UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

Refer to NMFS No:
WCRO-2021-02739

September 9, 2022

Mr. Christopher Page
Chief, Environmental Resources Branch
Department of the Army, U.S. Army Corps of Engineers, Portland District
P.O. Box 2946
Portland, Oregon 97208-2946

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Re-initiation of the Mount St. Helens Project Phased Construction Alternative

Dear Mr. Page:

Thank you for your letter of October 26, 2021, requesting re-initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the Mount St. Helens Project Phased Construction Alternative.

NMFS also reviewed the likely effects of the proposed action, as modified (see below), on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)), and concluded that the action would adversely affect the EFH of Pacific Coast Salmon. Therefore, we have included the results of that review in Section 3 of this document.

The USACE is implementing multiple elements of the Reasonable and Prudent Alternative (RPA) outlined in the jeopardy opinion, WCRO-2014-01164, but the USACE has proposed to modify one element of the RPA originally developed by NMFS and the USACE. The modification of the RPA is the basis for this re-initiation. We note that other elements of the RPA are underway, and NMFS is working with the USACE and the Washington Department of Fish and Wildlife (WDFW) to make these projects successful and avoid the previously identified jeopardy to ESA-listed fish. The Corps' proposal is to implement the RPA identified in the original consultation with one modification, which is to revise the sequence of one element. The corrections to the Fish Collection Facility (FCF) will follow the first spill raise, rather than precede it. For the purpose of this reinitiated consultation, and per the request of the action agency, we will treat the elements of the RPA outlined in WCRO-2014-01164, with the modification described herein, as part of the USACE's newly proposed action.

We have determined that the proposed action, as just described, is not likely to jeopardize the existence or recovery of Lower Columbia River coho salmon, Lower Columbia River steelhead, Lower Columbia River Chinook salmon or Columbia River chum salmon or adversely modify their designated critical habitat.

We have also determined that the proposed action, consistent with our conclusion in WCR 2014-01164, is not likely to adversely affect Upper Willamette River Chinook, Upper Willamette River steelhead, Snake River Spring/Summer Chinook, Snake River steelhead, Upper Columbia River Spring Chinook, Snake River Fall Chinook, Upper Columbia River steelhead, Middle Columbia River steelhead, Snake River sockeye, Pacific eulachon, or Green Sturgeon or adversely modify their critical habitat.

Please contact Tom Hausmann, 503-231-2315, tom.hausmann@noaa.gov, if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Kim W. Kratz, Ph.D
Assistant Regional Administrator
Oregon Washington Coastal Office

cc: Fenton Khan, Fish Passage Section, USACE, Portland District,
Karl Ahlen, Program Manager, USACE, Portland District

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the

Re-initiation of Consultation for Mt. St. Helens Sediment Retention Structure, Project Phased Construction Alternative (HUC 1708000505)

NMFS Consultation Number: WCR-2021-02739

Action Agency: U.S. Army Corps of Engineers, Portland District

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?*	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?*	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Lower Columbia River steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	Yes	No
Lower Columbia River coho salmon (*O. kisutch*)	Threatened	Yes	No	Yes	No
CR chum salmon (*O. keta)*	Threatened	Yes	No	Yes	No
Upper Willamette River Chinook	Threatened	No	No	No	No
Upper Willamette River steelhead	Threatened	No	No	No	No
Lower Columbia River Chinook	Threatened	Yes	No	Yes	No
Snake River Spring/Summer Chinook	Threatened	No	No	No	No
Snake River steelhead	Threatened	No	No	No	No
Upper Columbia River Spring Chinook	Endangered	No	No	No	No
Snake River Fall Chinook	Threatened	No	No	No	No
Upper Columbia River steelhead	Threatened	No	No	No	No
Middle Columbia River steelhead	Threatened	No	No	No	No
Snake River sockeye	Endangered	No	No	No	No
Pacific eulachon (*Thaleichthys pacificus)*	Threatened	No	No	No	No
Green Sturgeon (*Acipenser medirostiris*)	Threatened	No	No	No	No

Fishery Management Plan That Describes EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Kim
Issued By:

Kim W. Kratz, Ph.D
Assistant Regional Administrator
Oregon Washington Coastal Office

Date: September 9, 2022

TABLE OF CONTENTS

1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3 below.

1.1 Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), as amended, and implementing regulations at 50 CFR part 402.

This biological opinion is a re-initiation of WCR 2014-01164 Mt. St. Helens Sediment Retention Structure, Project Phased Construction Alternative. In that opinion, we concluded that the proposed action to raise the North Fork Toutle River (NFTR) Sediment Retention Structure (SRS) spillway crest was likely to jeopardize lower Columbia River (LCR) steelhead and LCR coho salmon and adversely modify their designated critical habitat. It included a Reasonable and Prudent Alternative (RPA) with two elements. The first element stated:

> The USACE will implement measures to achieve a 95 percent passage efficiency for all natural origin LCR steelhead and LCR coho salmon that reach the existing Fish Collection Facility (FCF) barrier. Total passage efficiency is described as the proportion of the migrating population that successfully passes through the far-field attraction zone, near-field attraction zone, technical fish passage facility, and the release zone. Before the first spillway crest raise is implemented, the USACE must make improvements to the current FCF, which must operate such that 95 percent of returning adult LCR steelhead and LCR coho salmon can safely and effectively access suitable spawning habitat in the upper NFTR watershed above the SRS. The goal of 95 percent total passage efficiency is consistent with NMFS fish passage guidance (NMFS, 2011a), and with guidance for numerous other passage designs implemented at dams throughout the LCR recovery domain.

NMFS provided its draft RPA, the USACE provided a draft implementation schedule in reply, and NMFS agreed to proposed schedule, which it incorporated into the RPA. The opinion was signed on August 10, 2017.

As detailed in the Consultation History (Section 1.2) below, in 2020 the USACE determined that it would have to begin to implement the phased construction portion of the RPA by raising the SRS spillway crest in 2023 to sustain its congressionally mandated flood risk levels for Lower Cowlitz River communities. At that time the USACE also determined that achieving 95 percent passage efficiency with the FCF would take up to three years of engineering analysis, design and testing, followed by 2 years of construction, once they began to receive funding in 2021. The USACE's currently proposed action subject to this reinitiation is to change the order of construction of the spillway crest raise so that it happens first (and will meet congressional mandates) and then follow that construction by the FCF improvements that were required to avoid jeopardy as part of the previous RPA discussed above. The proposed change in the sequence of work is a modification to the RPA, and the delay in achieving 95 percent passage efficiency at the FCF is part of what we are analyzing in this new opinion.

Where the information in the original opinion is correct and relevant, we have inserted that text into this new opinion with only necessary updates and edits, which were minimal, to ensure this analysis is consistent with our Section 7 obligations, including the requirement to use best available science. We marked paragraphs from the original opinion with an asterisk (*) at the beginning. New material is provided in italics without asterisks.

Since the USACE modified the RPA and added it to the proposed action we also include an updated EFH analysis in this re-initiation in accordance with section 305(b)(2) of the Magnuson–Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR part 600. The EFH analysis in this reinitiation also draws largely from the 2017 consultation, and is updated where appropriate.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at Lacey, Washington

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1.2 Consultation History

*The May 18, 1980, eruption of Mt. St. Helens (MSH) caused a catastrophic debris avalanche off the northwest slopes of Mt. St. Helens that delivered, and continues to deliver, millions of cubic yards of sediment per year into the Toutle River and lower Cowlitz River. As a result of the sediment delivered into the Cowlitz River watershed by the eruption, flood risks in the towns of Castle Rock, Longview/Kelso and Lexington greatly increased from the sediment deposition in the Lower Cowlitz River bed. To reduce this risk, the U.S. Army Corps of Engineers (USACE) dredged the lower Cowlitz River, constructed levees and built a Sediment Retention Structure (SRS) on the North Fork Toutle River (NFTR) at river mile (RM) 26 in 1989 (Figure 1), following recommendations outlined in a 1984 MSH, Washington Feasibility Report and Environmental Impact Statement and the 1985 MSH, Washington Decision Document (USACE, 1985). By 1998, sediment filled the impoundment behind the SRS. The SRS began operating as a run of the river project and the sediment trapping efficiency decreased.

*In 2010, the USACE determined that it needed to increase the sediment trapping efficiency at the MSH SRS by recreating an impoundment to maintain flood protection levels for Lower Cowlitz River communities based on analysis and modeling in the Toutle/Cowlitz River Sediment Budget (Biedenharn Group, 2010) and the MSH Future Expected Deposition Scenario (Biedenharn Group, 2011).

*In the spring of 2012, the USACE and NMFS conducted an informal consultation (NWR-2012-306) on a (proposed 10-foot, actual 7-foot) raise of the SRS spillway crest. The USACE constructed this new spillway crest in the summer of 2012. Later in 2012, the USACE also began work on a Supplemental Environmental Impact Statement (SEIS) to the 1984 MSH, Washington Feasibility Report and Environmental Impact Statement and the 1985 MSH, Washington Decision Document (USACE, 1985). The SEIS further analyzed solutions to the Lower Cowlitz River flood risk problem through the year 2035.

*To gather information for the SEIS, the USACE created the MSH Technical Advisory Team (TAT) with representatives from Federal Agencies (NMFS, USFWS, USGS, USFS), State Agencies (WDFW, DOE), Cowlitz County, the Cowlitz Indian Tribe, the Lower Columbia River Fish Recovery Board and interested stakeholders. Meetings of the TAT were held on Nov 13, 2013, Feb 12, 2013, March 19, 2013, September 4, 2013, Nov 1, 2013, Dec 10, 2013, and September 16, 2014. The USACE also contracted with Pacific Northwest National Laboratories (PNNL) to conduct studies in support of the SEIS. PNNL surveyed eulachon spawning and lamprey abundance in the Lower Cowlitz River in March 2014 and conducted spawning and rearing habitat surveys of Alder Creek and Hoffstadt Creek in the Summer of 2014 (Hughes et al., 2014).

*A key area of discussion by the TAT was the Fish Collection Facility (FCF) that is located about a mile downstream of the SRS. The FCF was built to trap adult coho salmon and steelhead that migrate up the NFTR to spawn in tributaries that were formerly accessible before the SRS was built. Fish trapped at the FCF are hauled and released in Alder Creek and Hoffstadt/Bear creek to spawn--tributaries of the NFTR above the SRS (Figure 1). The FCF was transferred by the USACE to the WDFW, as prescribed in the 1985 Decision Document (USACE, 1985) in 1993. The TAT visited the FCF on April 15, 2013, to inspect its current condition. This inspection confirmed two things: that the FCF is not maintained sufficiently, and that adult salmonid passage is currently compromised by the SRS operations in the absence of opportunity for volitional passage. The lack of proper maintenance limits the attractant flow and thereby limits the fraction of returning coho and steelhead that approach the FCF and enter the ladder. The SRS spillway is passable by strong steelhead (Liedtke et al., 2013) but the FCF barrier weir prevents any steelhead that might successfully ascend the SRS spillway to the Upper NFTR from reaching the base of the spillway.

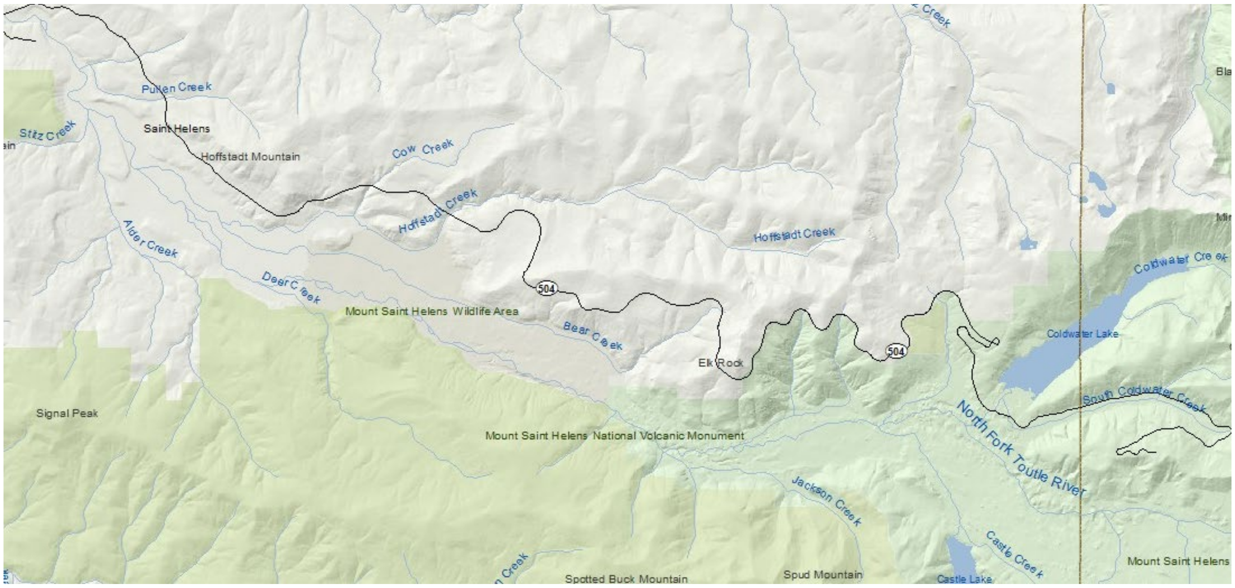

Figure 1. Upper North Fork Toutle River basin and tributary locations where adult salmon and steelhead captured at the Fish Collection Facility (FCF) associated with the Sediment Retention Structure (SRS) are released to spawn naturally.

*Through the SEIS process, the USACE identified a proposed action (its preferred alternative in the SEIS) and prepared a biological assessment that it included in the request for consultation with the National Marine Fisheries Service (NMFS). *The preferred alternative is the construction of up to two spillway crest raises (i.e. in ca. 2022, and ca. 2032) when Lower Cowlitz River communities approach flood risk thresholds, the construction of grade building structures if additional sediment trapping above the SRS is necessary following the ca. 2032 spillway crest raise and emergency dredging following extreme weather events that transport large amounts of sediment to the Lower Cowlitz River.*

*Numerous pre-consultation meetings were held between the USACE and NMFS from 2013 through 2015 to specifically address questions related to the proposed action, and operations of the FCF and its relation to functions of the SRS in its existing and proposed forms. NMFS met with the USACE and the WDFW at the FCF on November 1, 2013 to observe the FCF and the associated trap and haul procedures. On January 29, 2014, NMFS met with the USACE in Lacey, Washington for a pre-Biological Assessment (BA) workshop.

*On March 6, 2014, NMFS and the USACE met in Lacey, Washington to discuss the ESA status of the Toutle Basin salmon and steelhead populations.

*In April 2014, NMFS met with the USACE in Portland, Oregon to review the Biological Assessment outline.

*On June 25, 2014, the USACE provided NMFS with its Biological Assessment, including its determinations of effects from its proposed action on ESA-listed fish species and critical habitat of the Lower Columbia River and action area. In its BA, the USACE provided its determination that its proposed action is likely to adversely affect LCR steelhead and coho salmon, and is not likely to adversely affect Upper Willamette River Chinook salmon, Upper Willamette River steelhead, Lower Columbia River Chinook salmon, Columbia River Chum Salmon, Snake River Spring/Summer Chinook Salmon, Snake River Fall Chinook Salmon, Snake River sockeye salmon, Snake River steelhead, Upper Columbia River Spring Chinook salmon, Upper Columbia River steelhead, Middle Columbia River steelhead, Pacific eulachon and green sturgeon. Critical habitat is not designated within the action area for the southern DPS of green sturgeon so the USACE did not request consultation on its critical habitat. While the USACE did not directly ask NMFS for our concurrence with these determinations, we presumed concurrence was requested based on the summary determinations provided by the USACE in Table 4-1 of their BA.

*Toward the end of the consultation, through our closer examination of WDFW's section 10(a)(1)(A) permit and its associated biological opinion for activities at the FCF, it became apparent that there could be a small amount of handling of LCR Chinook salmon and CR chum salmon by WDFW at the FCF, which is considered a consequence of the proposed action and thus these species and their designated critical habitat were treated as "likely to adversely affect." The USACE also requested consultation on the potential effects to EFH pursuant to the Magnuson-Stevens Fisheries Conservation and Management Act (16 U.S.C. 1801 *et seq*).

*On August 14, 2014, the USACE delivered to NMFS the Draft Supplemental Environmental Impact Statement as supplemental information to its previously submitted BA. Between October 2014 and October 2015, NMFS and the USACE engaged in numerous other meetings and conference calls to discuss the effects of the proposed action on LCR steelhead and coho salmon of the Toutle River Basin, the two ESA-listed major population groupings (MPGs) considered to be most affected by the proposed action.

*On November 14, 2014, NMFS met with the USACE in Portland, Oregon to discuss comparisons between an action focused exclusively on Lower Cowlitz dredging and the preferred alternative identified in the SEIS (i.e., the proposed action for which consultation was sought under section 7(a) of the ESA) *vis a vis* Lower Cowlitz flood risk.

*On December 9, 2014, NMFS met with the USACE in Longview, Washington to discuss additional fish passage measures that the USACE could take to reduce the effects of the preferred alternative on critical habitat.

*On April 29, 2015, the USACE provided NMFS with a "Supplemental Analysis of Effects to Individual Lower Columbia River Evolutionary Significant Unit of coho salmon and Lower Columbia River Distinct Population Segment of steelhead trout and proposed and designated critical habitat for these species" as an amendment to the BA.

*On July 14, 2015, NMFS and the USACE met in Lacey to discuss the probability and conditions under which the connection between Alder Creek and the North Fork Toutle River (NFTR) could become subsurface. This is a potential outcome of the project wherein surface waters of the creek completely infiltrate before joining the NFTR—a condition that would adversely impact the migratory pathway physical and biological features (PBF) of critical habitat for LCR steelhead and coho salmon because there would be no surface water in the stream bed.

*Parallel with its consultation with NMFS, the USACE entered into discussions with the WDFW to better understand the current condition of the FCF. On October 7, 2015, the USACE and WDFW hosted, and NMFS attended, a meeting at the FCF to review operational problems and discuss possible solutions.

*In November 2015, the USACE MSH SRS Program Manager requested that NMFS summarize the critical elements of the project that might support a potential jeopardy/adverse modification determination for the project in a short memo that he could use to brief his Chain of Command. NMFS staff sent the USACE a memo, dated November 10, 2015, summarizing its preliminary thoughts on how the proposed action might jeopardize LCR steelhead and LCR coho and adversely modify their critical habitat, based on NMFS' preliminary analysis of the proposed action's effects.

*On November 20, 2015, formal consultation began because the USACE confirmed that no other project changes were anticipated for the proposed action.

*On June 10, 2015, NMFS sent a draft Jeopardy Opinion and a draft Reasonable and Prudent Alternative (RPA) to the USACE for its review and comments. On January 17, 2016, the USACE sent to NMFS its concurrence with the Jeopardy conclusion and its draft "Response" to the RPA that outlined how the USACE would comply with the RPA.

*On April 6, 2017 and May 12, 2017, NMFS and the USACE met with the Washington Department of Fish and Wildlife (WDFW) to brief them on the status of the biological opinion, and share with them the RPA and the USACE Response. At the May 12, 2017 meeting, the WDFW suggested that the RPA include the creation of a second adult release site on the mainstem NFTR to allow fish to spawn in small, upper basin tributaries. NMFS and the USACE agreed to add an investigation into the likelihood of success of a mainstem NFTR release site to the RPA.

*On June 5, 2017, NMFS and the USACE met with the Cowlitz Tribe to brief them on the status of the biological opinion, RPA and the USACE RPA Response. At that meeting, the Cowlitz Tribe recommended that the RPA include a monitoring study to determine steelhead and coho salmon smolt survival in the ponds and braided channel network through the sediment plain created by the proposed action. NMFS and the USACE agreed to add a conservation recommendation to develop a smolt survival study.

On August 10, 2017, NOAA's West Coast Regional Administrator signed the Biological Opinion (Opinion) that included a Reasonable and Prudent Alternative (RPA) requiring the USACE to construct or otherwise modify the Fish Collection Facility that met a fish passage requirement of 95 percent efficiency (capture and transport 95 percent of the returning coho and steelhead spawners that originated above the SRS) and construct a release site at Deer Creek. The RPA required this FCF to be constructed and operational no later than when the spillway was raised.

On October 24, 2017, representatives from the USACE, NMFS, WDFW, and Cowlitz Tribe met at the FCF to review, discuss and prioritize the problems at the facility that limit its efficiency and to begin to develop a strategy to attain 95 percent passage efficiency.

On October 3, 2018, the USACE signed the Record of Decision for the MSH Long Range Reevaluation Supplement Environmental Impact Statement.

In 2018 and 2019, the USACE continued to monitor MSH sediment erosion and deposition in the Lower Cowlitz River and model flood risk relative to the mandated levels of flood protection for Lower Cowlitz River communities. In 2019, the USACE determined that the second (of three total) spillway crest increases is necessary because the calculated flood recurrence intervals for one or more Lower Cowlitz River community is approaching the threshold where the Corps must take action to restore flood protection levels. The USACE project planning and construction sequence is Engineering Design Review (EDR), Design Documentation Report (DDR), Plans and Specifications (P&S), Bid and Contract Award and Construction. During EDR, alternatives to address the project are analyzed and a preferred alternative is identified. During DDR, the preferred alternative is refined such that P&S can be prepared for a contract bid package, contract award and construction. The USACE requests funds for the next phase of the project as the current phase nears completion. Because the second spillway crest raise would be the same as the 2012 spillway crest raise it did not require EDR. The 2023 spillway crest plans and specs are essentially the same as the 2012 spillway crest raise plans and specs and can go straight to bid and contract award. As no additional Engineering Design Review is required for this spillway crest increase, the project is ready to be implemented. In 2019, the USACE requested funds for DDR and P&S for the second spillway crest raise. The USACE also worked with the WDFW and the Washington State Governor's office to develop a plan to fund the RPA-required FCF upgrade project. In 2019 the USACE requested funds for the RPA FCF EDR.

