous adults
Sawtooth Hatchery		2013 - Present	None	2018-Present: on station approx. 2 weeks for acclimation. BY13 and BY17 reared there. No disease history.
Springfield Hatchery		Annual	Softshell	Egg bath 500 ml Argentyne/4 gal/10 min (preventative treatment)
Manchester Research Station		2013 - Present	None	No disease outbreak history
Burley Creek Hatchery		Annual	*Saprolegnia*	No disease outbreaks. Preventative egg treatment of 1,667 ppm formalin 15-minute flow through
		Annual	*IHNv*	No disease outbreaks. Preventative egg treatment of 100 ppm Argentyne; 20-min static bath for fertilized eggs.
		Annual	*Vibriosis*	No disease outbreaks. Preventative treatment of smolts in dip bath 5 L Vibrio vaccine/45 gal/1 min 2 weeks before saltwater transition.
Oxbow Hatchery		2013-2015	*BKD*	Aquamycin treatment
		2013-2015	*CWD*	Aquamycin treatment
		2022-present	None	No disease outbreak history.
Bonneville Hatchery		2013-Present	N/A	No disease outbreaks for sockeye salmon.

Population Viability

Salmon and steelhead population viability is determined through an evaluation of four parameters; abundance, productivity, spatial structure, and diversity (McElhany et al. 2000). Hatchery programs may have both beneficial and adverse effects on these parameters. As part of ESA status reviews and recovery planning for threatened and endangered populations, NMFS defines population performance measures for these key parameters and then estimates the effects of hatchery programs at the population scale on the survival and recovery of an entire ESU or DPS. NMFS has established population viability criteria for the three salmon ESUs and one steelhead DPS in the Upper Salmon Basin.

One aspect of population viability is fitness, for which productivity can serve as a surrogate. One factor that plays a role in productivity is reproductive success. Most of the empirical evidence of fitness depression due to hatchery-influenced selection comes from studies of species that are reared in the hatchery environment for an extended period – one to two years – prior to release (Berejikian et al. 2004). In addition, one of the basic tenets of an integrated hatchery program is to increase the likelihood that reproductive success of subsequent generations will improve because natural-origin genes are continually being incorporated into the population.

Nutrient Cycling

When adult salmon and steelhead return to freshwater, they can be important transporters of marine-derived nutrients into the freshwater and terrestrial systems through the decomposition of carcasses (Cederholm et al. 2000). Naturally spawning hatchery-origin fish from the ongoing hatchery programs can also contribute to increased nutrient cycling in the natural environment, especially when adults are released into areas where spawner numbers will increase.

Currently, the decreased abundance of natural-origin salmon and steelhead in the analysis area likely translates into a reduction of nutrient availability from the marine environment into freshwater and terrestrial ecosystems. Because natural-origin salmon and steelhead abundance is so low (relative to historical populations), hatchery-origin salmon and steelhead increase nutrient availability in areas where they return and are not removed from the system.

Facility Operations

Because water quantity and water quality are assessed as separate resources in Sections 3.1, Water Quantity and, 3.2, Water Quality, the discussion of the current and ongoing effects of facility operations on salmon and steelhead in this section is restricted to the operation of weirs and traps for juveniles and adults, water intake structures, and facility maintenance activities. The facilities (or related activities) that may currently affect salmon and steelhead species include:

- Springfield Hatchery
- Eagle Fish Hatchery
- Sawtooth Hatchery
- Bonneville Fish Hatchery
- Adult Collection Facility (Sawtooth Fish Hatchery trap, and weir on Redfish Lake Creek)
- Juvenile rotary screw trap (Redfish Lake Creek)

Operating hatchery facilities can affect instream fish habitat in the following ways: (1) reduction in available fish habitat due to water withdrawals, (2) operation of instream structures (e.g., water intake structures, fish ladders, and weirs), or (3) maintenance of instream structures (e.g., protecting banks from erosion or clearing debris from water intake structures). The following describes the on-going pertinent facility and operational features described in Chapter 2 and their effects on natural-origin salmon and steelhead.

The adult trap on Redfish Lake Creek is easily modified to capture downstream migrating salmonids. For juveniles, the trap is operated from early April until fish stopped emigrating from the lake in mid-June.

The only facility that uses surface water in the Upper Salmon River Basin is the Sawtooth Hatchery, and that facility's intake screens meet the latest NMFS screen criteria (Table 7). All facilities that are part of the sockeye salmon hatchery program have previously consulted on ((NMFS 2013); (NMFS 2017b).

There are no in-water construction activities proposed for the hatchery actions under consideration in this EA. Construction will not be analyzed further.

Research, Monitoring, and Evaluation

The Snake River Basin sockeye hatchery program includes extensive monitoring, evaluation and adaptive management, and many other actions to monitor and address program success and potential risks to natural-origin juvenile and adult fish. The co-managers conduct numerous ongoing monitoring programs, including catch, escapement, marking, scale and otolith sampling, genetic sampling, CWT and otolith tagging, fish health testing and extensive post-release juvenile monitoring.

Research, Monitoring, and Evaluation (RM&E) activities related to the Snake River sockeye salmon program being evaluated in this EA include:

- Marking (adipose clip) and tagging (CWT, PIT) juvenile hatchery-origin sockeye salmon prior to release.
    - Adipose Clipping: Clipping is dependent on availability of marking trailer. If trailer is available, all juveniles released from Springfield Hatchery are adipose clipped. If not adipose clipped, hatchery sockeye will still be identified via PBT.
    - CWT: All sockeye at Bonneville hatchery will receive a CWT
    - PIT: All sockeye at Eagle Fish Hatchery and Burley Creek will be PIT tagged. Representative groups at Springfield hatchery will be PIT tagged.
- Examination of juvenile and adult Snake River hatchery sockeye salmon, for an adipose clip and checking clipped fish for the presence of a tag (CWT, PIT).
- Surveying spawning grounds for redds performed by IDFG and SBT.
- Sampling the nursery lakes for abundance and size estimates of juveniles.

RM&E activities that are directly related to hatchery programs are currently implemented using well established (Galbreath et al. 2008) methods and protocols. Because the intent of RM&E for the hatchery program is to improve the understanding of the sockeye salmon population, the information gained outweighs the risks to the populations. Incidental effects resulting from tagging, such as injury to salmon, are also considered minimal.

Ongoing collection of adults at traps could delay individuals in their upstream migration. Individuals may also suffer stress or mortality during collection, tagging, or tissue sampling. Mortality from tagging could be both acute (occurring during or soon after tagging) and delayed (occurring long after the fish have been released into the environment). NMFS has developed general guidelines to reduce impacts when collecting listed adult and juvenile salmonids (NMFS 2000; 2008a).

3.4 Other fish species

The analysis area for the Other Fish Species resource is the Upper Salmon River watershed and the migration corridor to the ocean. The analysis area is not considered as one of the geographical areas occupied by the ESA-listed southern DPS of Pacific eulachon (76 FR 65324, October 20, 2011), and eulachon will not be discussed further in this document.

3.4.1 Other fish species affected by the hatchery operation

Many fish species in the Upper Salmon River Basin and adjacent nearshore marine areas have a relationship with salmon and steelhead as prey, predators, or competitors (Table 10).

Native fish present in Sawtooth Valley waters include the following: sockeye salmon and kokanee *O. nerka*, Chinook salmon *O. tshawytscha*, rainbow trout/steelhead *O. mykiss*, westslope cutthroat trout *O. clarkii lewisi*, bull trout *Salvelinus confluentus*, bridgelip sucker, *Catostomus columbianus hobbsi*, largescale sucker, *Catostomus macrocheilus*, northern pikeminnow *Ptychocheilus oregonensis*, mountain whitefish *Prosopium williamsoni*, redside shiner *Richardsonius balteatus*, chiselmouth, *Acrocheilus alutaceus* dace *Rhinichthys* spp., and sculpin *Cottus* spp. (NMFS 2015)

Bull trout in the Upper Salmon River Basin are also listed as a threatened fish species under the ESA. The Bull Trout Salmon River Recovery Unit encompasses the entire Salmon River Basin. Most core areas for bull trout in the Salmon River Basin contain large populations with many occupied stream segments. The Salmon River basin contains 10 of the 22 core areas in the Upper Snake Recovery Unit and contains the majority of the occupied habitat (USFWS 2015).

Connectivity within Salmon River Basin core areas is mostly intact except for the Pahsimeroi River and portions of the Lemhi River. Most core areas appear to have increasing or stable trends. The Idaho Department of Fish and Game reported trend data from 7 of the 10 core areas. Trend data indicated that populations were stable or increasing in the Upper Salmon River, Lemhi River, Middle Salmon River-

Chamberlain, Little Lost River, and the South Fork Salmon River. Trends were stable or decreasing in the Little-Lower Salmon River, Middle Fork Salmon River, and the Middle Salmon River-Panther (USFWS 2015).

Table 10. Range and status of other fish species that may interact with Snake River Basin salmon and steelhead.

Species	Range in Snake River Basin	Federal/State Listing Status	Type of Interaction with Salmon
Pacific Lamprey	Tributaries to the Snake, Clearwater, and Salmon rivers.	Federal Species of Concern	• Predator of salmon eggs and fry Potential prey item for adult salmon • May compete with salmon for food and space. • May benefit from additional marine-derived nutrients provided by hatchery-origin fish.
Mountain Whitefish	Throughout Salmon River Basin in rivers, streams, and lakes	None	• Predator of salmon eggs and fry. • Potential prey item for adult salmon • May compete with salmon for food and space. May benefit from additional marine-derived nutrients provided by hatchery-origin fish.
Sculpins	Entire basin above and below barriers to migration.	None	• Predator of salmon eggs and fry • Potential prey item for adult salmon • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Leopard dace	Columbia River Basin	None	• Potential prey item for adult salmon
Umatilla dace	Snake River		
Northern pikeminnow	Columbia River Basin	None	• Major predator of juvenile salmonids
Rainbow Trout (resident form)	Entire basin below, and potentially above barriers to anadromous fish migration.	None – the resident form of *O. mykiss* is not included as part of the listed Snake River steelhead DPS	• Predator of salmon eggs and fry • Potential prey item for salmon • May compete with salmon for food and space • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Kokanee	Stanley Basin lakes	None	• Predator of salmon eggs and fry • Potential prey item for salmon • May compete with salmon for food and space
Bull Trout	In all reaches of the Snake River Basin tributaries; also, estuarine and nearshore marine areas	Listed as threatened under the Federal ESA	• Predator of salmon eggs and fry • Potential prey item for salmon • May compete with salmon for food and space • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Cutthroat Trout	Snake River Basin reaches in mainstem, tributary, and pond habitats; also,	None	• Predator of salmon eggs and fry • Potential prey item for salmon • May compete with salmon for food and space • Can hybridize with rainbow trout

Species	Range in Snake River Basin	Federal/State Listing Status	Type of Interaction with Salmon
	estuarine and nearshore marine areas (sea-run form)		• May benefit from additional marine-derived nutrients provided by hatchery-origin fish

Source: NMFS (2014)

3.5 Wildlife

The analysis area for the Wildlife resource is the Salmon River watershed. In general, hatchery operations in the Salmon River Basin have potentially affected local wildlife species by changing the total abundance of salmon and steelhead in aquatic and marine environments, which serve as a food source for various wildlife species and can affect these individuals of these species through predator/prey interactions. Many wildlife species also feed on salmon and steelhead carcasses in the Salmon River Basin and subsequently bring marine derived nutrients into the terrestrial ecosystem (i.e., nutrient cycling). Salmon and steelhead hatchery operations may therefore provide additional prey availability to wildlife species that use salmon and steelhead as a food source. In addition, the hatcheries could affect wildlife through transfer of toxic contaminants from hatchery-origin fish to wildlife (Boxall et al. 2004), the operation of weirs (which could block or entrap wildlife, or conversely, make salmon and steelhead easier to catch through their corralling effect). These effects are at individual levels and are not considered to affect populations of wildlife, as the wildlife under consideration ranges broadly and is not documented to be food limited by salmon and steelhead availability in the area of analysis.

