SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT

Supplemental Environmental Assessment of NOAA's National Marine Fisheries Service Determination that Seven Hatchery Programs for Snohomish River Salmon as Described in Joint State-Tribal Hatchery and Genetic Management Plans Satisfy the Endangered Species Act Section 4(d) Rule

Prepared by the
National Marine Fisheries Service, West Coast Region

NOAA FISHERIES

In Cooperation with the
Bureau of Indian Affairs, Northwest Regional Office

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Cover Sheet

May 2021 Supplemental Environmental Assessment

Title of Environmental Review:	Supplemental Environmental Assessment of NOAA's National Marine Fisheries Service Determination that Seven Hatchery Programs for Snohomish River Salmon as Described in Joint State-Tribal Hatchery and Genetic Management Plans Satisfy the Endangered Species Act Section 4(d) Rule
Distinct Population Segments:	Puget Sound Chinook Salmon and Puget Sound Steelhead
Responsible Agency and Official:	Barry A. Thom, Regional Administrator National Marine Fisheries Service, West Coast Region 7600 Sand Point Way NE, Building 1 Seattle, WA 98115
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Legal mandate:	Endangered Species Act (ESA) of 1973, as amended and implemented – 50 C.F.R. Part 223
Location of Proposed Activities:	The Snohomish River Basin in Puget Sound, Washington State
Proposed Action:	Endangered Species Act determination that seven hatchery genetic management plans (HGMPs) submitted as resource management plans (RMP) by the co-managers, meet the requirements under Limit 6 of the 4(d) Rule under the Endangered Species Act (ESA) for listed Puget Sound Chinook salmon and steelhead.

This EA is being prepared using the 1978 CEQ NEPA Regulations. NEPA reviews initiated prior to the effective date of the 2020 CEQ regulations may be conducted using the 1978 version of the regulations. The effective date of the 2020 CEQ NEPA Regulations was September 14, 2020. This review began on September 2, 2020 and the agency has decided to proceed under the 1978 regulations.

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1.0 PURPOSE OF AND NEED

In 2012 and 2013, The Washington Department of Fish and Wildlife (WDFW) and the Tulalip Tribes (hereafter referred to as the co-managers) submitted six Hatchery Genetic Management Plans (HGMPs) for salmon hatchery programs in the Snohomish River Basin in Puget Sound. Pursuant to the National Environmental Policy Act (NEPA), the National Marine Fisheries Service (NMFS) prepared an Environmental Assessment [hereafter referred to as the 2017 EA] to analyze the impacts of the action and alternative and determine whether the hatchery programs met the requirements under Limit 6 of the ESA 4(d) Rule for threatened Puget Sound Chinook salmon and steelhead.

The draft 2016 Environmental Assessment on the effects of the six HGMPs was released for a 30-day public comment period on December 15, 2016 (81 FR 90784). A Final Environmental Assessment and a Finding of No Significant Impact (FONSI) were completed by NMFS on October 10, 2017. NMFS' determination that six hatchery programs in the Snohomish River basin as described in Hatchery and Genetic Management Plans satisfy the Endangered Species Act Section 4(d) Rule. In the 2017 EA, the Preferred Alternative was Alternative 2 (Make a determination that the submitted HGMPs meet the requirements of the 4(d) rule).

This Supplemental Environmental Assessment (SEA) is being prepared in response to the request by the co-managers to increase production of some of the hatchery programs evaluated in the 2017 EA, and to initiate a new native chum salmon program. A new HGMP was submitted by WDFW for the new chum salmon program on May 31, 2019. All seven HGMPs are considered in this evaluation.

The purpose of this SEA is to analyze a new alternative (Alternative 5, Increased Production). This SEA does not reopen the information from the 2017 EA for additional public review. The new alternative is based on the applicants' interest in increasing hatchery production of juvenile coho salmon, chum salmon, and summer-run Chinook salmon. In addition, within this SEA, NMFS will analyze the effects of the new action on endangered Southern Resident killer whales (SRKW), and the importance of Chinook salmon prey to their food base. Collectively, the SEA and the 2017 EA evaluate the Proposed Action under a full range of alternatives.

The 2017 EA includes the context (including the purpose and need and description of the action area) and much of the analysis for meeting the requirements of NEPA. The 2017 EA is available by request from NMFS WCR. Where methodologies, the affected environment, and environmental consequences under the new alternative are not the same as those discussed previously, this SEA provides further information and analyses.

The 2017 EA includes a description of the purpose of, and need for the Proposed Action, the Proposed Action, and NMFS' authorities under the ESA and NEPA in Chapter 1. The new alternative analyzed in this draft SEA does not affect the purpose and need for the action, or the hatchery facilities and activities that are described in the 2017 EA.

2.0 ALTERNATIVES

The 2017 EA includes a description of the alternatives analyzed in detail and alternatives considered but not analyzed in detail. The alternatives analyzed in the 2017 EA were: Alternative 1 (No Action), Alternative 2 (Proposed Action), Alternative 3 (Termination), and Alternative 4 (Reduced Production) (Table 2-1). In the following, only Alternative 5 will be described; please see the 2017 EA for additional information on the other alternatives.

Table 2-1. Maximum annual releases of juvenile salmon from hatcheries within the Snohomish River basin under existing conditions and the alternatives by species.

Species	Existing Conditions	Alternative 1 (No Action)	Alternative 2 (Proposed Action)	Alternative 3 (Termination)	Alternative 4 (Reduced Production)	Alternative 5 (Increased Production)	
						Phase 1	Phase 2
Summer-run Chinook Salmon							
Wallace River Subyearlings	1,000,000	1,000,000	1,000,000	0	250,000	2,200,000	1,200,000
Wallace River Yearlings	500,000	500,000	500,000	0	250,000	600,000	750,000
Tulalip Hatchery Subyearlings	2,400,000	2,400,000	2,400,000	0	1,200,000	4,400,000	Same as Phase 1
Total	3,900,000	3,900,000	3,900,000	0	1,700,000	7,200,000	6,350,000
Coho Salmon							
Wallace River Yearlings	150,000	150,000	150,000	0	75,000	300,000	Same as Phase 1
Woods Creek Subyearlings (Fry)	7,000	7,000	7,000	0	0	7,000	Same as Phase 1
Tulalip Yearlings	2,000,000	2,000,000	2,000,000	0	1,000,000	2,000,000	Same as Phase 1
Eagle Creek Yearlings	54,000	54,000	54,000	0	27,000	54,000	Same as Phase 1
Everett Bay Net-pens Yearlings	20,000	20,000	20,000	0	10,000	40,000	Same as Phase 1
Total	2,231,000	2,231,000	2,231,000	0	1,112,000	2,401,000	Same as Phase 1
Chum Salmon							
Tulalip Bay Subyearlings	12,000,000	12,000,000	12,000,000	0	12,000,000	12,000,000	Same as Phase 1
Wallace River Subyearlings (Fry)	0	0	0	0	0	2,000,000	Same as Phase 1
Total	12,000,000	12,000,000	12,000,000	0	12,000,000	14,000,000	Same as Phase 1
Grand total	**18,131,000**	**18,131,000**	**18,131,000**	**0**	**14,812,000**	**23,601,000**	**22,751,000**

2.1. Alternative 5 (increased production; Preferred Alternative)

Under this alternative, the applicants would use existing facility capacity to increase the number of summer-run Chinook salmon sub-yearlings and yearlings released from the Wallace River Fish Hatchery (FH) over current production. To compensate for low returns and available numbers of broodstock, the Snohomish co-managers have proposed two phases (1 and 2) for Chinook salmon releases under the Preferred Alternative in order to achieve production objectives. Production objectives for the other programs will not be affected during Phase 2 (Table 2-2). Intensified monitoring before and after hatchery Chinook salmon releases is proposed under the regional hatchery programs' ongoing monitoring program to assess the potential effects of increasing the number of hatchery fish released from the Snohomish River basin hatcheries.

Currently, 1,000,000 sub-yearling Chinook salmon are released from the Wallace River Hatchery. During Phase 1, releases of sub-yearling Chinook salmon will increase by 1,200,000 fish to 2,200,000, and once hatchery infrastructure and water supply improvements can be made, the Phase 2 release of Chinook salmon sub-yearlings will be reduced to 1,200,000 fish. Current release of yearling Chinook salmon at the Wallace River Hatchery is 500,000 fish, and this will increase to 600,000 fish during Phase 1, and 750,000 yearling Chinook salmon during Phase 2. All other programs will continue to release numbers of fish that are reached during Phase 1 (Table 2-2).

The Tulalip FH release of sub-yearling summer-run Chinook salmon would also increase by 2,000,000 fish (Table 2-2). The sum total of yearling and sub-yearling summer-run Chinook salmon released for all programs once Phase I targets are reached, would be 7,200,000 fish which would be reduced to 6,350,000 during Phase 2 (Table 2-2). The total number of coho salmon produced would also increase (Table 2-2). The total number of fall-run chum salmon released from the Tulalip Bay FH would not change from current production, but a new program producing native chum salmon at Wallace River Hatchery would produce additional chum salmon resulting in a grand total of up to 14,000,000 chum salmon sub-yearlings being released although in recent years the number of chum salmon sub-yearlings released have averaged 4.7 million due to the number of adult broodstock available (Table 2-2).

Table 2-2. Current and proposed hatchery production of salmon in the Snohomish River basin, and the amount of change in production.

Hatchery Program	Phase 1			Phase 2	
	Current Production	**Proposed Production**	**Increase**	**Proposed Production**	**Change from Phase I**
Wallace River Hatchery Summer-run Chinook salmon sub-yearlings	1,000,000	2,200,000	1,200,000	1,200,000	- 1,000,000
Wallace River Hatchery Summer-run Chinook salmon yearlings	500,000	600,000	100,000	750,000	150,000
Bernie Kai-Kai Gobin Salmon Hatchery "Tulalip Hatchery" Summer Chinook Salmon sub-yearlings	2,400,000	4,400,000	2,000,000	4,400,000	0
Wallace River Hatchery Coho salmon (with the Eagle Creek Hatchery cooperative program)	211,000[1]	361,000[1]	150,000	361,000	0
Everett Bay Net-Pen Coho Salmon	20,000	40,000	20,000	20,000	0
Tulalip Bay Hatchery Coho Salmon	2,000,000	2,000,000	0	2,000,000	0
Tulalip Bay Hatchery Fall-run Chum salmon	12,000,000	12,000,000	0	12,000,000	0
Wallace River Hatchery Integrated Chum salmon	0	2,000,000	2,000,000	2,000,000	0
Total	**20,030,001**	**23,601,000**	**5,470,000**	**22,731,000**	**- 850,000**

[1]7,000 of these coho salmon produced at Wallace River Hatchery are released near Woods Creek as sub-yearlings and 54,000 are released at Eagle Creek Hatchery as sub-yearlings.