The USACE began the process of designing and modeling corrective solutions to the FCF efficiency problems in 2019 and intends to continue that work, albeit on a schedule that differs from what was required by the original RPA (discussed more below). Therefore the FCF upgrade project to be constructed after the spillway raise, is now considered part of the currently proposed action for the purpose of this consultation.

In 2020, the USACE requested funds for construction of the spillway crest raise. The USACE also requested funds for the FCF DDR.

On November 4, 2020, the USACE informed NMFS during a conference call that the USACE received funding and would construct the SRS spillway crest increase in 2023 to maintain Lower Cowlitz River community flood risk levels. The USACE informed NMFS that the complexity of achieving 95 percent passage would require significantly more work at the FCF than anticipated during the original ESA consultation and that it estimated the project would take three years to design and test and two years to construct with a start date of 2021 and an estimated completion date of 2027. This schedule contradicts the RPA requirement that the FCF upgrade is complete at the same time that the spillway crest is raised.

On February 5, 2021, the USACE informed NMFS that it received funds for the FCF EDR.

On May 1, 2021, the USACE issued the report "Toutle River fish Collection Facility Modifications, Baseline Condition" summarizing all of the problems at the existing facility that limit its efficiency.

On May 11, 2021, the USACE recreated the MSH Technical Agency and Government Team (TAGT) with the USACE, NMFS, WDFW and the Cowlitz Tribe to keep agency and tribal partners informed on the progress of the SRS spillway crest raise and the RPA projects.

On July 7, 2021, the TAGT held a field trip to the FCF to discuss FCF project alternatives that address the efficiency deficiencies of the existing facility.

On October 10, 2021, the USACE sent NMFS a letter requesting re-initiation of WCR 2014-01164 Mt. St. Helens Sediment Retention Structure, Project Phased Construction Alternative consultation based on the four year interval between the 2023 construction of the spillway crest raise and the 2026-2027 construction of the FCF upgrades to achieve 95 percent passage efficiency. NMFS reinitiated on that date.

On November 11, 2021, the USACE submitted its FCF upgrade 30 percent design report to NMFS and WDFW for comments.

On July 5, 2022, the United States District Court for the Northern District of California issued an order vacating the 2019 regulations adopting changes to 50 CFR part 402 (84 FR 44976, August 27, 2019). This consultation was reinitiated when the 2019 regulations were still in effect. As reflected in this document, we are now applying the section 7 regulations that governed prior to adoption of the 2019 regulations. For purposes of this consultation, we considered whether the substantive analysis and its conclusions regarding the effects of the proposed actions articulated in the biological opinion and incidental take statement would be any different under the 2019 regulations. We have determined that our analysis and conclusions would not be any different.

1.3 Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (see 50 CFR 402.02). Under the MSA, "Federal action" means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal agency (see 50 CFR 600.910).

*The USACE proposes to raise the sediment retention structure (SRS) spillway crest on the NFTR 23 feet higher than its existing elevation above sea level of 947 National Geodetic Vertical Datum (NGVD) feet over the next 20 years, (approx.) in two increments, with the second raise dependent on Lower Cowlitz flood interval calculations. The USACE proposes the first incremental raise of the SRS in 20*23*, and the second raise in or around 20*33*, dependent on sediment accretion rates behind the SRS after the first raise. These actions are proposed to address downstream flood risks in the communities of Kelso, Longview, Castle Rock and Lexington, from excessive sediment accretion currently occurring in the lower Cowlitz River. This sediment largely originates from MSH and is transported into the Cowlitz system, primarily through the NFTR. Although the SEIS for this federal action analyzed four flood control alternatives (no action, an SRS raise of 43 feet, a dredge-only alternative in the Lower Cowlitz, and the preferred phased-raise alternative) only the SEIS preferred alternative, the proposed action described in its BA for ESA consultation, is analyzed in this biological opinion.

*Incremental construction is an adaptive management approach whereby the USACE will address Lower Cowlitz River flood risk with a series of actions based on the MSH avalanche sediment supply rate. The USACE will continue to monitor MSH avalanche erosion and Lower Cowlitz River sediment deposition rates. The USACE will use this monitoring data in calibrated, hydraulic and sediment transport numerical models to estimate sediment deposition above the SRS and sediment deposition and corresponding flood risk in the Lower Cowlitz River. Based on these Lower Cowlitz River flood risk estimates, the USACE will construct, in order: (1) an initial SRS spillway crest raise of 13 feet, (2) a second SRS spillway crest raise of 10 feet, and potentially, (3) a grade building structure (GBS) in the sediment plain above the SRS to increase the sediment trapping efficiency of the SRS. The USACE will manage Lower Cowlitz River flood risk with emergency dredging in response to large, unpredictable sediment transport event(s) that move a large pulse of sediment past the SRS. The USACE will manage Lower Cowlitz River flood risk with regularly programmed dredging when the capacity to manage MSH avalanche sediment with the SRS is exhausted.

*The first spillway crest raise will be 13 feet in 2023. This new spillway crest will be constructed 185 feet upstream from the existing spillway crest to retain the existing 7 percent slope (the maximum allowable slope should the spillway ever be modified to provide volitional fish passage over the SRS) of the spillway. This increase in the spillway crest height will create a 10 million cubic yard, 2,000 meter long pool that extends to the downstream tip of the large island in the sediment plain. Based on its sediment transport models and data from the 2012 spillway crest raise, the USACE expects this pool to fill with sediment over two or three years. After the pool is full, the reduced average slope of the sediment plain will continue to cause 44 million cubic yards of sediment to deposit in the sediment plain above the SRS before 2035. This sediment volume is about 12 million cubic yards more than would deposit with the existing spillway crest height and sediment plain slope.

*Following the first spillway raise under the proposed action, upstream of the SRS, the rate of sediment deposition in the zone of confluence where Alder Creek joins the NFTR will increase significantly. This will likely cause the surface connection to become subsurface, wherein waters from Alder Creek would infiltrate the very porous surface sediment, leaving no surface flows over the sediment plain. Such conditions could trap juvenile coho and steelhead in Alder Creek until such time that a surface connection to the NFTR could be reestablished through the sediment plain. To address this risk adaptively, the USACE proposes to monitor Alder Creek morphology, flow and fish presence in years 2025 and 2027 after the first spillway raise. If monitoring demonstrates there is a risk that additional sediment deposition will threaten the permanent surface connection between Alder Creek and the NFTR, they will construct a grade building structure (GBS) in the sediment plain above Alder Creek to prevent additional sediment deposition in this area. In its Response to the RPA, the USACE agreed to establish an adult release site at Deer Creek during construction of the first spillway crest raise.

*If the MSH avalanche sediment supply rate does not sufficiently decrease to a level that sustains Lower Cowlitz River flood risk intervals (118 and 147 year flood events in Castle Rock and Kelso/Longview, respectively), the USACE will construct a second spillway crest raise. The height and timing of this second spillway crest raise is not specified under the proposed action. Thus, for the analyses in this opinion, we assumed that the spillway crest will be raised another

10 feet in (about) 2033 because the USACE used spillway crest raises of 13 feet and 10 feet in its models to estimate the sizes of the resulting ponds and the depths of sediment deposition in the BA and SEIS. The USACE will construct this new spillway crest upstream from the first spillway crest raise to retain the existing seven percent spillway slope such that the opportunity to establish volitional fish passage through the spillway in the future is not foreclosed. The second spillway crest raise is anticipated to create an 18 million cubic yard, 3,000 meter long pond to the midpoint of the large island. This pool is anticipated to fill with sediment over the course of several years. After the pool is filled with sediment, the reduced average slope of the sediment plain will continue to cause 34 million cubic yards of sediment to deposit in the sediment plain before 2045. This is about 46 million cubic yards more than would deposit for the existing spillway crest height and sediment plain slope (i.e., but for the spillway raise, these 46 million cubic yards would otherwise transport downstream, below the SRS).

*Under the second raise, the USACE proposes three conservation measures as components of the proposed action: (1) they will construct a GBS above Alder Creek to direct the NFTR away from Alder Creek such that excessive sediment deposition from the NFTR does not obstruct the Alder Creek confluence, or functional alternative such as excavating within the Alder Creek confluence with the NFTR, if it was not constructed under the first phase; (2) they will monitor fish passage in 2027, 2030, and 2032 to gauge if modifications of the GBS or its alternative are needed; and (3) they will develop a new adult spawner outplanting site on Deer Creek, a tributary that enters the NFTR approximately 8 miles upstream of Alder Creek. Following the May 12, 2017 meeting with WDFW, the USACE agreed to an addition to the RPA to investigate establishing an adult release site on the mainstem NFTR during construction of the second spillway crest raise.

*If the sediment supply from an avalanche unexpectedly increases after the second spillway crest raise, it would not be possible to address Lower Cowlitz River flood risk at the SRS without raising the dam. Therefore, to sustain flood risk protection intervals, the USACE would construct a GBS. At this time the GBS design is planned as a sheetpile and rock structure keyed into the eastern sediment plain valley wall approximately 2 miles upstream of the SRS. This GBS would promote additional sediment deposition (in the vicinity of the confluence of Hoffstadt/Bear Creek with the NFTR) that would consolidate braided channels and push the channel towards the center of the valley. It would also disconnect east valley wall based channels that have formed from the confluence of hillside seeps with Hoffstadt Creek and branches of the NFTR in the sediment plain.

*Following the completion of the two spillway raises and the GBS, or following an extreme event that mobilizes a large volume of sediment that exceeds the capacity of the SRS to trap bedload, the USACE will address flood risk by dredging the Lower Cowlitz River. Dredging will be done with a cutterhead pipeline dredge that will remove 50,000 to 2.2 million cubic yards of sediment per year during the July 1 to September 3 work window, every year until the flood risk interval is restored. Dredge spoils will be transported to upland storage locations adjacent to the river and return water from the dredge pile will be clarified in settling ponds before it is discharged to the Cowlitz River.

*The USACE's authority for the proposed action is the Supplemental Appropriations Act of August 15, 1985 (Public Law 99-88). Precise levels of protection for Longview, Kelso, Lexington and Castle Rock were specified in 2000 under Section 339 of the Water Resources Development Act.

The USACE also proposes to fund (with WDFW), design, test and construct all necessary components of a FCF such that it successfully attracts, captures and releases 95 percent of the natural salmon and steelhead that return to the barrier dam as adults to spawn above the SRS. The USACE proposes to use a four step process to design and construct these FCF components as summarized and in accordance with the schedule outlined in Table 1 *below.*

Table 1. FCF design and construction timeline

Phase	***Request funds***	***Receive funds and start***	***Phase Complete***	***Purpose***
Engineering Documentation Report	*2019*	*2021*	*2022*	*The EDR establishes the project background, objectives, criteria and constraints, generates concepts with the potential to improve the function of the FCF for the target species of LCR steelhead and coho salmon, develops alternatives from the generated concepts, evaluates the alternatives, and provides a recommendation for a preferred alternative to carry forward to the Design Documentation Report (DDR) phase.*
Design Documentation Report	*2020*	*2022*	*2023*	*The DDR provides the technical basis for the plans and specifications and serves as a summary of the final design.*
Plans and Specs	*2021*	*2023*	*2024*	*Plans and Specifications contain all the necessary information required to bid and construct the plan detailed in the DDR.*
Contract and Construct	*2023*	*2025*	*2027*	*Compete and award contract and manage construction such that the FCF upgrades are complete and the FCF is operational at the end of the 2027 in water work window.*

The USACE proposes to implement the RPA in the original opinion by designing and constructing a release site in Deer Creek. A temporary Deer Creek release site will be constructed in Summer 2023 and used starting in Fall 2023/Winter 2024. The USACE will reconstruct about 1 mile of a closed road and install a retractable 24 inch diameter pipe from the road to the river. This work will have no effect to ESA listed salmon or steelhead. The permanent Deer Creek release site will be constructed following consultation with the USFWS on marbled murellet critical habitat. However, the timing of the passage improvements required by the original RPA would have preceded the SRS raise, and the USACE's proposed action here is to construct the initial SRS increase prior to the passage improvement. This analysis evaluates the effects of the elements in the USACE's proposed sequence.

"Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart

from the action under consideration (50 CFR 402.02). There are no interrelated or interdependent actions associated with the proposed action.

1.4 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

*Since the proposed action impacts fish passage above the SRS, all stream reaches that support LCR steelhead and coho salmon above the SRS are part of the action area. Since the proposed action impacts habitat conditions below the SRS, the lower NFTR, Toutle River and the Lower Cowlitz River from the Toutle River confluence to the Columbia River are part of the action area. The action area includes the confluence of the Cowlitz River and the Columbia River because the proposed action includes the provision to dredge the confluence and up to a mile downstream in the Columbia River.

*The action area is occupied by LCR coho salmon and LCR steelhead. Below the SRS the action area is also critical habitat for LCR Chinook, CR chum and the southern DPS of Pacific eulachon. Within the action area, the streams are designated as critical habitat for LCR steelhead. The following stream reaches are also now designated critical habitat for LCR coho salmon: 1) unnamed (referred to here as the NFTR mainstem) to Lat 46.321385, Long -122.488684, 2) unnamed (referred to here as Alder Creek) to Lat 46.392893, Long -122.585848 and an unnamed tributary to Alder Creek to Lat 46.294391, Long -122.526416, 3) Hoffstadt Creek to Lat 46.319718, Long -122.325454 and an unnamed tributary to Hoffstadt Creek (referred to here as Cow Creek) to Lat 46.331761, Long -122.316562 and 4) Bear Creek to Lat 46.309744, Long -122.430749. The area is also EFH for Pacific salmon (PFMC 2014).

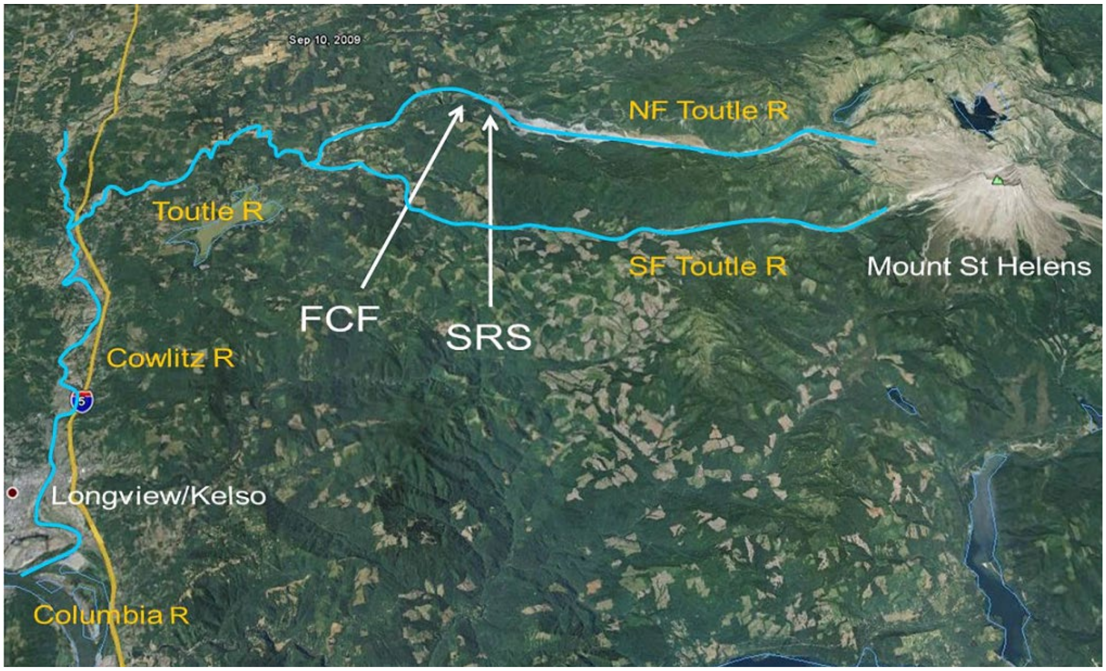

Figure 2. Action area for the project, which includes the entirety of the North Fork and mainstem Toutle River basins, and the lower Cowlitz River Basin to the Columbia River confluence. 1

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, Federal agencies must ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides an opinion stating how the agency's actions would affect listed species and their critical habitat. If incidental take is expected, section 7(b)(4) requires NMFS to provide an incidental take statement (ITS) that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures and terms and conditions to minimize such impacts.

2.1 Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of a listed species," which is "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50

[1] While this figure reflects the South Fork Toutle River basin, this watershed is outside the action area and is provided for geographic perspective only.

CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214, February 11, 2016).

The designations of critical habitat for LCR coho, LCR steelhead, LCR Chinook and CR chum use the term primary constituent element (PCE) or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the critical habitat regulations (50 CFR part 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their critical habitat using an exposure–response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species; or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the *conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that conservation value.*

One factor affecting the status of ESA-listed species considered in this opinion, and aquatic habitat at large, is climate change. Climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. Major ecological realignments are already occurring in response to climate change (IPCC Working Group II, 2022). Long-term trends in warming have continued at global, national and regional scales. Global surface temperatures in the last decade (2010s) were estimated to be 1.09 °C higher than the 1850-1900 baseline period, with larger increases over land ~1.6 °C compared to oceans ~0.88 (IPCC WGI, 2021). The vast majority of this warming has been attributed to anthropogenic releases of greenhouse gases (IPCC WGI, 2021). Globally, 2014-2018 were the 5 warmest years on record both on land and in the ocean (2018 was the 4th warmest) (NOAA NCEI 2022). Events such as the 2013-2016 marine heatwave (Jacox et al. 2018) have been attributed directly to anthropogenic warming in the annual special issue of Bulletin of the American Meteorological Society on extreme events (Herring et al. 2018). Global warming and anthropogenic loss of biodiversity represent profound threats to ecosystem functionality (IPCC WGII 2022). These two factors are often examined in isolation, but likely have interacting effects on ecosystem function.

Updated projections of climate change are similar to or greater than previous projections (IPCC Working Group I, 2021). NMFS is increasingly confident in our projections of changes to freshwater and marine systems because every year brings stronger validation of previous predictions in both physical and biological realms. Retaining and restoring habitat complexity, access to climate refuges (both flow and temperature) and improving growth opportunity in both freshwater and marine environments are strongly advocated in the recent literature (Siegel and Crozier, 2020a).

Climate change is systemic, influencing freshwater, estuarine, and marine conditions. Other systems are also being influenced by changing climatic conditions. Literature reviews on the impacts of climate change on Pacific salmon (Crozier, 2015; Crozier, 2016; Crozier, 2017; Crozier and Siegel, 2018; Siegel and Crozier, 2019; Siegel and Crozier, 2020b) have collected hundreds of papers documenting the major themes relevant for salmon. Here we describe habitat changes relevant to Pacific salmon and steelhead, prior to describing how these changes result in the varied specific mechanisms impacting these species in subsequent sections.

<u>Forests</u>

Climate change will impact forests of the western U.S., which dominate the landscape of many watersheds in the region. Forests are already showing evidence of increased drought severity, forest fire, and insect outbreak (Halofsky et al., 2020). Additionally, climate change will affect tree reproduction, growth, and phenology, which will lead to spatial shifts in vegetation. Halofsky et al. (2018) projected that the largest changes will occur at low- and high-elevation *forests, with expansion of low-elevation dry forests and diminishing high-elevation cold forests and subalpine habitats.*

Forest fires affect salmon streams by altering sediment load, channel structure, and stream temperature through the removal of canopy. Holden et al. (2018) examined environmental factors contributing to observed increases in the extent of forest fires throughout the western U.S. They found strong correlations between the number of dry-season rainy days and the annual extent of forest fires, as well as a significant decline in the number of dry-season rainy days over the study period (1984-2015). Consequently, predicted decreases in dry-season precipitation, combined with increases in air temperature, will likely contribute to the existing trend toward more extensive and severe forest fires and the continued expansion of fires into higher elevation and wetter forests (Alizadeh et al., 2021).

Agne et al. (2018) reviewed literature on insect outbreaks and other pathogens affecting coastal Douglas-fir forests in the Pacific Northwest and examined how future climate change may influence disturbance ecology. They suggest that Douglas-fir beetle and black stain root disease could become more prevalent with climate change, while other pathogens will be more affected by management practices. Agne et al. (2018) also suggested that due to complex interacting effects of disturbance and disease, climate impacts will differ by region and forest type.

Freshwater Environments

The following is excerpted from Siegel and Crozier (2019), who present a review of recent scientific literature evaluating effects of climate change, describing the projected impacts of climate change on instream flows:

> *Cooper et al. (2018) examined whether the magnitude of low river flows in the western U.S., which generally occur in September or October, are driven more by summer conditions or the prior winter's precipitation. They found that while low flows were more sensitive to summer evaporative demand than to winter precipitation, interannual variability in winter precipitation was greater. Malek et al. (2018), predicted that summer evapotranspiration is likely to increase in conjunction with declines in snowpack and increased variability in winter precipitation. Their results suggest that low summer flows are likely to become lower, more variable, and less predictable.*

The effect of climate change on ground water availability is likely to be uneven. Sridhar et al. (2018) coupled a surface-flow model with a ground-flow model to improve predictions of surface water availability with climate change in the Snake River Basin. Projections using RCP 4.5 and 8.5 emission scenarios suggested an increase in water table heights in downstream areas of the basin and a decrease in upstream areas.