The analysis area supports a variety of birds, large and small mammals, amphibians, and invertebrates that may eat or be eaten by salmon and steelhead, compete with salmon and steelhead for food and space, and scavenge on salmon and steelhead (Table 11).

Table 11. Wildlife species that may interact with Snake River Basin salmon and steelhead.

Species	Status	Habitat [1]			Relationship with Salmon and Steelhead			
		Fresh-water	Estuary	Marine	Predator	Competitor	Prey	Scavenger
Bald eagle (*Haliaeetus leucocephalus*)	Federally protected under Bald Eagle and Golden Eagle Protection Act	X	X	X	X			X
Golden eagle (*Aquila chrysaetos)*	Federally protected under Bald Eagle and Golden Eagle Protection Act	X	X	X	X		X	X
Osprey (*Pandion haliaetus*)	None	X	X		X			
Great blue heron (*Ardea herodias*)	None	X	X		X			
Canada lynx (*Lynx canadensis*)	Federally threatened Idaho State threatened Washington State endangered	X			X			

Species	Status	Habitat [1]			Relationship with Salmon and Steelhead			
		Fresh-water	Estuary	Marine	Predator	Competitor	Prey	Scavenger
North American wolverine (*Gulo gulo luscus*)	Federally proposed threatened Oregon State threatened Washington State candidate	X			X			
Northern Idaho Ground Squirrel (*Urocitellus brunneus*)	Federally threatened, Idaho State threatened	X						X
Black bear (*Ursus americanus*)	None	X	X		X			
River otter (*Lontra canadensis*)	None	X	X		X			X
Mink (*Neovison vison*)	None	X	X		X			X
Bliss Rapids Snail (*Taylorconcha serpenticola*)	Federally threatened	X					X	
Snake River Physa Snail (*Physa natricina*)	Federally threatened	X					X	
Pinnepeds	Protected under MMPA[2]	X	X	X	X	X		

Source: USFWS Environmental Conservation Online System (ECOS): https://ecos.fws.gov/ecp/report/species-listings-by-state?stateAbbrev=ID&stateName=Idaho&statusCategory=Listed and NMFS (2019b)

[1] Includes those habitats most relevant for evaluating interactions with salmon and steelhead; does not include all habitats used by each species.

[2] Marine Mammal Protection Act. Enacted by Congress in 1972, the MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S.

Salmonid predators include several species of birds, black bear, river otter, mink, and some amphibians. Some bird species, including bald and golden eagles (protected under the Bald and Golden Eagle Protection Act) scavenge on salmon carcasses, as do minks, otter, and several invertebrate species. Other wildlife species compete with salmon and steelhead for food or habitat. Salmon and steelhead interact with wildlife, but represent only a small proportion of the total salmonids available for such interactions.

Marine mammals are protected under the Federal Marine Mammal Protection Act (MMPA) (16 U.S.C. 1361, Marine Mammal Protection Act). Harbor seals, sea lions, harbor porpoises and Dall's porpoises are commonly present in nearshore marine areas immediately adjacent to where Columbia River Basin hatchery-origin adult salmon and steelhead return. Southern resident killer whales, which are ESA-listed as endangered, are also observed in marine waters proximate to the analysis area. However, sockeye salmon are not a main component of their diet and are not considered in this EA (Hanson et al. 2010; Ford et al. 2016).

Currently, the transfer of pathogens to wildlife associated with the hatchery program is unlikely to contribute to their presence/load in wildlife due to the regulation of hatchery operations through the NPDES permit and the applicants' fish health policies. Weirs and traps used for collection of fish may impede individual wildlife movement and/or benefit individual wildlife by restricting migration of fish and thereby enhancing predation efficiency.

3.6 Freshwater Habitat

3.6.1 Critical habitat

Critical habitat has been designated for the Snake River fall, and spring/summer Chinook Salmon ESUs, and the Snake River Steelhead DPS. Within designated critical habitat, NMFS or the USFWS identifies physical and biological features (PBFs) essential for conservation of the species. PBFs for listed salmon and steelhead include freshwater spawning and rearing sites, freshwater migration corridors, estuarine and nearshore marine areas free of obstruction and excessive predation, and offshore marine areas with conditions supporting growth and maturation.

Nine PBFs have been developed for bull trout, focusing on water quality and quantity, habitat quality and complexity, prey base, and low levels on nonnative predators.

Ongoing direct effects on critical habitat for listed salmon, steelhead, and bull trout result from facility operation (e.g., water diversion and effluent discharge), maintenance (e.g., instream sediment removal), and the presence of hatchery program-related weirs and water withdrawal structures. Hatchery programs such as those included in this EA can also affect critical habitat for bull trout by influencing abundance of prey species. Genetic and ecological interactions between hatchery-reared fish and fish in the natural environment also contribute to minor degradation of critical habitat, particularly as related to rearing habitat.

3.6.2 Essential Fish Habitat

All the aquatic habitat in the project area described above, including critical habitat for ESA-listed salmon and steelhead species, is part of essential fish habitat (EFH), which is defined under the Magnuson-Stevens Fishery Conservation and Management Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." As described by PFMC (2014), the freshwater EFH for Pacific salmon has five habitat areas of particular concern: (1) complex channels and floodplain habitat, (2) thermal refugia, (3) spawning habitat, (4) estuaries, and (5) marine and estuarine submerged aquatic vegetation. Chinook salmon have designated EFH in the Study Area, and NMFS recognizes the need to consider EFH to minimize risks from hatchery operations, and genetic and ecological interactions of hatchery-origin fish with natural-origin fish (PMFC and NMFS 2014).

All facilities that support the hatchery program included in this EA currently operate and/or release juvenile hatchery fish into Pacific Salmon EFH. Ongoing direct effects on EFH are similar to those described for critical habitat for listed salmon and steelhead in Section 3.6.1, Critical Habitat. Effects result primarily from facility operation, maintenance, and the presence of weirs and water withdrawal structures.

3.7 Socioeconomics

Socioeconomics is defined as the study of the relationship between economics and social interactions with affected regions, communities, and user groups. Hatchery programs affect economic conditions by providing fish for commercial and recreational fishing opportunities, employment, and economic opportunities through hatchery operations. Hatchery-related spending affects the economy in the community surrounding the hatchery, and those economic impacts can extend outward, having a wider regional effect. The Study Area for socioeconomics includes the Snake River watershed and mainstem Columbia River, and estuary.

One important impact hatchery programs can have on social economics is through tribal and nontribal commercial and recreational fisheries that target hatchery fish. Changes in hatchery production levels can create beneficial or adverse effects on harvests, which affect the industries and communities that depend on them. The hatchery programs assessed in this EA are part of the larger Lower Snake River economic impact region analyzed in the Mitchell Act FEIS ((NMFS 2014), Figure 3-1). According to the Mitchell Act FEIS, the total hatchery-generated activity in the Lower Snake River economic impact region creates about 934 jobs, generates about $24.5 million in personal income and results in about $29.3 million to $35.0 million in recreational expenditures ((NMFS 2014), Table 3-23 and Table 4-109). Effects on fisheries beyond the Columbia River are not likely to be discernable

The evaluation of the Snake River Basin salmon and steelhead hatchery programs effects on socioeconomics focuses on the contribution of hatchery-origin fish to local and regional economies. This section describes the baseline contribution of hatchery-origin Snake River Basin salmon and steelhead to commercial and recreational socioeconomic values and to the communities where the hatchery facilities operate.

3.7.1 Employment and Operations

In addition to providing fish for harvest and conservation, the salmon and steelhead hatchery programs directly affect socioeconomic conditions within the communities where these facilities operate. These facilities provide employment opportunities and procure goods and services for their operations. Direct hatchery-related expenditures for labor and procurement of supplies also generate secondary economic activity, both locally and in more distant areas.

The current BPA contract for the IDFG portion of the program is approximately $2,861,000 (Eagle & Springfield hatcheries; personnel/operating/capital combined). The BPA contract for the NOAA Fisheries program is $1,103,000 (personnel/operating/capital combined) and the contract for the Shoshone – Bannock Tribes is $521,231. Oxbow Hatchery is primarily funded via a Pacific States Treaty (PST) contract for approximately $850,000/year and a nominal amount of state funds for $40,000/year. The state funds are directed towards sockeye smolt production. Oxbow Hatchery facilities are staffed with three employees with a fourth pending (IDFG 2022).

3.7.2 Fisheries

Fisheries contribute to local economies through the purchase of supplies such as fishing gear, camping equipment, consumables, and fuel at local businesses. All these expenditures help to support local businesses, but it is unknown how dependent these businesses are on fishing-related expenditures. Recreational anglers also contribute to the economy through payments for fishing outfitters, guides, and charter fees.

Fisheries in the Columbia River Basin and those that rely upon Columbia River fish stocks are managed by numerous entities, including Federal, state, and tribal governments. These entities are guided by a complex array of policies, laws, compacts, and agreements. The management of Pacific salmon fisheries in particular is complex, and involves numerous entities representing a variety of social, political, and conservation interests. Changes in allowable fishery harvest in the Columbia River Basin are a result of decisions made by state, Federal (i.e., NMFS), and tribal fishery managers based on a variety of environmental, biological, economic, and social factors.

The primary basis for fisheries management in the Columbia River Basin is *United States v. Oregon,* the ongoing Federal court proceeding first brought in 1968, *Sohappy v. Smith,* 302 F. Supp. 899, to enforce the reserved fishing rights of the Confederated Tribes of Warm Springs, Confederated Tribes of the Umatilla Indian Reservation, Nez Perce Tribe, and the Confederated Tribes and Bands of the Yakama Nation.

Salmon and steelhead fisheries in the Columbia River are managed by NMFS and other state, tribal, and local entities subject to provisions of *United States v. Oregon* under the continuing jurisdiction of the Federal court. Snake River sockeye salmon are listed as Endangered under the ESA, therefore, there are no specific harvest objectives for this program. Substantive information on fisheries benefitting from the program is lacking.