Research and monitoring to assess the effectiveness and impacts of increasing hatchery salmon releases is proposed in the Snohomish estuary and adjacent marine areas. Increased hatchery releases may support SRKW, which feed primarily on Chinook salmon in Puget Sound from October to April. Estuary and marine juvenile fish monitoring studies estimate the effects of release strategy on survivorship, time-area fishery contributions, size at recruitment, and ongoing Genetic Stock Identification analyses conducted by NOAA Fisheries of SRKW fecal samples and fish tissues collected during predation events to infer contribution to the SRKW prey base. Monitoring will also allow operators to identify potential ecological and genetic impacts to ESA-listed natural-origin juvenile and adult salmonids to enable strategies to reduce and mitigate such impacts. Sub-yearling Chinook salmon will be released in one of three, uniquely

otolith marked and/or coded-wire tagged experimental "Early" mid- to late-April/early-May, "Normal" early-June, and "Late" October rearing and release groups from each hatchery, contingent upon available funding for this work to continue after the 2022 outmigration year. Yearling Chinook salmon will also be uniquely thermally marked and/or coded-wire tagged and released from Wallace River Hatchery in early-April prior to the sub-yearling treatment groups and included in the studies for the same outmigration years for juvenile monitoring but through broodyear 2020. Capture numbers, lengths, scales, otoliths, and stomach content samples will be collected from fish originating from each experimental release along with recording release numbers, lengths, and weights. Scales and otoliths will be collected from each group prior to each release and compared to samples collected with coinciding natural-origin juvenile Chinook salmon encountered before and after the releases. This sampling will be conducted in marine and estuarine areas to compare relative growth and residence times along with coinciding environmental conditions (e.g. temperature, salinity, dissolved oxygen). Chinook salmon will be monitored and collected from the Snohomish estuary as shown in Table 2-3 as part of this research. A maximum of 900 juvenile Chinook salmon will be collected annually for this research program.

Table 2-3. Snohomish estuary and nearshore marine juvenile Chinook salmon sampling sites included in intensive monitoring efforts before and after releases of hatchery Chinook salmon. Approximately thirty samples per site will be collected weekly for 2-3 weeks preceding and following each release event. The number of samples indicated below will be collected annually predicated on funding availability.

Site	Target Samples Off Channel Area	Target Samples Marine/Distributary Area	Sampling Events Off Channel Spring/Summer	Sampling Events Marine Spring/Summer	Sampling Events Off Channel Spring/Summer	Sampling Events Marine Spring/Summer	Habitat Type
Fields Riffle	60	60	38	38	12	12	Forested Riverine Tidal
Langus	0	60	38	38	12	12	Estuarine Forest Transitional
North Jetty Island	N/A	60	N/A	38	N/A	12	Unconsolidated Shoreline
Old Barge/Dead Water	60	60	38	38	12	12	Estuarine Forest Transitional
Big Tree	N/A	60	N/A	38	N/A	12	Forested Riverine Tidal
Priest Point	N/A	60	N/A	38	N/A	12	Unconsolidated Shoreline
Tulalip Bay	60	60	N/A	38	N/A	12	Unconsolidated Shoreline
Mission Beach	N/A	60	N/A	38	N/A	12	Unconsolidated Shoreline
Quilceda Off Channel	60	N/A	38	N/A	12	N/A	Estuarine Emergent Marsh
Lower Steamboat	N/A	60	N/A	38	N/A	12	Estuarine Emergent Marsh

Otter Island	60	60	38	38	12	12	Estuarine Forest Transitional

3.0 AFFECTED ENVIRONMENT

3.1. Introduction

Chapter 3, Affected Environment of the 2017 EA includes a description of existing conditions and the analysis areas for the resources below that may be affected by the alternatives Critical Habitat:

- Fish Habitat, including Water quantity and Water quality
- Salmon and steelhead
- Other fish
- Wildlife, including Southern Resident Killer Whale
- Socioeconomics
- Cultural resources
- Human health and safety
- Environmental justice

The SEA only includes updated information to resource areas where new information is available since the 2017 EA. Please consult the 2017 EA for a more complete discussion of the Affected Environment and its components.

3.2. Salmon and Steelhead

The analysis area for the Salmon and Steelhead resource is the Snohomish River watershed and estuary, immediately adjacent nearshore marine areas, and independent tributaries to those immediately adjacent nearshore areas. The current abundance, spatial structure, genetic and life history diversity, and productivity of natural-origin salmon and steelhead populations in the Snohomish River basin are all severely diminished relative to historical levels. The relatively poor status of natural populations in the basin continues under current conditions.

Under baseline conditions, the salmon hatchery programs may potentially affect natural-origin salmon and steelhead populations and their habitat in the Snohomish River basin through genetic risks, competition, predation, fish disease transfer, and facility effects. Any effects - positive, neutral, or negative - depend on the design of hatchery programs, the condition of the habitat, and the current status of the species, among other factors.

3.2.1. Genetics

A typical indicator used to describe the influence of hatchery-origin spawners based on demographic surveys on the natural population is called the proportionate natural influence (PNI_D). The proportion of hatchery-origin fish on the spawning grounds based on demographic surveys ($pHOS_D$) and the proportion of natural-origin fish used in the broodstock (pNOB) are used to calculate demographic based PNI_D. NMFS calculates PNI_D according to Ford (2002) and Busack (2015). A PNI_D exceeding 0.5 is an indicator that natural selection may outweigh hatchery-influenced selection, which incorporates the assumption that demographic spawner estimates are the same as the number of genetically effective spawners. In other words, the natural environment has the propensity to influence the total population (hatchery- and natural-origin fish) genetic diversity more than the hatchery environment.

Historical and current estimates of $pHOS_D$ for the Snohomish River basin are shown in Table 3-1 below.

Table 3-1. The Average number and (proportion) of hatchery-origin (pHOS) Chinook salmon escapement to natural spawning areas in the Snohomish basin from 2017-2019 as determined using thermal otolith marks.

Aggregation	Average Tulalip HORs	Average Wallace HORs	Average Other HORs	Average All Snohomish HORs
Skykomish Population (excluding Wallace)	12 (0.5%)	354 (14.7%)	221 (7.6%)	587 (24.4%)
Skykomish Population (including Wallace)	14 (0.5%)	640 (22.2%)	269 (7.9%)	923 (36.2%)
Snoqualmie Population	36 (3.0%)	43 (3.6%)	224 (12.3%)	303 (19.3%)
Snohomish Basin Total	50 (1.2%)	683 (16.7%)	587 (11.4%)	1,320 (31.4%)

Source: (Haggerty 2020a; NMFS in prep).

3.2.2. Nutrient Recycling

The 2017 EA did not evaluate nutrient cycling for individual populations, but it is reasonable to assume that the current hatchery production increases marine-derived nutrients to the Snohomish River basin, particularly considering the low abundance of natural-origin spawners compared to the estimated historical run size.

3.3. Wildlife

The analysis area for the Wildlife resource is the Snohomish River watershed and estuary adjacent nearshore marine areas, independent tributaries to adjacent nearshore areas, and other marine waters encompassed by Snohomish County.

Hatchery-origin salmon also supplement the diets of marine mammals which may compete with Southern Resident killer whales (SRKW) for salmon as prey (Chasco et al. 2017a; Chasco et al. 2017b). Steller sea lions, California sea lions, and harbor seals occur within the Puget Sound and predate on Chinook salmon, which may lead to direct prey competition with SRKW. In a recent study by Chasco et al. (2017a), which summarizes Chinook salmon consumption by the four marine mammals most likely to consume substantial amounts of Chinook salmon (SRKW, California sea lion, harbor seals, and Steller sea lion), there was variation among these marine mammal predators concerning the age of Chinook salmon consumed (harbor seals consumed more juvenile salmon while SRKW consumed more adult salmon) and variation in the amount of Chinook salmon consumed.

Using information from the scat studies near Vancouver Island, (Jeffries 2011; Pearson and Jeffries 2012), concluded that Steller sea lion are expected to include salmon as part of its diet depending on availability, detectability, and ease of capture. Thus, the proportion of salmon and steelhead (including specific species) in the diet of Steller sea lions within the project area is likely to vary by study location and season. Available information does not suggest that California sea lions are dependent on salmon and steelhead in the project area (Everitt et al. 1981; NMFS 1997). Salmon and steelhead can form an important component of harbor seal diets, with variations that reflect seasonal and local availability of different species close to harbor seal haulouts and pupping sites in the project area, but other fish species may compose a larger proportion of their diet overall based on season and location (Zamon 2001).

Additional information on other wildlife species can be found in Section 3.5 of the 2017 EA, however, because one of the reasons for reinitiation of consultation is to provide additional food for SRKW, more detail follows on SRKW.

The SRKW is listed under the ESA as endangered and is present in marine areas adjacent to the analysis area. During the spring, summer, and fall, the whales spend a substantial amount of time in the inland waterways of the Strait of Georgia, Strait of Juan de Fuca, and Puget Sound (Bigg 1982; Ford et al. 2000; Hanson and Emmons 2010; Hauser et al. 2007; Krahn et al. 2002). The whales generally remain in the Georgia Basin through October and make frequent trips to the outer coasts of Washington and southern Vancouver Island and are occasionally sighted as far west as Tofino and Barkley Sound (Ford et al. 2000). The species is known to expand its movement into Puget Sound particularly during the fall months. Southern Resident killer whales' primary prey in inland marine waters during the summer months is adult Chinook salmon (Chasco et al. 2017a; Chasco et al. 2017b; Ford et al. 2016), even when other salmon species are more abundant. Based on preliminary results from genetic analysis of a limited number of samples collected during killer whale feeding events, Chinook salmon are also important to

SRKWs in Puget Sound during the winter (Michael Ford, Northwest Fisheries Science Center, email set to Tim Tynan, NMFS, January 30, 2017, regarding killer whale diets). Adult coho salmon are important in their diet in inland waters in late summer (Ford et al. 2016), whereas chum salmon are also important in the fall. Of all the Pacific salmon species, Chinook salmon are the most calorie rich (O'Neill et al. 2014). Switching by the whales to less calorically rich salmon species as prey may be due to reduced availability of Chinook salmon at that time and area.

Adult hatchery-origin Chinook salmon represent 74 percent of the total number of Chinook salmon (hatchery-origin and natural-origin) returning to Puget Sound (NMFS 2014c). There is no evidence that SRKW distinguish between hatchery- and natural-origin salmon. Therefore, it is highly likely that hatchery-origin adult salmon (especially Chinook salmon) contribute to the diet of the whales in Puget Sound. Adults from hatchery releases have partially compensated for declines in natural-origin salmon and may have benefited Southern Resident killer whales (Chasco et al. 2017b). Other salmon and steelhead are also prey items during specific times of the year, but at much less frequency than would be expected based on their relative abundances (Subsection 3.5.3.1.1, Killer Whale, in the PS Hatcheries DEIS) (NMFS 2014a). Hatchery-origin salmon also supplement the diets of other marine mammals which may compete with Southern Resident killer whales for salmon prey (Chasco et al. 2017a; Chasco et al. 2017b).

The number of adult Chinook salmon produced by hatchery programs in the Snohomish River basin is unsubstantial relative to the total abundance of Chinook salmon present in Puget Sound and Pacific coastal marine areas. Fraser River Chinook salmon stocks are an important component of the SRKW summer diet in the vicinity of the San Juan Islands and the western Strait of Juan de Fuca, British Columbia. In May, the composition of prey in samples of the whales' diet indicated over 25 percent were Chinook salmon originating from south Puget Sound areas, followed by Central Valley, Upper Fraser, and mid-Fraser River areas. In August in the Strait of Juan de Fuca, over 17 percent of the diet of SRKW was from Chinook salmon originating in south Puget Sound. During the fall months when the whales' geographic range extends into Puget Sound, Chinook salmon from the south Puget Sound comprise approximately 64 percent of the whales' diet (NWFSC unpubl. data).