As cited in Siegel and Crozier (2019), Isaak et al. (2018), examined recent trends in stream temperature across the Western U.S. using a large regional dataset. Stream warming trends paralleled changes in air temperature and were pervasive during the low-water warm seasons of 1996-2015 (0.18-0.35°C/decade) and 1976-2015 (0.14-0.27°C/decade). Their results show how continued warming will likely affect the cumulative temperature exposure of migrating sockeye *salmon O. nerka and the availability of suitable habitat for brown trout Salmo trutta and rainbow trout O. mykiss. Isaak et al. (2018) concluded that most stream habitats will likely remain suitable for salmonids in the near future, with some becoming too warm. However, in cases where habitat access is currently restricted by dams and other barriers salmon and steelhead will be confined to downstream reaches typically most at risk of rising temperatures unless passage is restored (FitzGerald et al., 2021; Myers et al., 2018).*

Streams with intact riparian corridors and that lie in mountainous terrain are likely to be more resilient to changes in air temperature. These areas may provide refuge from climate change for a number of species, including Pacific salmon. Krosby et al. (2018), identified potential stream refugia throughout the Pacific Northwest based on a suite of features thought to reflect the ability of streams to serve as such refuges. Analyzed features include large temperature gradients, high canopy cover, large relative stream width, low exposure to solar radiation, and low levels of human modification. They created an index of refuge potential for all streams in the region, with mountain area streams scoring highest. Flat lowland areas, which commonly contain migration corridors, were generally scored lowest, and thus were prioritized for conservation and restoration. However, forest fires can increase stream temperatures dramatically in short time-spans by removing riparian cover (Koontz et al., 2018), and streams that lose their snowpack with climate change may see the largest increases in stream temperature due to the removal of temperature buffering (Yan et al., 2021). These processes may threaten some habitats that are currently considered refugia.

Marine and Estuarine Environments

Along with warming stream temperatures and concerns about sufficient groundwater to recharge streams, a recent study projects nearly complete loss of existing tidal wetlands along the U.S. West Coast, due to sea level rise (Thorne et al., 2018). California and Oregon showed the greatest threat to tidal wetlands (100%), while 68% of Washington tidal wetlands are expected to be submerged. Coastal development and steep topography prevent horizontal migration of most wetlands, causing the net contraction of this crucial habitat.

Rising ocean temperatures, stratification, ocean acidity, hypoxia, algal toxins, and other oceanographic processes will alter the composition and abundance of a vast array of oceanic species. In particular, there will be dramatic changes in both predators and prey of Pacific salmon, salmon life history traits and relative abundance. Siegel and Crozier (2019) observe that changes in marine temperature are likely to have a number of physiological consequences on fishes themselves. For example, in a study of small planktivorous fish, Gliwicz et al. (2018) found that higher ambient temperatures increased the distance at which fish reacted to prey. Numerous fish species (including many tuna and sharks) demonstrate regional endothermy, which in many cases augments eyesight by warming the retinas. However, Gliwicz et al. (2018) suggest that ambient temperatures can have a similar effect on fish that do not demonstrate this trait. Climate change is likely to reduce the availability of biologically essential omega-3 fatty acids produced by phytoplankton in marine ecosystems. Loss of these lipids may induce cascading trophic effects, with distinct impacts on different species depending on compensatory mechanisms (Gourtay et al., 2018). Reproduction rates of many marine fish species are also likely to be *altered with temperature (Veilleux et al., 2018). The ecological consequences of these effects and their interactions add complexity to predictions of climate change impacts in marine ecosystems.*

Perhaps the most dramatic change in physical ocean conditions will occur through ocean acidification and deoxygenation. It is unclear how sensitive salmon and steelhead might be to the direct effects of ocean acidification because of their tolerance of a wide pH range in freshwater (although see Ou et al. (2015); (Williams et al., 2019)), however, impacts of ocean acidification and hypoxia on sensitive species (e.g., plankton, crabs, rockfish, groundfish) will likely affect salmon indirectly through their interactions as predators and prey. Similarly, increasing frequency and duration of harmful algal blooms may affect salmon directly, depending on the toxin (e.g., saxitoxin vs domoic acid), but will also affect their predators (seabirds and mammals). The full effects of these ecosystem dynamics are not known but will be complex. Within the historical range of climate variability, less suitable conditions for salmonids (e.g., warmer temperatures, lower streamflows) have been associated with detectable declines in many of these listed units, highlighting how sensitive they are to climate drivers (Ford, 2022; Lindley et al., 2009; Ward et al., 2015; Williams et al., 2016). In some cases, the combined and potentially additive effects of poorer climate conditions for fish and intense anthropogenic impacts caused the population declines that led to these population groups being listed under the ESA (Crozier et al., 2019).

<u>*Climate change effects on salmon and steelhead*</u>

In freshwater, year-round increases in stream temperature and changes in flow will affect physiological, behavioral, and demographic processes in salmon, and change the species with which they interact. For example, as stream temperatures increase, many native salmonids face increased competition with more warm-water tolerant invasive species. Changing freshwater temperatures are likely to affect incubation and emergence timing for eggs, and in locations where the greatest warming occurs may affect egg survival, although several factors impact intergravel temperature and oxygen (e.g., groundwater influence) as well as sensitivity of eggs to thermal stress (Crozier et al., 2021). Changes in temperature and flow regimes may alter the amount of habitat and food available for juvenile rearing, and this in turn could lead to a restriction in the distribution of juveniles, further decreasing productivity through density dependence. For migrating adults, predicted changes in freshwater flows and temperatures will likely increase exposure to stressful temperatures for many salmon and steelhead populations, and alter migration travel times and increase thermal stress accumulation for ESUs or DPSs with early-returning (i.e. spring- and summer-run) phenotypes associated with longer freshwater holding times (Crozier et al., 2020; FitzGerald et al., 2021). Rising river temperatures increase the energetic cost of migration and the risk of en route or pre-spawning mortality of adults with long freshwater migrations, although populations of some ESA-listed salmon and steelhead may be able to make use of cool-water refuges and run-timing plasticity to reduce thermal exposure (Barnett et al., 2020; Keefer et al., 2018).

Marine survival of salmonids is affected by a complex array of factors including prey abundance, predator interactions, the physical condition of salmon within the marine environment, and carryover effects from the freshwater experience (Burke et al., 2013; Holsman et al., 2012). It is generally accepted that salmon marine survival is size-dependent, and thus *larger and faster growing fish are more likely to survive (Gosselin et al., 2021). Furthermore, early arrival timing in the marine environment is generally considered advantageous for populations migrating through the Columbia River. However, the optimal day of arrival varies across years, depending on the seasonal development of productivity in the California Current, which affects prey available to salmon and the risk of predation (Chasco et al., 2021). Siegel and Crozier (2019) point out the concern that for some salmon populations, climate change may drive mismatches between juvenile arrival timing and prey availability in the marine environment. However, phenological diversity can contribute to metapopulation-level resilience by reducing the risk of a complete mismatch. Carr-Harris et al. (2018), explored phenological diversity of marine migration timing in relation to zooplankton prey for sockeye salmon O. nerka from the Skeena River of Canada. They found that sockeye migrated over a period of more than 50 days, and populations from higher elevation and further inland streams arrived in the estuary later, with different populations encountering distinct prey fields. Carr-Harris et al. (2018) recommended that managers maintain and augment such life-history diversity.*

Synchrony between terrestrial and marine environmental conditions (e.g., coastal upwelling, precipitation and river discharge) has increased in spatial scale causing the highest levels of synchrony in the last 250 years (Black et al., 2018). A more synchronized climate combined with simplified habitats and reduced genetic diversity may be leading to more synchrony in the productivity of populations across the range of salmon (Braun et al., 2016). For example, salmon productivity (recruits/spawner) has also become more synchronized across Chinook populations from Oregon to the Yukon (Dorner et al., 2018; Kilduff et al., 2014). In addition, Chinook salmon have become smaller and younger at maturation across their range (Ohlberger et al., 2018). Other Pacific salmon species (Stachura et al., 2014) and Atlantic salmon (Olmos et al., 2020) also have demonstrated synchrony in productivity across a broad latitudinal range.

At the individual scale, climate impacts on salmon in one life stage generally affect body size or timing in the next life stage and negative impacts can accumulate across multiple life stages (Gosselin et al., 2021; Healey, 2011; Wainwright and Weitkamp, 2013). Changes in winter precipitation will likely affect incubation and/or rearing stages of most populations. Changes in the intensity of cool season precipitation, snow accumulation, and runoff could influence migration cues for fall, winter and spring adult migrants, such as coho and steelhead. Egg survival rates may suffer from more intense flooding that scours or buries redds. Changes in hydrological regime, such as a shift from mostly snow to more rain, could drive changes in life history, potentially threatening diversity within an ESU (Beechie et al., 2006). Changes in summer temperature and flow will affect both juvenile and adult stages in some populations, especially those with yearling life histories and summer migration patterns (Crozier and Zabel, 2006; Crozier et al., 2019; Crozier et al., 2010).

At the population level, the ability of organisms to genetically adapt to climate change depends on how much genetic variation currently exists within salmon populations, as well as how selection on multiple traits interact, and whether those traits are linked genetically. While genetic diversity may help populations respond to climate change, the remaining genetic diversity of many populations is highly reduced compared to historic levels. For example, Johnson et al. (2018), compared genetic variation in Chinook salmon from the Columbia River Basin between contemporary and ancient samples. A total of 84 samples determined to be

Chinook salmon were collected from vertebrae found in ancient middens and compared to 379 contemporary samples. Results suggest a decline in genetic diversity, as demonstrated by a loss of mitochondrial haplotypes as well as reductions in haplotype and nucleotide diversity. Genetic losses in this comparison appeared larger for Chinook from the mid-Columbia than those from the Snake River Basin. In addition to other stressors, modified habitats and flow regimes may create unnatural selection pressures that reduce the diversity of functional behaviors (Sturrock et al., 2020). Managing to conserve and augment existing genetic diversity may be increasingly important with more extreme environmental change (Anderson et al., 2015), though the low levels of remaining diversity present challenges to this effort (Freshwater et al., 2019). Salmon historically maintained relatively consistent returns across variation in annual weather through the portfolio effect (Schindler et al., 2015), in which different populations are sensitive to different climate drivers. Applying this concept to climate change, Anderson et al. (2015) emphasized the additional need for populations with different physiological tolerances. Loss of the portfolio increases volatility in fisheries, as well as ecological systems, as demonstrated for Fraser River and Sacramento River stock complexes (Freshwater et al., 2019; Munsch et al., 2022).

2.2.1 Status of the Species

Table 2, below provides a summary of listing and recovery plan information, status summaries and limiting factors for the species addressed in this opinion. More information can be found in recovery plans and status reviews for these species. Acronyms appearing in the table include DPS (Distinct Population Segment), ESU (Evolutionarily Significant Unit), ICTRT (Interior Columbia Technical Recovery Team), MPG (Multiple Population Grouping), NWFSC (Northwest Fisheries Science Center), TRT (Technical Recovery Team), and VSP (Viable Salmonid Population).

Table 2. Listing classification and date, recovery plan reference, most recent status review, status summary, and limiting factors for each species considered in this opinion.

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Lower Columbia River Chinook salmon	Threatened 6/28/05	(NMFS, 2013a)	(Ford, 2022; NMFS, 2016)	This ESU comprises 32 independent populations. Relative to baseline VSP levels identified in the recovery plan (NMFS, 2013a), there has been an overall improvement in the status of a number of fall-run populations although most are still far from the recovery plan goals; Spring-run Chinook salmon populations in this ESU are generally unchanged; most of the populations are at a "high" or "very high" risk due to low abundances and the high proportion of hatchery-origin fish spawning naturally. Many of the populations in this ESU remain at "high risk," with low natural-origin abundance levels. Overall, we conclude that the viability of the Lower Columbia River Chinook salmon ESU has increased somewhat since 2016, although the ESU remains at "moderate" risk of extinction	• Reduced access to spawning and rearing habitat • Hatchery-related effects • Harvest-related effects on fall Chinook salmon • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Contaminant

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Columbia River chum salmon	Threatened 6/28/05	(NMFS, 2013a)	(Ford, 2022; NMFS, 2016)	This species has 17 populations divided into 3 MPGs. 3 populations exceed the recovery goals established in the recovery plan (NMFS, 2013a). The remaining populations have unknown abundances. Abundances for these populations are assumed to be at or near zero. The viability of this ESU is relatively unchanged since the last review (moderate to high risk), and the improvements in some populations do not warrant a change in risk category, especially given the uncertainty regarding climatic effects in the near future.	• Degraded estuarine and nearshore marine habitat • Degraded freshwater habitat • Degraded stream flow as a result of hydropower and water supply operations • Reduced water quality • Current or potential predation • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Lower Columbia River coho salmon	Threatened 6/28/05	(NMFS, 2013a)	(Ford, 2022; NMFS, 2016)	Of the 24 populations that make up this ESU. Only six of the 23 populations for which we have data appear to be above their recovery goals. Overall abundance trends for the Lower Columbia River coho salmon ESU are generally negative. Natural spawner and total abundances have decreased in almost all DIPs, and Coastal and Gorge MPG populations are all at low levels, with significant numbers of hatchery-origin coho salmon on the spawning grounds. Improvements in spatial structure and diversity have been slight, and overshadowed by declines in abundance and productivity. For individual populations, the risk of extinction spans the full range, from "low" to "very high." Overall, the Lower Columbia River coho salmon ESU remains at "moderate" risk, and viability is largely unchanged since 2016.	• Degraded estuarine and near-shore marine habitat • Fish passage barriers • Degraded freshwater habitat: Hatchery-related effects • Harvest-related effects • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Lower Columbia River steelhead	Threatened 1/5/06	(NMFS, 2013a)	(Ford, 2022; NMFS, 2016)	This DPS comprises 23 historical populations, 17 winter-run populations and 6 summer-run populations. 10 are nominally at or above the goals set in the recovery plan (NMFS, 2013a); however, it should be noted that many of these abundance estimates do not distinguish between natural- and hatchery- origin spawners. The majority of winter-run steelhead DIPs in this DPS continue to persist at low abundance levels (hundreds of fish), with the exception of the Clackamas and Sandy River DIPs, which have abundances in the low 1,000s. Although the five-year geometric abundance means are near recovery plan goals for many populations, the recent trends are negative. Overall, the Lower Columbia River steelhead DPS is therefore considered to be at "moderate" risk,	• Degraded estuarine and nearshore marine habitat • Degraded freshwater habitat • Reduced access to spawning and rearing habitat • Avian and marine mammal predation • Hatchery-related effects • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Multiple populations comprise a species. We describe here the status of the specific populations that are present in the action area, and the recovery role described for the populations.

Toutle Basin Winter Steelhead

*LCR winter steelhead are threatened under the ESA (NMFS, 2013a). This DPS is made up of 23 historical populations distributed across 4 MPGs. There are 12 winter steelhead populations in the Cascade stratum of the DPS in addition to the North Fork Toutle and Lower Cowlitz populations affected by the proposed action; Upper Cowlitz, Cispus, Tilton, SF Toutle, Coweeman, Kalama, North Fork Lewis, East Fork Lewis, Salmon Creek, Clackamas, Sandy and Washougal.

*The delisting criteria for a viable steelhead DPS in the Cascade stratum is two populations with a persistence score of 4.0 and an average population persistence score of 2.25 or higher for all the populations (NMFS, 2013b). Recovery planners assigned a level of persistence probability to each population by determining; which are "core" populations that historically were the most highly productive, which populations are "legacy" populations that represent important historical genetic diversity, which core and legacy populations are sufficiently dispersed to minimize risk from catastrophic events, and for which core and legacy populations it is feasible to make significant recovery progress (NMFS, 2013b). The recovery of some LCR winter steelhead populations face significant challenges. The Upper Cowlitz, Upper Cispus, Tilton and North Fork Lewis populations are produced above dams and depend on elaborate upstream and downstream transport systems for juvenile and adult passage. The efficiency of these fish passage systems is a limiting factor to the recovery of these populations.

*NFTR winter steelhead were designated by the recovery plan as a "primary" population targeted for a persistence score of 3. Primary steelhead and salmon populations are those that must demonstrate low risk of extinction in order to recover the MPG and DPS/ESU (NMFS, 2013a), and they are targeted for restoration to reach high (persistence score of 3) or very high (persistence score of 4) viability. Primary populations are typically the strongest extant populations with the best prospects for protection or restoration. In the Cascade stratum, Coweeman, Upper Cowlitz, Cispus, and East Fork Lewis River winter steelhead populations are also targeted for a persistence score of 3 (NMFS, 2013b). The South Fork Toutle, Kalama, Clackamas and Sandy River populations are targeted for a higher probability of persistence and the Lower Cowlitz, Tilton, North Fork Lewis, Salmon Creek, and Washougal populations are targeted for a lower probability of persistence such that the average population persistence score is 2.25. Contributing populations are those for which some improvement will be needed to achieve a stratum-wide average of medium viability.

*Fish population levels under current and potential restored habitat conditions were compared using the Ecosystem Diagnosis and Treatment (EDT) model based on habitat characteristics of each stream reach and a synthesis of habitat effects on fish life cycles processes. The EDT model and its use is described in Appendix E of the Washington Recovery Plan (LCFRB, 2010). Ecosystem Diagnosis and Treatment modeling results estimate that historical NFTR productivity has declined 90 percent for winter steelhead. Adult abundance level has declined to 19 percent of historical NFTR levels for winter steelhead. Diversity has declined 60 percent for winter steelhead. EDT estimates that restoration of proper functioning habitat conditions in all Toutle Basin reaches would increase winter steelhead returns by 255 percent.

*The average number of winter steelhead that spawned in the NFTR from 1989 to 2001 is 157. The number of steelhead spawners transported around the SRS from 2002 to 2011 ranged from 89 to 410. Redd monitoring estimates that currently fewer than 100 winter steelhead spawn in the NFTR below the SRS each year (LCFRB, 2010). A population size of 300 steelhead or less results in a high (>25percent) or very high (>60percent) quasi-extinction risks at productivities of under 3 recruits per spawner for steelhead life history patterns. The LCR recovery team used a demographic population viability analysis model to map persistence scores to abundances necessary to reduce extinction risks to levels consistent with delisting. They applied these estimates to representative LCR steelhead populations including NF Toutle populations. For NF Toutle steelhead (with data from EDT model and Beverton-Holt stock recruitment model); equilibrium abundance = 200, recruits/spawner=2.0, a stock recruitment variance = .4, autocorrelation lag=.6 and a critical risk threshold of 100. 590 NFTR steelhead spawners satisfy the high population viability requirement for this population that is needed to support the possibility of recovery (NMFS, 2013b).

The 5-year geometric mean of raw natural spawners of North Fork Toutle winter steelhead between the 2010-2014 period and the 2015-2019 period increased by 39%. The mean abundance of natural and hatchery steelhead in the 2015-2019 period was 409 fish; target abundance is 600 (Ford 2022).

The 5-year geometric mean of raw natural spawners of South Fork Toutle winter steelhead between the 2010-2014 period and the 2015-2019 period increased by 53%. The mean abundance of natural and hatchery steelhead in the 2015-2019 period was 660 fish; target abundance is 600 (Ford 2022).

The 5-year geometric mean of raw natural spawners of Upper Cowlitz winter steelhead between the 2010-2014 period and the 2015-2019 period increased by 18%. The mean abundance in the 2015-2019 period was 199 fish; target abundance is 500 (Ford 2022).

Lower Cowlitz mean abundance in the 2015-2019 period was not available; target abundance is 400 (Ford 2022).

*Because the DPS is widely dispersed and subject to so many, varied threats, recovery experts depend on statistical models in simulations to estimate the population abundances, productivities and diversities that combine to produce DPS survival. Core populations are currently robust populations facing fewer threats but DPS survival requires more than core population survival. Primary populations, such as the NFTR population, generally face fewer or more manageable threats to their survival than contributing populations. The NFTR steelhead population is a primary population because of its importance to the recovery of the entire DPS. Addressing SRS passage, coupled with steady habitat recovery from the MSH eruption will give the population an excellent prospect for survival at abundances that enhance the survival and likelihood of recovery of the DPS.

Although the situation in the Cascade stratum is better, improvements in fish passage/collection need to be realized in the Upper Cowlitz, North Fork Toutle, and North Fork Lewis Rivers to achieve recovery goals (Ford 2022).

Toutle Basin Coho Salmon
*The Lower Columbia coho salmon ESU is made up of 24 historical independent populations and 3 strata that span Oregon and Washington. There are 11 Washington LCR coho populations in the Cascade stratum in addition to the North Fork Toutle and Lower Cowlitz populations affected by the proposed action; Upper Cowlitz/Cispus, Tilton, SF Toutle, NF Toutle, Coweeman, Kalama, NF Lewis, EF Lewis, Salmon Creek, Clackamas, Sandy and Washougal. The ESU is considered likely to become endangered and has a greater than 60 percent risk of extinction over the next 100 years (Ford, 2022).

*The delisting criteria for a viable coho salmon ESU in the Cascade stratum is two populations with a persistence score of 4.0 and an average population persistence score of 2.25 or higher (NMFS, 2013a). As with winter steelhead, this goal could be met through many different combinations of individual population persistence scores but recovery planners assigned a level of persistence probability to each population by determining; which are “core” populations that were the most highly productive, which populations are “legacy” populations that represent important historical genetic diversity, which core and legacy populations are sufficiently dispersed to minimize risk from catastrophic events, and for which core and legacy populations it is feasible to make significant recovery progress. Recovery of some LCR coho populations face significant challenges. The Upper Cowlitz, Cispus, Tilton, and NF Lewis populations are produced above dams and depend on elaborate upstream and downstream transport systems for juvenile and adult passage. The efficiency of the fish passage systems is a limiting factor to the recovery of these populations. Recovery of Upper Cowlitz, Cispus, Tilton and North Fork Lewis coho populations are further complicated by the potential for density dependent compensatory effects when natural fish combine with large hatchery releases in watersheds with significant amounts of historical habitat modified by dams (ISAB, 2015).