Recent Ocean and Lower River Harvest

Few Snake River Sockeye salmon are caught in ocean fisheries, and ocean-fishing mortality on SR Sockeye salmon is assumed to be zero (NMFS 2018c). Non-Indian fisheries in the Columbia River mainstem below the Highway 395 Bridge, which crosses the Columbia River between Kennewick and Pasco, Washington, are limited to a harvest rate of 1 percent and Treaty Indian fisheries to 5 to 7 percent, depending on the run size of upriver sockeye salmon stocks. NMFS' completed a biological opinion on the 2018 to 2027 *U.S. v. Oregon* Management Agreement (NMFS 2018a) concluded that the effects of harvest on SR Sockeye salmon, when considering the current reliance on hatchery programs, will allow continued gains in viability scores.

3.8 Cultural Resources

Salmon fishing has been central to the existence of Tribes in the Pacific Northwest for thousands of years. Beyond the generation of jobs and income for commercial tribal fisherman, salmon are regularly eaten by individuals and families and served at tribal community gatherings. Pacific Northwest Tribes depend on salmon for subsistence purposes and attach great cultural importance to salmon for ceremonial purposes. Salmon and steelhead are a core symbol of tribal identity, individual identity, and the ability of Native American cultures to endure (NMFS 2004; 2005a). The survival and well-being of salmon and steelhead are inextricably linked to the survival and well-being of Native American people and tribal culture. Columbia River tribes share a passionate concern for the future of salmon runs in the region because of their importance to tribal culture, history, and economic subsistence. Salmon harvested for ceremonial and subsistence purposes are important to maintaining cultural viability, and provide a valuable food resource, among other traditional foods, in tribal ceremonies.

Treaty Tribes in the Columbia River Basin include the Confederated Tribes of Warm Springs, Confederated Tribes of the Umatilla Indian Reservation, Nez Perce Tribe, and the Confederated Tribes and Bands of the Yakama Nation. The Columbia River Treaty Tribes with fishing rights are entitled to up to 50 percent of the available harvest at usual and accustomed grounds and stations. Present day tribal reservations may encompass a fraction of a Tribe's previously occupied territory; therefore, Tribes have the exclusive right of taking fish at all usual and accustomed places in accordance with applicable treaties.

The analysis area for Cultural Resources is the Snake and the lower Columbia River watershed and estuary, adjacent nearshore marine areas. Impacts on cultural resources typically occur when an action disrupts or destroys cultural artifacts, disrupts cultural use of natural resources, or disrupts cultural practices. This hatchery program does not include activities that could disrupt or destroy cultural artifacts. However, the hatchery programs can positively affect the ability of Native American tribes to use salmon and steelhead in their cultural practices. The hatchery programs, have been benefitting salmon and steelhead population viability for many years, as discussed in Section 0, which has contributed to enhancing the cultural resources for the tribes.

Harvest of salmon and steelhead generally occurs within a tribe's usual and accustomed fishing areas when forecasted returns of hatchery-origin and natural-origin steelhead are sufficient to provide for both a fishery and escapement for natural reproduction. Tribal harvest usually occurs in in one of the fishery zones (Zone 6) of the lower Columbia River. Zone 6 extends from Bonneville to McNary Dam (Figure 2).

Adult fish returning from the hatchery programs in the Snake River Basin are currently used for ceremonial and subsistence purposes, which could have the potential to provide substantial benefits to the Treaty Tribes.

Figure 2. Map of designated fishing zones in the lower Columbia River. Image from CRITFC website (https://critfc.org/about-us/columbia-river-zone-6/).

3.9 Environmental Justice

In 1994, the President issued Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations. Environmental justice is defined as "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies." The objectives of the Executive Order include developing federal agency implementation strategies, identifying minority and low-income populations where proposed federal actions could have disproportionately high and adverse human health and environmental effects, and encouraging the participation of minority and low-income populations in the NEPA process. Environmental justice analysis leads to a determination of whether high and adverse human health or environment effects of a program would be disproportionately borne by minority or low-income populations, often referred to as the environmental justice communities of concern.

The analysis area for environmental justice includes minority and low-income communities that may be affected directly, indirectly, or cumulatively by implementing the project alternatives and is the same as for socioeconomics (Section 3.7, Socioeconomics) and includes the geographic area where the Proposed Action (Section 1.2, Project Area and Study Area) would occur. The analysis area for Environmental Justice includes the Snake River Basin where the hatchery programs analyzed in this EA operate. Harvest of salmon and steelhead produced by the hatchery programs occurs primarily in the Lower Columbia River (Figure 2).

For the analysis of environmental justice effects, minority and low-income communities of concern were identified by comparing demographic data for counties in which physical hatchery facilities are located with a statewide reference. The three environmental justice metrics used to determine if a county is considered a minority community of concern are (1) percentage of county residents that are non-white, (2) percentage that are Indian, and (3) percentage that are Hispanic. The metric for determining if a county is a low-income community of concern is based on the poverty rate and per capita income. Counties were determined to be minority or low-income communities of concern if the level in any category (percent minority, poverty rate, or income) exceeded the applicable data in the statewide reference area.

Aside from tribal fisheries and cultural practices, there are no data regarding fishing specific to minority and low-income communities and there is no information to suggest that disproportionate effects to these communities from the proposed action seem likely, so only tribes will be further analyzed for environmental justice impacts.

3.9.1 Native American Tribes

All treaty Tribes with federally recognized treaty fishing rights have an interest in fishery management in Columbia River and qualify as environmental justice groups. Through treaties, the United States made commitments to protect Tribes' rights to take fish. These rights are of cultural and societal importance to Tribes; thus, impacts to commercial, subsistence, and recreational harvest opportunities are examined for any effect on tribal and low-income harvest. All Tribes identified in Section 3.8, Cultural Resources, are considered an environmental justice community and, accordingly, tribal effects are a specific focus of the environmental justice analysis. Although individual Tribes may not meet traditional environmental justice analysis thresholds for minority or low-income populations, they are regarded as affected communities for environmental justice purposes, as defined by USEPA guidance; guidance regarding environmental justice extends beyond statistical threshold analyses to consider explicit environmental effects on Tribes (USEPA 1998).

The environmental justice evaluation for Native American tribes includes:

- Ceremonial and subsistence uses
- Tribal commercial fisheries
- Economic value to tribes from hatchery and trap and haul operations

Ceremonial and subsistence use and tribal fisheries are described in Section 3.8, Cultural Resources. Environmental justice analysis will focus on the potential for the proposed action and alternatives to disproportionately affect the tribal communities.

4 ENVIRONMENTAL CONSEQUENCES

This chapter describes the analysis of the direct and indirect environmental effects associated with the alternatives on the nine resource categories. The effects on resources from other general factors (e.g., climate change, development, habitat restoration, hatchery production, and fisheries) are described in Chapter 5, Cumulative Effects. The relative magnitudes of impacts are described using the following terms:

- Undetectable – The impact would not be detectable.
- Negligible – The impact would be at the lower levels of detection.
- Low – The impact would be slight, but detectable.
- Medium – The impact would be readily apparent.
- High – The impact would be severe.

If the effect is detectable, then it may be either adverse or beneficial. Adverse is defined as harmful or unfavorable relative to a benchmark condition. Beneficial is defined as favorable or advantageous relative to a benchmark condition. The effects of Alternative 1, No Action/Current Program, are described in terms of how current conditions (Chapter 3, Affected Environment) are likely to appear in the future under continued implementation of the hatchery program being evaluated in this EA. The effects of another alternative is described relative to Alternative 1.

4.1 Water Quantity

This section discusses the effects of the alternatives on water quantity (Table 12). All water withdrawals under all alternatives would be non-consumptive, returned to the source within a short distance of the

point of withdrawal, and remain within permitted water rights (Table 12). The effects on water quantity under each of the alternatives are summarized in Table 12.

Table 12. Summary of effects on water quantity.

Resource	Alternative 1 – No Action/Current Program	Effect of Alternative relative to Alternative 1 Alternative 2 – Proposed Action
Water Quantity	Negligible-adverse	Negligible-adverse

4.1.1 Alternative 1 (No Action/Current Program)

Under Alternative 1, the hatchery programs would continue to use water resources as previously described (Section 3.1, Water Quantity). No stream reaches have been dewatered to the extent that migration and rearing of listed natural-origin fish have been impaired and there has been no net loss of river or tributary flow volume. Therefore, the effects on water quantity at hatchery facilities would be the same as current conditions because all operations at these hatcheries would remain the same, and therefore the effects would be negligible-adverse (Table 12).

4.1.2 Alternative 2 (Proposed Action)

The quantity of water used under Alternative 2 would be the same as Alternative 1. Water withdrawals would not be affected under Alternative 2 compared to Alternative 1, so Alternative 2 would have a negligible-adverse effect on water quantity (Table 12).

4.2 Water Quality

This section discusses the effects of the alternatives on water quality. All discharge under alternatives 1 and 2 would continue to contain fish, fish food, chemicals, and pharmaceuticals used for production of other salmonids not considered in this EA. The pollutant discharges are limited in accordance with NPDES permits. These facilities would continue to comply with applicable Federal, state, and tribal water quality and groundwater standards. Other chemicals not regulated by the NPDES permit (e.g., therapeutic chemicals) are not likely to have a detectable effect on water quality because they are used at a level lower than the therapeutic level approved by the U.S. Food and Drug Administration and in accordance with the labeled instructions. The effects on water quality under each of the alternatives are summarized in (Table 13).

Table 13. Summary of effects on water quality.

Resource	Alternative 1 – No Action/Current Program	Effect of Alternative relative to Alternative 1 Alternative 2 – Proposed Action
Water Quality	Negligible-adverse	Negligible-adverse

4.2.1 Alternative 1 (No Action/Current Program)

The effects on water quality from Alternative 1 would be the same as under current conditions. Therefore, Alternative 1 would have a negligible-adverse effect on water quality (Table 13).

4.2.2 Alternative 2 (Proposed Action)

Compared to Alternative 1, water quality would remain the same under Alternative 2. The amount of effluent discharge related to the programs under Alternative 2 would be the same as the amount produced at the hatchery facilities under Alternative 1. Based on the amount of effluent under Alternative 2 compared to Alternative 1, it would have a negligible-adverse effect on water quality (Table 13).

4.3 Fish

4.3.1 ESA-listed Salmon and Steelhead

The analyses of salmon and steelhead focus on effects of the alternatives on natural-origin salmon and steelhead in the analysis area. The types of effects to salmon and steelhead are described in Table 8. In addition, the effects of monitoring directly associated with salmon hatchery operations and performance are also evaluated. The effects on salmon and steelhead from other factors (e.g., habitat restoration, climate change) are described in Chapter 5, Cumulative Effects.

4.3.2 Genetics

As discussed in Section 3.3.5.1, Genetics, natural-origin Snake River Basin Chinook salmon and steelhead do not have the potential to be genetically affected by the No Action and Proposed Action alternatives (Table 14). The No Action and Proposed Action will have a negligible-beneficial effect on sockeye salmon genetics. The proposed hatchery program is opting to increase the amount of natural-origin spawners in place of managing genetic diversity during the early stages in order to help increase sockeye salmon return numbers into the Snake River Basin. In the short term, this has an effect on the genetic diversity of sockeye by emphasizing hatchery origin spawners in the wild, but an overall beneficial effect on the status of the species by increasing abundance without allowing potential genetic impacts to offset the overall benefits.