The contribution of hatchery programs in the Snohomish River basin to the prey base for SRKW is likely small but biologically meaningful. The estimated total annual abundance of adult Chinook salmon from Washington State and British Columbia Pacific Ocean coastal waters averages approximately 1,000,000 fish (Larrie LaVoy, NMFS, email sent to Tim Tynan, Fish Biologist, NMFS, January 6, 2012, regarding total abundance of adult Chinook salmon). Thus, even if none of the adult Chinook salmon are used for other management purposes, the overall number of adult Chinook salmon produced by hatchery

programs in the Snohomish River basin available as prey for SRKW is small relative to the total abundance of Chinook salmon present in Puget Sound and British Columbia Pacific coastal marine areas. However, the number of Chinook salmon produced from the programs that overlap with the whales in time and space is likely meaningful during specific times and in localized areas. Therefore, although fish from hatchery programs in the Snohomish River basin co-occur in Puget Sound along with many other hatchery-origin and natural-origin salmon originating from other Puget Sound river basins, the Fraser River, Columbia River, and Washington Coast, it is likely that fish from the hatchery programs form a small but meaningful part of the diet of SRKW.

In summary, considering all adult natural-origin and hatchery-origin salmon and steelhead in Puget Sound that are part of the food base for the SRKW, the contributions of adult hatchery-origin salmon and steelhead from the Snohomish River basin under existing conditions have had an effect on the diet, survival, distribution, and listing status Southern Resident killer whales, primarily because adults returning from the hatchery programs (especially Chinook salmon) would represent a small but meaningful part of the SRKW food base provided by the total number of hatchery-origin and natural-origin salmon and steelhead available from throughout the greater Puget Sound, the Strait of Georgia, and Pacific Coast area, particularly in south Puget Sound during the fall months.

4.0 Environmental Consequences

4.1. Introduction

The environmental consequences of the four alternatives evaluated in the 2017 EA are described in Chapter 4 of the 2017 EA. This chapter provides an analysis of the direct and indirect effects associated with Alternative 5.

The effects of all of the alternatives are described relative to Alternative 1 (No Action). The relative magnitude of impacts is 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.

4.1.1. Effects of hatchery programs

Table 4-1 below provides a general list of the potential effects of hatchery programs. The information in this table was found in the 2017 EA and is repeated here for the reader for additional information.

Table 4-1. General mechanisms through which hatchery programs can affect natural-origin salmon and steelhead populations.

Effect Category	Description of Effect
Genetics	• Hatchery-origin salmon and steelhead interbreeding with natural-origin fish in the wild can change the genetics of the affected natural population(s). • Hatchery-origin fish can alter the genetic integrity and/or genetic diversity of the affected natural population(s) depending upon the magnitude of interaction. • Hatchery-origin salmon and steelhead can act to preserve the genetic integrity and diversity of depleted natural populations.
Competition and predation	• Hatchery-origin fish can increase competition for food and space. • Adult hatchery-origin fish can increase predation on natural-origin salmon and steelhead. • Juvenile hatchery-origin fish can decrease predation on natural-origin salmon and steelhead by providing an alternative prey source.
Pathogen transfer	• Hatchery-origin fish can have elevated levels of endemic infectious fish pathogens from rearing in the hatchery which can be transferred to natural populations from hatchery fish and/or release of hatchery effluent.
Hatchery facilities	• Hatchery facilities can reduce water quantity or quality in adjacent streams through water withdrawal and discharge of effluent. • Hatchery facility weirs and dams to collect broodstock and/or control hatchery fish on the spawning grounds can have the following unintentional consequences: o Isolation of formerly connected populations o Limiting or slowing movement of migrating fish species, which may enable poaching, increase predation, and/or alter spawn timing and distribution o Alteration of stream flow o Alteration of streambed and riparian habitat o Alteration of the distribution of spawning within a population o Increased mortality or stress due to capture and handling o Impingement of downstream migrating fish o Forced downstream spawning by fish that do not pass through the weir o Increased straying due to either trapping adults that were not intending to spawn above the weirs, or displacing adults into other tributaries
Masking	• Unmarked, untagged hatchery-origin fish spawning naturally can increase the difficulty in determining the true status of the natural-origin population.
Incidental fishing	• Fisheries targeting hatchery-origin fish could include impacts on natural-origin fish when they are caught incidentally. • Fishing in times and areas to selectively target hatchery-origin fish in areas largely devoid of wild fish can reduce harvest impacts on natural populations.
Disease transfer	• Concentrating salmon and steelhead for rearing in a hatchery facility can lead to an increased risk of amplifying the incidence of infectious disease pathogens. If disease control policies are not followed and infected fish are released from

Effect Category	Description of Effect
	hatchery facilities, they may increase the disease risk to natural-origin salmon and steelhead.
Population viability benefits	Depending upon the objective of the specific hatchery program, hatchery-origin fish can potentially: • Abundance: Preservation of, and possible increase in, the abundance of a natural-origin fish population resulting from increased numbers of adults returning to the spawning grounds. • Spatial structure: Preservation or expansion of the spatial structure of a natural-origin population resulting from increases of adults returning to spawning areas. • Genetic diversity: Retention, or preservation of within-population genetic diversity of a natural-origin population by including natural-origin broodstock into the hatchery. • Productivity: Hatchery programs could increase the productivity of a natural-origin population if naturally spawning hatchery fish have similar reproductive success as natural-origin spawners. In addition, productivity could increase if the natural-origin population abundance is low enough to limit natural-origin productivity (e.g., not be able to find a mate, or forced to spawn in degraded habitat), or if hatchery fish are reintroduced to more productive habitat.
Nutrient cycling benefits	• Returning hatchery-origin adults can increase the amount of marine-derived nutrients in freshwater and terrestrial systems from natural spawning and/or outplanting of carcasses from hatcheries.

In the following, the potential effects of the Preferred Alternative (5) are discussed in terms of each of the resources that have been analyzed in the 2017 EA and this SEA.

4.1.2. Critical Habitat

Critical habitat for ESA-listed species in the Snohomish River basin includes many of the identified primary constituent elements (PCEs). As described in Subsection 3.1.1 of the 2017 EA, the specific aspects of critical habitat that may be affected by Alternative 2 include: adequate water quantity and quality; excessive predation; and, migration corridors free of obstruction. If these aspects are negatively affected, the population viability could be reduced by reducing food and space, or the ability of a fish to reach different habitats.

4.2. Water Quality

Under Alternative 5, the salmon hatchery programs overall would have an undetectable effect on water quality in the Snohomish River basin (Table 4-2), primarily because hatchery operations would limit their pollutant discharges in accordance with their National Pollutant Discharge Elimination System (NPDES) permits and would not be expected to contribute substantially to water quality impairments in the basin, which would be the same as under Alternative 1, Alternative 2, and Alternative 4. In comparison to Alternative 3 (negligible positive), water quality effects under Alternative 5 would be increased because

the hatchery programs would be terminated under Alternative 3, thereby eliminating the potential for water quality effects.

4.3. Water Quantity

Under Alternative 5, the salmon hatchery programs would have a low negative effect on water quantity because water is not "consumed" by the hatchery, but returns the majority of flow back to the river, thereby not reducing habitat (Table 4-2), which would be the same as under all of the other alternatives, because water use would be non-consumptive. All water diverted (except that lost to evaporation or spillage) would be returned near the points of withdrawal after circulating through the hatchery facilities, and all water use would be limited by water right permits. Surface water quantity would only be affected between the water intake and discharge structures (the bypass reach). No stream reaches would be dewatered to the extent that migration and rearing of listed natural-origin fish would be impaired, and there would be no net loss of river or tributary flow volume.

Table 4-2. Estimated effects of the Snohomish River basin hatchery programs on water quantity and quality for the alternatives analyzed in the 2017 EA and this SEA.

Resource	Species	Resource sub-category	Alternative 1 (No-action)	Effects of Alternative Relative to No-action			
				2	3	4	5
Water Quality	NA	NA	Undetectable	Same as Alt 1	Negligible positive	Same as Alt 1	Same as Alt 1
Water Quantity	NA	NA	Low negative	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1

4.4. Salmon and Steelhead

4.4.1. Genetics

Summer-run Chinook Salmon

The 2017 EA determined that the genetic effects (potential risk of hatchery-origin fish spawning with natural-origin fish that could reduce fitness) of the current hatchery programs (Alternative 1 and 2) result in a low effect for the Skykomish River Chinook salmon population, and under Alternative 5, the effects would stay the same because, while $pHOS_D$ will increase, PNI_D will also increase because of a substantial increase in pNOB (Table 4-3, Table 4-4). The operators plan to use the 400 natural-origin broodstock they collect to create the yearling component of the Wallace River Hatchery Chinook salmon program instead of the current practice of using natural-origin fish to create both the sub-yearling and yearling components of the program. The yearling Chinook salmon survive and return at a higher rate than the sub-yearlings,

which increases the return of fish with natural-origin parents, preserving the genetics of the natural origin population. Some yearlings would volunteer back to the hatchery as adults and be used as broodstock and some would spawn in the wild. For these reasons, integrating only the yearling component of the Chinook salmon program increases PNI_D without requiring the collection of additional natural-origin Chinook salmon. This plan is discussed in detail in the Biological Opinion analyzing the effects of the Snohomish River Basin hatchery programs (NMFS 2021). For Alternative 3, the potential risk of genetic effects from the hatchery program would be eliminated and it would have a medium-positive effect, while for Alternative 4 (reduction in production), $pHOS_D$ would be reduced and PNI_D would increase by 24 percentage points, resulting in a low-positive effect (Table 4-3, Table 4-4).

In the 2017 EA, the genetic risk to the Snoqualmie Chinook salmon population was estimated as medium. The risk determination was made based on hatchery fish from the Wallace River Hatchery and Bernie Kai-Kai Gobin Salmon Hatchery programs spawning in the wild since there are no releases of hatchery Chinook salmon in the Snoqualmie River basin. Current estimates (2006-2019) of $pHOS_D$ are 23.8 percent, and $pHOS_D$ is estimated to rise to 30.2 under Phase 2 of the preferred alternative (Table 4-3).

Table 4-3. Estimated $pHOS_D$, pNOB, and PNI_D values for each alternative (NA is not applicable).

Population	Alternative	Estimated			Comment
		$pHOS_D$ (%)	**pNOB (%)**	**PNI_D (%)**	
Skykomish	1, 2	23.8	25.8	56.0	$pHOS_D$ estimate does not include Wallace River spawners. Including Wallace River increases $pHOS_D$ to 33.7, and PNI_D decreases to 55.6.
	3	0.0	NA	100.0	The analysis does not include effects from out-of-basin hatchery-origin fish spawning naturally.
	4	20.2	51.0	79.8	The analysis is based on half of current production.
	5 (Phase 1)	33.3	82.7	56.3	$pHOS_D$ estimate does not include Wallace River spawners.
	5 (Phase 2)	30.2	87.4	60.7	$pHOS_D$ estimate does not include Wallace River spawners. Assumes 16% pre-spawning holding mortality.
Snoqualmie	1, 2	27.5	NA		No hatchery programs are operated in the Snoqualmie River basin, so no broodstock are used from this population, so PNI_D values are not applicable.
	3	20.5			
	4	25.4			
	5 (Phase 1)	29.9			
	5 (Phase 2)	29.8			

Source: M. Haggerty (2020a).