*NF Toutle coho were designated “primary” populations targeted for a persistence score of 3. In the Cascade stratum, the Lower Cowlitz, Coweeman, SF Toutle, Upper Cowlitz, Cispus, EF Lewis, and Sandy River coho populations are also targeted for persistence score of 3. The Clackamas River coho population is targeted for a very high probability of persistence and the Tilton, Kalama, NF Lewis and Washougal population are targeted for a lower probability of persistence.

The 5-year geometric mean of raw natural spawners of North Fork Toutle River coho between the 2010-2014 period and the 2015-2019 period decreased by 45%. The mean abundance of natural coho in the 2015-2019 period was 43 fish; target abundance is 500 (Ford 2022).

The 5-year geometric mean of raw natural spawners of South Fork Toutle coho between the 2010-2014 period and the 2015-2019 period decreased by 51%. The mean abundance of natural coho in the 2015-2019 period was 1275 fish; target abundance is 500 (Ford 2022).

The 5-year geometric mean of raw natural spawners of Upper Cowlitz coho between the 2010-2014 period and the 2015-2019 period decreased by 42%. The mean abundance of natural coho in the 2015-2019 period was 686 fish; target abundance is 2000 (Ford 2022).

The 5 year geometric mean of raw natural spawners of Lower Cowlitz coho between 2010-2014 period and the 2015-2019 period decreased by 50%. The mean abundance of naural coho in the 2015-2019 period was not available; target abundance is 2000 (Ford 2022).

*EDT model results estimate that NFTR historical productivity has declined 70 percent for LCR coho salmon. Adult abundance has declined 89 percent and diversity has declined 70 percent from historical levels. EDT estimates that restoration of proper functioning conditions in all Toutle Basin reaches would increase coho returns by 600 percent. The number of adult coho salmon transported above the SRS from 2003 to 2011 ranged from 127 to 475. Redd monitoring estimates that currently fewer than 100 coho spawn in the NFTR below the SRS each year (LCFRB, 2010). A population size of 300 or less result in high (>25percent) or very high (>60percent) quasi-extinction risks at productivities of under 3 recruits per spawner for coho salmon life history patterns. The LCR recovery team estimates that the combined North Fork and South Fork Toutle River coho populations (with data from EDT model, inference from habitat conditions and Beverton–Holt stock recruitment model); equilibrium abundance = 3200, recruits/spawner=2.7, a stock recruitment variance = 1.0, autocorrelation lag=.3, a critical risk threshold of 300). 3780 total North Fork and South Fork coho spawners satisfy the high population viability requirement.

*Because the ESU is widely dispersed and subject to so many varied threats, recovery experts depend on statistical models in simulations to estimate the population abundances, productivities and diversities that combine to produce ESU survival. Core populations are currently robust populations facing fewer threats but ESU survival requires more than core population survival. Primary populations, such as the NFTR/SFTR population, generally face fewer or more manageable threats to their survival than contributing populations. The NFTR/SFTR coho salmon population is a primary population because of its importance to the recovery of the entire ESU. Implicit to its designation as a primary population for recovery, and consistent with the NFTR steelhead, addressing SRS passage, coupled with steady habitat recovery from the MSH eruption will give the population an excellent prospect for survival at abundances that enhance the survival and likelihood of recovery of the ESU broadly.

LCR Chinook salmon populations
*The LCR Chinook salmon populations affected by the proposed action include Toutle River spring, Toutle River, Toutle River fall, Upper Cowlitz spring, Lower Cowlitz fall, and Lower Cowlitz spring. The Cowlitz populations are only affected by the dredging portion of the proposed action.

*The Toutle River spring population is considered a 'contributing' population and targeted for moderate persistence probability. The Toutle River fall population is primary population targeted for high persistence probability (NMFS, 2013a). Both populations have significant gaps between current and desired status (NWFSC 2015). Some assessment indicate a spring population may no longer be present in the Toutle River (NWFSC, 2015)(NWFSC 2015, LCFRB and WDFW

2016). In the North Fork Toutle River, much of the production for these populations come from the Green River, which is a tributary located approximately ¼ mile downstream of the FCF.

The percent change in the 5-year geometric mean of raw natural spawner counts of Toutle River Fall Chinook, between the 2010-2014 period, and the 2015-2019 period, is a decline of 15 percent. This population's average abundance in the 2015-2019 time frame is 280 fish; Target abundance is 4,000 (Ford 2022).

*The Upper Cowlitz spring population is a primary population targeted for high persistence probability.

The percent change in the 5-year geometric mean of raw natural spawner counts of Upper Cowlitz spring Chinook, between the 2010-2014 period, and the 2015-2019 period, is not identified. This population's average abundance in the 2015-2019 time frame is 171 fish; the target abundance is 1,800 (Ford 2022).

*The Lower Cowlitz fall population is 'contributing' population targeted for moderate persistence probability. *The percent change in the 5-year geometric mean of raw natural spawner counts of Lower Cowlitz Fall Chinook, between the 2010-2014 period, and the 2015-2019 period, is an increase of 25 of 15 percent. This population's average abundance in the 2015-2019 time frame is 3,208; the target abundance is 3,000 (Ford 2022).*

*The Upper Cowlitz fall population is a 'stabilizing' population targeted for very low persistence probability (NMFS, 2013a).

The percent change in the 5-year geometric mean of raw natural spawner counts of Upper Cowlitz Fall Chinook, between the 2010-2014 period, and the 2015-2019 period, is a decline of 33 percent. This populations average abundance is 1,761; no target abundance is specified (Ford 2022).

CR Chum salmon populations
*The recovery plan for this species did not identify a population specific to the Toutle River (NMFS, 2013a). The Cowlitz River hosts a summer and fall population of chum salmon. Both Cowlitz populations are considered 'contributing' populations and are targeted for moderate persistence probability (NMFS, 2013a). Any fish occurring in the action area would be from one of the Cowlitz River populations. Since the Toutle River is not a major production area for this ESU, overall fish densities in the Toutle Basin portion of the action area is expected to be very low.

There have been recurring observations of early-returning summer-run chum salmon in the Cowlitz River, primarily at the Cowlitz Salmon Hatchery trap (Ford 2022).

2.2.2 Status of Critical Habitat

This section describes the status of designated critical habitat affected by the proposed action by examining the condition and trends of the essential physical and biological features of that *habitat throughout the designated areas. These features are essential to the conservation of the ESA-listed species because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging).*

For most salmon and steelhead, NMFS's critical habitat analytical review teams (CHARTs) ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC5) in terms of the conservation value they provide to each ESA-listed species that they support (NMFS, 2005). The conservation rankings were high, medium, or low. To determine the conservation value of each watershed to species viability, the CHARTs evaluated the quantity and quality of habitat features, the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area. Even if a location had poor habitat quality, it could be ranked with a high conservation value if it were essential due to factors such as limited availability, a unique contribution of the population it served, or is serving another important role. Results are summarized in Table 3.

Table 3. Status of Critical Habitat

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Lower Columbia River Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 47 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some, or high potential for improvement. We rated conservation value of HUC5 watersheds as high for 30 watersheds, medium for 13 watersheds, and low for four watersheds.
Columbia River chum salmon	9/02/05 70 FR 52630	Critical habitat encompasses six subbasins in Oregon and Washington containing 19 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 16 watersheds, and medium for three watersheds.
Lower Columbia River coho salmon	2/24/16 81 FR 9252	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 55 occupied watersheds, as well as the lower Columbia River and estuary rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 34 watersheds, medium for 18 watersheds, and low for three watersheds.
Lower Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses nine subbasins in Oregon and Washington containing 41 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 28 watersheds, medium for 11 watersheds, and low for two watersheds.

Lower Columbia River

*This section describes the range-wide status of designated critical habitat for LCR coho salmon LCR steelhead, LCR Chinook salmon and CR Chum salmon. The final rule designating critical habitat for LCR coho salmon became effective on March 25, 2016 (81 FR 9252).

*The designations of critical habitat for these species used the term primary constituent element or essential features. The new critical habitat regulations (81 FR 7214) replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ‘‘destruction or adverse modification’’ analysis, which is the same regardless of whether the original designation identified primary constituent elements, physical or biological features, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

*On the mainstem of the Columbia River, hydropower projects, including the Federal Columbia River Hydropower System (FCRPS), have significantly degraded salmon and steelhead habitats (Bottom et al., 2005; Fresh et al., 2005; NMFS, 2011b; NMFS, 2013c). The series of dams and reservoirs that make up the FCRPS block an estimated 12 million cubic yards of debris and sediment that would otherwise naturally flow down the Columbia River and replenish shorelines along the Washington and Oregon coasts. In 2008, the Federal Columbia River Power System (FCRPS) biological opinion (NWR-2005-5883) was updated with the Adaptive Management Implementation Plan in 2009 and a supplemental biological opinion in 2010. NMFS subsequently developed a 2014 supplemental FCRPS biological opinion (NWR-2013-9562) to address a 2011 Court Remand Order requiring the agency to re-examine the 2008 and 2010 biological opinions and requiring more specific identification of habitat actions planned for the 2014-2018 period of operation.

*In addition to the significant effects of the FCRPS on mainstem critical habitat functions that affect ESA-listed LCR salmonid populations, there are a number of LCR tributary actions analogous to the proposed action with completed ESA section consultations that affect LCR critical habitat function. These include four FERC-licensed hydropower projects. NMFS completed a biological opinion (NWR-2001-2045) on the 35-year FERC relicensing of Tacoma Power’s Cowlitz River Hydroelectric Projects in 2004. As components of the settlement agreement for this hydroelectric project, and considered in the biological opinion, Tacoma Power updated the hatchery complex, developed a Fisheries Hatchery Management Plan, improved the Mayfield Dam downstream passage system and tested methods to increase juvenile fish collection at Cowlitz Falls Dam. Collection of downstream migrants at Cowlitz Falls from the upper basin is occurring at Cowlitz Falls Dam. Tacoma is in the process of constructing a new collector there to improve collection rates. The new collector is scheduled to be operational for the 2017 downstream migration season. The recent 5-year averages for collection rates are 49 percent for coho, 45 percent for steelhead, and 12 percent for Chinook (Kock et al., 2015). Improvements in collection must occur to establish viable populations of spring Chinook (primary populations), and is also necessary to establish populations of LCR coho and steelhead upstream of the dam to support recovery.

*Outside of the action area of the proposed project, but within the recovery domain for LCR coho, Chinook and chum salmon and LCR steelhead, NMFS completed a biological opinion on the surrender of the FERC license for the Pacificorp Powerdale Hydroelectric Project on September 19, 2005 (NWR-2001-1480). Pacificorp removed the dam in 2010, opening volitional access to miles of previously habitat on the Hood River. On August 27, 2007 NMFS completed a biological opinion (NWR-2005-5891) on the 50-year FERC license for the three dams on the North Fork Lewis River that constitute the Hydroelectric Complex for this system (Settlement Agreement Concerning the Relicensing of the Lewis River Hydroelectric Projects FERC Project Nos. 935, 2071, 2111, 2213). The agreement calls for minimum streamflows, habitat improvements, and opening up more than 170 miles of river habitat that is now blocked to migrating fish, plus numerous protection, mitigation and enhancement measures to benefit fisheries and other resources. A floating surface collector was constructed at Swift Dam on the North Fork Lewis River and began operating it for the 2013 downstream migration season. Adult salmonids, for the purpose establishing populations above the dam, were transported above Swift Dam the season prior. The recent 2-year averages for collection efficiency rates are 20.5 percent for coho, 20.6 percent for steelhead, and 0 percent for spring Chinook. PacifiCorp is installing a guide net in 2016 to improve collection. For recovery, it is necessary to achieve a healthy population of Spring Chinook (primary population) above Swift Dam.

*Associated with the Clackamas River hydroelectric project in Oregon (Settlement Agreement Concerning the Relicensing of the Clackamas River Hydroelectric Project – FERC Project No. 2195. March 2006), juvenile salmonid transport and sorting facilities have been completely revamped with the extension of the migrant pipeline and Timber Park migrant facility. These modifications have reduced travel times from over 2 weeks to 2 hours. In addition, these actions have decreased predation vulnerability in the North Fork Ladder and new facilities have decreased handling during enumeration. The North Fork adult sorting facility has decreased/removed handling of all species for hatchery fish removal. This facility has improved holding conditions and decreased water temperatures ~1.0 C during the max summer temperatures in the North Fork Ladder. Improvements to downstream passage have been made at River Mill Dam and North Fork Dam through the addition of a 500 and 1,000 cubic feet per second cubic feet per second (cfs) surface collectors. Initial evaluations have determined these to be about 97 and 90 percent effective for guiding fish respectively. New flow requirements in the Oak Grove Fork and Faraday Diversion reach have improved production capacity, spawning distribution and migration conditions.

*In the fall of 2011, Pacificorp, similar to their earlier action on the Hood River, surrendered their FERC license for the Condit Hydroelectric Project and removed the Condit Dam on the White Salmon River in the LCR (NMFS Opinion NWR-2002-977: Decommissioning of the Condit Dam (FERC No. 2342), White Salmon River, WA). Critical habitat has not been designated above the former Condit dam site for LCR Chinook or coho salmon, or CR chum salmon, though the passage improvements and beneficial effects on wood and gravel recruitment from the dam's removal will be beneficial to designated critical habitat function in the lower White Salmon river for these species. (Steelhead using this system are recognized to belong to the MCR steelhead recovery domain, and were already documented using habitat above this former impassable dam site in the summer of 2012).

*Industrial harbor and port development are also significant influences on the Lower Columbia rivers (Bottom et al., 2005; Fresh et al., 2005; NMFS, 2011b; NMFS, 2013c). Originally dredged to a 20-foot minimum depth, the Federal navigation channel of the Lower Columbia River is now maintained at a depth of 43 feet and a width of 600 feet. The Lower Columbia River supports five ports on the Washington State side: Kalama, Longview, Skamania County, Woodland, and Vancouver. In addition to loss of riparian habitat, and disruption of benthic habitat due to dredging, high levels of several sediment chemicals, such as arsenic and polycyclic aromatic hydrocarbons (PAHs), have been identified in Lower Columbia River watersheds in the vicinity of the ports and associated industrial facilities.

*The most extensive urban development in the Lower Columbia River subbasin has occurred in the Portland/Vancouver area. Outside of this major urban area, the majority of residences and businesses rely on septic systems.

*Common water quality issues with urban development and residential septic systems include higher water temperatures, lowered dissolved oxygen, increased fecal coliform bacteria, and increased chemicals associated with pesticides and urban runoff.

*The Columbia River estuary has lost a significant amount of the tidal marsh and tidal swamp habitats that are critical to juvenile salmon and steelhead, particularly small or ocean-type species (Bottom et al., 2005; Fresh et al., 2005; NMFS, 2011b; NMFS, 2013c). Edges of marsh areas provide sheltered habitats for juvenile salmon and steelhead where food, in the form of amphipods or other small invertebrates which feed on marsh detritus, is plentiful, and larger predatory fish can be avoided. Historically, floodwaters of the Columbia River inundated the margins and floodplains along the estuary, allowing juvenile salmon and steelhead access to a wide expanse of low-velocity marshland and tidal channel habitats. In general, the riverbanks were gently sloping, with riparian and wetland vegetation at the higher elevations of the river floodplain becoming habitat for salmon and steelhead during flooding river discharges or flood tides. Sherwood *et al.* (1990) estimated that the Columbia River estuary lost 20,000 acres of tidal swamps, 10,000 acres of tidal marshes, and 3,000 acres of tidal flats between 1870 and 1970. This study further estimated an 80 percent reduction in emergent vegetation production and a 15 percent decline in benthic algal production.

*Habitat and food-web changes within the estuary, and other factors affecting salmon population structure and life histories, have altered the estuary's capacity to support juvenile salmon (Bottom et al., 2005; Fresh et al., 2005; NMFS, 2011b; NMFS, 2013c). Diking and filling activities have reduced the tidal prism and eliminate emergent and forested wetlands and floodplain habitats. These changes have likely reduced the estuary's salmon-rearing capacity. Moreover, water and sediment in the Lower Columbia River and its tributaries have toxic contaminants that are harmful to aquatic resources (Lower Columbia River Estuary Partnership, 2007).

*Contaminants of concern include dioxins and furans, heavy metals, polychlorinated biphenyls (PCBs) and organochlorine pesticides such as DDT. Simplification of the population structure and life-history diversity of salmon possibly is yet another important factor affecting juvenile salmon viability. Restoration of estuarine habitats, particularly diked emergent and forested wetlands, reduction of avian predation by terns, and flow manipulations to restore historical flow patterns have likely begun to enhance the estuary's productive capacity for salmon, although historical changes in population structure and salmon life histories may prevent salmon from making full use of the productive capacity of estuarine habitats.

Critical Habitat Conditions within the Action Area

* At this time, only ESA listed LCR coho salmon and ESA listed LCR steelhead are trapped and hauled to spawn and rear in and migrate from action area critical habitat above the SRS. ESA listed LCR Chinook salmon spawn and rear in and migrate from the NFTR, Toutle River and Cowlitz River action area critical habitat below the SRS and ESA listed CR chum salmon spawn and rear in and migrate from the Cowlitz River action area critical habitat below the SRS. NMFS developed a list of physical and biological features (PBFs) specific to salmon and steelhead and relevant to determining whether occupied stream reaches within a watershed meet the ESA section (3)(5)(A) definition of "critical habitat," consistent with the implementing regulation at 50 CFR 424.12(b). For this action area, the PBFs include:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.
2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. These features are essential to conservation because without them, juveniles cannot access and use the areas needed to forage, grow, and develop behaviors (e.g., predator avoidance, competition) that help ensure their survival.
3. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. These features are essential to conservation because without them juveniles cannot use the variety of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and reach the ocean in a timely manner. Similarly, these features are essential for adults because they allow fish in a non-feeding condition to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores.

*Within the action area of this project, the Upper NFTR mainstem has about 12 miles of migration and rearing critical habitat. Alder Creek has 6 miles of spawning and rearing critical habitat. Hoffstadt/Bear Creek have 11 miles of spawning and rearing critical habitat. Spawning and rearing habitat also exist in Deer Creek but since fish are not currently planted there it could only be used by spawners that leave Alder Creek or Hoffstadt Creek and migrate upstream to Deer Creek volitionally. No monitoring has been conducted in Deer Creek to confirm its use. Critical habitat in Alder Creek and Hoffstadt Creek is reported to be in good shape (Hughes et al., 2014). Carrying capacity is unknown. Deer Creek may add another 10 miles of spawning and rearing habitat above the SRS. The lower NFTR has 11.6 miles of spawning and rearing critical habitat. The mainstem Toutle River has 15.3 miles of spawning/rearing critical habitat and the Lower Cowlitz River has approximately 19 miles of rearing and migration critical habitat below the confluence with the Toutle River.

*Factors limiting critical habitat function include: impaired runoff conditions with increased peak flows from the MSH eruption, the SRS passage obstruction, high suspended sediment and chronic fine sediment in bedload and substrate, a deficit of gravel as bedload is trapped behind the SRS, low marine-derived nutrient input from decomposing fish carcasses in the upper and lower NFTR, channel instability in the lower NFTR above dredge spoil areas, limited riparian density and function in both the upper and lower NFTR, and disconnected floodplain function in the lower NFTR and lower Cowlitz rivers. The Cowlitz Hydroelectric project previously referenced, affects habitat conditions in the lower Cowlitz River of the action area of the proposed project through the flow regulation, and the interference of sediment/gravel movement and large wood recruitment to the lower river that are disrupted by dams associated with this project. The recovery plan emphasizes the need to restore these watershed processes that provide functional fish habitat throughout the North Fork Toutle Basin. It predicts that the reaches with the highest restoration potential are located just downstream of the Green River confluence and between Hoffstadt Creek and Castle Creek above the SRS. The recovery plan also acknowledges that recovery is limited by fish passage around the SRS and the effects of fine sediment that is not trapped by the SRS on spawning habitat below the SRS.

2.3 Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

The environmental baseline includes the past and present impacts of the SRS, but does not include its future effects because they cannot be meaningfully separated out from the effects associated with the proposed raising of the spillway crest, which extends and exacerbates the ongoing effects of the SRS. Thus, the effects of the SRS and raised spillway crest are analyzed as effects of the proposed action.

General description of baseline conditions.
*Historic LCR coho salmon and LCR steelhead spawning habitat in the upper NFTR is gone because the MSH eruption initially destroyed habitat conditions that would support spawning, and then the SRS inundated the valley with sediment and transformed the geomorphology of the NFTR into a meandering, fine-sediment laden channel above the sediment plain and a braided channel through the sediment plain. While the upper NFTR currently has none of the habitat elements that support salmon and steelhead spawning and few of the elements that support juvenile rearing, spawning and rearing habitat above the MSH SRS in the Alder Creek, Bear/Hoffstadt Creek and Deer Creek tributaries to the NFTR is of high quality and

underutilized. Below the SRS, spawning habitat is generally degraded because the SRS passes a large mass of fine sediment over the spillway and blocks gravel and large wood necessary to sustain and restore spawning habitat.