Table 14. Summary of effects to salmon and steelhead regarding genetics.

Species	Alternative 1 - No Action/Current Program	Alternative 2 – Proposed Action
Spring/Summer Chinook salmon	Undetectable	Undetectable
Sockeye salmon	Negligible-beneficial	Negligible-beneficial
Steelhead	Undetectable	Undetectable

Alternative 1 (No Action/Current Program)

Under Alternative 1, the sockeye salmon hatchery program would continue to propagate sockeye salmon. Because run sizes are currently low, the co-managers will not initially be controlling pHOS to achieve a PNI target. It is likely that pHOS will not be controlled for the sockeye salmon population for many years because at this point, it is more important to increase the number of natural spawners (regardless of origin) than manage the program for genetic diversity. Once the program reaches a sufficient level of returns, management will increase its focus on preserving genetic diversity. IDFG is currently working to increase genetic preservation by crossing sockeye salmon with their least related individual (IDFG 2022). While the continued hatchery program does have the potential to have an effect on sockeye salmon genetics, the increase in hatchery-origin and natural-origin releases provides a negligible-beneficial impact to the overall abundance of the population by preventing further extirpation of the species. The genetic loss due to extirpation of the species is far worse than the potential risk caused by the proposed hatchery program. The effects of the program on genetic diversity of Chinook salmon and steelhead would be undetectable due to the minimal interaction between steelhead and Chinook with sockeye.

Alternative 2 (Proposed Action)

Alternative 2 provides a negligible-beneficial effect on genetics for sockeye salmon and an undetectable effect on the genetics of Chinook salmon and steelhead. Alternative 2 proposes an increase in hatchery releases further down in the system (Bonneville Hatchery) to increase survival of juvenile sockeye (IDFG 2022). The increased survival of juvenile sockeye provides the opportunity for increased adult returns. These returning fish are not incorporated into the broodstock program, providing less of a strain on the genetic diversity within the Stanley Basin providing a negligible-beneficial effect. With the minimal

interaction of sockeye on Chinook salmon and steelhead, the effect of genetic diversity is undetectable with the increase in release of juvenile sockeye salmon.

4.3.3 Competition and Predation

The overall competition and predation effects from hatchery-origin salmon on natural-origin steelhead and salmon would be undetectable under Alternative 1 and 2 (Table 15).

Table 15. Summary of effects on natural-origin salmon and steelhead from competition and predation with hatchery-origin fish.

Species	Alternative 1 - No Action/Current Program	Alternative 2 – Proposed Action
Spring/Summer Chinook Salmon	Undetectable	Undetectable
Sockeye Salmon	Undetectable	Undetectable
Steelhead	Undetectable	Undetectable

Alternative 1 (No Action/Current Program)

Under Alternative 1, hatchery production would continue to occur at current levels. The Snake River sockeye salmon hatchery program manages fish size at release, release location, and release timing to minimize competition and predation from hatchery-origin juveniles. Hatchery sockeye salmon smolts are known to move rapidly downstream after release and spend little time rearing in the migration corridor (NMFS 2015). It is estimated that less than 1% of released sockeye smolts remain at the release sites (Peterson pers. comm.), with movement from Redfish Lake to Lower Granite Dam in less than 12 days (NMFS 2017a). This rapid rate of movement through the system reduces the opportunity for interspecies competition (Peterson et al. 2012). In addition, sockeye are known to be exclusively planktivorous, mostly eating zooplankton minimizing competition and predation effects on natural-origin salmonids and steelhead ((Burgner 1987), (NMFS 2015); (2017a)). Although Juvenile sockeye salmon experience significant mortality in the Columbia River estuary, they presumably are affected to a lesser degree by limiting factors and threats in the estuary because of their shorter residency times in the reach (NMFS 2011a). Therefore, the effects of the Snake River sockeye hatchery program would have undetectable effects on competition and predation of natural-origin sockeye salmon, spring/summer Chinook salmon and steelhead.

Adults from the hatchery programs included in this EA may compete for spawning sites but impacts are minimal due to difference in run timing, holding, spawn timing and return numbers. Adult steelhead and fall Chinook utilize different run and spawn timing compared to sockeye salmon (NMFS 2015). Sockeye finish returning when fall Chinook and steelhead start returning (NMFS 2015), minimizing interactions between the species. While spring/summer Chinook are known to be present during sockeye returns, impacts are expected to be minimal due to different habitat use (NMFS 2017a). IDFG tracks sockeye migration and returns, and attempt to close the spring/summer chinook fishery when sockeye begin to arrive. This allows only a small amount of incidental catch and allows hatchery staff to be able to properly handle all returning salmonids and minimize any harmful interactions. Interactions between natural-origin and hatchery-origin sockeye is not a concern due to the low numbers of returning sockeye natural-origin or hatchery-origin. Therefore, impacts of hatchery-origin adults competing with natural-origin adults in the Study Area would continue to be undetectable.

Alternative 2 (Proposed Action)

Under Alternative 2, production would be the same as Alternative 1, resulting in similar effects (Undetectable) of competition and predation on natural-origin salmon and steelhead.

4.3.4 Prey Enhancement

The hatchery programs in this EA currently implement or propose to implement a number of actions (e.g., managing fish size at release, release location, and release timing) to reduce the potential interaction between hatchery- and natural-origin salmon. Steelhead are the only species likely to be present and potentially feeding as adults when hatchery fish are released; however, juvenile salmon may prey upon smaller juvenile salmon released from hatcheries (Section 3.3.3.4, Prey Enhancement). The effects of prey enhancement are therefore analyzed for all species other than sockeye salmon because sockeye salmon are not piscivorous (Table 16).

Table 16. Summary of prey enhancement effects.

Species	Alternative 1 - No Action/Current Program	Effect of Alternative relative to Alternative 1
		Alternative 2 – Proposed Action
Salmon and steelhead	Negligible-beneficial	Negligible-beneficial

Alternative 1 (No Action/Current Program)

Under Alternative 1, the hatchery programs would operate as under current conditions. No change would therefore be expected in the prey enhancement effects from the hatchery programs compared to those described in Section 0, Prey Enhancement. Upon release into the natural environment, hatchery-origin juveniles may become prey for natural-origin salmon and steelhead and provide an additional food source. Although Chinook salmon may consume small hatchery fish, the effects would be undetectable. The overall effects of providing potential prey for juvenile and adult Salmon and steelhead would be negligible-beneficial.

Alternative 2 (Proposed Action)

Under Alternative 2, production would be would be the same as under Alternative 1. This alternative would have negligible-beneficial effects compared to Alternative 1 for Sockeye salmon, Chinook salmon, and steelhead.

4.3.5 Disease

Under all alternatives, health monitoring and the implementation of best management practices would take place as described in Chapter 0. The disease effects on salmon and steelhead under each of the alternatives are summarized in Table 17.

Table 17. Summary of disease effects on salmon and steelhead.

Species	Alternative 1 – No Action/Current Program	Effect of Alternative relative to Alternative 1
		Alternative 2 – Proposed Action
Salmon and steelhead	Negligible-adverse	Negligible-adverse

Alternative 1 (No Action/Current Program)

Under Alternative 1, hatchery production would continue to occur at current levels. Disease occurrence would continue at the very low level that has been observed (Table 9). One concern for disease is the addition of sockeye salmon and the incidence of IHN virus. IDFG is taking precautions to minimize to the extent possible any outbreaks of IHN. Since there would essentially be no changes from the current conditions, Alternative 1 is considered to have negligible-adverse effects.

Alternative 2 (Proposed Action)

Under Alternative 2, the number of fish reared would not change from Alternative 1, and therefore would be negligible-adverse compared to Alternative 1.

4.3.6 Population Viability

The Snake River sockeye salmon hatchery program is intended to provide viability benefits to the sockeye salmon population in the analysis area. The sockeye salmon hatchery program is intended to be used as a conservation program to increase spatial structure and abundance. The effect of the hatchery program on population viability for both alternatives can be seen in Table 18.

Table 18. Summary of population viability effects on salmon and steelhead.

ESU or DPS	Alternative 1 – No Action/Current Program	Effect of Alternative relative to Alternative 1 Alternative 2 – Proposed Action
Snake River Sockeye Salmon ESU	Medium-beneficial	Medium-beneficial
Snake River spring/summer Chinook salmon	Undetectable	Undetectable
Snake River steelhead	Undetectable	Undetectable

Alternative 1 (No Action/Current Program)

Under Alternative 1, the sockeye salmon program would result in a benefit to Snake River sockeye salmon population viability by increasing spawner abundance and spatial structure. The hatchery program intends to increase natural-origin, hatchery-origin and juvenile releases of sockeye salmon into the Snake River Basin. The increase of natural-origin and hatchery-origin fish into the system, increases the overall abundance of sockeye. With an increase in abundance, sockeye have a better chance of reproducing, which increases the survivability of the species leading to an increased population viability. Therefore, the effects of the hatchery programs on viability would not change from the current condition, and have a medium-beneficial effect. For spring/summer Chinook salmon and steelhead, the Snake River sockeye salmon hatchery program would have undetectable effects on population viability.

Alternative 2 (Proposed Action)

Under Alternative 2, the effects from the hatchery programs on population viability in the Snake River Basin would be the same as Alternative 1, and therefore would have a medium-beneficial population viability effect on Snake River sockeye salmon, and undetectable effects on Chinook salmon and steelhead.

4.3.7 Nutrient Cycling

The nutrient cycling effects on salmon and steelhead under each of the alternatives are summarized in Table 19.

Table 19. Summary of nutrient cycling effects.

Resource	Alternative 1 – No Action/Current Program	Effect of Alternative relative to Alternative 1 Alternative 2 – Proposed Action
Salmon and steelhead	Negligible-beneficial	Negligible-beneficial

Alternative 1 (No Action/Current Program)

Under Alternative 1, a portion of the returning adults from the sockeye salmon hatchery program are allowed to reach the spawning grounds after escaping fisheries and collection for broodstock, and thus contribute to marine-derived nutrients to the streams after they spawn. The release of adult hatchery fish to spawn naturally directly increases the marine-derived nutrients into the section of river where they spawn. While the addition of hatchery fish on the spawning grounds will increase marine-derived nutrients into the stream, the total nutrients needed to increase food productivity for salmon and steelhead

would still be lacking because of the amount needed to be added to be detectable. Therefore, Alternative 1 would have a negligible-beneficial effect on nutrient cycling compared to current conditions because of the increase in nutrient cycling.

Alternative 2 (Proposed Action)

There would only be a potentially small incremental increase in nutrient cycling effects under Alternative 2 compared to Alternative 1 because release numbers and potential adult returns would be higher compared to Alternative 1. While numbers are small, the increase in returns would provide more marine-derived nutrients to the spawning grounds. Therefore, Alternative 2 would have negligible-beneficial nutrients cycling effects similar to Alternative 1 because it maintains the increase in nutrient cycling.

4.3.8 Facility Operations

The facility operation effects on salmon and steelhead under each of the alternatives are summarized in Table 20. The discussion of ongoing effects of hatchery facility operations on salmon and steelhead in this section is restricted to the operation of weirs and traps for juveniles and adults, water intake structures, and facility maintenance activities. The effects also include the effects of trapping and hauling salmon and steelhead.