Steelhead

Because the programs being evaluated in this SEA do not release steelhead, there are no potential genetic effects on natural-origin steelhead from any of the Chinook salmon, coho salmon, or chum salmon hatchery programs since steelhead do not interbreed with any of the three salmon species, so there is an undetectable effect (Table 4-4).

Coho Salmon and Chum Salmon

Under Alternative 5, the Wallace River Hatchery coho salmon hatchery program would release additional yearlings into the Wallace River, Woods Creek (a tributary to the Skykomish River), and from Everett Bay Net-Pens (mouth of the Snohomish River at Port Gardner Bay near the Port of Everett Marina). Because of their release locations, and high harvest rates, coho salmon released through the Tulalip Hatchery and Everett Bay Net Pens program are unlikely to migrate at substantial rates into areas in the Snohomish River watershed where natural populations of coho salmon spawn. Data collected from spawning ground surveys conducted from 2016 to 2019 indicate approximately 5 percent of hatchery coho escape to natural spawning areas in the Snohomish Basin. Given that, it is estimated the hatchery adult coho escapement to natural spawning areas in the Snohomish Basin from production increases at Wallace River Hatchery and the Everett Bay net-pen program would double from 0.33 percent to 0.67 percent (Haggerty 2020b). In the 2017 EA, the genetic effects for the coho salmon hatchery program was estimated to have a negligible effect for Alternative 1 and Alternative 2. Under Alternative 5, genetic effects on natural coho salmon associated with the hatchery coho salmon programs are negligible, the same as the genetic effects under all alternatives (1, 2, 3, and 4) (Table 4-4).

Under Alternative 5, a new integrated native Skykomish chum salmon hatchery program would begin operating at Wallace River Hatchery (Wallace River, tributary to the Skykomish River near Sultan). Under Alternative 5 there are potential effects of collecting adult chum for broodstock that would otherwise spawn in the river which could reduce the effective population size, and the genetic diversity of the population. However, because of the size of the natural population, and restrictions of the proportion of the natural-origin population that can be used as broodstock, this risk is considered negligible under all alternatives (Table 4-4).

Pink salmon and Sockeye salmon

Because the programs being evaluated in this SEA do not release pink salmon or sockeye salmon, there are no potential genetic effects on natural-origin pink salmon or sockeye salmon from any of the Chinook

salmon, coho salmon, or chum salmon hatchery programs, therefore, the effects are considered undetectable for all alternatives.

Table 4-4. Estimated effects of the Snohomish River basin hatchery programs on genetics for the alternatives analyzed in the 2017 EA and this SEA.

Resource	Species	Resource sub-category	Alternative 1 (No-action)	Effects of Alternative Relative to No-action			
				2	3	4	5
Salmon and Steelhead	Puget Sound Chinook salmon	Genetics	Low-negative (Skykomish); and (Snoqualmie)	Same as Alt 1	Medium-positive (Skykomish and Snoqualmie)	Low-positive (Skykomish and Snoqualmie)	Same as Alternative 1
	Puget Sound steelhead	Genetics	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
	Puget Sound coho salmon	Genetics	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
	Puget Sound chum salmon	Genetics	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
	Puget Sound pink salmon	Genetics	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
	Sockeye salmon	Genetics	Undetectable effects	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1

4.4.2. Competition and Predation

Competition between hatchery-origin and natural-origin fish could result in reduced food or space, if either are limited and hatchery-released fish out-compete natural-origin fish for limited resources. Effects of predation from hatchery-origin fish could result in the population of concern having higher rates of predation, either by attracting additional predators or hatchery fish preying on natural-origin fish.

Summer-run Chinook Salmon

The determination of risk effects from competition and predation in the 2017 EA indicated the effect of competition from fish released from the Wallace River Hatchery programs with natural Chinook salmon was considered low for Alternative 1 and Alternative 2 (Table 4-5). The 2017 EA suggested that the risk of competition was low because of the relatively short duration the hatchery fish interact with natural fish as the hatchery smolts emigrate seaward, release timing for hatchery subyearling Chinook salmon that separates the fish from their earlier migrating natural counterparts, and differences in diet preferences

between larger hatchery yearling Chinook salmon and coho salmon and smaller natural-origin fish, including chum salmon and pink salmon.

Under Alternative 5, the risk of competition impacts on natural-origin summer-run Chinook salmon in the Snohomish River basin could potentially be increased because the number of hatchery-origin fish released would increase. In addition, the fish would be released at similar times that could occupy similar freshwater areas as similarly sized natural-origin summer-run Chinook salmon during rearing/outmigration. However, the reasons given for a determination of low effect in the 2017 EA still remain (e.g., short duration in areas of potential competition, release timing). While Alternative 5 may have the potential to increase competition, the potential increased level of competition does not warrant an increase of the effect, so the determination remains at low for Alternative 5 (Table 4-5).

The analyses in the 2017 EA suggest that there is a medium negative risk of predation from Wallace River Hatchery Chinook salmon sub-yearlings and yearlings under current conditions because the relative size of both the sub-yearlings (average length 3.1 inches fork length) and the yearlings (average length 6.1 inches fork length) would be large compared to the natural-origin Chinook salmon that the hatchery-origin fish may encounter after release in the watershed (average length of 1.6 to 4.7 inches fork length, dependent on life stage). Under Alternative 5, the risk level remains at medium negative for the yearling Chinook salmon program because of the increase in production for yearlings is not high enough to increase the risk of predation on natural-origin fish.

Steelhead and Coho Salmon

In the 2017 EA, fish released from the Wallace River Hatchery Chinook salmon program and Eagle Creek Hatchery coho salmon program were determined to have a high competition effect on natural-origin steelhead (Table 4-5). The relatively large size of the hatchery yearlings released through the programs, and the release locations in the upper watershed are believed to be risk factors regarding potential competition with similarly sized natural-origin steelhead smolts emigrating at the same time, downstream of the hatchery release sites. However, these fully-smolted yearlings likely emigrate seaward rapidly with 90% passing the smolt trap within one to two weeks after release, which should reduce the period of overlap in the river, estuary and marine areas and associated ecological risks.

Under Alternative 5, the risk of competition impacts on natural-origin steelhead in the Snohomish River basin would most likely stay the same as alternatives 1, 2, and 4 because, while releases will increase, it is not believed they will be increased to levels that would affect the determination. While Alternative 5 may have the potential to increase competition with natural-origin steelhead (through increased releases of

yearling Chinook salmon), the level of increase does not warrant an increase of the determination of effect, so the determination remains at high for Alternative 5 (Table 4-5) because best management practices are applied (i.e., optimizing fish size, location, and timing of releases; release of smolts only) that are designed to limit opportunities for co-occurrence and interaction between hatchery-origin fish and natural-origin fish, reducing the potential for adverse effects from competition.

In the 2017 EA, there is no determination of effect of predation by yearling Chinook salmon on steelhead because natural-origin steelhead fry are present from June through October, and no hatchery-origin yearlings are released during this period. Thus, predation from hatchery-origin yearling Chinook salmon is not considered a risk factor to natural-origin steelhead fry. Natural-origin steelhead parr occur from October through mid-May and are generally not susceptible to predation from hatchery-origin fish because they would be at their peak size when hatchery-origin fish are released in the spring. Similarly, the peak out-migration period for natural- origin steelhead smolts may be at a time when other hatchery-origin fish are released, but the large size of the smolts (4.3 to 8.5 inches fork length) would prevent other hatchery-origin fish from preying on steelhead smolts. Conversely, hatchery-produced subyearling Chinook and chum salmon from hatchery facilities could serve as prey for natural-origin steelhead smolts. The large size of natural-origin steelhead smolts and their propensity to move directly offshore once in marine waters helps juvenile steelhead avoid risks from predation.

Under Alternative 5, the risk of predation impacts on natural-origin coho salmon in the Snohomish River basin could potentially be increased compared to under Alternative 1 and Alternative 2, because releases of similarly large-sized yearling summer-run Chinook salmon and coho salmon would be increased, however, the increase in the number of fish released is not large enough to affect the risk determination. The majority of the increased Chinook salmon production will occur at the Tulalip Hatchery which releases juveniles into Tulalip Bay and thus would not contribute to predation or competition risks to ESA-listed fish in freshwater areas within the action area. The proposed increased coho release of 300k would increase the proportion of coho from Wallace River Hatchery by 7.4 percent so Wallace River Hatchery coho would constitute 16.4 percent of the total emigrating coho. Available data indicate the majority of hatchery fish migrate rapidly downstream which reduces opportunities for predation. Thus, even this increase of 7.4% hatchery-origin coho would not likely produce a measurable increase in impacts. Therefore, under Alternative 5, the increased production alternative, predation risk remains the same. For Alternative 3, the risk is reduced to negligible (Table 4-5) because hatchery releases would be eliminated.

Chum Salmon and Pink Salmon

Because of the size of fish at release, the 2017 EA considered the risk for competition to be negligible for natural-origin chum salmon and pink salmon under Alternative 1 (Table 4-5). Under Alternative 5, the risk of competition impacts on natural-origin chum salmon in the Snohomish River basin would be the same as under alternatives 1, 2, 3, and 4 because hatchery-origin summer-run Chinook salmon would be unlikely to compete for food and space with natural-origin chum salmon and pink salmon in fresh water or marine waters (Table 4-5). Natural-origin chum salmon and pink salmon fry hatch and then out-migrate promptly to marine waters early in the season, spending relatively little time in fresh water. As such, it is not likely that the risk effect would be higher for Alternative 5 than alternatives 1, 2, 3, and 4.

The 2017 EA determined the risk of predation from hatchery releases results in a medium negative effect determination because of the small size of natural-origin pink and chum salmon and the larger size of the hatchery-origin Chinook and coho that would be found in the river and estuary when most of the hatchery fish are released. Under Alternative 5, the risk of predation impacts on natural-origin chum salmon and pink salmon in the Snohomish River Basin would remain the same compared to under Alternative 1 and Alternative 2 (Table 4-5).

Table 4-5. Estimated effects of the Snohomish River basin hatchery programs on competition and predation for the alternatives analyzed in the 2017 EA and this SEA.

Resource	Species	Resource sub-category	Alternative 1 (No-action)	Effects of Alternative Relative to No-action			
				2	3	4	5
Salmon and Steelhead	Puget Sound Chinook salmon	Competition	Low negative (Skykomish and Snoqualmie);	Same as Alt 1	Low positive	Negligible	Same as Alt 1
		Predation	Medium negative (Skykomish)	Same as Alt 1	Negligible	Low negative	Same as Alt 1
	Puget Sound steelhead	Competition	High negative	Same as Alt 1	Negligible	Medium negative	Same as Alt 1
		Predation	NA – see text				
	Puget Sound coho salmon	Competition	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Predation	Low negative	Same as Alt 1	Negligible	Same as Alt 1	Same as Alt 1
	Puget Sound chum salmon	Competition	Negligible	Same as Alt 1	Undetectable	Same as Alt 1	Low negative
		Predation	Medium negative	Same as Alt 1	Negligible	Low negative	Same as Alt 1
	Puget Sound pink salmon	Competition	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Predation	Medium negative	Same as Alt 1	Negligible	Low negative	Same as Alt 1
	Sockeye salmon	Competition	NA				
		Predation	NA				

4.4.3. Facility Operations

Potential effects from facilities include reduction in water quality or quantity, blockage or delay of migration if a structure is used (such as a weir), isolation of formerly connected populations, alteration of the streambed and/or riparian habitat, increased mortality from the stress of capture and handling, and potential impingement of fish migrating downstream.