*The SRS spillway is impassable to all fish attempting to migrate upstream through the turbid waters of the NFTR to productive tributary systems relatively unaffected by the aftermath of the MSH eruption and the SRS. As mitigation for the barrier to fish passage created by the SRS, the USACE designed and built the FCF about one mile below the SRS to trap returning adult LCR steelhead and LCR coho such that they could be transported above the SRS to spawning tributaries in the upper NFTR. The WDFW owns, maintains and operates the FCF, and about half of the coho and steelhead spawners captured at the FCF are planted by WDFW in Alder Creek with the remainder transported to Bear/Hoffstadt Creek. Potential production from other tributaries is not currently accommodated by the SRS's trap and haul operations facilitated by the FCF. The passage around the SRS to and from suitable upstream spawning and rearing habitat is unsafe and ineffective.

*Only small numbers of adults are passed upstream, and juveniles are harmed as they pass downstream.

We describe the baseline with more specificity below.

Baseline sediment transport

*The eruption of MSH inundated the headwaters of the NFTR with an avalanche of sediment 17.2 miles long and 10 to 600 feet deep. Erosion of this avalanche transported millions of cubic yards of sediment into the NFTR, Toutle River, Cowlitz River and Columbia River. To block this sediment from the lower rivers, the USACE constructed the SRS to trap it in the upper NFTR. The SRS trapped sediment in an impoundment behind the dam until 1998 (Phase I). As a run of the river system, the SRS continues to trap some sand sized sediment in the braided network of channel through the sediment plain (Phase II) until the slope reaches approximately 0.003 many decades from now. Then the SRS will only trap gravel and cobble until the slope reaches 0.006 (Phase III). The lower NFTR and the Toutle River transport virtually all of the sand sized sediment that passes over the spillway to the lower Cowlitz River where sand sizes greater than 0.5 mm accumulate.

*During Phase I, the permanent impoundment behind the SRS trapped virtually all of the sediment (cobble, gravel, sand and silt) that eroded from the avalanche and created the sediment plain. The water released by the SRS outlet tower had no bedload and little suspended load. This clean water helped to remove residual MSH avalanche sediment from the bed of the Lower NFTR. Phase I ended in 1998.

*During Phase II, the SRS impoundment has been full and all of the NFTR flow goes over the spillway. The low sediment plain slope and high width prevents the Upper NFTR from forming a cascade stream. Instead, the channel responds to an increase in flow volume with short flashy floods. The sediment plain above the SRS continues to actively aggrade with gravel and sand creating a, sparsely vegetated, braided channel network that changes widely and rapidly during winter storm events. Channels form, migrate across the sediment plain and fill in with sediment during high water events. Stream energy decreases and sediment particle size decreases from upstream to downstream as the river is increasingly influenced by the SRS. As aggradation increases slope, larger sized particles are transported over the spillway and the channels become deeper and more permanent. Channels stabilize during the summer when flow is low to allow establishment of early successional plants. The SEIS states: "It is theorized that as the sediment plain slope increases and sediment load from the debris avalanche declines, the SRS sediment plain will transition from the current vegetated braided network to a (more stable) multichannel and island network. The sediment plain is showing the beginnings of an ability to grow depositional islands and vegetate them near the SRS, although these islands are fragile and quickly eroded during high water events."

*Although the Phase II concept provides a useful description of sediment size transport thresholds, 2D hydraulic and sediment transport modeling revealed that it is an overly simplified description of how the sediment plain will evolve over time. When they built the SRS it created a reservoir that trapped all of the sediment coming down off of the avalanche until the reservoir filled in creating the sediment plain. That was 'Phase I'. Once the reservoir was filled the dam became run of the river but continued to trap medium to coarse sand, gravel and cobble because the sediment plain slope is flat; this is Phase II. As the sediment plain steepens there will come a time when it only traps gravel and cobble until it gets so steep that all sediment sizes are transported through the sediment plain and over the spillway—that is phase III. The proposed action is to use the spillway crest to create a shallow pond so that the dam is still run of the river but the pond traps all sediment sizes for a few years. One might call this 'Phase 1.5'. So the effect of the proposed action is not that it creates Phase II, per se, but rather that it alters Phase II for a short time to go back to trapping fine sediment sizes in ponds.

*The slope of the sediment plain determines which sediment size fractions are captured and which size fractions are transported over the spillway. The USACE now believes that the SRS is less efficient at capturing and storing sediment during Phase II than the original planners believed. These models estimate that before the 2012 spillway raise, the SRS would pass 90 percent of 2 mm sand and 50 percent of 4 mm sand over the spillway by 2035 at a sediment plain slope well below 0.003. This realization drove the need to modify the SRS by raising the spillway crest (as shown in Figure 4) to recreate settling ponds in order to continue to provide flood risk reduction to Lower Cowlitz county communities (Biedenharn Group, 2011).

*As the sediment plain slope increases, an increasing fraction of avalanche sediment goes over the spillway, into the lower NFTR where it is transported to the Toutle River and lower Cowlitz River. This sediment is virtually all finer than 1 mm and 90 percent finer than 0.5 mm (as evidenced by the size of sediment at the base of the SRS). The Future Expected Deposition Scenario (Biedenharn Group, 2011) states that at 2,700 cfs the input of sediment from the avalanche is 35 percent coarser than 2 mm and 65 percent finer than 2 mm. At 1,600 cfs the input is 15 percent coarser than 2 mm and 85 percent finer than 2 mm. Sediment material from the avalanche to the N-1 structure ranges from fine sands to small cobles with a D_{50} of 32 mm (coarse gravel). Bed material size in the upper sediment plain ranges from fine sands to coarse gravels with a D_{50} between 1.0 mm to 1.8 mm. Bed material size in the lower sediment plain ranges from silts to coarse sands with a D_{50} of 0.2 to 0.3 mm (fine sand).

*Phase III is in the (distant) future where the SRS will continue to cause the upper NFTR channel to aggrade as it traps gravel and cobble from the MSH avalanche. There are no meaningful predictions about whether the avalanche will continue to erode and supply sediment into a Phase III of the SRS and the concept of a Phase III has no relevance for this consultation because the system will be in Phase II for many decades at the current avalanche erosion rates, and what will happen beyond that is too speculative too be meaningful.

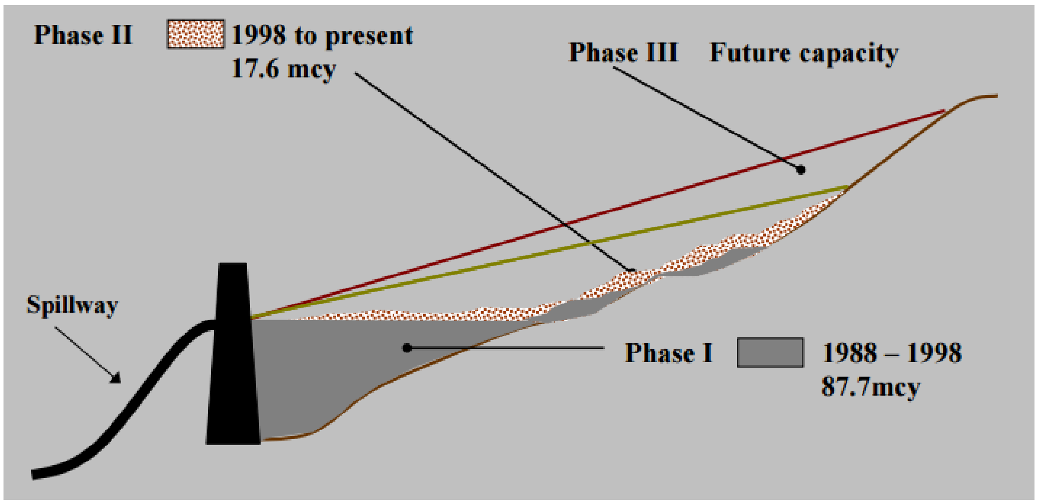

Figure 3. Conceptual Diagram of the Three SRS Operation Phases

Figure 4. The SRS and the location of the proposed spillway crests.

Baseline Upper NFTR habitat
*Spawning and rearing habitat in the mainstem NFTR above the SRS is greatly diminished since the eruption and SRS construction. Upland large wood debris (LWD) is too far from the channel to be available for recruitment. LWD would stabilize streambanks, provide refuge and provide benthic invertebrates for forage. Gravel from the avalanche settles out above the sediment plain. Instead, coho and steelhead are planted in Alder Creek and Hoffstadt Creek to spawn.

*Alder Creek is the first tributary above the SRS. It enters the NFTR approximately 10,000 feet above the SRS. Alder Creek has 6 miles of high quality spawning habitat below a natural small waterfall passage barrier. This passage barrier could be removed to create another 6 miles of spawning habitat (Hughes et al., 2014). Although Alder Creek has not gone subsurface to this point in time, as sediment accumulates in the sediment plain, there is a risk that the surface connection between Alder Creek and the NFTR could become ephemeral.

*The SRS has affected downstream groundwater flow and groundwater in the sediment plain behind the SRS is nearly at the ground surface upstream to the N-1 structure. (The dam is keyed into valley bedrock and backfilled with 140 foot deep porous sand so the sand pore space is full of groundwater almost to the surface). Alder Creek flows into the sediment plain where the high groundwater table prevents it from infiltrating into the ground and becoming subterranean flow (Hughes et al., 2014). Increasing the sediment deposition depth in the sediment plain could increase the depth to the groundwater. To help preserve the surface connection, the USACE constructed a 6 foot high, sediment filled, geotextile barrier backed with native sediments to block the NFTR from flowing to the west of the large island and depositing sediment in the Alder Creek confluence with the sediment plain.

*Hoffstadt Creek and Bear Creek have 11 miles of spawning and rearing habitat for LCR steelhead and coho salmon. The SEIS reports that surveys of juvenile fish density in Hoffstadt Creek reveal lower juvenile coho densities than would be expected from the number of adults released. Adults may leave Hoffstadt Creek before spawning or juveniles may be eaten by resident cutthroat trout. (Hughes et al., 2014)

*The USACE estimates that the avalanche will supply an average of 6 million cubic yards of sediment to the NFTR each year through 2035 (Biedenharn Group, 2010). The MSH debris avalanche is 23.8 square miles, 17.2 miles long and 10 to 600 feet deep. It accounts for 79 percent of all sediment sources in the Cowlitz River subbasin. The US Forest Service manages the MSH Wilderness Area and monitors the cross section of NFTR headwater channels in the avalanche at 30 points above the N-1 structure. By doing a regression of the change in these cross sections with respect to time, the USACE determined that the erosion rate is decreasing. However, for Lower Cowlitz River flood risk planning, the USACE decided that the high degree of variability in the daily flow-sediment load relationship observed in the basin made the decreasing erosion rate insufficiently conservative for planning purposes and they use a constant avalanche average sediment supply assumption in the SEIS. To develop a sediment supply estimate for its models, the USACE randomly selected sets of coupled sediment and hydrologic data to create a time series of sediment inputs from between 1999 and 2008. They then selected the years that represented the median sediment and hydrologic conditions and expanded this data into daily flows and sediment loads such that the distribution of peak events was similar to the observed data. This time series ranges from 0 and 20 million cubic yards (mcy) with an average of 6 mcy (Biedenharn Group, 2011).

*Before the MSH eruption, snow would accumulate in the Toutle River Basin at higher elevations and snow pack provided a significant contribution to the base flow from March through June. The total snow pack on the mountain has been greatly reduced. Monthly average discharge at the Kid Valley gage ranged from 300 cfs in August to 2,000 cfs in February. The average peak (i.e. bankfull, bedload moving) flow rate at Kid Valley is 5,108 cfs. Sixty-two percent of peak flow comes from the NFTR above Deer Creek. 19 percent of peak flow comes from Hoffstadt Creek, 6 percent of peak flow comes from Deer Creek, 10 percent of peak flow comes from Alder Creek and 3 percent of peak flow comes from Pullen Creek.

*The slope of the lower 5 miles of the debris avalanche to the N1 structure is 0.02 (m/m). The slope of the upper sediment plain from the N1 structure to approximately 3 miles downstream is 0.01. The slope of the lower 3.5 miles of the sediment plain is approximately 0.002 (m/m). Manning's roughness n is 0.035 in the upper sediment plain at the N-1 structure, 0.033 above the large island, 0.025 at the large island and 0.017 from the large island to the SRS.

Baseline Lower NFTR habitat
*The water flowing over the spillway carries suspended fine sediment and sand bedload. Below the SRS, the slope of the channel steepens to 0.012 before it steadily decreases as it exits the mountains and enters the alluvial part of the basin. Three thousand meters below the SRS, the NFTR merges with the Green River. The average peak flow increases to 8,700 cfs at the confluence.

*Between 2000 and 2007, an average of 8.6 million tons of sediment from the debris avalanche passed the N-1 structure with 2.7 million tons of that sediment deposited between N-1 and the SRS spillway. Deposited sediment was 2 percent fines, 74 percent sands, 20 percent gravels and 3 percent cobbles. 38 percent of the sand passing the N-1 structure is retained by the SRS. 62 percent is transported to the Lower Cowlitz River. Because the SRS removed most gravel from the flow, the substrate below the SRS is bimodal with cobbles and sand in the interstitial spaces.

*Under the SEIS no action alternative, meaning no spillway crest raises, by 2035, about 203 million tons of clay and silt (24 percent), sands (72 percent) and gravel (4 percent) will enter the Toutle River. This includes 30.9 million tons of sediment from the Green and South Fork River bank erosion. The trapping efficiency for all sediment sizes decreases over time. Between 2007 and 2035, the SRS will pass 16, 26 and 29 million tons of 2 mm, 1 mm and 0.5 mm sand over the spillway respectively. During lower than average flow years, the SRS has trapped medium and coarse sand (0.5 mm to 2 mm diameter) that is transported through the low slope of the sediment plain as bedload. During higher than average flow years, the medium and coarse sand has been transported over the spillway into the Lower NFTR, Toutle River and Cowlitz River.

*The Lower NF Toutle has the power to transport bedload and is a transport reach for sand sized material passed by the SRS. The hydraulics and sediment transport in the Lower NFTR is characterized with 1D rather than 2D models because it has little effect on Lower Cowlitz flood risk. The 1985 USACE Decision Document discussed the tradeoff between Upper and Lower NFTR fish habitat:

> A structure of this nature would totally block all natural upstream and downstream migration of anadromous fish. Fish passage facilities are proposed. Providing these facilities would allow the continuing reestablishment of anadromous fish runs into tributaries above the SRS. The backup of sediment behind the structure will inundate the streambed of the (upper) NFTR with sediment. This inundation would not be significant since this stream is already subjected to sedimentation from the debris avalanche. However, the height of sediment backup will also affect the tributaries that were not significantly affected by the eruption. Alder Creek, which currently provides productive spawning and rearing areas, will be inundated." "The blockage of downstream sediment

> movement by this structure will result in more rapid recovery of fish habitat below the structure; improved conditions will develop on approximately 17 miles of Main Stem Toutle River and 13.2 miles of NFTR. With reduced sediment delivery, materials in the stream below the structure will erode and allow the reestablishment of a gravel bottomed stream with riparian vegetation supporting fish life (USACE, 1985).

*Although LCR salmon and steelhead were not ESA-listed at this time, this statement shows that the intent of the mitigation (passage facility) was to maintain the presence of coho and steelhead above the SRS. However, passage has not been safe and effective due to poor maintenance and insufficient operation of the FCF (US Army Corps of Engineers, 2007). Additionally, the SRS was expected to help habitat below the SRS recover from increased sedimentation due to the eruption, as the SRS traps avalanche sediment. The SEIS acknowledges that the spawning and rearing habitat below the SRS did not recover as planned. By removing bedload from the water above the SRS the water entrained channel sediment and gravel when it entered the steeper channel below the SRS. That gravel hasn't been resupplied because it continues to be trapped by the SRS. The SRS and sediment plain have also prevented large wood from being recruited into the channel to be transported downstream where it can create salmon habitat. Therefore, the Lower NFTR has less spawning and rearing habitat than the Upper NFTR and produces less than half as many fish as are produced above the SRS.

*When steelhead and coho salmon have built redds from lower NFTR bed material, the fine sand fraction in the substrate has increased the probability that suspended sediment will plug the intergranular spaces and reduce embryo survivability because the permeability of uniform granular material decreases with the square of the particle diameter (i.e. 1 mm coarse sand is 44 times more permeable than 0.15 mm fine sand). Darcy's law (Zheng and Bennett, 1995) states that the bulk flow velocity (specific discharge) through spawning gravel is a function of the product of hydraulic conductivity (grain size distribution and packing) and the hydraulic head gradient that drives interstitial flow through the riffle substrate. At high fine sand fractions, sand in the interstitial space of gravel allows silt to bridge the smaller pore spaces. Fine sediment intrusion into the incubation zone blocks the passage of oxygenated water across the egg membrane and reduce natural flushing of harmful metabolic waste products excreted by embryos. The fraction of fines within a gravel/cobble substrate matrix is a primary predictor of spawning habitat quality. (Lapointe et al., 2004) tested the hypothesis that over a range of substrate sand fractions the variation of silt fraction effects reproductive success. Hydraulic conductivity of uniform material varies with diameter $(D)^2$. For silt$<$0.062 mm diameter and 0.63$<$sand$<$2 mm diameter, $\text{percent survival} = 83 - 2.3\text{x}(\text{percent sand}) - 6(\text{percent sand x percent silt})$. Long term increases in fine sediment inputs into rivers can silt up spawning beds, reduce intergravel flow and threaten egg survival. (Zimmermann and Lapointe, 2005) investigated the short term sensitivity of intergravel flow through salmon redds to low-intensity sediment transport events to determine if individual runoff events affect intergravel flow in salmon nests. They found that interstitial velocities were reduced whenever a runoff event deposited more than 7 g/m^2 of sand in infiltration traps in the redd zones.

*This loss of lower NFTR spawning habitat should have been offset by the FCF that transports native steelhead and coho spawners around the SRS to higher quality spawning habitat in Alder

Creek and Hoffstadt Creek. However, the FCF has only resulted in the capture and transport of approximately one out of five fish[2] that enter the ladder, due to wear and tear on the facility, design flaws and manpower constraints.

Baseline fish passage.
*The FCF is the only means of upstream passage for coho and steelhead. The condition of the facility is poor, and operation is insufficient, resulting in a small percentage of the total number of adults being able to safely pass upstream to spawning and rearing habitat. To attract fish into the FCF, a portion of the river above the FCF is diverted into a fish ladder. Fish are attracted to this flow, swim into the ladder and move into a collection pond. Fish are collected and sorted by hand, anesthetized, moved into transport tanks on trucks and taken to release locations in Hoffstadt Creek and Alder Creek. WDFW's 10(a)(1)(A) permit for the FCF authorizes take associated with fish handling, tagging and transport up to the following numbers: LCR Chinook (100), LCR coho (800), LCR Steelhead (1090) and CR Chum (20).[3] These numbers were analyzed in the Opinion on the permit; (WCRO 2020-03672)[4] however, actual numbers are anticipated to be much lower due to the issues associated with conditions and operations.[5] Fish are released randomly in each stream without knowledge of their stream of origin. Hatchery fish that enter the FCF are returned to the Lower NFTR. The FCF was constructed by the USACE, and has been owned and operated by the WDFW since 1993. The FCF is providing unsafe and ineffective passage, as explained below.

- The FCF was designed and constructed when the SRS collected over 90 percent of the sediment from the MSH avalanche in the impoundment behind the dam. Although sediment supply from the avalanche was higher, the water from the SRS outlet works was very clean. Now the SRS traps less than 30 percent of the sediment from the avalanche so the water supply to the FCF is laden with suspended sediment and bedload.
- The NFTR is meandering to the right hand side of the floodplain at the FCF (the FCF is on the left side) and depositing sediment on the left hand side. The inlets to the facility would be covered by sediment but the flow demand of the FCF maintains a side channel adjacent to the facility. The fish barrier dam at the FCF has a notch next to the FCF. All of the stop logs have been removed from the notch to try to keep the velocity through this side channel as high as possible. The notch has vertical pipes to hold the stop logs in place and these pipes can grab large wood and create backwater that slows down the flow

[2] Although data are limited, it appears that a small fraction of fish that would naturally migrate over the spillway are captured by the FCF Liedtke, T.L., T.J. Kock, and D.W. Rondorf. 2013. Evaluation of the behavior and movement patterns of Adult coho salmona and steelhead in the North Fork Toutle River, Washington, 2005-2009. U.W.G.S.O.F.R. 2013-1290, editor. 26.. From 2008 to 2009, the USGS attached radio transmitters to 9 coho salmon and 11 winter steelhead that were captured in the FCF and then released them below the FCF to observe behavior near the facility and estimate the recapture rate at the FCF. None of the tagged coho salmon were recaptured and 3 of the 11 tagged winter steelhead were recaptured. Underwater observations found that over 100 adult salmon entered and exited the FCF.

[3] https://apps.nmfs.noaa.gov/preview/applicationpreview.cfm?RecType=Project&RecordID=19827&ProjectID=19827&view=01100110011000100000#Location

[4] The Opinion notes that WDFW anticipates the Corps will upgrade the fish collection facility in the near future, increasing the efficiency of the trap.

[5] The Annual Report covering 2/8/16 – 12/31/2016 reported 3 LCR Chinook; 588 LCR coho; 327 LCR Steelhead and 10 CR Chum. The five-year average is approximately 170 steelhead and 200 coho.

past the FCF. When the notch is plugged, the flow past the FCF slows down and the sediment concentration in the flow entering the FCF increases.