Table 20. Summary of facility operation effects on salmon and steelhead.

Resource	Alternative 1 – No Action/Current Program	Effect of Alternative relative to Alternative 1 Alternative 2 – Proposed Action
Salmon and Steelhead	Negligible-adverse	Negligible-adverse

Alternative 1 (No Action/Current Program)

Under Alternative 1, broodstock would still be trapped at the Sawtooth Hatchery and the weir on Redfish Lake Creek. In addition, the juvenile trap in Redfish Lake Creek would still operate. Sawtooth Hatchery weir and Redfish Lake Creek weir are checked, and maintained daily to reduce or eliminate stress, injury or mortality to any listed salmonids. All weirs are engineered properly and installed in locations that minimize adverse impacts to ESA listed salmonids (IDFG 2022). Hatchery staff are trained on how to properly handle, and transport salmonids to minimize any stress on the fish. Mortality rates are low and are monitored and reported by the hatchery facilities annually. New mitigation efforts are considered every year to further prevent stressors from effecting ESA listed salmonids. All facilities intake screens abide by the most recent NMFS' 2011 screen criteria (NMFS 2011b). These criteria ensure that the mesh or slot-size in the screening material and the approach velocity of water toward the intake screening meet standards that reduce the risk of both entrainment and impingement of listed juvenile salmonids. Moreover, facilities are routinely observed for any signs that screens are no effectively excluding fish from intakes. Thus, we do not anticipate effects on listen salmon and steelhead from water intake structures. Therefore, operation of the facilities will impact salmon and steelhead to some very low-level degree, meaning Alternative 1 is considered to have a negligible-adverse effect.

Alternative 2 (Proposed Action)

Under Alternative 2, production levels and facility operations effects would be the same as current conditions for some facilities, but also increase at some facilities. However, production increases are minimal and therefore have a negligible-adverse effect on salmon and steelhead in the analysis area under Alternative 2, compared to Alternative 1.

4.3.9 Research Monitoring and Evaluation

As described in Section 0, Research Monitoring and Evaluation, RM&E activities have resulted in stress and low levels of mortality of natural-origin salmon and steelhead in the analysis area under current

conditions, though the information gained through RM&E activities outweighs the risks to the populations. The RM&E effects on salmon and steelhead under each of the alternatives are summarized in Table 21.

Table 21. Summary of research, monitoring, and evaluation effects on salmon and steelhead.

Resource	Alternative 1 – No Action/Current Program	Effect of Alternative relative to Alternative 1 Alternative 2 – Proposed Action
Salmon and steelhead	Low-adverse	Low-adverse

Alternative 1 (No Action/Current Program)

Under Alternative 1, RM&E activities would continue as currently outlined in Section 0, Research Monitoring and Evaluation. These activities include spawning ground surveys, measurements on broodstock, trapping, counting and measuring salmon captured in weirs and traps, and evaluation of whether performance targets are met. Many of the associated RM&E activities involve fish handling, and other associated impacts that can harm the fish. The fish are handled during genetic sampling efforts, broodstock collection, transport between laboratory, tanks, weirs, and collection facilities which can lead to increased stress levels and sometimes mortality. However, IDFG and tribal staff members are trained in proper fish handling protocol and exercise caution to minimize any stressors the salmonid might incur (IDFG 2022). Because of the stress and potential for mortality of some of these activities on salmon and steelhead, Alternative 1 has a low-adverse effect on salmon and steelhead through RM&E.

Alternative 2 (Proposed Action)

Under Alternative 2, RM&E activities effects would be the same as Alternative 1 for all activities, and therefore have a low-adverse effect on salmon and steelhead in the analysis area under.

4.4 Other Fish Species

The Snake River Basin Sockeye Salmon Hatchery Program may have some similar effects on other fish species as those effects described in Section 3.3.2, Ongoing Effects of the Hatchery Program. Predators, prey base, and competitors of salmon and steelhead might be affected by the proposed hatchery program. Predators, such as ESA-threatened bull trout, may be positively affected to the extent they prey on hatchery-origin salmon released from the hatchery program. Species of other fish that are prey of salmon may be adversely affected by hatchery-origin salmon released from the hatchery program, however, sockeye salmon are not piscivorous.

Other species of fish that compete with salmon and steelhead may be adversely affected by hatchery-origin salmon released from the Snake River Basin Sockeye Salmon Hatchery Program. Under existing conditions, current releases of sockeye salmon contribute to a relatively small portion of the prey base for the other fish species because of other hatchery releases, natural salmon and steelhead, trout, and aquatic insects that are important prey items in the analysis area. The analysis here first discusses the impacts of the hatchery programs on other fish species generally, then discusses additional impacts on bull trout. The effects on other fish species under each of the alternatives are summarized in Table 22.

Table 22. Summary of effects on other fish species.

Resource	Alternative 1 – No Action/Current Program	Effect of Alternative relative to Alternative 1 Alternative 2 – Proposed Action
Other Fish Species	Negligible-adverse	Negligible-adverse
Bull trout	Low-beneficial	Low-beneficial

4.4.1 Alternative 1 (No Action/Current Program)

For Alternative 1, one million (1,000,000) yearlings would be released from the sockeye salmon hatchery program in the Salmon River Basin (Table 2). Some of these fish would be available as prey or competitors for other fish species. In general, there is a very low potential for adverse effects on other fish species through predation and competition, because sockeye are known to spend most of their time in their nursery lake before quickly moving through the migratory corridor and out to the ocean (Burgner 1987; NMFS 2015). Sockeye are also planktivorous mostly feeding on zooplankton and not known to prey on other fish species ((Burgner 1987), (NMFS 2015); (2017a)). Therefore, Alternative 1 would have a negligible-adverse effect on other fish species.

For bull trout, the hatchery programs are most likely having a beneficial effect by providing a larger prey base. Bull trout are believed to be the top native piscivorous predator in the Sawtooth Valley lakes. It was estimated that bull trout along with introduced rainbow trout consumed up to 60% of the sockeye salmon eggs, fry and pre-smolts in Alturas Lake as well as seen in the guts of bull trout collected from Pettit Lake (Bowles and Cochnauer 1984; Taki et al. 2005). Therefore, by increasing the potential food source, Alternative 1 would have a low-beneficial effect.

4.4.2 Alternative 2 (Proposed Action)

Under Alternative 2, the same number of juvenile sockeye salmon released under Alternative 1 would be released, and would be available as prey or competitors for other fish species. However, the number of sockeye salmon juveniles released under Alternative 2 would be only a small fraction of other hatchery releases and natural abundance of other fish species that could be prey, be predators or competitors of hatchery-origin salmon and steelhead in the analysis area. Therefore, the effect of operating the Snake River Basin salmon and steelhead hatchery programs would be the same as Alternative 1 (Table 22).

4.5 Wildlife

Under all alternatives, hatchery-origin sockeye salmon interact with wildlife but represent only a small proportion of other hatchery-origin and natural-origin salmonids interacting with wildlife. The effects on wildlife under each of the alternatives are summarized in Table 23.

Table 23. Summary of effects on wildlife.

Resource	Alternative 1 – No Action/Current Program	Effect of Alternative relative to Alternative 1 Alternative 2 – Proposed Action
Wildlife	Negligible-beneficial	Negligible-beneficial

4.5.1 Alternative 1 (No Action/Current Program)

Under Alternative 1, hatchery-origin sockeye salmon juveniles would be released and would be available as prey or be a predator for wildlife. In 2013, osprey (*Pandion haliaetus*) were found actively feeding in Little Redfish Lake, located below the release site, as fish were moving through the area (NMFS 2015). Other species that prey on sockeye include Mink, otter, and several bird species but more research is needed to document the extent and impact of predation (NMFS 2015). But increasing the prey base could result in a beneficial impact due to providing a larger food source for native species. Overall, the effects on wildlife under Alternative 1 would be negligible-beneficial because of current prey availability related to the salmon and steelhead hatchery programs.

4.5.2 Alternative 2 (Proposed Action)

Under Alternative 2, hatchery-origin salmon and steelhead juveniles would be released and would be available as prey or be a predator for wildlife. However, the hatchery releases from the Snake River Basin Sockeye Salmon Hatchery Program only account for 5% of releases within the Basin which is only a

small fraction compared to the number of other salmonids available as prey or predators for wildlife (NMFS 2018b; 2019c).

Overall, compared to Alternative 1, the effects on wildlife under Alternative 2 would be negligible-beneficial based on the same number of prey availability.

4.6 Marine and Freshwater Habitat

The following discusses the effects of the alternatives on marine and freshwater habitat. The overall effects of the alternatives on critical habitat and EFH vary depending upon species (Table 24). Chinook salmon are the only species with both designated critical habitat and EFH in the Study Area. Depending on the species, effects range from negligible-adverse to negligible-beneficial for Alternative 1 and Alternative 2.

Table 24. Summary of the Snake River sockeye salmon hatchery program effects on Critical Habitat and EFH.

Species	Alternative 1 - No Action/Current Program	Alternative 2 – Proposed Action
Species with Both Critical Habitat and Essential Fish Habitat		
Chinook Salmon	Negligible-beneficial	Negligible-beneficial
Species with Critical Habitat Only		
Steelhead	Negligible-beneficial	Negligible-beneficial
Bull Trout	Negligible-adverse	Negligible-adverse

4.6.1 Alternative 1 (No Action/Current Program)

Under Alternative 1, the sockeye salmon hatchery program would be operated the same as under current conditions, with no change in water use or juvenile release strategies. Therefore, NMFS expects no change in effects on critical habitat or EFH compared to current conditions.

Alternative 1 would result in a negligible-beneficial effect on critical habitat and EFH for Chinook salmon through hatchery operations and existence of associated structures (e.g., weirs, water withdrawal structures), effluent, and operations and maintenance affecting complex channels and floodplain habitat, thermal refugia, and spawning habitat. Sockeye utilize habitat differently than Chinook salmon and steelhead. Sockeye mature in their natal lakes for 1 to 2 years before rapidly leaving the Action Area on their journey to the Pacific Ocean (NMFS 2015). Because of the limited time spent within the critical and EFH habitat, the interaction and effect on other salmonids is excepted to be minimal and result in a negligible-beneficial effect. Although the hatchery programs may enhance the prey base for bull trout, the overall effect would be negligible-adverse because of operation effects described for Chinook salmon and steelhead.

4.6.2 Alternative 2 (Proposed Action)

Under Alternative 2, the sockeye salmon hatchery program would be operated the same as under current conditions, with no change in water use or juvenile release strategies. Therefore, NMFS expects no change in effects on critical habitat or EFH compared to current conditions. The effects of the sockeye salmon hatchery program would be the same for all species considered as Alternative 1 (Table 24).