Within the 2017 EA, the determination of effect for facilities from the PS Hatcheries DEIS (NMFS 2014b) was used to determine the effects of Wallace River hatchery facility operations as medium for the Skykomish Chinook salmon population and negligible for the Snoqualmie Chinook salmon population (Table 4-6). The effect of facilities was considered to be undetectable for the streams in which the Tulalip and Eagle Creek hatchery programs operate because there are no natural-origin fish in those streams. In addition, the Everett Bay Net Pen Program effects would also be undetectable because fish are released into saltwater.

Under Alternative 5, the effects of facilities would not change from those under alternatives 1, 2, and 4 because the timing and use of facilities will not change (effects of facilities under Alternative 3 would be undetectable with the hatchery programs being eliminated). Salmon hatchery programs overall would have a medium negative facility operations effect on natural-origin salmon and steelhead in the Snohomish River basin primarily because the abundance and distribution of fish would be affected by one of the facilities that would not comply with current water intake screening criteria (Wallace River Hatchery) . Improvements in Wallace River Hatchery operations and facilities that will be initiated in 2020 are anticipated to be completed as early as 2023. These improvements will include updating the intake screens to become compliant with the most recent screening requirements[1] (NMFS 2011), therefore, the risk determination under Alternative 5 remains the same as Alternative 1 (Table 4-6).

Table 4-6. Estimated effects of the Snohomish River basin hatchery programs on facility operations for the alternatives analyzed in the 2017 EA and this SEA.

Resource	Species	Resource sub-category	Alternative 1 (No-action)	Effects of Alternative Relative to No-action			
				2	3	4	5
Salmon and Steelhead	Puget Sound Chinook salmon	Facility operations	Medium negative (Skykomish);	Same as Alt 1	Undetectable	Same as Alt 1	Same as Alt 1

[1] Funding has been allocated to WDFW to complete upgrades to the Wallace River Hatchery intake screens. This work will be completed as soon as 2023 and the completion of this work is a Term and Condition of the Biological Opinion associated with the Snohomish River Basin hatchery programs. The medium determination is based on NMFS (2011) intake screening requirements.

Resource	Species	Resource sub-category	Alternative 1 (No-action)	Effects of Alternative Relative to No-action			
				2	3	4	5
			Negligible (Snoqualmie)				
	Puget Sound steelhead	Facility operations	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
	Puget Sound coho salmon	Facility operations	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
	Puget Sound chum salmon	Facility operations	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
	Puget Sound pink salmon	Facility operations Genetics	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
	Sockeye salmon	Facility operations	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1

4.4.1. Population Viability

Summer-run Chinook salmon, Coho Salmon, and Native Chum Salmon

The 2017 EA determined the Chinook salmon hatchery programs (for both yearlings and subyearlings) as having a low effect on viability for the Skykomish Chinook salmon population and negligible for the Snoqualmie Chinook salmon population for Alternative 1 (Table 4-7). This determination was made because the hatchery programs operate for integrated harvest purposes, using native or localized adult fish as broodstock, which are not genetically diverged from the donor native Skykomish River Chinook salmon population. The 2017 EA determined that the effect was the same as Alternative 1 for alternatives 2, 3, and 4, while there would be a low negative effect for Alternative 3.

Under Alternative 5, although the increased production could increase some population viability benefits (Table 4-7), the hatchery programs overall would continue to have a low positive effect on population viability for natural-origin summer-run Chinook salmon, coho salmon, and native chum salmon in the Snohomish River basin. This is primarily because although the hatchery programs would help increase overall abundance quicker than may occur naturally and most likely have a similar level of genetic diversity as the natural-origin salmon populations. The extent to which other aspects of viability would be affected is uncertain and is dependent on future climate and habitat conditions.

4.4.2. Research and Monitoring

Population viability can also be affected by hatchery releases, and therefore it is important to conduct research and or monitoring to understand the potential effects of hatchery releases on the viability of a listed population that could be affected by the release of hatchery-origin fish.

Juvenile outmigrant trapping associated with these programs were analyzed and were determined not to result in a decrease in the likelihood of survival and recovery of the listed species in NMFS (2018) and in NMFS (2017). Other activities, such as direct observation and carcass surveys, remain the same as analyzed in the 2017 BiOp and are expected to cause avoidance behaviors that are within the range of normal predator and disturbance behaviors.

The proposed estuary and nearshore marine post-release juvenile monitoring program would collect 900 juvenile Chinook salmon annually, assuming a smolt-to-adult escapement (SAE) survival rate of 0.229% (calculated for broodyears 2000-2011) would equate to about two adults annually. This reduction in adult escapement will not result in a detectable effect to Snohomish Chinook salmon viability but the information gained through the research project may be beneficial in managing the hatchery programs to moderate potential effects to natural populations and to identify important opportunities for restoration of habitats and addressing limiting factors necessary to make progress toward recovery goals.

Based on a similar estuary monitoring program conducted in this area, the estimated incidental steelhead catch is estimated to be up to 15 fish annually. In addition, an estimated up to 120 mostly subadult bull trout could be captured, with up to 2 mortalities occurring annually from the estuary monitoring program (Robinson and Zackey 2020). Any steelhead or bull trout encountered would be released unharmed as soon as possible. This low number of steelhead and bull trout encounters will not have a detectable effect on the Snohomish populations.

The co-managers will include information about the results of the estuary monitoring efforts in their annual reports and will specify the number of juvenile Chinook salmon sampled as well as the number of incidental steelhead and bull trout encountered.

4.4.3. Masking

Masking is a term used to describe the potential for not being able to determine the viability of population of concern because they cannot be distinguished from returning hatchery-origin fish. Because all fish from the Snohomish River basin hatchery programs are thermally marked as well as externally marked with an adipose fin clip and/or coded wire tag, the 2017 EA determined the effects of masking as undetectable for the baseline condition (Table 4-7). This would not change under any of the other

alternatives (2, 3, and 4), including Alternative 5 because all of the fish will still be marked prior to release (Table 4-7).

Table 4-7. Estimated effects of the Snohomish River basin hatchery programs on population viability, masking, disease, and nutrient recycling for the alternatives analyzed in the 2017 EA and this SEA.

Resource	Species	Resource sub-category	Alternative 1 (No-action)	Effects of Alternative Relative to No-action			
				2	3	4	5
Salmon and Steelhead	Puget Sound Chinook salmon	Population viability	Low positive (Skykomish population); Negligible (Snoqualmie population)	Same as Alt 1	Low negative	Same as Alt 1	Same as Alt 1
		Masking	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Disease	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Nutrient recycling	Negligible	Same as Alt 1	Low negative	Same as Alt 1	Low positive
	Puget Sound steelhead	Population viability	NA				
		Masking					
		Disease					
		Nutrient recycling					
	Puget Sound coho salmon	Population viability	Low positive	Same as Alt 1	Low negative	Same as Alt 1	Same as Alt 1
		Masking	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Disease	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Nutrient recycling	Medium positive	Same as Alt 1	Low negative	Same as Alt 1	Low positive
	Puget Sound chum salmon	Population viability	Undetectable	Same as Alt 1	Low negative	Same as Alt 1	Same as Alt 1
		Masking	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Disease	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Nutrient recycling	Negligible	Same as Alt 1	Low negative	Same as Alt 1	Low positive
	Puget Sound pink salmon	Population viability	NA				
		Masking	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Disease	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Nutrient recycling	Negligible	Same as Alt 1	Low negative	Same as Alt 1	Low positive
	Sockeye salmon	Population viability	NA				

Resource	Species	Resource sub-category	Alternative 1 (No-action)	Effects of Alternative Relative to No-action			
				2	3	4	5
		Masking					
		Disease					
		Nutrient recycling					

4.4.4. Incidental Fishing

Incidental fishing effects associated with harvest of salmon produced through the program were reviewed through separate ESA Section 7(a)(2) consultations by NMFS to determine the role of the Bureau of Indian Affairs (BIA) in the development of harvest plans in Puget Sound, and determined to have no substantial adverse effects on listed natural fish populations (NMFS 2020) .

4.4.5. Disease

The effect of transfer of diseases to natural-origin salmon and steelhead in the Snohomish River basin was determined to be negligible in the 2017 EA for Alternative 1. The effect determination would not change for any of the other alternatives. Under Alternative 5, no changes in hatchery operations or how fish are treated for disease would change, and therefore, the transfer of disease would be the same and have negligible effects would be the same (Table 4-7).

4.4.6. Nutrient Cycling

Nutrient recycling refers to the increases in marine-derived nutrient load to the stream when spawner carcasses deteriorate. Hatchery programs in general increase this effect if returning fish are allowed to spawn naturally, or carcasses from broodstock are planted. The PS Hatchery DEIS (NMFS 2014a) and the 2017 EA did not evaluate nutrient cycling for individual populations, but determined hatchery programs for Chinook salmon, chum salmon and pink salmon as negligible, and coho salmon as medium under the baseline condition (Alternative 1 and Alternative 2). For all species, Alternatives 4 is the same effect as Alternatives 1 and 2, while there would be a low negative effect under Alternative 3 (Table 4-7).

Under Alternative 5, the salmon hatchery programs overall would have a low positive nutrient cycling effect for Chinook salmon and chum salmon programs and a continued medium positive effect for coho salmon because the annual escapement of hatchery-origin coho salmon, chum salmon, and summer-run Chinook salmon spawners and distribution of carcasses from hatchery operations in the Snohomish River basin would increase the total number of carcasses and associated marine-derived nutrients to the river basin.

4.5. Other Fish Species

The 2017 EA determined that all effects of the Snohomish River basin hatchery programs as undetectable on other fish species (Table 4-8). Under Alternative 5, the salmon hatchery programs overall would have a negligible negative or low positive effect on other fish species (e.g., negative if the hatchery-origin fish compete with or prey on other fish species and positive for other fish species that consume hatchery-origin salmon). This would be the same as under the alternatives 3 and 4, primarily because (1) the analysis area is only a small portion of each species' range, and (2) hatchery-origin salmon are not exclusive predators or prey for any of the other fish species (including bull trout). Under Alternative 5, the hatchery programs would have a greater positive effect on bull trout compared to Alternative 1 and Alternative 2, because there would be more hatchery-origin salmon for bull trout to eat.

Table 4-8. Estimated effects of the Snohomish River basin hatchery programs on other fish species, wildlife, socioeconomics, cultural, environmental justice, and human health and safety for the alternatives analyzed in the 2017 EA and this SEA.

Resource	Species	Resource sub-category	Alternative 1 (No-action)	Effects of Alternative Relative to No-action			
				2	3	4	5
Other Fish Species	All	NA	Undetectable	Same as Alt 1	Negligible to Low positive	Negligible to Low positive	Negligible to Low positive
Wildlife (Southern resident killer whales)	All	NA	Low positive	Low positive	Low negative	Low positive	Medium positive
Socioeconomics	NA	NA	Undetectable	Same as Alt 1	Medium negative	Low to medium negative	Medium positive
Cultural	NA	NA	Undetectable	Same as Alt 1	High negative	Medium to High negative	High positive
Environmental Justice	NA	NA	Undetectable	Same as Alt 1	High negative	Low positive	Medium positive
Human Health and Safety	NA	NA	Undetectable	Same as Alt 1	Medium negative	Low negative	Low positive

4.6. Wildlife – Southern Resident Killer Whale

As described in Subsection 3.3, Wildlife, the contribution of hatchery programs in the Snohomish River basin to the prey base for Southern Resident killer whales is small but may be biologically meaningful. Alternative 1 was determined as low positive in the PS Hatcheries DEIS (NMFS 2014a) (Table 4-8). The

2017 EA did not determine an effect of the hatchery programs on SRKW, but that the effect was undetectable for all wildlife.