- The water enters the facility through a trash rack with four inch openings that keeps floating debris and large bedload out of the facility. This rack is located within the wall of the facility so it does not benefit from sweeping velocity cleaning. The WDFW staff use long rakes to remove accumulated debris from the trash racks.
- Once water enters the facility there is a 24-inch diameter bypass pipe at the bottom of the first chamber that is designed to carry concentrated sediment slurry out of the intake and return it to the river. This bypass pipe is plugged with sediment so all of the sediment that enters the facility goes through the basin and channels. The USACE believes that the pipe plugged when a channel avulsion on the avalanche delivered a very large slug of sediment through the river in 2006.
- The FCF is intended to operate with an attraction flow of 200 cfs (5 percent of bankfull river flow rate) with 25 cfs through the fish ladder and 175 cfs through the diffuser. The diffuser is a wide, screened (1 inch) outlet that flows at 1 ft/sec to minimize its attraction to fish swimming up the inlet to the ladder which flows at 8 ft/sec. When WDFW tries to operate with the diffuser they get eight times the sediment into the facility than they do when they just operate with 25 cfs through the fish ladder so they never operate with the diffuser. As a result the attractant flow is significantly decreased to approximately 1/8th of the design attractant flow needed for proper operation of the facility, contributing to a significant drop in the number of adults that are attracted to the FCF.
- The bottom of the river is 1 to 2 feet lower at the fish entrance now than it was when the facility was built. A concrete apron below the barrier is gone and the river has down cut the channel. With the existing openings, the fish must jump an extra foot or two to enter the inlet. Therefore fewer fish are able to enter the inlet because it is very hard for them to jump this high.
- There are three fish openings that need to be used to allow fish to enter the ladder, but WDFW only uses the center one because it needs to concentrate the low attractant flow rate as much as possible. The upstream opening is used to discharge sediment laden water during the flushing operation and the lowermost opening is kept closed to force more water through the center opening.
- The water to the fish collection basin and the ladder is pumped in from a holding tank below the first chamber with the plugged bypass pipe. This water should be more sediment free but it still contains suspended sediment that builds up in the basin. Water from the basin is used to fill the tanker truck used to haul fish. The fish crowder and elevator do not work, so instead, to sort fish the workers draw down the basin and climb down into the basin with nets to capture fish, pass them up to be sorted and natural fish are placed into the truck. When the workers have more fish to transport than they can haul in one trip they have to fill the tanker, they draw down the basin and collect the first load of fish, refill the basin. They then take the first load around the SRS, return and refill the tanker and draw down the basin again to catch, sort and transport the second load of fish.

*Downstream migration over the SRS spillway injures smolts. Juveniles that are able to outmigrate through the sediment plain are cascaded downstream over a 132 foot elevation drop atop the bedrock face of the SRS. These conditions have been documented to cause injury in outmigrant salmonids captured below it (Olds 2002, *as cited in* USACE 2007),

> Olds, C.A., 2002. Fisheries Studies at the SRS on the NFTR 1993, 2001, 2002. Washington Department of Fish and Wildlife, prepared for the U.S. Army Corps of Engineers, Portland District. This report presented the results of fish studies conducted at the SRS. The studies used hatchery fish and likely presented a conservative estimate of SRS wild coho salmon smolt passage impact. The data indicated that 22percent of wild smolts from upstream of the SRS were injured passing the SRS and FCF during emigration. Holding smolts 160 hours post treatment showed that treatments (passing spillway and FCF) did not appear to effect smolt survival in the short term. While many smolts that passed the spillway in 2001 had dorsal scrapes between the head and dorsal fin, no internal damage due to these scrapes was found. Actions that reduce spillway water velocities or suspended sediment need to be taken due to smolt passage impact and the conservation status of wild salmonids populations upstream of the SRS.

2.4 Effects of the Action

Under the ESA, “effects of the action” means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

As indicated above, the future effects of the SRS cannot be meaningfully separated out from the effects of the proposed action, which is to raise the SRS spillway crest; thus the effects of the SRS, with the raised crest, are analyzed together as effects of the proposed action.

The USACE proposes to raise the spillway crest 13 feet and construct a Deer Creek adult release site during the summer work window of 2023. The WDFW will continue trapping adult fish at the existing FCF until 2027. The USACE will design, test and complete construction revisions to the FCF by 2027 that will enable the WDFW to capture 95 percent of the returning natural adult coho and steelhead.

The higher spillway crest will cause sediment plain elevations up to 960 feet to fill with impounded backwater. The 2012 spillway crest raise functioned to impound water for 3 years, and the 2023 spillway crest raise will also likely impound water for an additional 3 years. The impoundment will capture and store virtually all of the sediment transported by the NFTR during that time (USACE, 2014). Once the impoundment is full, the sediment trapping efficiency of the SRS begins to decrease until it reaches the point where the system only traps about 30 percent of the sediment that will otherwise lodge in, and reduce in-channel capacity of, the lower Cowlitz River (USACE, 2014). Reduced channel capacity increases the frequency of overbank conditions (floods). To maintain required flood protection for Lower Cowlitz communities, perhaps as early as 2033, the USACE may construct another spillway crest increase, create another impoundment *and reset the sediment trapping efficiency of the SRS. That will be the final spillway crest raise and future efforts to manage sediment will be with grade building structures upstream from the SRS and dredging in the Lower Cowlitz River (USACE, 2014).*

The USACE knew that the spillway crest could be increased up to 30 feet to trap sediment without increasing the height of the SRS. They raised the spillway crest 7 feet in 2012. In the 2016 SEIS and BA they proposed to raise the spillway crest up to 13 feet when the sediment trapping capacity of the 7 foot spillway crest raise is exhausted and then 10 feet when the sediment trapping capacity of the 13 foot spillway crest raise is exhausted. From annual monitoring and modeling the USACE determined that the 7 foot raise was no longer trapping sediment, Lower Cowlitz communities are approaching their flood risk thresholds and the 13 foot raise will be necessary in 2023. The 10 foot raise will likely be necessary sometime after 2030, depending of sediment supply rates from the avalanche. In order to perform an effects analysis for this biological opinion, we evaluated the predicted sediment depth and geomorphology changes in the SRS sediment plain following the 13 foot and 10 foot spillway crest raises. We also evaluated the effect of the FCF proposed to but built and operation by 2027 and the Deer Creek adult release site that will be constructed by the end of 2023.

2.4.1 Effects to Critical Habitat

*As discussed in Section 2.2.2, the action area supports the PBFs of designated LCR steelhead, LCR Chinook salmon, CR chum salmon and LCR coho salmon critical habitat for migration, rearing and spawning.

The physical and biological features (PBF) for each of these salmonid species are the same:

The PBF of freshwater spawning sites are water quantity and quality conditions and substrate supporting spawning, incubation and larval development.

The PBF of freshwater rearing sites are water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility, water quality and forage supporting juvenile development, and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels and undercut banks.

The PBF of migration corridors are freedom of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels and undercut banks supporting juvenile and adult mobility and survival.

*We interpret the action to adversely affect these PBFs in the following manners:

- Increased turbidity in the NFTR below the SRS during spillway crest construction
- Blocked passage for adults past the SRS and in the NFTR above the SRS but for the FCF which was not designed to operate with the current suspended sediment loads in the NFTR below the SRS.

- Blocked sediment and wood transport past the SRS to the Lower NFTR
- An obstructed outmigration pathway for juvenile coho salmon and steelhead by impounded backwater above the SRS;
- An obstructed outmigration pathway for juvenile coho salmon and steelhead by the braided channel network above the SRS after the impoundment is filled with sediment; and
- Habitat impacts below the SRS from the interruption of gravel and large wood transport.

*These effects are discussed in greater detail below.

We note here that the construction of the Deer Creek release site consists of reconstructing an abandoned road to the site and installing a pipe from the road to the Deer Creek channel. These actions will have no effect of critical habitat. We also note that at this time, the FCF EDR is not far enough along to consult of any critical habitat effects from construction. At the 90 percent design phase, we will consult with the USACE on short term FCF construction effects and FCF operation effects to critical habitat.

Critical habitat effects from construction of each spillway crest raise

As described in the proposed action, the USACE will raise the spillway crest two times, 13 feet in 2023 and 10 feet when Lower Cowlitz community flood risk returns to threshold levels. Although the spillway crest raises are not identical, the response of sediment plain critical habitat to each raise is the same, the creation of an impoundment followed by the evolution of channels through the flat sediment plain. Our effects analysis for each spillway crest raise is the same. The spillway crest construction activities may disturb small amount of sediment stored by the SRS. When transported downstream, this sediment increases turbidity and may increase substrate embeddedness in the lower NFTR action area. *Sediment deposition in the bed is coincident with salmonid eggs incubating during the fall and winter. Introduction of fine sediments (sand and smaller, < 2mm diameter) alters channel morphology and habitat by several mechanisms. The smallest particles travel downstream as wash load, while larger particles may travel as bed load (Richards, 1982). Suspended particles and fine bed load can accumulate in spaces between gravel particles (Beschta and Jackson, 1979; Lisle, 1989), restricting the subsurface movement of water through the gravel. Fine sediments can also fill pools and then increase turbidity levels during subsequent runoff events. Fine sediment deposition also reduces food production (Suttle et al., 2004). However, since the purpose of the proposed action is to reduce the extraordinarily high sediment load from Mount St. Helens that is transported through the North Fork Toutle River and Cowlitz River, the effect of the small amount of sediment from construction activities will be extremely minor. None of these effects are expected to rise to the level of take. *These effects will temporarily diminish water quality and may alter benthic prey communities for rearing or migrating juveniles in downstream areas. These reductions will ameliorate after work stops. We expect the work to last for one in-water work window and the reduction in water quality to be contemporaneous, abating within days or weeks after work ceases, while modified benthic conditions may persist for months or longer.*

Critical habitat effects of the SRS

The sediment plain behind the SRS blocks upstream passage of adults returning to spawn above the SRS. Although the slope of the spillway allows fish to volitionally ascend, the NFTR channel across the sediment plain provides extremely poor upstream passage to spawning tributary confluences. Instead of volitional passage, the existing FCF captures returning spawners and transports them around the SRS. However, the existing FCF has poor collection efficiency, largely because it was not designed to work with the high suspended sediment concentration in its water supply. The spillway crest raise reduces the suspended sediment concentration in the lower NFTR by trapping it, first in the impoundment and then in the aggrading sediment plain. Thus, we expect the 2033 spillway crest raise is likely to indirectly increase the collection efficiency of the FCF from 2023 to 2027 while FCF redesign and reconstruction is taking place.

*The SRS spillway crest raises will extend the time that habitat forming bedload gravels and large wood are prevented from moving to the Lower NFTR. These materials sustain and improve spawning and rearing habitat conditions in the Lower NFTR, Toutle River and Cowlitz over the long term. This outcome occurs under the existing conditions and will be worsened by the action by extending the height of the SRS further upstream in the NFTR. Without the proposed action a significant mass of small gravel would be transported over the spillway within a decade. The spillway raises will reset the slope of the sediment plain to essentially zero and will delay the transport of coarser material to the Lower NFTR by several decades. Interrupting this gravel and wood transport downstream below the SRS over the course of decades prevents the development of more stable spawning conditions in the lower river that would develop in a shorter time frame.

While the spillway currently, and with the proposed action, retains suitable spawning material behind the structure, and passes fine material downstream, the increase in the spillway crest will also decrease the amount of fine sediment being transported downstream, which will be beneficial to downstream water quality and substrate conditions.

Critical habitat effects of the spillway crest raise impoundment

The impoundment will not reach or affect spawning substrate in Alder Creek, Hoffstadt/Bear Creek or Deer Creek (tributaries to the NFTR), and there is no known spawning habitat or suitable spawning substrate in the NFTR above the SRS.

The USACE raised the spillway crest in 2012 and the increased sediment trapping had beneficial effects on critical habitat below the SRS. The impoundment traps 95 percent of sediment for 3 or 4 years. Once the impoundment is full the flat sediment plain continues to capture sand size sediment as it steepens so sediment trapping efficiency goes from 95 percent to 30 percent over about a decade. At 30 percent, the SRS isn't trapping enough sediment to manage Lower Cowlitz community flood risk. The impoundment may improve spawning substrate in the NFTR below the SRS, in the Toutle River and in the Cowlitz River because it will trap so much of the sediment from the MSH avalanche that relatively clean water will flow down the spillway. Cleaner water may entrain and transport fine sediment that has accumulated in spawning substrate in these rivers below the SRS (Lane, 1954; Southard, 2006) leaving the substrate more suitable for redd construction (Lapointe et al., 2004; Zimmermann and Lapointe, 2005).

The impoundment will not reach or affect rearing habitat natural cover in Alder Creek, Hoffstadt/Bear Creek or Deer Creek. The impoundment will inundate and may damage or kill natural cover that has started to become established in the NFTR sediment plain above the SRS between the large island and the SRS since the 2012 spillway crest raise. This may alter the macrodetritus (terrestrial plant litter) base to microdetritus (phytoplankton) base ratio of the food web in the lower sediment plain which determines the types of forage available to outmigrating smolts (ISAB, 2011). The impoundment will not affect natural cover in the NFTR below the SRS, the Toutle River or the Cowlitz River.

The impoundment will not reach or obstruct migration corridors in Hoffstadt/Bear Creek or Deer Creek, but the impoundment will be a passage obstruction in the NFTR above the SRS because the flow velocity through the impoundment will be lower than the flow through the existing channel network across the sediment plain (Zabel, 2002; Zabel and Anderson, 1997). The impoundment will not obstruct migration corridors in the NFTR below the SRS, the Toutle River or the Cowlitz River.

The impoundment has a significant probability of altering the connection between Alder Creek and the NFTR, at some point during the life of the project. Alder Creek currently flows through the sediment plain for thousands of meters before it merges with the NFTR. After the impoundment fills with sediment in this part of the sediment plain, under some summer low flow conditions, the surface connection between Alder Creek and the NFTR could become subsurface. While this confluence will be monitored and mitigation would be provided through adaptive management under the proposed action to minimize this potential effect, the risk is not eliminated completely, and some potential for at least temporal blockage would remain. By keeping NFTR channels out of the west side of the large island and Alder Creek, the USACE can control the sediment deposition depth there but the surface connection between Alder Creek and the NFTR also depends on how the NFTR braided network reforms in the sediment plain after the pond is full and on how groundwater level responds to the additional depth of sediment in the sediment plain after the pond is full. It is likely that during very low flow years when Alder Creek is at the margin of maintaining its surface connection to NFTR today, that connection could go subsurface after the proposed action. This outcome is more likely under predictions of climate change effects on streamflow into the future.

Critical habitat effects of the braided channel network

The approximately 2,000 meter long impoundment will fill with sediment in about three years leaving a flat slope from the tip of the large island to the spillway. The NFTR channel(s) across this flat slope will evolve as the sediment plain steepens from sediment deposition. During the first years after the pond fills, the NFTR will cross the non-cohesive sediment plain as overland flow that both carves and abandons many shallow rills and gullies across the width of the plan (Reitz et al., 2014). As the slope steepens, water transported sediment will create a network of many shallow channels and low islands that exhibit rapid creation, migration and abandonment dynamics (Reitz et al., 2014; Schuurman et al., 2013). Slowly it will evolve into a network of fewer, deeper channels and higher islands such as those identified in the baseline. The evolution of this dynamic braided channel network to a steady channel across the plain to the spillway is *expected to take decades but within 10 years following the 2012 spillway crest raise the sediment plain had steepened sufficiently to provide reliable downstream passage to the spillway.*

The modification to the spillway crest resulting in an evolving braided channel network will not alter Alder Creek, Hoffstadt/Bear Creek or Deer Creek spawning substrate. There is no known spawning substrate or spawning in the NFTR above the SRS. As described in the baseline, the NFTR is responding to the discontinuity created by the SRS by depositing sediment from the SRS back to the avalanche to steepen the channel slope. Spillway crest raises reset the elevation of the sediment plain so this process starts over but follows the same pattern for each spillway crest raise. As the slope steepens, channels consolidate, get deeper and more stable and downstream passage to the spillway improves (Lisle, 1989; Piegay et al., 2006).

The modification of the spillway crest resulting in a braided channel network will not alter natural cover of rearing habitat in Alder Creek, Bear-Hoffstadt Creek or Deer Creek. Natural cover in the NFTR above the SRS will first decrease but gradually re-establish as the braided channel network steepens the sediment plain by trapping sediment, allowing channels to stabilize and allowing plants to become re-established on islands between the channels.

Once the impoundment is filled the flow across the flat sediment plain will be through an evolving network of braided channels which networks present modification to the migratory pathway of smolts because the routes that actually reach the spillway may be occluded, and new routes may form that are difficult to detect because of low velocity. Again, a flat, braided channel network is not a common natural feature near the headwaters of rivers but braided networks in floodplains with dead end channels are common in floodplains lower in the river. During the first years after the impoundment is filled, juvenile outmigration through the braided network will be more difficult. After the final spillway crest raise, the ability to store sediment sizes that get stuck in the Lower Cowlitz River at the SRS is exhausted and additional sediment management will be with grade building structures that force upstream meander deposition processes and emergency dredging in the Lower Cowlitz. These strategies do not affect fish passage.

*Although this vegetation is fragile and susceptible to be washed away during large flow events, the natural evolution of braided networks is for the channels to deepen and for the bars' elevations to raise over time so that the natural succession of vegetation colonization and establishment can occur under all conditions.

The changes in the braided channel network will not alter natural cover of rearing habitat in the NFTR below the SRS, the Toutle River or the Cowlitz River.

The changes in the braided channel network will not reach or obstruct the Hoffstadt/Bear Creek or Deer Creek migration corridors. As discussed in Section 2.3, Alder Creek enters the sediment plain southwest of the small island and runs thousands of meters through the sediment plain on the west side of the large island. Sediment deposited in the sediment plain between the large island and the SRS could ultimately force the connection between Alder Creek and the NFTR to become subsurface, particularly during summer low flows (SEIS, 2014). The likelihood of this depends on the elevation of the groundwater table. The proposed action includes contingency *plans to monitor the sediment depth and groundwater table where Alder Creek enters the sediment plain and to construct a grade building structures that will prevent the NFTR from migrating to and depositing sediment onto the sediment plain west of the large island. The USACE proposes to construct an adult release site in Deer Creek in 2023 to use more of the productive spawning habitat above the SRS (NMFS, 2013) and to offset the future possibility that the Alder Creek connection to the NFTR becomes ephemeral as sediment accumulates. The braided channel network will obstruct the migration corridor from the tip of the large island to the spillway because not all of the braids will form a continuous, uninterrupted path to the spillway (Reitz, 2014). The braided channel network will not affect or obstruct the migration corridor in the NFTR below the SRS, the Toutle River or the Cowlitz River. However, the natural braided channels in the open sediment plain always have higher sunlight and higher temperature that produces high algal growth and high invertebrate abundance before channels are flushed by autumn floods (Gray and Harding, 2009). Resetting the slope of the sediment plain with the spillway crest raises delays temporal development of the braided channel network towards this more valuable habitat state by up to 10 years.*

Critical habitat effects of dredging

Because the increase in the SRS height is intended to reduce the amount of sediment transported downstream, the frequency of dredging to maintain channel capacity may decrease. However dredging is unlikely to become entirely unnecessary.

*The possible effects of Lower Cowlitz and Columbia River dredging to LCR coho, LCR steelhead, LCR Chinook salmon, and CR chum salmon rearing and migration PBFs includes the disruption of the benthic ecology, temporary noise from dredging equipment, and suspended sediment generated to the water column. The Lower Cowlitz River and the downstream extent of the action area at the confluence with the Lower Columbia River supports rearing and migration critical habitat with minimal salmon and steelhead spawning habitat below the Toutle River confluence (NMFS, 2005). The cutterhead used for dredging will be buried in the sediment or near the bottom to minimize the generation of suspended sediment in the water column. The operation creates noise that is not loud enough to injure fish but the water quality disturbance generated is reasonably certain to cause them to avoid the immediate dredge site. Localized suspended sediment concentrations that may be high near the channel bed will settle once the dredge moves. Use of the cutterhead will only be for up to 30 days per year during the in water work window each year, and in the lower 19 miles of the river. Further, the dredging proposed would target sand shoals in low velocity reaches that would not be suitable for salmon and steelhead spawning habitat. Benthic food resources removed with the dredge sediment are prey items for LCR coho, LCR Chinook salmon, CR chum, and LCR steelhead, but the Lower Cowlitz streambed is highly mobile so benthic communities are regularly disturbed during winter high flows and then recolonized. The dredging disturbance will take place in the summer so recolonization will be even more immediate. There is no evidence that benthic food resources for salmon or steelhead are limited in the Cowlitz River or in the Columbia River at the confluence. As a result of these factors, we do not consider the dredging proposed in this action in the lower Cowlitz River to result in adverse effects to critical habitat.

2.4.2 Direct Effects to Salmon and Steelhead

Adult coho and steelhead with adipose fins that are trapped by the FCF are transported above the SRS. Hatchery fish and every other species that gets trapped is released below the barrier to spawn elsewhere. At this time there is no plan to transport ESA listed Chinook or chum salmon around the SRS. *Because the effects of the action are considered to affect LCR coho salmon and LCR steelhead, through the same mechanisms, the analysis below considers these effects collectively for the affected species. Both coho and steelhead spawners are collected and planted in Alder Creek and Hoffstadt/Bear Creek. Salmon and steelhead smolts follow the same migration pathway through the sediment plain and over the SRS spillway. At this time, adult LCR Chinook and CR chum salmon that enter the FCF are released below the barrier. In the future, they may be transported above the SRS and planted in the mainstem or in tributaries to spawn. If that happens, subyearling smolts will be exposed to the same stressors described below that now affect coho and steelhead smolts.