4.7 Socioeconomics

The following analysis discusses the effects of the alternatives on socioeconomics. As described in Section 3.7, Socioeconomics, the Snake River Basin Sockeye Salmon Hatchery Program provides employment opportunities and procures goods and services for hatchery operations under existing conditions. Tribal salmon and steelhead fisheries may include some commercial harvest in addition to

ceremonial and subsistence harvest, and the effects of this harvest on culture are discussed in Section 3.8, Cultural Resources. Data regarding tribal commercial harvest is not available. The effects on socioeconomics under each of the alternatives are summarized in Table 25.

Table 25. Summary of effects on socioeconomics.

Resource	Alternative 1 – No Action/Current Program	Effect of Alternative relative to Alternative 1 Alternative 2 – Proposed Action
Socioeconomics	Negligible-beneficial	Negligible -beneficial

4.7.1 Alternative 1 (No Action/Current Program)

Under Alternative 1, the hatchery program would continue current numbers of juvenile releases. However, because the return of hatchery fish has been very low, this hatchery program is not contributing to harvest at this time. So, returning hatchery-origin adult sockeye salmon would not be available for Tribal and recreational harvest, but, the economic contributions from hatchery and fishway operations and employment of staff (2 to 4 per hatchery facility) would continue under existing conditions. Because the sockeye salmon hatchery production does not contribute to recreational and Tribal fisheries, Alternative 1 would result in a negligible-beneficial effect on socioeconomics.

4.7.2 Alternative 2 (Proposed Action)

Under Alternative 2, the hatchery production would continue at current levels. Economic contributions from hatchery and fishway operations and employment of staff would continue under Alternative 2. Because the economic contributions from employment would continue under this alternative, Alternative 2 would result in a negligible-beneficial effect on socioeconomics.

4.8 Cultural Resources

The following section discusses the effects of the alternatives on cultural resources. The survival and well-being of Native American people and tribal culture are inextricably linked to the survival and well-being of salmon and steelhead. The total number of adult salmon and steelhead returning to the Upper Salmon River Basin is limited and has impacted the tribes' ability to harvest. As described in Section 3.8, Cultural Resources, sockeye salmon produced by the Snake River Basin Sockeye Salmon Hatchery Program provide an important cultural benefit to the Treaty Tribes in the Columbia River Basin. The effects on cultural resources under each of the alternatives are summarized in Table 26.

Table 26. Summary of effects of the Snake River sockeye salmon hatchery program on cultural resources.

Resource	Alternative 1 – No Action/Current Program	Effect of Alternative relative to Alternative 1 Alternative 2 – Proposed Action
Cultural Resources	Low-beneficial	Low-beneficial

4.8.1 Alternative 1 (No Action/Current Program)

Under Alternative 1, the Snake River sockeye salmon hatchery program would continue to release juveniles. However, because the return of hatchery fish has been very low, this hatchery program is not contributing to harvest at this time. So, returning hatchery-origin adult sockeye salmon would not be available for Tribal and recreational harvest. Under Alternative 1, there would be a low-beneficial effect

on cultural resources because, while not contributing to fisheries at this time, reestablishment of Snake River sockeye salmon is still a priority for cultural and environmental reasons to the Tribes.

4.8.2 Alternative 2 (Proposed Action)

Under Alternative 2, sockeye salmon would be annually released, and a portion of those released would return to the Upper Salmon River Basin. However, because the return of hatchery fish has been very low, this hatchery program is not contributing to harvest at this time. So, returning hatchery-origin adult sockeye salmon would not be available for Tribal and recreational harvest. Under Alternative 2, as with Alternative 1, there would be a low-beneficial effect on cultural resources because, while not contributing to fisheries at this time, reestablishment of Snake River sockeye salmon is still a priority for cultural and environmental reasons to the Tribes.

4.9 Environmental Justice

This section assesses if there would be disproportionately high adverse human health or environmental effects from the sockeye salmon hatchery program under the alternatives on minority and low-income environmental justice populations. In Section 3.9, Environmental Justice, Native American tribes were identified as the potentially affected environmental justice population. The analysis of environmental justice effects is different from the analysis of effects on the other resources in Chapter 4. The analysis first determines whether effects on the resources analyzed in the EA are adverse under any alternative, and if so, whether such adverse effects would be disproportionately high to the identified environmental justice populations. Effects of the alternatives on water quantity, water quality, salmon and steelhead, other fish species, and wildlife would not disproportionately affect environmental justice populations or communities. The effects analyzed in Section 4.7, Socioeconomics, also did not pertain to tribal harvest.

As described in Section 3.9, Environmental Justice, the availability of fish for tribal harvest use provides an important cultural resource value to Native American tribes. The current Snake River Basin Sockeye Salmon Hatchery Program does not currently support tribal harvest.

Table 27. Summary of effects of the Snake River sockeye salmon hatchery program on environmental justice.

Resource	Alternative 1 – No Action/Current Program	Effect of Alternative relative to Alternative 1
		Alternative 2 – Proposed Action
Environmental justice	Low-beneficial	Low-beneficial

4.9.1 Alternative 1 (No Action/Current Program)

Effects on cultural resources important to Tribes would continue to be low-beneficial under Alternative 1. The hatchery programs would continue to provide economic opportunities (Section 4.7, Socioeconomics) and fish of cultural importance to Tribes (Section 4.8, Cultural Resources). Tribal commercial fishing and tribal hatchery employment would be the same as under existing conditions. This effect would not be disproportionate because all commercial and recreational fishermen, as well as Tribes, would be equally affected.

4.9.2 Alternative 2 (Proposed Action)

Under Alternative 2, returning hatchery-origin adult salmon are expected in the future to be available for tribal harvest. Because beneficial cultural resource effects are anticipated under Alternative 2, no disproportionate adverse effects are anticipated, and therefore the effects of the hatchery programs would be low-beneficial.

4.10 Summary

A summary of the effects of the alternatives on the nine resources is shown in Table 28. Effects of the sockeye salmon hatchery program on the nine resources evaluated ranged from undetectable to low-adverse.

Table 28. Summary of effects of the alternatives on nine resources.

Resource	Species	Alternative	
		No Action/Current Program (1)	**Proposed Action (2)**
Water Quantity	All	Negligible-adverse	Negligible-adverse
Water Quality	All	Negligible-adverse	Negligible-adverse
Fish			
Genetics	Spring/summer Chinook salmon	Undetectable	Undetectable
	Sockeye salmon	Negligible-beneficial	Negligible-beneficial
	Steelhead	Undetectable	Undetectable
Competition and Predation	Chinook salmon	Undetectable	Undetectable
	Sockeye salmon	Undetectable	Undetectable
	Steelhead	Undetectable	Undetectable
Prey enhancement	Salmon and steelhead	Negligible-beneficial	Negligible-beneficial
Disease	Salmon and steelhead	Negligible-adverse	Negligible-adverse
Population Viability	Snake River Sockeye Salmon ESU	Medium-beneficial	Medium-beneficial
	Snake River spring/summer Chinook salmon	Undetectable	Undetectable
	Snake River steelhead	Undetectable	Undetectable
Nutrient Cycling	Salmon and steelhead	Negligible-beneficial	Negligible-beneficial
Facility Operation	Salmon and steelhead	Negligible-adverse	Negligible-adverse
Research, Monitoring, and Evaluation	Salmon and steelhead	Low-adverse	Low-adverse
Other Fish Species	Other Fish Species	Negligible-adverse	Negligible-adverse
	Bull trout	Low-beneficial	Low-beneficial
Wildlife	All	Negligible-beneficial	Negligible-beneficial
Marine and Freshwater Habitat			
Species with Both Critical Habitat and Essential Fish Habitat	Chinook salmon	Low-adverse	Low-adverse
Species with Critical Habitat Only	Steelhead	Low-adverse	Low-adverse
	Bull trout	Negligible-adverse	Negligible-adverse
Socioeconomics	NA	Negligible -beneficial	Negligible -beneficial
Cultural Resources	NA	Low-beneficial	Low-beneficial
Environmental Justice	NA	Low-beneficial	Low-beneficial

5 CUMULATIVE EFFECTS

Cumulative effects were assessed by combining the effects of each alternative with the effects of other past, present, and reasonably foreseeable future actions that are impacting or will impact the same resources potentially affected by each alternative. Actions are included only if they are tangible and specific, and if effects overlap temporally and geographically with the Proposed Action.

5.1 Past, Present, and Reasonable Foreseeable Actions

The effects of past and present actions on resources potentially affected by the Proposed Action are recognized as current conditions described in Chapter 3. Historical development of the Columbia River Basin for electrical power, drinking water, flood control, navigation, and agricultural needs influenced the existing condition of resources in the study areas. These developments, along with other factors such as historic harvest, has led to implementation of management and recovery actions, including numerous hatchery programs.

The expected impacts of the alternatives on all of the resources are described in Chapter 4, Environmental Consequences. However, Chapter 4 does not account for other future foreseeable actions. Reasonably foreseeable future actions with the potential to have cumulative effects with the alternatives described in this EA include climate change, land development, habitat restoration, hatchery production, and fisheries. The following subsections describe the reasonably foreseeable actions and conditions related to these factors.

5.1.1 Geographic and Temporal Scales

The geographic area included in the cumulative effects analysis for this EA includes the portions of the Snake River Basin defined in Section 1.2, Project and Analysis Area. The Project Area includes locations immediately adjacent to hatchery facilities, acclimation sites, and weir locations. The scope of the action considered in this EA includes the rearing and release of sockeye salmon in the Snake River Basin. Adult collection, rearing, and release activities would occur in localized areas only; the associated direct and indirect effects of these activities would occur to varying degrees in the Project Area and larger study areas, depending on the affected resource, as analyzed in Chapter 4, Environmental Consequences.

Although direct and indirect effects of the Proposed Action are not expected to be measurable outside the Study Area, it is important to consider how effects of certain activities outside the Study Area may or may not interact with the Proposed Action to exacerbate impacts on resources. Potential cumulative effects are analyzed below, as is how these effects might correspond with the cumulative effects of hatchery programs in the Columbia River Basin.

Issuance of an ESA section 10(a)(1)(A) does not have a specified time limit. NMFS reviews annual reports provided by applicants, and authorizations may be modified when warranted by NMFS.

5.1.2 Climate Change

The Project Area is in the Pacific Northwest where the effects of climate change are affecting hydrologic patterns and water temperatures. Climate change impacts to the regional hydrologic cycle and ESA-listed salmon and steelhead populations, as well as their habitats, have been evaluated extensively (ISAB 2007; Karl et al. 2009; USBR 2016). Evidence of climate change includes increased average annual air and water temperatures over the past century. Ford et al. (2011) summarized expected climate changes in the coming years as leading to a high certainty of some physical and chemical changes:

- Increased air temperature
- Reduced winter and spring snowpack
- Reduced summer stream flow
- Earlier spring peak flow

- Higher sea level
- Higher ocean temperatures
- Increased ocean acidity

Climate change is expected to continue to occur over the long term. Thus, the analysis of resource effects reflects shorter-term effects in relation to the scale of climate change. Localized future actions (e.g., urbanizing developments) have a greater potential to impose immediate, substantial cumulative effects on resources when combined with the direct and indirect effects analyzed in Chapter 4, Environmental Consequences.