Under Alternative 5, additional summer-run Chinook salmon sub-yearlings and yearlings, coho salmon yearlings, and native chum salmon sub-yearlings (Table 2-1) would be released from Snohomish River basin salmon hatchery programs. The managers intend to intensively monitor and sample the resulting fishery and escapement contributions from these hatchery programs as production is increased to determine the number of fish produced by these hatchery programs available to be consumed by SRKW.

Under Alternative 5, the salmon hatchery programs would have a medium positive effect on the diet, survival, distribution, and listing status of Southern Resident killer whales, which would be greater than under alternatives 1, 2, and 4 (low positive) (Table 4-8). This is because the adults returning from the hatchery programs (especially Chinook salmon) would represent a small but meaningful part of the Southern Resident killer whale food base provided by the total number of hatchery-origin and natural-origin salmon and steelhead available from throughout the greater Puget Sound, the Strait of Georgia, and Pacific Coast area, particularly in south Puget Sound during the fall months. Under Alternative 3, the positive effects of the hatchery program on SRKW would be eliminated and would have a low negative effect.

4.7. Socioeconomics

The 2017 EA determined the resource socioeconomics as an undetectable effect for all species under Alternatives 1 and 2 (Table 4-8). Under Alternative 5, the salmon and steelhead hatchery programs would increase releases, which would increase the number of adult fish coming back, thus increasing harvest. Therefore, Alternative 5 would have a medium positive benefit compared to alternatives 1 and 2 (Table 4-8). For Alternative 3, the risk effect would be determined as medium negative because of the reduction in harvest by eliminating the hatchery programs, while Alternative 4 would be a low to medium positive effect because the number of returning hatchery-origin fish would be reduced compared to alternatives 1, 2, and 5 (Table 4-8).

4.8. Cultural Resources

Potential effect on cultural resources for Alternatives 1-4 are described in the 2017 EA. Alternative 5 would likely have a high positive effect on cultural resources because of the increase in the number of hatchery fish returning and available for harvest to the Tulalip Tribe (Table 4-8).

4.9. Environmental Justice

The potential effects of the hatchery programs on environmental justice for alternatives 1-4 were described in the 2017 EA (Table 4-8). Under Alternative 5, the salmon and steelhead hatchery programs would release additional summer-run Chinook salmon sub-yearlings and yearlings, coho salmon yearlings, and native chum salmon sub-yearlings (Table 3-1). Under Alternative 5, there would be a medium positive effect because of the increase in the number of hatchery-origin fish returning (Table 4-8). Below, additional information is presented that further explains the effect of Alternative 5 on Environmental Justice.

Communities of Concern

Under Alternative 5, the contributions from the hatchery programs to communities of concern to commercial harvest, recreational fishing trips and related expenditures, and jobs and personal income would increase compared to the other alternatives, and most of those increases would occur in Snohomish County and the South Puget Sound subregion.

Non-tribal User Groups of Concern

Under Alternative 5, contributions from the hatchery programs to landings by non-tribal commercial fishermen at three ports in the North Puget Sound and South Puget Sound subregions (representing non-tribal user groups of concern) would increase catch and ex-vessel values compared to all alternatives; most of those increases would occur in Snohomish County.

Native American Tribes of Concern

Under Alternative 5, contributions from the hatchery programs to tribal ceremonial and subsistence uses and tribal commercial fisheries in terms of the number of fish and ex-vessel values would increase compared to all alternatives. Income and jobs from tribal hatchery operations would not be affected under Alternative 5.

4.10. Human Health

The hatchery programs were determined as having an undetectable effect on Human Health for Alternative 1 and Alternative 2, a medium effect for Alternative 3, and a low effect for Alternative 4. (Table 4-8) in the 2017 EA. Alternative 5 would have a low positive effect compared to Alternative 1 because it would increase the potential human nutritional benefits by increasing the number of hatchery fish returning and subsequently eaten.

4.11. Summary of Resource Effects

Table 4-9 summarizes the potential effects of all of the alternatives on the resources discussed above.

Table 4-9. Summary of effects for the nine resources evaluated in the 2017 EA and this SEA.

Resource	Species	Resource sub-category	Alternative 1 (No-action)	Effects by Alternative Relative to No-action			
				2	3	4	5 (preferred alternative)
Water Quality	NA	NA	Undetectable	Same as Alt 1	Negligible positive	Same as Alt 1	Same as Alt 1
Water Quantity	NA	NA	Low negative	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
Salmon and Steelhead	Puget Sound Chinook salmon	Genetics	Low negative (Skykomish and Snoqualmie)	Same as Alt 1	Medium-positive (Skykomish and Snoqualmie)	Low-positive (Skykomish and Snoqualmie)	Same as Alt 1
		Competition	Low negative (Skykomish and Snoqualmie);	Same as Alt 1	Low positive	Negligible	Same as Alt 1
		Predation	Medium (Skykomish)	Same as Alt 1	Negligible	Low negative	Same as Alt 1
		Facility operations	Medium negative (Skykomish); Negligible (Snoqualmie)	Same as Alt 1	Undetectable	Same as Alt 1	Same as Alt 1
		Population viability	Low positive (Skykomish); Negligible (Snoqualmie)	Same as Alt 1	Low negative	Same as Alt 1	Same as Alt 1
		Masking	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Disease	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Nutrient recycling	Negligible	Same as Alt 1	Low negative	Same as Alt 1	Low positive
	Puget Sound steelhead	Genetics	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Competition	High negative	Same as Alt 1	Negligible	Medium negative	Same as Alt 1
		Predation	NA – see text				

Resource	Species	Resource sub-category	Alternative 1 (No-action)	Effects by Alternative Relative to No-action			
				2	3	4	5 (preferred alternative)
		Facility operations	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Population viability	NA				
		Masking					
		Disease					
		Nutrient recycling					
	Puget Sound coho salmon	Genetics	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Competition	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Predation	Low negative	Same as Alt 1	Negligible	Same as Alt 1	Medium negative
		Facility operations	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Population viability	Low positive	Same as Alt 1	Low negative	Same as Alt 1	Same as Alt 1
		Masking	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Disease	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Nutrient recycling	Medium positive	Same as Alt 1	Low negative	Same as Alt 1	Same as Alt 1
	Puget Sound chum salmon	Genetics	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Competition	Negligible	Same as Alt 1	Undetectable	Same as Alt 1	Low negative
		Predation	Medium negative	Same as Alt 1	Negligible	Low negative	Same as Alt 1
		Facility operations	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1

Resource	Species	Resource sub-category	Alternative 1 (No-action)	Effects by Alternative Relative to No-action			
				2	3	4	5 (preferred alternative)
		Population viability	Undetectable	Same as Alt 1	Low negative	Same as Alt 1	Same as Alt 1
		Masking	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Disease	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Nutrient recycling	Negligible	Same as Alt 1	Low negative	Same as Alt 1	Low positive
	Puget Sound pink salmon	Genetics	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Competition	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Predation	Medium negative	Same as Alt 1	Negligible	Low negative	Same as Alt 1
		Facility operations	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Population viability	NA				
		Masking	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Disease	Negligible	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Nutrient recycling	Negligible	Same as Alt 1	Low negative	Same as Alt 1	Low positive
	Sockeye salmon	Genetics	Undetectable effects	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Competition	NA				
		Predation					
		Facility operations	Undetectable	Same as Alt 1	Same as Alt 1	Same as Alt 1	Same as Alt 1
		Population viability	NA				
		Masking					

Resource	Species	Resource sub-category	Alternative 1 (No-action)	Effects by Alternative Relative to No-action			
				2	3	4	5 (preferred alternative)
		Disease					
		Nutrient recycling					
Other Fish Species	All	NA	Undetectable	Same as Alt 1	Negligible to Low positive	Negligible to Low positive	Negligible to Low positive
Wildlife (Southern resident killer whales)	All	NA	Low positive	Low positive	Low negative	Low positive	Medium positive
Socioeconomics	NA	NA	Undetectable	Same as Alt 1	Medium negative	Low to medium negative	Medium positive
Cultural	NA	NA	Undetectable	Same as Alt 1	High negative	Medium to High negative	High positive
Environmental Justice	NA	NA	Undetectable	Same as Alt 1	High negative	Low positive	Medium positive
Human Health and Safety	NA	NA	Undetectable	Same as Alt 1	Medium negative	Low negative	Low positive

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5.0 CUMULATIVE EFFECTS

The 2017 EA discusses past, present, and reasonably foreseeable future actions and the incremental effects of the alternatives on the resources analyzed. It is likely that the type and extent of salmon and steelhead hatchery programs and the numbers of fish released in the cumulative effects analysis area will change over time in response to new information and evolving management objectives. These changes are likely to reduce effects on natural-origin salmon and steelhead. For example, effects on natural-origin salmon and steelhead are expected to decrease over time to the extent that hatchery programs are reviewed and approved by NMFS under the ESA. 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. Where needed, reductions in effects on listed salmon and steelhead may occur through changes such as refinement of times and locations of fish releases to reduce risks of competition and predation; management of overlap in hatchery-origin and natural-origin spawners to meet gene flow objectives; decreased use of isolated hatchery programs; increased use of integrated hatchery programs for conservation purposes; incorporation of new research results and improved BMPs for hatchery operations; decreased production levels; or termination of programs. Similar changes are expected for non-listed species in many cases as well, motivated by the desire to reduce negative effects where possible and to help avoid species from becoming listed.

The descriptions in the 2017 EA for all of these resources in the context of climate change, development, habitat restoration, hatchery production, and fisheries in the cumulative effects analysis area are adequate to evaluate the incremental effects of Alternative 5 (Increased Production). The effects of Alternative 5 is also considered within the context of the "All-H" framework developed by the Tulalip Tribes (Rawson and Crewson 2017) as discussed in Section 5.3.1 in the 2017 EA. Below is an analysis of the cumulative effects under Alternative 5 for each resource analyzed in the 2017 EA.

5.1. Water Quantity and Quality

Under Alternative 5, as under the other alternatives, it is likely that cumulative effects from climate change, development, habitat restoration, and hatchery production would impact water quantity (increased demand on limited water supplies) and water quality (particularly changes in water temperature) in the cumulative effects analysis area. Alternative 5 would not affect the overall trend in cumulative effects on water quantity and quality.

5.2. Salmon and Steelhead

Under Alternative 5, as under the other alternatives, it is likely that cumulative effects from climate change and development would continue to degrade aquatic habitat over time, and abundance and productivity of natural-origin salmon and steelhead populations may be reduced. 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 not fully mitigate for habitat loss and degradation or the cumulative effects from climate change. Effects on abundance, productivity, and diversity of natural-origin salmon and steelhead from changes in hatchery production and fisheries would be expected to continue. Alternative 5 would not affect the overall trend in cumulative effects on salmon and steelhead, although it may increase the adverse cumulative effect on the genetics of natural-origin summer-run Chinook salmon. If the natural origin escapement continues to decline, the hatchery fish could provide a demographic boost and preserve genetic and life-history variation. However, this cumulative impact would not substantially add to the cumulative impacts compared to the other alternatives because the increase in production would represent a small component of the total abundance of summer-run Chinook salmon in the cumulative effects analysis area.