The direct effects of the proposed action on ESA listed species are:

- Increased exposure of juvenile salmon and steelhead in the Lower NFTR to suspended sediment during spillway crest construction
- Increased injury to smolts migrating down the longer spillway
- Increased energy expenditure and mortality to smolts migrating through the impoundment as the velocity declines and conditions become more lacustrine
- Increased energy expenditure and mortality to smolts migrating through the braided channel network after the impoundment is full because nascent channel configuration is occluded
- Increased collection efficiency of the existing FCF due to increased impoundment of sediment, and then increased efficiency that will result from the FCF upgrades
- Lower Cowlitz dredging effects

Direct effects from constructing the spillway crests

LCR Chinook salmon, CR chum salmon, steelhead and LCR coho salmon juveniles may be rearing in the North Fork Toutle River below the SRS during the proposed construction. The construction activities may release sediment stored near the spillway that increases suspended sediment, turbidity and substrate embeddedness in the downstream action area. Juvenile Chinook, chum, steelhead and coho salmon in the North Fork Toutle River below the SRS could ultimately be exposed to this turbidity although juvenile Chinook and coho salmon are blocked from the NFTR from the base of the spillway to the FCF barrier.

The effects of suspended sediment on fish increase in severity with sediment concentration and exposure time and can progressively include behavioral avoidance and/or disorientation, physiological stress, gill abrasion, and death—at extremely high concentrations. Newcombe and Jensen (1996) analyzed numerous reports on documented fish responses to suspended sediment in streams and estuaries, and identified a scale of ill effects based on sediment concentration and duration of exposure. Exposure to elevated concentrations of suspended sediments can elicit sublethal effects such as a short-term reduction in feeding rate or success, or minor physiological stress such as coughing or increased respiration. However, studies show that salmonids have an ability to detect and distinguish turbidity and other water quality gradients (Quinn 1988, Simenstad 1988), and that larger juvenile salmonids are more tolerant to suspended sediment than smaller juveniles (Servizi and Martens, 1991). Because the mass of sediment entering the streamflow will be controlled by Best Management Practices and it is mixed in the lower spillway before it reaches rearing habitat, NMFS anticipates that the concentrations of suspended sediment from construction on juvenile steelhead, Chinook, chum and coho will not result in adverse effects.

*Adult salmon and steelhead are not exposed to or affected by the spillway crest construction because coho and steelhead are not migrating up the NFTR during the in-water work window and all adult salmon and steelhead are blocked from approaching the SRS by the FCF barrier over a mile below the SRS.

Direct effects from the increased height of the spillway crest on downstream juvenile migrants.

The proposed action includes two planned spillway raises, one in 2023, and the second roughly 10 years later. Because the structure alters migration conditions for both juveniles and adults, we present an analysis of the effects for each life stage, separately.

*Under existing conditions, some juvenile LCR coho salmon and steelhead are injured as they migrate down the existing spillway. Their *rate of injury or level of injury during* downstream passage may be worsened by the raises by increasing the height of the drop over the spillway.

*With a net increase in the drop of 23 feet that will transpire over the two raises proposed, there is a greater likelihood of injury or mortality to outmigrant smolts. Each spillway crest raise (i.e., of 'h' feet) is set back from the existing spillway crest a distance equal to $\frac{h}{.07}$ to maintain the slope of the spillway at 7 percent. The two proposed spillway crest raises will increase the length of this part of the out migration journey by approximately 185 feet and 143 feet respectively so the number of fish that are injured is likely to increase.

*The SRS, as perpetuated and modified by the proposed crest raises, also has severe impacts on upstream passage – in that volitional upstream passage of adult salmonids will be completely blocked. The SRS blocks volitional upstream passage of adult salmonids. Blocked upstream passage causes significant effects to both listed species by preventing access to upstream spawning and rearing habitat. If volitional passage past the SRS was possible, the number of coho and steelhead that spawn in the upper NFTR would not be limited by the intrinsic inefficiencies in trap and haul systems. Fish that pass the SRS volitionally would be less likely to fall back over the spillway than trap and haul fish. Coho and steelhead would have access to and very likely colonize spawning habitat that is not used in the trap and haul system. Blocked passage affects both species by forcing them to use spawning and rearing habitat below the SRS; habitat that is degraded by the way the SRS alters natural sediment and large wood transport and that is unable to support numbers of fish needed to sustain, much less increase their population numbers. As collection efficiency improves (both from the spillway increase retaining more sediment and from the corrective actions expected by 2027) movement of fish to spawning areas is expected to improve.

Direct effects of the impoundment on rearing and migrating juveniles behind the spillway

After the spillway crest is raised, all salmon and steelhead smolts produced above the SRS will be exposed to the presence of the impoundment between their natal tributaries (Alder Creek, Hoffstadt/Bear Creek and Deer Creek) and the spillway. The impoundment will be present year round, and its presence will overlap with rearing and the outmigration timing of all salmon and steelhead smolts produced in Alder Creek, Hoffstadt/Bear Creek and Deer Creek above the SRS.

From 2024 to 2026 (and again for three years after the third and final spillway crest raise) every coho and steelhead smolt produced above the SRS will have to pass through the impoundment to reach the spillway crest and migrate downstream. Although impoundments are not natural features of smolt outmigration routes to the ocean, they are common anthropogenic features of water management systems such as dams and most smolts, especially larger smolts like coho and steelhead, successfully migrate through run of river reservoirs behind dams and find passage at the dam (Amado, 2012; Zabel and Anderson, 1997). The stressors from impoundments are low flow velocity causing greater energy expenditure, lacustrine like food webs and tactical advantages to some smolt predators.

Since the flow velocity in an impoundment is low, smolts must swim and expend energy rather than be carried downstream by the flow (Amado, 2012). In this case, the impoundment length is relatively short (compared to a reservoir behind a dam) so the additional energy required is likely minimal. Likewise, permanent reservoirs behind dams alter the base of the salmonid food web from macrodetritus (terrestrial plant litter) to microdetritus (phytoplankton) with corresponding alterations to the forage available to smolts (ISAB, 2011; Jeffres et al., 2020). Again, in this case the dimensions and duration of the impoundment are too small and short to result in such a food web shift.

If the connection between Alder Creek and the NFTR becomes at times subsurface, juvenile fish in Alder Creek would be trapped until the surface connection is reestablished by higher flows from fall rains. Some coho life histories include downstream summer migration of age 0 fry (Bennett et al., 2015) (Koski, 2009) when food is limited. This life history diversity contributes to the resilience of the species and if the Alder Creek confluence becomes subsurface this diversity could be reduced.

Direct effects of the impoundment on FCF collection efficiency

When the sediment trapping efficiency of the SRS is low, operation of the FCF is compromised by high levels of sediment in the water supply that decrease the FCF ability to attract spawners produced above the SRS to the entrance, up the ladder and into the collection basin. The impoundment from the spillway crest raise captures over 90 percent of the sediment from the avalanche for about three years, sending relatively clean water to the lower NFTR and the FCF. This will eliminate the sediment burden on FCF operation and improve collection efficiency from fall 2023 through 2026, likely increasing the number of spawners to be captured. An increase in FCF efficiency was noted following the 2012 spillway crest raise. Coho smolts outmigrate as 1 year old fish, and steelhead as 1 or 2 year old fish so offspring from these additional spawners will out migrate between spring 2025 and 2027. Based on this, along with *the analysis presented in Appendix 1, we therefore expect that only in 2024 will the decline in smolt survival through the impoundment not be offset by increased adult spawner abundance and productivity. Any effects of the impoundment following the final spillway crest raise on downstream juvenile passage is expected to be offset by the increase in the number of smolts produced from the increased number of returning adults captured and transported by the upgraded FCF starting in 2027. See Appendix 1.*

Direct effects of the braided channel network on migrating smolts

The changes in the braided channel do not directly not affect the adults because they are transported above to the natal streams for spawning. The changes the channel configuration affect the progeny of these adults, however, and are described below.

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Once the impoundment is filled the flow across the flat sediment plain will be through an evolving network of braided channels as described above in Section 2.3. As described in the Effects to Critical Habitat section above, braided channel networks present a different migration stressor to smolts because they must select a route that actually reaches the spillway from the multiple channels they encounter. Again, a flat, braided channel network is not a common natural feature near the headwaters of rivers but braided networks in floodplains with dead end channels are common in floodplains lower in the river. During the first years after the impoundment is filled, juvenile outmigration through the braided network will be more difficult and some smolts are likely to be stranded and die in very shallow or dead end side channels. We expect the channel network to eventually reestablish, beginning at about 10 years after each spillway increase.

Direct effects of the FCF

The WDFW operates the FCF with incidental take of coho salmon, steelhead, Chinook salmon and chum salmon authorized by NOAA Fisheries Scientific Research Permit 15611-3R under the authority of Section 10(a)(1)(A) of the Endangered Species Act from 5/18/2021 to 12/31/2025. We incorporate by reference NMFS Consultation Number WCRO-2020-03672 effects analysis of handling, transporting and releasing salmon and steelhead by the FCF here.

Direct effect of not upgrading the FCF and achieving 95 percent collection efficiency until 2027

Here, we combine the adverse effects on juveniles and the expected beneficial effects on adults, to estimate the net effect of the proposed action on the abundance of coho and steelhead above the SRS. Because the existing FCF is expected to improve function (trap more adults) as more sediment is retained behind the raised spillway, we expect additional spawners to be transported and released in spawning streams in each year between the crest increase and the time that the FCF is modified, and that additional redds and progeny will result (see Appendix 1). When the FCF is corrected (by 2027), attraction flows are expected to conform with NMFS passage guidelines, so that larger numbers of adults are captured more consistently annually, and transported to spawning streams. In this case we expect the corrected FCF to achieve 95% collection efficiency by the end of 2027.

Direct effects of FCF upgrade construction in 2026 and 2027

The construction of upgrades to the FCF is not part of this proposed action. As this re-initiation is being finalized the USACE is developing and analyzing alternative solutions to the deficiencies of the existing FCF to transition into the DDR phase of their planning process.

Once the design of the FCF upgrades are finalized, the USACE will prepare a detailed biological assessment of these and other construction effects for a separate consultation on those effects. This separate analysis will allow a detailed evaluation of the design specifications against the most current NMFS passage criteria.

Direct effects from dredging

*Spillway crest raises are an alternative to Lower Cowlitz River dredging to manage Lower Cowlitz River flood risk, but both may be necessary and the adaptive management scheme includes the provision for Lower Cowlitz River dredging if an extreme flow event moves enough sediment past the SRS to abruptly reduce the channel volume. Dredging of the Lower Cowlitz River associated with the proposed action would occur between July 16 and August 15, as needed based on an annual evaluation of flood capacity of lower Cowlitz riverine corridor. The Lower Cowlitz is a rearing and migration corridor. Stream-type salmonids such as LCR steelhead and coho salmon typically emigrate in the spring of their second year as larger yearlings, with ocean entry occurring from May through June. Steelhead may migrate year-round, however, and may spend more than two years in freshwater before smolt outmigration.

*The potential effects of dredging to LCR steelhead and LCR coho salmon juveniles include: entrainment, underwater noise, and suspended sediment. The risk of individual fish from these MPGs being entrained during dredging is expected to be limited due to the low likelihood of their presence during the in-water work window. The in-water work window is after the peak outmigration of LCR coho and steelhead.

*The cutterhead used for dredging will be buried in the sediment or in the lower 3 feet of the water column when the pumps are running to minimize the possibility of entrainment and decrease dredging noise in the water column. Juveniles are less able to avoid entrainment than adults but are unlikely to be near the dredge because the dredging will be conducted during the in water work window when only a very few juveniles are expected to be migrating past the dredge site. Those juveniles that might be migrating at this time will be in different parts of the stream because they rear at the margins of the channel and activities associated with dredging will cause juveniles to avoid the dredging site. Dredging also has the possibility to harm adult salmonids by sucking them into the dredge. In this proposed action, dredging will be conducted with a cutterhead buried beneath the sediment surface, thereby avoiding this possibility. Further, adult LCR coho and LCR steelhead have sufficient swimming power to avoid entrainment, would naturally avoid the benthic disturbance created by the dredging, and are, regardless, unlikely to be present during the work window because their spawning migrations largely begin after the closure of the work window.

*We expect that the suspended sediment concentrations produced by cutterhead pipeline dredging will be less than the concentrations produced by clamshell bucket dredging because the pump pulls all sediment sizes into the pipeline. The impact, penetration, withdrawal and rise of the clamshell bucket through the water column causes suspended sediment concentrations that can be estimated with the empirical equation $\frac{C_a}{\rho x 10^{-6}} = .0023\left(\frac{b}{wT}\right)^3$ (Collins, 1995) where *b* is a representative size of the clamshell bucket, T is the cycle time in seconds, w is the settling velocity from Stokes law for the median grain diameter *d* and specific gravity of the dredge sediments. For a 1x1 meter open bucket, a nominal particle size of .5 mm and a cycling time of 60 seconds, this equation predicts a suspended sediment concentration of 457 mg/L. Using the Newcombe and Jensen (1996) scale of severity (SEV), juvenile salmonids exposed to this range of suspended sediment concentrations for an eight hour workday would experience the sublethal effects between moderate physiological stress and major physiological stress including a reduction in feeding rate and success. Since the cutterhead pipeline dredge suspended sediment concentrations are expected to be significantly lower, there is no expectation that fish will follow the moving cutterhead and be exposed to suspended sediment for hours at a time to cause injury Studies also show that salmonids have an ability to detect and distinguish turbidity and other water quality gradients (Bisson and Bilby, 1982), and that larger juvenile salmonids are more tolerant to suspended sediment than smaller juveniles (Servizi and Martens, 1991). To the extent that juvenile salmonids are present in the areas affected by turbidity they are expected to be of sufficient size (80-110 millimeters fork length) that they can respond by avoiding waters affected by the disturbance and find refuge and/or passage within unaffected adjacent areas. Given that juvenile peak outmigration should be well past by conducting the dredging during the work window as proposed, and that only larger sizes of juvenile salmonids would be anticipated in the action area at the time of construction-if present at all, the potential effects to the ESA-listed salmon and steelhead from the suspended sediment generated by the proposed action would be short term, and localized, and therefore, insignificant.

*We do not expect sound generated from dredging to adversely affect the ESA-listed juvenile or adult fish considered in this opinion because dredge equipment does not produce acoustic energy at frequencies or with wave forms that produce acute injuries in fish and the migrating fish are not exposed to noise long enough to receive chronic effects (Hawkins et al., 2015).

2.5 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. Because this action occurs on federal lands, and the watersheds above the SRS are exclusive forested and managed under federally approved management plans, future state or private activities that contribute additional effects to the effects of this action under consultation are not anticipated above the SRS in the action area.

*Non-Federal future actions that are likely to affect the action area below the SRS will include a variety of upland activities associated with human population growth and the conversion or intensification of uses. These actions are reasonably likely to lead to increased impervious surface, surface runoff, and non-point discharges in the Toutle and Cowlitz basins. While non-Federal regulations address input of pollutants and other degrading factors and restrict them to low levels, chronic low level inputs are still likely, including input of unregulated compounds such as pharmaceuticals and cosmetic elements, the effects of which are not well documented, either individually or in combination. Regardless of the efficacy of regulatory restrictions in place, without regulatory oversight and enforcement of chronic low-level inputs such as those discussed above, degraded water quality will continue into the future and contribute to a lower likelihood of successful growth to maturity for, LCR steelhead, and LCR coho salmon in the Lower NFTR and Toutle River systems.

*Additional non-federal future activities that may affect the action area below the SRS also include state, tribal and locally developed plans and initiatives to benefit ESA listed salmon and steelhead..

*Above the SRS the landscape is dominated by commercial forestry on privately owned and managed timber lands until the boundaries of the Mt. St. Helens national monument are encountered along the flanks of the mountain itself. Effects from commercial forestry on privately managed lands will include sedimentation from forest roads, sediment conveyance from timber lands recently harvested, and the indirect effects of increased sedimentation on spawning and rearing tributary habitat PBFs. These lands are managed under Washington State's Forest Practices Rules, which are, in turn, subject to provisions adopted in the Washington State Forest Practices Rules HCP with the WDNR (WDNR 2005). Implementation of this plan has carried forward improvements to fish passage and road management via Road Maintenance and Abandonment Plans (RMAPs) to properly abandon or stabilize existing forest roads, and improve standards on how new roads are to be built and existing roads maintained or abandoned to ensure fish passage and minimize sediment delivery to streams and rivers. These rules, and the HCP that provides incidental take coverage to private forestry operations that comply with them, also specify riparian buffers to minimize adverse effects from logging operations on stream sedimentation, water quality, and habitat. Thus, the incremental effects of non-federal actions above the SRS are insignificant relative to the effects of the proposed action. That the effects of logging on surrounding timberlands above the SRS are insignificant is supported by the high survival and juvenile production obtained from the few adult coho salmon and steelhead that are transported above the SRS into Alder and Bear/Hoffstadt creeks for spawning.

*Finally, cumulative effects include the effects of recovery actions that are reasonably certain to occur. In June, 2013, NMFS approved a final recovery plan developed by LCFRB in collaboration with local citizens, tribes, technical experts and policy makers to protect and restore steelhead and salmon runs within the lower Columbia River. In partnership with the LCRFB, the Lower Columbia Fish Enhancement Group, the Cowlitz Tribe, and other organizations are conducting many on-going habitat restoration projects in the Cowlitz and Toutle sub-basins that will be beneficial to the recovery of listed LCR salmonids that use the action area. These projects include, but are not limited to: riparian plantings, fish passage culvert replacements, the placement of in-river structures to improve in-channel habitat complexity, and the breaching of levees to restore access to off-channel floodplain habitats.

2.6 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated critical habitat for the conservation of the species.

LCR coho salmon and LCR steelhead

*The NFTR coho salmon and steelhead populations depend on abundance and productivity in the tributaries above the SRS to offset the negative effects of the high suspended sediment concentrations and blocked bedload spawning gravels on spawning habitat below the SRS. Suspended sediment has adverse effects on listed fish and critical habitat by becoming incorporated into and reducing the hydraulic conductivity of substrate used to construct redds and decreasing the dissolved oxygen supply available to eggs and embryos within those redds. The gravel captured by SRS is unavailable to replenish spawning substrate.

*The SRS blocks volitional upstream passage of adult salmonids. The number of smolts produced above the SRS depends on the number of adults that are captured and transported around the SRS by the FCF. NMFS (2013b) estimates that an annual average abundance of 300 coho and 300 steelhead are necessary to sustain the North Fork Toutle Basin populations. With fewer than 300 spawners of each species, both coho and steelhead populations are at a high risk of extinction. NMFS (2013a) also estimates that fewer than 100 steelhead are spawning below the SRS. The annual average number of adults transported around the SRS approached 250 coho and 250 steelhead in the mid-2000s, but the number of fish captured and transported from 2006 to 2016 declined to a five-year average of approximately 170 steelhead and 200 coho.

*The SRS spillway is the only downstream passage route past the SRS and injures some number of juveniles as they use it to migrate downstream. The increased length and height of the SRS spillway from each crest increase will likely increase the amount of injury. Injured fish are more susceptible to predation and less likely to reach the ocean.

*The SRS no longer traps enough sediment to manage flood risk in the Lower Cowlitz River. Meanwhile, the average sediment supply from the avalanche continues to affect lower Cowlitz flood risk because it supplies sand sizes that are transported over the SRS spillway that accumulate in the lower Cowlitz River, decreasing channel volume needed to carry increased flood level flows. Raising the spillway crest creates an impoundment behind the SRS that fills with sediment over several years. During this time, the avalanche should continue to recover and stabilize, and decrease sediment supply to the North Fork Toutle Basin. Once the impoundment is full, a stable braided network of channels through the new sediment plain will take many years to be recreated and its functions will be impaired through this delay.

*All of these effects will reduce the average number of coho and steelhead smolts that migrate from the upper NFTR. Since the populations are already at a risk for extinction, and well below numbers needed to support the likelihood of recovery, any reduction in juvenile and smolt numbers, no matter how small, is significant.

*LCR coho salmon and steelhead are at high risk of extinction, so any additional harm could decrease their likelihood of survival and recovery. The additional harm from the proposed action is exacerbated by the likelihood of impacts caused by climate change. Climate change will further constrain the ability of ESA-listed salmonid stocks to recover, by further reducing the quality of habitats in the lower reaches of accessible rivers throughout the recovery domains of LCR coho salmon and steelhead. Species such as coho salmon and steelhead, which exhibit the longest freshwater stream residency of the PNW salmonids, are predicted to be impacted the greatest by high summer temperatures and low flows anticipated from climate change (Mantua et al., 2010). The effects of climate change on stream temperatures and flows in the lower portions of the recovery domains magnifies the importance of protecting and enhancing upper basin critical habitat functions for spawning and rearing, as these areas will be less affected and will thereby provide fundamental buffers to allow for the persistence of at risk populations (McClure et al. 2013). The recovery plan (NMFS 2013) estimates that population numbers of both species need to double in order to allow for the likelihood of their survival and potential for recovery.

*The reduction in smolts will be offset by capturing and delivering more adults spawners to the Upper North Fork Toutle Basin spawning tributaries. Adult salmonids attempting to reach upriver tributaries that support productive habitat are collected about a mile below the SRS at the FCF, which is owned and operated by WDFW. The FCF is not currently properly functioning such that all of the fish that approach the facility are rapidly captured, and are transported above the SRS into outplanting sites in Alder Creek and/or Hoffstadt/Bear Creek to spawn.

*Cumulative effects are also reasonably likely to cause additional critical habitat degradation downstream of the SRS that further emphasizes the need to ensure productive critical habitat conditions above the SRS are maintained such that the spatial distribution, viability and abundance of LCR steelhead and coho salmon are maintained as a fundamental buffer against extinction risks throughout their respective recovery domains.