5.1.3 Development

Human population growth in the Colombia River Basin area is expected to continue over the next 15 years (Council 2013), which will result in increased demand for housing, transportation, food, water, energy, and commerce. These needs will result in changes to existing land uses because of increases in residential and commercial development and roads, increases in impervious surfaces, conversions of private agricultural and forested lands to developed uses, increases in use of non-native species and increased potential for invasive species, and redevelopment and infill of existing developed lands. Development will continue to affect the natural resources in the cumulative effects Study Area.

5.1.4 Habitat Restoration

Throughout the Columbia River Basin, habitat restoration efforts are supported by Federal, state, and local agencies; tribes; environmental organizations; and communities. Projects supported by these entities focus on improving general habitat and ecosystem function or species-specific conservation objectives that, in some cases, are identified through ESA recovery plans. The larger, more region-wide, restoration and conservation efforts, either underway or planned throughout the Columbia River Basin, are presented below. These actions have helped restore habitat, improve fish passage, and reduce pollution. While these efforts are reasonably likely to occur, funding levels may vary on an annual basis. Some examples include:

- National Oceanic and Atmospheric Administration (NOAA) – Community-based Restoration Program (CRP)
- NMFS – Pacific Coastal Salmon Recovery Fund (PCSRF), Columbia and Snake Rivers
- Northwest Power Planning and Conservation Council – Fish and Wildlife Program, Columbia and Snake Rivers
- State of Idaho – ESA Section 6 Cooperative Agreement
- State of Oregon – Oregon Plan for Salmon and Watersheds
- State of Washington – Governor's Salmon Recovery Office
- Miscellaneous Funding Sources – Regional and Local Habitat Restoration and Conservation Support

5.1.5 Hatchery Production

The type and extent of salmon and steelhead hatchery programs other than those considered under the alternatives and the numbers of fish released in the cumulative effect's analysis area will likely change over time in response to new information and evolving management objectives. The Mitchell Act Final Environmental Impact Statement (NMFS 2014), outlines 112 out of the 115 current hatchery programs spread across the Columbia Basin that are incorporated into the *US v Oregon* Management agreement. The *US v Oregon* Impact Analysis Final Environmental Impact Statement (NMFS 2017c) concludes that salmon and steelhead hatchery programs can have beneficial effects to these species but also pose risks. However, the benefits outweigh the risks (NMFS 2017c).

Hatchery program compliance with conservation provisions of the ESA will ensure that listed species are not jeopardized and that "take" under the ESA from salmon and steelhead hatchery programs is minimized or avoided. New conservation programs for the Snake River Basin may be proposed in the future to bolster natural-origin populations. Assuming future compliance with the ESA and continued implementation and/or expansion of conservation hatchery programs, such hatchery programs would be a benefit to help increase the abundance of salmon and steelhead populations in the future.

5.1.6 Fisheries

Fisheries that harvest salmonids in the study area will likely change over time in response to new information and revised management objectives.

5.2 Impacts Analysis

This subsection discusses the effects on resources assessed in Chapter 4, Environmental Consequences, when considered cumulatively with the alternatives and the past, present, and reasonably foreseeable future actions described above.

5.2.1 Water Quantity

Successful operation of hatcheries included in this EA depends primarily on a constant supply of high-quality water that, after use in hatchery facilities, is discharged to adjacent receiving environments. Under existing conditions, the Snake River Basin Sockeye Salmon Hatchery Program has had a negligible-adverse effect on water quantity (Section 4.1, Water Quantity). The direct and indirect effects of the alternatives on water quantity would result in a negligible-adverse effect under Alternative 1 (No Action/Current Program) and a negligible-adverse effect under Alternative 2 (Proposed Action). Climate change and development are expected to affect water quantity by changing seasonality and magnitude of flows. If available water decreases to levels below those required for hatchery programs, then hatchery production would be reduced or even terminated if necessary. Although existing regulations are intended to help protect water quantity from effects related to future development, the effectiveness of these regulations over time is likely to vary. Future habitat restoration may improve water quantity (such as helping to decrease water diversions and protect aquifers and recharge areas).

5.2.2 Water Quality

Under existing conditions, the Snake River Basin Sockeye Salmon Hatchery Program has had a negligible-adverse effect on water quality (Subsection 4.2, Water Quality). The direct and indirect effects of the alternatives on water quality would result in a negligible-adverse effect under Alternative 1 (No Action/Current Program) and a negligible -adverse effect under Alternative 2 (Proposed Action). Climate change and development are expected to affect water quality by increasing water temperatures, and the presence of toxic chemicals and other pollutants in stormwater runoff. Although existing regulations are intended to help protect water quality from effects related to future development, the effectiveness of these regulations over time is likely to vary. Future habitat restoration would likely improve water quality (such as helping to decrease water temperatures through shading, and decreased sedimentation).

As discussed in Subsection 5.1.5, Hatchery Production, changes in hatchery programs other than those considered under the alternatives may occur over time. Water quality would be protected from changes in production within the existing programs, or from new programs, by compliance with NPDES permits where applicable. Salmon and steelhead fisheries would not be expected to affect water quality because fishing activities, other than the potential for unintentional and generally minor oil and gas leakage from motor boat use, do not result in the release of any contaminants into the aquatic environment.

Overall, climate change, development, and hatchery production are likely to impair water quality more than is described in Subsection 4.2, Water Quality. These effects may be offset to some extent by habitat restoration; however, these habitat actions may not fully, or even partially, mitigate for the impacts of

climate change and development on water quality. Effects under Alternative 1 and Alternative 2 would continue to contribute to the adverse trends on water quality due to the production of hatchery-origin salmon. Nevertheless, the overall adverse trends in water quality resulting from the cumulative effects of climate change, development, habitat restoration, hatchery production, and fisheries would be similar under all alternatives because increased stream temperatures caused by climate change and development, and degraded water quality caused by development would occur regardless of alternative and would outweigh any adverse effects on water quality caused by hatchery operations.

5.2.3 ESA-listed Salmon and Steelhead

As described in Subsection 4.3.1, ESA-listed Salmon and Steelhead, and shown in Table 28, depending on the species affected, the hatchery programs under Alternative 1 (No Action/Current Program) and Alternative 2 (Proposed Action) would have undetectable to low-adverse effects on natural-origin salmon and steelhead due to genetics, competition and predation, disease transfer risks, facility operations, RM&E, prey enhancement, population viability, and nutrient enhancement.

Salmon and steelhead abundance naturally alternate between high and low levels on large temporal and spatial patterns that may last centuries and on more complex ecological scales than can be easily observed (Rogers et al. 2013). Thus, cumulative effects on salmon and steelhead may be greater than the direct and indirect effects of each alternative as analyzed in Subsection 4.3.1, ESA-listed Salmon and Steelhead.

Climate change and development may reduce fish habitat and result in increased competition and predation compared to that described in Subsection 4.3.1, ESA-listed Salmon and Steelhead. Continuing development results in environmental effects such as reduced forested area, sedimentation, impervious surface water runoff to streams, changes in stream flow because of increased consumptive uses, shoreline armoring, barriers to fish passage, and other types of changes that would continue to affect hatchery-origin and natural-origin salmon and steelhead (Quinn 2010). Although habitat may be improved through restoration efforts, climate change and development may result in short- and long-term losses of habitat quality and quantity. Reductions in habitat may increase competition and predation risks within and among salmon and steelhead. In contrast, improved habitat conditions and increased food sources for salmon and steelhead (from habitat restoration), may ameliorate competition and predation risks, particularly in the context of other environmental threats that may impede salmon and steelhead recovery.

Climate change and development have the potential to exacerbate genetic risks to salmon and steelhead. For example, small salmon and steelhead population sizes can be further reduced to critical levels by the effects of climate change and development, posing genetic risks to within-population diversity. Furthermore, climate change and development may result in habitat changes that affect the way groups of fish are adapted to be genetically similar or different from each other. These habitat changes may include the extent to which water of suitable volume and temperature exists for adult salmon and steelhead to reach spawning areas. They may also affect patterns of straying in natural-origin and hatchery-origin fish, which may affect genetic diversity that prevents fish from being able to adapt to changing environmental conditions, and thus persist over time.

Climate change and development in the cumulative effects Study Area may reduce the abundance and productivity of natural-origin salmon and steelhead because of mechanisms such as:

- Increased mortality of salmon and steelhead because of more frequent and seasonally different flood flows, changed thermal regime during incubation, and lower disease resistance,
- Higher metabolic demands on fish because of warmer winter temperatures, which may also contribute to lower survival in winter if food is limiting, and
- Increased predator activity because of warmer winter temperatures, which can also contribute to lower winter survival.

Similarly, climate change and development may also impact the spatial structure and diversity of natural origin salmon and steelhead compared to direct and indirect conditions described in Subsection 4.3.1, ESA-listed Salmon and Steelhead. It is anticipated that cumulative adverse effects of climate change and development on overall viability of natural origin salmon and steelhead species in terms of individual abundance, productivity, spatial structure, and diversity parameters would occur over the next 15 years and beyond.

After spawning naturally, salmon and steelhead carcasses decompose in streams and thus return nutrients from the ocean to freshwater habitat. Hatchery-origin carcasses resulting from hatchery operations are also placed in streams to increase marine-derived nutrients in aquatic habitat in some programs. To the extent fewer natural-origin adult salmon and steelhead spawn in the future because of climate change and development, the relative importance of marine-derived nutrient contributions from hatchery-origin fish may be greater than described in Subsection 4.3.1, ESA-listed Salmon and Steelhead. Increased natural production of salmon and steelhead from habitat restoration actions may mitigate for these potential cumulative effects, but it is unlikely that habitat restoration could fully mitigate for the combined adverse effects of climate change and development in the cumulative effects Study Area.

Under all alternatives, effects on salmon from climate change and development are expected to be similar, because development would impact fish habitat and life history stages under each alternative in the same manner. Salmon hatchery production levels would not change the effects of climate change and development on aquatic habitat conditions (e.g., changes in sedimentation and stormwater runoff from impervious surfaces); however, the effects of Alternative 1 and Alternative 2 may partially offset some climate change and development effects on salmon populations. For example, salmon reared in a hatchery would not be exposed to mortality resulting from more frequent peak flows that are projected to occur with climate change, or from increased sedimentation that is projected to occur with development.

Habitat restoration efforts described in Subsection 5.1.4, Habitat Restoration, are anticipated to occur in the cumulative effect's analysis area in the future, and although difficult to quantify, potential benefits are expected to occur in localized areas. Benefits from habitat restoration are expected to affect salmon and steelhead survival and abundance similarly under all alternatives. Examples of such benefits may include increased habitat quality for foraging and spawning, improved water quality for fish survival, and increased fish passage through culverts to previously blocked habitat. However, these actions may not fully mitigate for the impacts of climate change and development on fish and their associated habitats. In part, this is because climate change and development will likely continue to occur over time and affect aquatic habitat, while habitat restoration is less certain under all alternatives due to its dependence on funding. Benefits from habitat restoration are expected to affect salmon and steelhead survival and abundance similarly under all alternatives.