5.3. Other Fish Species

Under Alternative 5, as under the other alternatives, it is likely that cumulative effects from climate change, development, habitat restoration, hatchery production, and fisheries would impact other fish species, including bull trout, in the cumulative effects analysis area. Under Alternative 5, cumulative effects on other fish species that compete with, prey on, or are prey items for salmon may be greater. However, Alternative 5 would not affect the overall trend in cumulative effects on other fish species, because the production would be a small component of the total abundance of salmon in the cumulative effects analysis area.

5.4. Wildlife – Southern Resident Killer Whale

Under Alternative 5, as under the other alternatives, climate change and development in the cumulative effects analysis area may reduce the abundance and productivity of natural-origin salmon and steelhead populations. Hatchery-origin salmon may be similarly affected. Consequently, the total number of salmon available as prey to wildlife may decrease. The potential benefits of habitat restoration actions within the cumulative effects analysis area are difficult to quantify. These actions may not fully, or even partially, mitigate for the effects of climate change and development on salmon and steelhead abundances. Changes in hatchery programs and fisheries may occur over time and may affect wildlife species that have a relationship to salmon, including Southern Resident killer whales. It is likely that cumulative effects from

climate change, development, habitat restoration, hatchery production, and fisheries would impact Southern Resident killer whales in the cumulative effects analysis area. Cumulative effects on Southern Resident killer whales may include changes in their distribution in response to changes in the abundance and distribution of their food supply. Alternative 5 would not affect the overall trend in cumulative effects on Southern Resident killer whales, although it may benefit the whales by increasing the number of summer-run Chinook salmon, coho salmon, and chum salmon available for the whales to eat. Over the long term, Washington State Executive Order 18-02[2] may help increase production of hatchery-origin Chinook salmon to provide additional prey for the Southern Resident killer whale.

5.5. Socioeconomics

Under Alternative 5, as under the other alternatives, it is likely that cumulative effects from climate change, development, habitat restoration, hatchery production, and fisheries would decrease the number of fish available for harvest and reduce expenditures and economic values in the cumulative effects analysis area. Under Alternative 5, the overall trend in cumulative effects associated with socioeconomics may be positively affected because more summer-run Chinook salmon, coho salmon, and chum salmon would be available to catch. While these contributions would be critical to segments of the community in the analysis area, these changes would comprise a small component of the overall economic activity associated with salmon and steelhead production, harvest, and socioeconomic activity in the analysis area.

5.6. Environmental Justice

Under Alternative 5, as under the other alternatives, it is likely that cumulative effects from climate change, development, habitat restoration, hatchery production, and fisheries would decrease the number of fish available for harvest in the cumulative effects analysis area. Under Alternative 5, the overall trend in cumulative effects associated with environmental justice may be positively affected because more summer-run Chinook salmon, coho salmon, and chum salmon would be available to catch. However, this change would comprise a small percentage of the total number of harvestable salmon and steelhead in the cumulative effects analysis area available to environmental justice populations and communities.

5.7. Human Health

Under Alternative 5, as under the other alternatives, it is likely that cumulative effects from climate change, development, habitat restoration, and hatchery production would impact human health in the cumulative effects analysis area. Alternative 5 would not be expected to affect the overall trend in

[2] Washington State Executive Order 18-02 was issued by Governor Jay Inslee to implement immediate actions to benefit SRKW.

cumulative effects associated with the use of hatchery chemicals, the transfer of toxic contaminants from fish to humans, or the transmission of diseases from fish to humans.

6.0 REFERENCES

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7.0 DISTRIBUTION LIST

The EA includes a distribution list.

8.0 LIST OF PREPARERS

The EA includes a list of preparers. No other preparers were involved in preparation of this supplemental EA.

9.0 Appendix A: Finding of No Significant Impact

Background

Proposed Action:

The National Marine Fisheries Service (NMFS) determines that the seven hatchery and genetic management plans (HGMPs), submitted as resource management plans (RMPs) by the Tulalip Tribes and Washington Department of Fish and Wildlife (WDFW), meet the requirements under Limit 6 of the 4(d) Rule under the Endangered Species Act (ESA) for listed salmon and steelhead. The hatchery programs considered herein are the (1) Wallace River Hatchery Summer-run Chinook salmon program, (2) Tulalip Hatchery Summer-run Chinook salmon program, (3) Wallace River Hatchery coho salmon program, (4) Everett Bay Net-Pen coho salmon program, (5) Tulalip Bay Hatchery coho salmon program, (6) Tulalip Bay Hatchery Fall-run chum salmon program, and (7) Wallace River Hatchery native chum salmon program. See the Snohomish Environmental Assessment (Snohomish EA), and Snohomish Supplemental Environmental Assessment (Snohomish SEA) for more details about these hatchery programs.

Alternatives evaluated in the Snohomish SEA are the following:

- Alternative 1 (No Action): NMFS would not make a determination under the 4(d) Rule
- Alternative 2 (Proposed Action): NMFS would make a determination that the submitted HGMPs meet the requirements of the 4(d) Rule
- Alternative 3 (Termination): NMFS would make a determination that the submitted HGMPs would not meet the requirements of the 4(d) Rule
- Alternative 4 (Reduced Production): NMFS would make a determination that revised HGMPs with production levels 50 percent less than the currently submitted HGMPs meet the requirements of the 4(d) Rule
- Alternative 5 (Increased Production): NMFS would make a determination that the submitted HGMPs modified by the agreed upon increases in salmon production meet the requirements of the 4(d) Rule

Selected Alternative:

Alternative 5 is the alternative selected by NMFS.

Related Consultations:

NMFS completed ESA section 7 consultation on the evaluation of six HGMPs for Snohomish River basin salmon under Limit 6 of the ESA section 4(d) Rule, and issued a biological opinion on 9/27/2017, (consultation number WCR-2012-00841). NMFS then completed ESA section 7 consultation on the evaluation of seven HGMPs for Snohomish River basin salmon under Limit

6 of the ESA section 4(d) Rule, and issued a biological opinion on 5/03/2021, (consultation number WCR-2020-02561).

Significance Review

The Council on Environmental Quality (CEQ) Regulations state that the determination of significance using an analysis of effects requires examination of both context and intensity, and lists ten criteria for intensity (40 C.F.R. § 1508.27). In addition, the Companion Manual for National Oceanic and Atmospheric Administration Administrative Order 216-6A provides sixteen criteria, the same ten as the CEQ Regulations and six additional, for determining whether the impacts of a proposed action are significant. Each criterion is discussed below with respect to the Alternative 5 and any measures to reduce impacts and considered individually as well as in combination with the others.

1. ***Can the proposed action (Alternative 5) reasonably be expected to cause both beneficial and adverse impacts that overall may result in a significant effect, even if the effect will be beneficial?***

Response: The NMFS' 4(d) determination for continuation of the seven hatchery programs analyzed in the attached Snohomish SEA is expected to have both beneficial and adverse impacts. Beneficial effects include low-positive effects on the viability of the Skykomish River Chinook salmon population; medium-positive effects on Wildlife (Southern Resident killer whales), Socioeconomics, Environmental Justice and Human Health and Safety; and a high-positive beneficial effect on Native American cultural resources.

Alternative 5 may impact nine resources as discussed in the Snohomish SEA. The magnitude of these potential impacts range from negligible to high, and the direction of impact being either positive impacts (i.e., beneficial) or negative impacts (i.e., adverse). With the exception of the above-mentioned resources, the remaining four resources (water quality, water quantity, salmon and steelhead, and other fish species) were determined to range from undetectable to high negative (competition effects on Puget Sound steelhead), but taken together, the effects to these resources were determined to be insignificant on Alternative 5. Although there are negative and beneficial effects of varying degree, the effect of no single impact, nor the overall effects of impacts, are unlikely to result in a significant effect.

2. ***Can the proposed action (Alternative 5) reasonably be expected to significantly affect public health or safety?***

Response: Increased Production is expected to have a negligible, negative impact on Public Health and Safety, directly or indirectly. Hatchery facility operations associated with Alternative 5 are implemented in compliance with state and Federal safety regulations and environmental laws, thus reducing potential risks to public health. The public will have limited exposure to

hatchery facility operations. The contribution of toxic contaminants from hatchery operations under Alternative 5 to the body toxins of hatchery-origin salmon at a harvestable size that could be consumed by humans is not substantial, and therefore would have no significant effect on Public Health or Safety.

3. *Can the proposed action (Alternative 5) reasonably be expected to result in significant impacts to unique characteristics of the geographic area, such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas?*

Response: Under Alternative 5, no significant impacts are expected on any unique geographic areas, such as proximity to historic or cultural resources, park land, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas; because no new infrastructure is proposed through the action (hatchery operations and release of hatchery-origin fish), and the potential impacts from Increased Production would not occur within or otherwise affect a unique geographic area.

4. Are the proposed action's (Alternative 5) effects on the quality of the human environment likely to be highly controversial?

Response: NMFS recognizes that the use of hatcheries, in general, can be controversial to some members of the public, with views ranging from adamantly opposed to hatcheries regardless of the hatchery program objectives, to adamantly in favor of achieving a program's intended benefits. The wide range of potential effects evaluated in the Snohomish EA and SEA are, in part, a reflection of NMFS' understanding of the potentially controversial aspects of Increased Production. The effects of Alternative 5 on the quality of the human environment are not likely to be highly controversial because all seven programs are relatively small in comparison to the basin-wide number of salmonids and use native stocks, only one negative effect (competition effects to Puget Sound steelhead) is high, are consistent with implementation of the hatchery programs over prior years, and the programs are beneficial to the affected human communities.

5. Are the proposed action's (Alternative 5) effects on the human environment likely to be highly uncertain or involve unique or unknown risks?

Response: The effects of Alternative 5 on the human environment are not likely to be highly uncertain or involve unique or unknown risks. No unique or unknown risks have been identified, and numerous scientific studies on hatchery risks have identified what NMFS believes is an accurate list of potential concerns. Although there are some uncertainties involved in the ongoing operation of hatchery programs, the risks are known, and the proposed hatchery programs include explicit steps to monitor and evaluate these uncertainties in a manner that allows timely adjustments to minimize or avoid adverse impacts. NMFS retains the ability, through its regulations, to require changes if the programs are determined to be ineffective with

respect to any of the anticipated impacts to the human environment. The proposed operation of the hatchery programs is similar to other recent hatchery operations in many areas of the Pacific Northwest, and the procedures and effects are well known.

6. Can the proposed action (Alternative 5) reasonably be expected to establish a precedent for future actions with significant effects or represent a decision in principle about a future consideration?

Response: Alternative 5 is not likely to establish a precedent for future actions with significant effects, or represent a decision in principle about a future consideration. Other hatchery operations in Puget Sound have been analyzed through similar ESA analyses and NEPA reviews, so this action and the analysis thereof, is not unique. Moreover, future applications for ESA section 4(d) determinations in Puget Sound would be analyzed on their own merits and impacts. Each such activity presents unique actions and effects, limiting the extent to which NMFS could or would regard any prior analyses as any sort of precedent.