In 2017 the USACE agreed to an RPA (to avoid jeopardizing LCR coho and LCR steelhead and adversely modifying their critical habitat) to analyze, design, test and construct upgrades to the FCF such that it attracts, captures, transports and releases 95 percent of the natural LCR coho and LCR steelhead that reach the barrier dam. The RPA required this upgrade to occur before the second [the currently proposed]spillway crest increase. In 2020, the USACE informed NMFS that the spillway crest would need to be raised in 2023 and that FCF upgrade construction would not be complete until 2027, thus modifying the RPA schedule. The USACE requested that we reinitiate consultation to analyze the proposed action now including the modified RPA, and specifically whether the 5-year delay between the second spillway crest raise and a 95 percent FCF efficiency would jeopardize and adversely modify LCR coho and LCR steelhead and their critical habitat respectively. In our reinitiation effects analysis, we've determined that the delay is not likely to appreciably reduce the abundance of LCR coho or LCR steelhead above the SRS in spite of likely reductions in successful smolt migration from natal tributaries to the SRS *spillway during this delay. As described above, the reduction of juveniles is expected but the additional reduction in abundance is not expected to be a large increase and the duration of this increase is temporally limited. Simultaneously some of that reduction is expected to be offset by increases in spawner collection, with a corollary expected increase in spawning. In other words the relative loss of juveniles remains almost constant but the total number of juveniles in the system should increase, and this increase of juveniles compensates for the loss in a manner that avoids impairment of other VSP parameters. See also Appendix 1.*

LCR Chinook salmon and CR chum salmon

*LCR Chinook salmon and CR chum salmon are both at moderate risk of extinction. The status of their critical habitat varies depending on location but in general, PBFs are degraded in most areas. These species are not transported above the SRS, but adult strays are sometimes captured and handled at the FCF. Most production of the LCR Chinook NFTR salmon population occurs in the Green River, a tributary to the North Fork Toutle River. Lower Cowlitz chum critical habitat extends to the Green River confluence but population abundance is currently so low spawners very seldom enter the NFTR. Environmental baseline conditions for the portion of the action area below the FCF are described above.

*The effects of the proposed action on LCR Chinook salmon and CR chum salmon include their occasional capture and handling at the FCF, the ongoing Lower NFTR habitat impacts from operation of the SRS, occasional dredging in the Lower Cowlitz River, and a temporary increase in suspended sediment concentration increase during the construction of the new SRS spillway. Since the Lower NFTR is only a migration corridor for NFTR LCR Chinook and is, in every practical sense, unoccupied by Lower Cowlitz chum, none of these impacts are expected to be of a magnitude that would affect their population abundance, productivity, spatial structure or diversity.

As noted above, cumulative effects are also reasonably likely to cause additional critical habitat degradation downstream of the SRS.

2.7 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of LCR coho salmon and destroy or adversely modify its designated critical habitat.

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is also NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of LCR steelhead and destroy or adversely modify its designated critical habitat.

It is also NMFS biological opinion that the proposed action will not jeopardize the continued existence of LCR Chinook salmon and CR chum salmon or destroy or adversely modify their designated critical habitat

2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. “Take” is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. “Harm” is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). “Incidental take” is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this Incidental Take Statement (ITS).

2.9.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

Take in the form of harm, injury or death to juvenile salmonids from the construction and effects of the spillway crest increases:

1. Take from increased suspended sediment during construction.
2. Take from juvenile salmonids migration down the longer spillway.
3. Take from migration through the impoundment and then the shifting channel formation in the sediment plain that results in low flow velocity, blind channels with no outlet, or subsurfacing of flowing water, stranding juveniles.

The extent of take for these three sources of injury or mortality is the height of the spillway increases, specifically no more than 13 feet increase in 2023 and 10 feet in or around 2033.

2.9.2 Effect of the Take

In this Opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat..

2.9.3 Reasonable and Prudent Measures

Reasonable and prudent measures are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). The USACE shall:

1. Ensure completion of a comprehensive monitoring and reporting program to confirm of the Corps is minimizing take from its proposed action.

2.9.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. The [name Federal agency] or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implements reasonable and prudent measure 1:

- *a) Report the height of each spillway crest raise by December 31 of the year of the construction.*
- *b) If proposed action monitoring of Alder Creek in 2025 and 2027 indicates that the surface connection between Alder Creek and the NFTR is in danger of becoming subsurface, report by December 31 of those years when and how the USACE will execute proposed actions to block the NFTR from the Alder Creek with a GBS.*
- *c) Prepare and submit a report by December 31, 2024 that describes how the fish collection efficiency of the reconstructed FCF will be measured and an adaptive management plan to reach the 95 percent collection efficiency goal.*
- *d) Submit these reports to:projectreports.wcr@noaa.gov. Include the WCR tracking number for this consultation (WCRO-2021-02739) in the regarding line when the reports are submitted.*

This concludes formal consultation for the Re-initiation of the Mount St. Helens Project Phased Construction Alternative.

Under 50 CFR 402.16(a): “Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action.”

2.10 Conservation Recommendation

NMFS recommends that the USACE (in collaboration with the WDFW, Cowlitz Tribe and/or other partners, as appropriate, establish a monitoring plan to assess downstream passage and survival of steelhead and coho smolts to the lower NFTR. This monitoring could serve to evaluate the success of adult fish passage (and thus effectiveness of the RPA), as well as identify where further measure could be taken to improve juvenile survival through the sediment plain.

NMFS recommends that the USACE include the requirement that the FCF operate such that at least 98 percent of fish that are trapped and hauled to tributaries above the SRS are alive at the time they are released.

2.11 *Species and Critical Habitat Not Likely to Adversely Affected*

*In its BA, the USACE provided its determination that its proposed action is not likely to adversely affect Upper Willamette River Chinook salmon, Upper Willamette River steelhead, Snake River Spring/Summer Chinook salmon, Snake River Fall Chinook Salmon, Snake River sockeye salmon, Snake River steelhead, Upper Columbia River Spring Chinook salmon, Upper Columbia River steelhead, Middle Columbia River steelhead, Pacific eulachon and Green Sturgeon. They reasoned that these species could only be potentially affected by dredging in the lower Cowlitz River because they do not exist in the upper NFTR where the other proposed actions take place. The USACE concluded that the emergency dredging action was NLAA for all species because the in-water work window limits the species and the number of individuals of those species that could be present during dredging, the USACE hydraulic dredge BMPs minimize the risk of entrainment, changes to the river bottom do not affect migration, suspended sediment is localized to the dredging work area, and the disturbance to benthic populations in the sandy substrate in these channels is small compared to their regular disturbance from bedload transport during high flows. We consult on a species rather than an activity basis so we analyzed the effects of dredging on LCR coho, LCR Chinook, CR chum and LCR steelhead in the opinion, and here we consider the effects of dredging on these other species potentially found in the action area downstream of the NFTR. Critical habitat is not designated within the action area for the southern DPS of green sturgeon so their critical habitat cannot be affected and is not further addressed below.

*The applicable standard to find that a proposed action is not likely to adversely affect listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. This analysis considers effects of the action to Upper Willamette River Chinook salmon, Upper Willamette River steelhead, Snake River Spring/Summer Chinook salmon, Snake River Fall Chinook salmon, Snake River sockeye salmon, Snake River steelhead, Upper Columbia River Spring Chinook salmon, Upper Columbia River steelhead, Middle Columbia River steelhead. These species are never exposed to the effects of the proposed actions that take place in the upper North Fork Toutle River (spillway crest raises and grade building structures) because they are not ever in the North Fork Toutle River. Likewise, they are not expected to be significantly exposed to the effects of lower Cowlitz River dredging because they are not known to use the lower Cowlitz River for spawning, rearing or migration. These species could, however, be exposed to the effects of Columbia River dredging at the Cowlitz River confluence necessary for Cowlitz River flood risk management that is associated with the proposed action.

Willamette, Mid-Columbia, Upper Columbia and Snake River Salmonids
*Upper Willamette River Chinook salmon, Upper Willamette River steelhead, Snake River Spring/Summer Chinook Salmon, Snake River Fall Chinook Salmon, Snake River sockeye salmon, Snake River steelhead, Upper Columbia River Spring Chinook salmon, Upper Columbia River steelhead, and Middle Columbia River steelhead could be exposed to the effects of the action at the margin of the action area, at the confluence of the Cowlitz River with the Columbia River. In this area some minor water quality disturbance from the Cowlitz River and confluence dredging may still be possible, reflected as elevated suspended sediment over background. This area for these species is part of their migratory corridor, as they quickly pass through it to their natal habitats in other portions of the Columbia basin for spawning (adults) or estuarine rearing (juveniles). Any exposure to suspended sediments associated with Cowlitz River dredging to these species will be highly localized to this area, and of extremely short duration, and hence, insignificant. The action area, including the NFTR and Cowlitz River and Cowlitz River confluence is not critical habitat for these species[6] and effects are therefore considered insignificant to both the species and their critical habitats.

Green Sturgeon
*The effects of the proposed dredging to green sturgeon are considered discountable because it is extremely unlikely they would be exposed to any effects of this component of the action. Specifically, there is no evidence of which we are aware that green sturgeon use habitats in the action area; they are recognized to use the LCR estuary for rearing, and occasionally have been captured up to Bonneville dam, but they are not recognized to use LCR tributary habitats (74FR52300). Other potential effects of the proposed action similarly are considered to be discountable to green sturgeon because of the lack of potential exposure.

Pacific Eulachon
*The analysis here considers the effects of the action on Pacific eulachon because this species is known to use the Cowlitz River for spawning, and migration, and the portion of the action area affected by dredging is within their designated critical habitat. As described in the effects section of the biological opinion, the proposed action affects how sediment, particularly sand sized sediment (0.25-4 mm diameter), from the MSH avalanche is delivered to the Lower NFTR, the Toutle River, the Lower Cowlitz River and ultimately to the Columbia River. While the spillway crest raise ponds are present, the USACE expects the SRS to capture and retain virtually all of the avalanche sediment that reaches the pond. After each pond is full, the SRS will become increasingly less able to capture and retain sediment, especially during large storm events, and the size distribution of sediment that is transported over the spillway and into the lower rivers will gradually increase. Sediment particles greater than 0.5 mm diameter accumulate in the Lower Cowlitz River, reduce its channel volume and increase flood risk for the adjacent communities. The USACE may dredge this sand in the Lower Cowlitz River and its confluence

[6] http://www.westcoast.fisheries.noaa.gov/maps_data/endangered_species_act_critical_habitat.html

with the Columbia River, during the annual July 16 to August 15 in-water work window of the mainstem Cowlitz River, to recreate necessary channel volume for flood protection. The USACE will dredge the river with a pipeline cutterhead dredge and dispose of dredge sediment at upland sites. The effects of this dredging are considered below to the critical habitat and species potentially affected by it.

Effects to Eulachon Critical Habitat.
*The possible effects of dredging to eulachon critical habitat include the removal of spawning substrate, the disruption of the benthic ecology, temporary noise from dredging equipment, and suspended sediment generated to the water column. However, these effects are discountable or insignificant for the following reasons.

*The Lower Cowlitz River and the small part of the action area at the confluence with the Lower Columbia River supports spawning and migration critical habitat. Pacific eulachon spawn on coarse sand that would be removed by dredging, but sand is constantly resupplied from the Upper Cowlitz and Toutle basins so coarse sand substrate for eulachon spawning habitat on the Lower Cowlitz would never be limiting. Therefore, the effect of this component of the action is insignificant because it is so small that it will not adversely affect critical habitat function for spawning in the portion of the action area where dredging effects could occur. The sand substrate upon which they spawn will not be altered in any manner such that the spawning of subsequent year classes, which spawn well in advance of the proposed dredging, would be affected because sand is constantly recruited and deposited back into the channel.

*Neither adult nor larval eulachon feed on external food sources while on their spawning migration or passive larval emigration. Therefore, alterations to benthic food resources, while not considered to be a significant factor for salmonids, will have no effect on Pacific eulachon.

*The dredging action will generate sediment disturbance and minor underwater noise that potentially affects the water quality and migratory pathway PBFs for Pacific eulachon. In this case, however, the cutterhead will be buried in the sediment or near the bottom to minimize the generation of suspended sediment in the water column. The operation creates noise that is not loud enough to injure fish but may disturb them and cause them to avoid the dredge site (Hawkins et al., 2015). Localized suspended sediment concentrations may be high near the channel bed the sediment will settle once the dredge moves. Use of the cutterhead will only be for a up to 30 days each year, and in a small section of the streambed. These effects are sufficiently temporary and localized to be insignificant to the migratory PBF of critical habitat for eulachon.

Effects to species.
*The Lower Cowlitz river is a spawning and migration area for eulachon.. Eulachon are found seasonally in the lower reaches of the Columbia River as far upstream as Bonneville Dam. Eulachon spawn in the Cowlitz River and the Cowlitz supports the largest component of the southern DPS of eulachon. Eulachon returns to the Columbia River start as early as December and peak in February, though larvae have been collected in the LCR mainstem and Cowlitz River up to late June, indicating spawning can occur through May during years when their spawning migration is protracted (Willson et al., 2006). They generally spawn in areas of coarse sand

where there is sufficient current to carry sperm downstream to waiting eggs. Incubation takes 30-40 days, after which hatched larvae are passively transported to the estuary and ocean. Subadult and adult green sturgeon are in the lower Columbia River year-round but the Columbia River does not support green sturgeon spawning or juvenile rearing.

*As summarized above, dredging of the lower Cowlitz River associated with the proposed action would occur between July 16 and August 15, as needed, based on an annual evaluation of flood capacity of the lower Cowlitz riverine corridor. The potential effects of dredging on eulachon include: entrainment, underwater noise, and suspended sediment.

*Adult eulachon run timing typically occurs from December through May, with peaks in February through early April. Even allowing for a 30 to 40 larval incubation period which is consistent with the biology of the species, neither their adult or larval outmigration periods will overlap with the proposed timing of dredging in the allowable work window. All eulachon will have spawned, hatched and emigrated well in advance of the proposed dredging, on every year that it may be required as an emergency flood control action. Because eulachon will not be present, they cannot be exposed to entrainment, underwater noise, or elevated suspended sediment from the dredging. Thus, effects to this species are discountable.

Summary of NLAA Determinations

*In conclusion, the effects of the action to Upper Willamette River Chinook salmon, Upper Willamette River steelhead, Snake River Spring/Summer Chinook Salmon, Snake River Fall Chinook salmon, Snake River sockeye salmon, Snake River steelhead, Upper Columbia River Spring Chinook salmon, Upper Columbia River steelhead, Middle Columbia River steelhead, Pacific eulachon and Green Sturgeon are considered insignificant and/or discountable because these ESA-listed species are extremely unlikely to be exposed to any of the effects of the action. For all but Pacific eulachon, these species do not have critical habitat designated within the action area, therefore it won't be affected by the action.

*Effects to Pacific eulachon critical habitat are insignificant because effects of the dredging are localized and temporal, and the area disturbed from dredging is migratory corridor habitat that will not be affected long term, nor during periods when these species will be predominantly using it for migration.. Therefore, NMFS concurs with the USACE' NLAA determinations in its BA.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT CONSULTATION

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the USACE and descriptions of EFH for Pacific coast salmon (PFMC 2014) contained in the fishery management plans developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

The proposed action adversely affects EFH for coho salmon above and below the SRS, and for Chinook salmon below the SRS. *This EFH consultation incorporates section 1.0 of this document, found above.*

3.2 Adverse Effects on Essential Fish Habitat

Effects of the proposed action are described more fully in Section 2.0 of this document and are summarized here:

1. Sediment deposition leads to a small but finite probability that the surface connection between Alder Creek and the NFTR will be subsurface under some flow conditions. Trapping salmon in Alder Creek until a surface connection is reestablished could result in the loss of critical juvenile life history diversity.

2. The spillway raises temporarily replace the braided channel network between Alder Creek and the SRS with a pond. Smolt migration through the pond will be delayed relative to migration through the existing channel network. Smolts are more likely to become lost and fail to find the spillway.

3. Sediment deposition in the pond resets the evolution of the braided channel network between Alder Creek and the SRS such that the channels are shallower and the islands are lower. Smolt migration through the immature channel network will be more difficult. Smolts are more likely to become lost and trapped in dead end channels.

No EFH conservation recommendations are identified for this consultation.

3.5 Supplemental Consultation

The USACE must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations (50 CFR 600.920(l)).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the U.S. Army Corps of Engineers. Other interested users could include the WDFW, the Cowlitz Tribe, and the LCFRB as well as citizens of the affected areas. Individual copies of this opinion were provided to the U.S. Army Corps of Engineers. The format and naming adheres to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion and EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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6. Appendix 1

The loss of smolts in the impoundment or braided channel is expected to be offset by increased FCF efficiency, first from the presence of the impoundment and then from the proposed FCF upgrades to achieve 95 percent efficiency. This efficiency, as described above, should increase the number of adults available to spawn, and sustain productivity. The smolt to adult return (SAR) ratio for stream type life histories is around 50. Stream type life history fish rear in freshwater for one to four years (typically 1 year for coho, the longer periods for steelhead), and then they spend about three to five years in the ocean before they return to spawn.

Thus, if the variable t represent time in years, then every 50 smolts lost in the impoundment or braided channel network in year t only represent about one lost returning adult between years t+3 to t+5 while each additional adult captured in year t represents 50 additional smolts between years t+1 and t+4.

Until the spillway crest is raised in 2023 there are reasonably well established channels across the sediment plain to the spillway, indicating such that the SRS is trapping a relatively small fraction of sediment; and the FCF efficiency is limited by the suspended sediment transported to the NFTR below the SRS. Once the spillway crest is raised, the impoundment will exists for 3 years and that the extensively braided channel network will exist for five to ten years before the sediment plain slope steepens sufficiently from sediment deposition that more well-established channels across the sediment plain to the spillway are recreated. Let $p_n(t)$ *be the probability of successful smolt migration through the well-established channels (n=1), the impoundment (n=2), or the braided channel network (n=3) and let* $f_m(t)$ *be the probability of trapping a returning adult spawner when there are well established channels trapping relatively little sediment (m=1), an impoundment behind the SRS trapping almost all sediment (m=2), or an extensively braided network across the sediment plain trapping considerable sediment (m=3).*

Holding all other life history factors constant, the probability of trapping an adult returning to the FCF in year t (T(t)) is the product of the probability that it successfully crossed the sediment plain as a smolts in year t-3 and the FCF efficiency in year t or $T(t) = p_n(t-3)f_m(t)$*. We've argued that* $p_1(t) > p_2(t) > p_3(t)$*, that* $f_1(t) < f_3(t) < f_2(t)$ *and that* $f(t \geq 2027) = 0.95$*. When we plot this equation subject to these probability conditions on a timeline where .01 represents a SAR of 50, a 100 percent probability that the smolt migrated from its tributary to the spillway and the FCF efficiency is 0.5 (Leitke, 2013), there are no reasonable combination of probabilities where the number of adults transported around the SRS from 2023 to 2027 is less than the number transported around the SRS before 2023 due to the conditions created by the spillway crest increase (Figure* 1*). Therefore, although the proposed action modifies and delays the RPA schedule it does not alter the abundance of coho or steelhead above the SRS during the delay.*

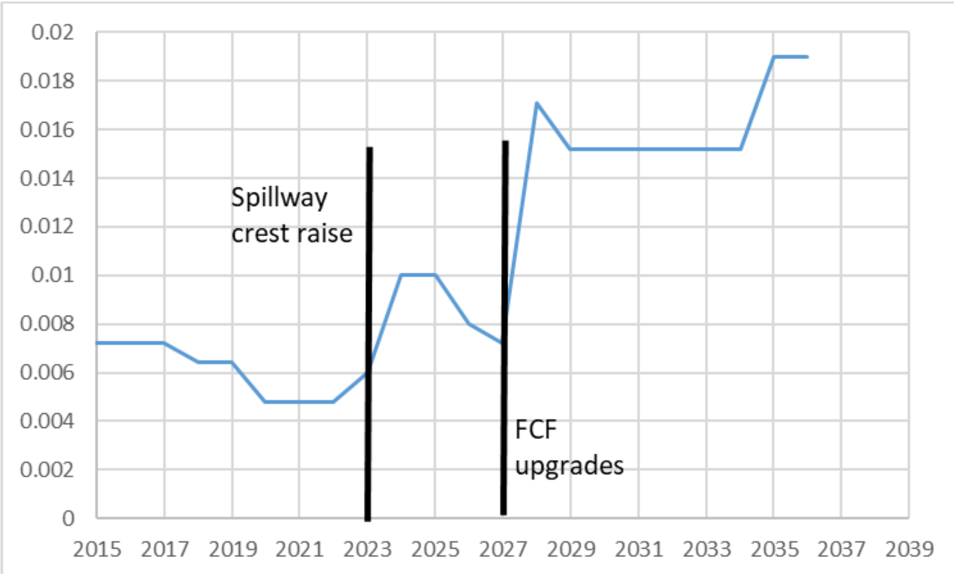

Figure 5. Adults transported around the SRS per smolt leaving its natal tributary.

Although the efficiency of the existing FCF is unknown, it is likely less than 50 percent (Leitke, 2013) such that each smolt represents 1/50th of a returning adult that has less than a 50 percent chance of getting transported back around the SRS when it returns or less than 0.01 adult. When we multiply 1/50 adults per smolt by the probability that a smolt will make it from its natal tributary to the spillway crest and the probability that the returning adult will be captured by the FCF, we get a baseline estimate that each smolt represents about 0.007 adults. In Figure 1 we show using the same set of probabilities that the number of trapped and hauled adults per smolt exiting its natal tributary, never drops below this baseline value of 0.007 from 2023 when the spillway crest is raised until 2027 when the FCF upgrades are constructed.