The adverse effects on natural-origin salmon and steelhead from future salmon and steelhead hatchery releases in the Columbia River Basin are expected to decrease over time, especially for listed species, as hatchery programs are reviewed and approved under the ESA (Subsection 5.1.5, Hatchery Production). For example, reduction of genetic risks may occur through application of new research results that lead to improved BMPs, increased use of integrated hatchery programs, and reductions in production levels, where appropriate. Over time, changes like these would also be expected to reduce the ecological risks of competition and predation because BMPs would increase the efficiency of hatchery operations, and reduced production would decrease the potential for encounters between hatchery-and natural-origin fish in migration, rearing, and spawning areas.

Risks posed by hatchery facilities and operations include genetic, survival, disease, straying, competition, predation, water quality and quantity, and passage issues risks. These risks are based on hatchery facility design, operation, and maintenance. In the long term, some local climate change effects from hatchery facilities and their operation may occur to salmon and steelhead (e.g., flood damage to hatchery infrastructure and operations [e.g., roads], disruption of water flow resulting in difficulty in attracting

broodstock, and increased flow-related siltation that could smother egg incubation trays). However, these effects would be localized and temporary and would not likely affect salmon and steelhead in the short term or over the entire cumulative effects Study Area.

As described in Subsection 5.1.5, Fisheries, management of fisheries resources is expected to continue into the indefinite future and would change over time, based on pre-season forecasts of fisheries returns, such that harvest meets resource conservation needs, meets sustainable fisheries goals, and assures all parties are afforded their allotted harvest opportunity. Co-managers conduct pre-season planning each year for salmon and steelhead fisheries in the Columbia River Basin, and all available information is considered. Adverse effects of fisheries on ESA-listed natural-origin salmon and steelhead are expected to decrease over time to the extent that fisheries management programs continue to be revised by the co-managers and reviewed and approved by NMFS. Fisheries management program compliance with conservation provisions of the ESA will ensure that listed species are not jeopardized and that "take" under the ESA from salmon and steelhead fisheries is minimized or avoided. Effects on salmon and steelhead from fisheries are expected to be similar for each alternative, because management and planning would take different release numbers and expected adult returns into account.

In summary, effects from climate change and development would likely continue to degrade aquatic habitat over time, and abundance and productivity of natural-origin salmon and steelhead populations may be reduced relative to existing conditions considered in Section 3.3.1, Salmon and Steelhead. Hatchery-origin salmon and steelhead may be similarly affected. Habitat restoration and associated (mostly localized) benefits to salmon and steelhead would be expected to continue but may not fully mitigate for all habitat degradation. In addition, effects on abundance and productivity of ESA-listed natural-origin salmon and steelhead from changes in hatchery production and fisheries would be expected to continue but may decrease over time. Under all alternatives, the negative trend in cumulative adverse effects on salmon and steelhead would not be substantially affected.

5.2.4 Other Fish Species

As described in Subsection 4.4, Other Fish Species, the hatchery programs under Alternative 1 (No Action/Current Program) and Alternative 2 (Proposed Action) would have negligible-adverse to low-beneficial effects on other fish species due to competition and predation, disease transfer risks, facility operations, prey enhancement, and nutrient cycling, and RM&E.

Effects from climate change, development, and fisheries would likely result in adverse trends for other fish species, whereas habitat restoration and hatchery production in the Snake River Basin would partially offset this trend. As discussed in Subsection 5.1.4, Habitat Restoration, the extent to which habitat restoration actions may mitigate impacts from climate change and development is difficult to predict. These actions may not fully mitigate for the effects of climate change and development. Changes in overall hatchery programs within Columbia River Basin over time may also affect other fish species. For example, reductions in hatchery production or terminations of hatchery programs may decrease the prey base available for piscivorous fish species, whereas increases in production may increase the prey base, but could also increase the effects of competition with and predation on other salmonids.

5.2.5 Wildlife

As described in Section 4.5, Wildlife, the hatchery programs under Alternative 1 (No Action/Current Program) and Alternative 2 (Proposed Action) would have negligible-beneficial effects on wildlife due to prey enhancement. Because climate change and development in the cumulative effects Study Area may reduce the abundance and productivity of salmon and steelhead populations, the total number of salmon and steelhead available as prey to wildlife may be lower than that considered in Subsection 4.5, Wildlife. The potential benefits of habitat restoration actions within the cumulative effects analysis area may not fully mitigate for the effects of climate change and development on salmon and steelhead abundance. Reduced abundance of salmon and steelhead would also decrease the number of carcasses available to

wildlife for scavenging. Effects would be most detrimental to wildlife species that have a strong relationship with salmon and steelhead. Cumulative effects to these species may include changes in distribution in response to changes in the distribution of their food supply, decreases in abundance, and decreases in reproductive success compared to that described in Subsection 4.5, Wildlife.

As discussed in Subsection 5.1.5, Hatchery Production, and Subsection 5.1.6, Fisheries, changes in hatchery programs and fisheries may occur over time. For example, changes in prey abundance, climate change and habitat degradation may cause populations to decrease or change over time.

5.2.6 Freshwater Habitat

As described in Section 4.6, Freshwater Habitat, depending on the species affected, the hatchery programs under Alternative 1 (No Action/Current Program) and Alternative 2 (Proposed Action) would have low-beneficial and low-adverse effects on critical and essential habitat due primarily to hatchery operations and associated structures (adverse), and increased prey availability (beneficial).

Climate change and development may make it more difficult to protect the physical components of critical and essential habitat. Habitat restoration actions may not fully mitigate for these cumulative effects. Thus, cumulative effects on salmon and steelhead may be greater than the direct and indirect effects of each alternative as analyzed in Section 4.6, Freshwater Habitat.

Under all alternatives, effects on freshwater habitat from climate change and development are expected to be similar, because development would impact habitat under each alternative in the same manner. Salmon hatchery production levels would not change the effects of climate change and development on aquatic habitat conditions; however, the effects of Alternative 1 and Alternative 2 may partially offset some climate change and development effects on critical habitat through increased prey availability for some species

Habitat restoration efforts described in Subsection 5.1.4, Habitat Restoration, are anticipated to occur in the cumulative effects analysis area in the future, and although difficult to quantify, potential benefits are expected to occur in localized areas. Benefits from habitat restoration are expected to affect freshwater habitat similarly under all alternatives. However, these actions may not fully mitigate for the impacts of climate change and development. Benefits from habitat restoration are expected to affect salmon and steelhead survival and abundance similarly under all alternatives.

In summary, effects from climate change and development would likely continue to degrade aquatic habitat over time, and condition of marine and fresh water habitat may be reduced relative to existing conditions considered in Section 4.6, Freshwater Habitat. Habitat restoration would be expected to continue but may not fully mitigate for all habitat degradation. Under all alternatives, the negative trend in cumulative adverse effects on habitat would not be substantially affected.

5.2.7 Socioeconomics

Under existing conditions, the sockeye salmon hatchery program has a negligible-beneficial effect on socioeconomics (Subsection 4.7, Socioeconomics). The direct and indirect effects of the alternatives on socioeconomics would result in a negligible-beneficial effect under Alternative 1 (No Action/Current Program) and Alternative 2 (Proposed Action).

Climate change and development may reduce the number of salmon and steelhead available for harvest over time. Habitat restoration actions may not fully mitigate for these cumulative effects. Changes in fisheries may also occur over time, which could alter the direction and magnitude of socioeconomic effects provided by hatchery production of salmon and steelhead. Reductions in the number of salmon and steelhead available for harvest over time reduces the income earned through commercial fisheries, and the number of salmon and steelhead exported to outside economies relative to conditions considered in Section 4.7, Socioeconomics. If abundance of salmon and steelhead decreases as a result of future climate change combined with development in the cumulative effects Study Area, then the benefit of

commercial fisheries may be lower than described in Section 4.7, Socioeconomics, unless prices increase as a result of reduced supply.

If fewer fish are available for harvest and more restrictions are in place (e.g., reduced bag limits and fishing seasons), fewer recreational fishermen may be willing to pay for the opportunity to fish or travel to the area to fish. As a result, cumulative effects on gross and net economic values for recreational fishermen may lead to values lower than those considered in Subsection 5.2.7, Socioeconomics, as well as lead to decreased economic benefits to local communities from those considered in Subsection 5.2.7, Socioeconomics.

Climate change and development are unlikely to affect the education and outreach opportunities provided by hatcheries in the urban setting unless the reduction in abundance of salmon reaches a point at which educational opportunities are limited. Changes in hatchery production may affect education and outreach opportunities through increased or decreased opportunities to observe returning fish.

Overall, effects from climate change and development would likely adversely affect socioeconomic resources by decreasing the number of salmon and steelhead available for harvest and reducing associated expenditures and economic values relative to existing conditions described in Section 3.7, Socioeconomics. Reductions may also occur in the number of salmon and steelhead available to tribal members for subsistence use. It is possible that reduced numbers could also reduce the opportunities for education and outreach at the urban hatcheries. Alternative 1 and Alternative 2 would partially offset the negative trend of cumulative effects on socioeconomics due to the availability of salmon from the hatchery programs for harvest, maintenance of or increase in the abundance of natural- origin salmon, and the contribution to hatchery employment and related expenditures.

5.2.8 Cultural Resources

As described in Section 4.8, Cultural Resources, the sockeye salmon hatchery programs has had a low-beneficial effect on cultural resources. The direct and indirect effects of the alternatives on cultural resources would remain low-beneficial under Alternative 1 (No Action/Current Program) and Alternative 2 (Proposed Action).

As described in Section 5.2.7, Socioeconomics, climate change and development may reduce the number of salmon and steelhead available for harvest over time, and habitat restoration actions may not fully mitigate for these cumulative effects. If abundance of salmon and steelhead decreases further as a result of future climate change combined with development in the cumulative effects Study Area, then the potential benefit of increased production may be lower than described in Section 5.2.8, Cultural Resources.

Overall, effects from climate change and development would likely adversely affect cultural resources by decreasing the number of salmon and steelhead available for harvest relative to existing conditions described in Section 5.2.8, Cultural Resources. Reductions may also occur in the number of salmon and steelhead available to tribal members for subsistence use. Alternatives 1 and 2 could partially offset the negative trend of cumulative effects on cultural resources if increased production results in more opportunities for tribal harvest.

5.2.9 Environmental Justice

As discussed in Section 4.9, Environmental Justice, low-beneficial effects were identified for cultural resources, specifically related to the importance of salmon to Tribes.

As described in Subsection 5.2.3, Salmon and Steelhead, and Subsection 5.2.8, Cultural Resources, the overall effects from climate change, development, habitat restoration, and fisheries would likely continue to decrease the number of salmon and steelhead available to Tribes. Distribution of surplus fish from hatchery programs is dependent on fish availability and at least indirectly affected by levels of hatchery production and harvest policies. Cumulative effects including climate change and development may lead

to fewer salmon being available. A decrease in harvest may also affect further adversely affect tribal salmon fishing revenues and tribal fishing employment. Similarly, cumulative effects may lead to less harvest and less net revenue for non-tribal user groups.

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National Marine Fisheries Service (NMFS)

NMFS's Northwest Fisheries Science Center (NWFSC)

Idaho Department of Fish and Game (IDFG)

Shoshone-Bannock Tribe (SBT)

Oregon Department of Fish and Wildlife (ODFW)

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