7. Is the proposed action (Alternative 5) related to other actions that when considered together will have individually insignificant but cumulatively significant impacts?

Response: NMFS is well aware of the possibility that hatchery practices in one river basin may not likely raise significant impacts on their own, but that the totality of hatchery operations in Puget Sound could give rise to cumulatively significant impacts. As described in the associated Snohomish ESA consultations, impacts on salmonid species in the Snohomish River Basin is small enough to result in a no-jeopardy ESA determination when considering all existing conditions, all other permits, and other actions in the area affecting these conditions and permits. These hatchery programs are coordinated with monitoring so that hatchery managers can respond to changes in the status of affected listed species.

Alternative 5 is similar to other hatchery production programs in Puget Sound in that they are guided by the same legal agreements and mitigation responsibilities, and they are managed by the same agencies. While direct and indirect impacts of Alternative 5 are not expected to be measurable outside the analysis area, it is also important to consider how impacts of certain activities outside the project area (the Snohomish River Basin) may or may not interact with Alternative 5 in such a way that impacts on resources are exacerbated.

Chapter 5 of the Snohomish EA and the SEA (Cumulative Effects) evaluated the incremental impact of Alternative 5 when added to other past, present, and reasonably foreseeable future actions; and conditions related to climate change, development, habitat restoration, hatchery production, and fisheries. The evaluation concluded that Alternative 5 would be unlikely to change the trends in cumulative effects on the nine resources analyzed because the effects attributable to Alternative 5 would be very small relative to other actions and conditions. Therefore, NMFS does not believe that Alternative 5 would combine with other actions to result in cumulatively significant impacts.

8. Can the proposed action (Alternative 5) reasonably be expected to adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources?

Response: Alternative 5 does not include any new construction and is, therefore, unlikely to adversely impact districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places. Accordingly, it is equally unlikely that Alternative 5 may cause loss or destruction of significant scientific, cultural, or historic resources because of the limited geographic scope of the analysis area, which includes none of the aforementioned structures or resources.

Implementation of Alternative 5 is expected to provide high positive cultural resource benefits by increasing the potential for ceremonial and subsistence harvest of salmon by the Tulalip Tribe of Indians, which has been limited under current conditions. However, a variety of other factors besides the Snohomish River Basin salmon hatcheries also contribute to the amount of harvestable salmon, including freshwater and estuarine habitat quality and quantity, marine productivity, climate change, and recreational and commercial fishing that occurs in Puget Sound, Canada, and Alaska. Consequently, among all factors considered, the positive benefits from the hatchery programs under Alternative 5 do not result in significant impacts to cultural resources.

9. Can the proposed action (Alternative 5) reasonably be expected to have a significant impact on endangered or threatened species, or their critical habitat as defined under the Endangered Species Act of 1973?

Response: The degree to which Alternative 5 adversely impacts endangered or threatened species, or their critical habitat, as described in the Snohomish EA and the SEA, will be negligible to high depending upon the specific effect. The Wallace River Chinook and chum salmon hatchery programs are integrated programs designed to support salmon populations experiencing low productivity and abundance in the Snohomish River Basin. In the Snohomish EA, NMFS considered the analyses performed in the biological opinions completed in 2017 and 2021 on the proposed hatchery programs that considered and summarized all effects to ESA-listed species. Those biological opinions ultimately determined that the programs will not appreciably reduce the likelihood of survival and recovery of the four ESA-listed species within the analysis area, and potentially affected by Increased Production, and therefore concluded the Puget Sound Chinook salmon evolutionarily significant unit, the Puget Sound steelhead Distinct Population Segment (DPS), Coastal-Puget Sound bull trout DPS, and Southern Resident killer whale DPS will not be jeopardized.

The Snohomish SEA summarizes the impacts of Increased Production on critical habitat for Chinook salmon, steelhead, Southern Resident killer whale, and bull trout, which were also analyzed in detail in the aforementioned ESA consultations. The biological opinions concluded

that the expected impacts on critical habitat for endangered and threatened species from the activities associated with the hatchery programs (such as maintenance of facilities and instream structures) are unlikely to adversely modify or destroy critical habitat.

10. Can the proposed action (Alternative 5) reasonably be expected to threaten a violation of Federal, state, or local law or requirements imposed for environmental protection?

Response: Alternative 5 is not expected to violate any Federal, state, or local laws or requirements imposed for environmental protection. Alternative 5 was developed in the broader context of consultations involving Federal and state agencies charged with recovery planning and implementation of the ESA. No regulatory violations or other significant environmental impacts are expected to result from Alternative 5.

Hatchery operations are required to comply with the Clean Water Act, which is administered by the Environmental Protection Agency and the state of Washington's Department of Ecology (Ecology), including obtaining and operating within the limits of National Pollutant Discharge Elimination System permits for discharge from hatchery facilities. Wallace River Hatchery has water rights permitted by Ecology that constrain the amount of water the facility can withdraw from surface or groundwater sources.

11. Can the proposed action (Alternative 5) reasonably be expected to significantly adversely affect stocks of marine mammals as defined in the Marine Mammal Protection Act?

Response: Alternative 5 is not expected to significantly adversely affect stocks of marine mammals as defined in the Marine Mammal Protection Act. The analysis area is used by a variety of marine mammals that may eat salmon. Increases or decreases in the abundance of juvenile and adult salmon associated with hatchery operations in the Snohomish River Basin may affect marine mammal species that prey on them. However, the effects of salmon hatchery programs on wildlife species, including most marine mammals, have generally been negligible. The exception to this general conclusion was the potential effects on Southern Resident killer whales, which were analyzed in the Snohomish SEA. The Snohomish SEA concluded that the salmon hatchery programs in the Snohomish River Basin would have a medium positive effect on the diet, survival, and distribution of Southern Resident killer whales because the returning hatchery-origin adult salmon (especially Chinook salmon) would represent a small but meaningful part of their prey base relative to the total number of hatchery-origin and natural-origin salmon available from throughout the greater Puget Sound, Strait of Georgia, and Pacific Coast areas.

12. Can the proposed action (Alternative 5) reasonably be expected to significantly adversely affect managed fish species?

Response: Alternative 5 is not expected to significantly adversely affect managed fish species beyond what the Snohomish SEA identifies as negligible to medium negative effects. The impacts of Alternative 5 on managed salmon species within Puget Sound are limited to the ecological impacts of intra- and inter-species competition and predation related to the release of juveniles; genetic diversity from hatchery-origin spawners, and the direct effects on target and non-target species due to broodstock collection activities. The impacts of Alternative 5 on other managed fish species are limited to inter-species competition and predation related to the release of juveniles.

13. Can the proposed action (Alternative 5) reasonably be expected to significantly adversely affect essential fish habitat as defined under the Magnuson-Stevens Fishery Conservation and Management Act?

Response: Alternative 5 is not expected to significantly adversely affect EFH, as defined under the Magnuson-Stevens Fishery Conservation and Management Act, to a degree beyond negligible-negative, and as described in the 2017 and 2021 NMFS biological opinions, and Subsection 4.4.3, Facility Operations, in the Snohomish SEA. Specifically, the activities described in the HGMPs, such as surface water withdrawals and maintenance of intake structures, are unlikely to remove or destroy habitat elements, and these activities do not include any construction or habitat modification, and therefore do not affect EFH necessary for these species to carry out spawning, breeding, feeding, or growth to maturity.

The return of Snohomish summer-run Chinook salmon, coho salmon, and chum salmon produced by these hatchery programs is likely to have a positive effect on water quality, aquatic insect production, and riparian function because the additional returns from hatchery production will result in an increase of marine-derived nutrients benefitting the aquatic habitats in the analysis area.

14. Can the proposed action (Alternative 5) reasonably be expected to significantly adversely affect vulnerable marine or coastal ecosystems, including but not limited to, deep coral ecosystems?

Response: Alternative 5 is not expected to have a significantly adverse effect on vulnerable marine or coastal ecosystems, including but not limited to, deep coral ecosystems, for several reasons that are described in the Snohomish SEA. First, the number of hatchery-origin fish released by the hatchery programs is relatively small compared to the basin-wide numbers of salmonids, which reduces the likelihood that they could cause a significantly adverse effect. Second, while hatchery-origin fish from the Snohomish River Basin may use vulnerable marine or coastal ecosystems such as estuaries or eel grass beds as habitat and foraging areas for a portion of their life cycle, this use is temporary. Finally, Pacific salmon, including the species produced at Snohomish River Basin hatcheries, primarily use surface waters in the ocean less

than 300 feet deep and consequently are not found in many vulnerable marine ecosystems such as deep coral ecosystems.

15. Can the proposed action (Alternative 5) reasonably be expected to significantly adversely affect biodiversity or ecosystem functioning (e.g., benthic productivity, predator-prey relationships, etc.)?

Response: Alternative 5 is expected to have no more than a low-negative effect on biodiversity or ecosystem functions within the analysis area. As described in the Snohomish SEA, the hatchery programs minimize the effects on ecosystems within the analysis area through the use of endemic broodstock native to the Snohomish River Basin, and improved hatchery management protocols that limit the effects of hatchery-origin fish spawning in the wild. The hatchery programs may result in small improvements to benthic productivity through increased deposits of marine-derived nutrients resulting from returning hatchery-origin adult carcasses to the river basin post-spawning.

Although salmon produced in these hatchery programs are expected to prey on other fish species in the analysis area, predation is not expected in large quantities since juvenile hatchery-origin salmon generally migrate through fresh and estuarine waters quickly after being released. Hatchery-origin salmon produced by these hatchery programs may also provide a prey base for other predatory species such as bull trout, but these programs represent only a small portion of the total amount of food available to predator species. Consequently, Alternative 5 is not expected to have significant impacts on biodiversity and ecosystem function.

16. Can the proposed action (Alternative 5) reasonably be expected to result in the introduction or spread of a nonindigenous species?

Response: Alternative 5 is not expected to result in the introduction or spread of nonindigenous species because Alternative 5 has no potential to cause the transport, release, propagation, or spread of nonindigenous species. Alternative 5 involves the operation of hatchery facilities for the purpose of artificial propagation of salmonids in the Snohomish River Basin for integrated conservation programs and fisheries. These artificial propagation programs use local endemic Chinook salmon, coho salmon, and chum salmon adults as broodstock, and therefore will not introduce nonindigenous species into the analysis area.

Determination

In view of the information presented in this document, and the analysis contained in the supporting Snohomish Supplemental Environmental Assessment prepared for NMFS' determination under ESA section 4(d) for the continuation and increased production of seven proposed hatchery programs (i.e., Wallace River Hatchery summer-run Chinook salmon program, Tulalip Hatchery summer-run Chinook salmon program, Wallace River Hatchery coho

salmon program, Everett Bay Net-Pen coho salmon program, Tulalip Bay Hatchery coho salmon program, Tulalip Bay Hatchery fall-run chum salmon program, and Wallace River Hatchery native chum salmon program), it is hereby determined that Alternative 5 will not significantly impact the quality of the human environment as described above, and in the supporting Snohomish Supplemental Environmental Assessment. In addition, all beneficial and adverse impacts of the proposed action have been addressed to reach the conclusion of no significant impacts. Accordingly, preparation of an environmental impact statement for this action is not necessary.

May 6, 2021

Barry A. Thom
Regional Administrator
West Coast Region
National Marine Fisheries Service

Date