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-2020-02559

March 19, 2021

Michelle Walker
Corps of Engineers, Seattle District
Regulatory Branch CENWS-OD-RG
P.O. Box 3755
Seattle, Washington 98124-3755

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Pacific Fishermen Shipyard and Electric, LLC Dry Dock #3 Maintenance Dredging Project, King County, Washington (COE Number: NWS-2019-1049, HUC: 171100120400 – Lake Washington Ship Canal)

Dear Ms. Walker:

Thank you for your letter of September 11, 2020, requesting 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 U.S Army Corps of Engineers (COE) authorization of the Pacific Fishermen Shipyard and Electric, LLC Dry Dock #3 Maintenance Dredging Project.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action.

The enclosed document contains the biological opinion (opinion) prepared by the NMFS pursuant to section 7 of the ESA on the effects of the proposed action. In this opinion, the NMFS concludes that the proposed action would adversely affect but is not likely to jeopardize the continued existence of Puget Sound (PS) Chinook salmon and PS Sound steelhead. The NMFS also concludes that the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon but is not likely to result in the destruction or adverse modification of that designated critical habitat. This opinion also documents our conclusion that the proposed action is not likely to adversely affect southern resident (SR) killer whales and their designated critical habitat.

This opinion includes an incidental take statement (ITS) that describes reasonable and prudent measures (RPMs) the NMFS considers necessary or appropriate to minimize the incidental take associated with this action, and sets forth nondiscretionary terms and conditions that the COE must comply with to meet those measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of listed species.

Section 3 of this document includes our analysis of the action's likely effects on EFH pursuant to Section 305(b) of the MSA. Based on that analysis, the NMFS concluded that the action would adversely affect designated freshwater EFH for Pacific Coast Salmon. However, the NMFS knows of no practical measures that would reduce the action's expected effects beyond those already proposed by the applicant, and those that are required by the applicant's State and County discharge permits. Therefore, the NMFS offers no conservation recommendations pursuant to MSA (§305(b)(4)(A)). The NMFS also concluded that the action would not adversely affect marine EFH for Pacific Coast Salmon, or EFH for Pacific Coast Groundfish and Coastal Pelagic Species. Therefore, consultation under the MSA is not required for those EFHs.

Section 305(b)(4)(B) of the MSA requires that an action agency provide a detailed response in writing to the NMFS within 30 days after receiving an EFH Conservation Recommendation. However, because the NMFS has offered no EFH Conservation Recommendations, no EFH response is required from the COE for this action.

Please contact Donald Hubner in the North Puget Sound Branch of the Oregon/Washington Coastal Office at (206) 526-4359, or by electronic mail at Donald.Hubner@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: Colleen Anderson, COE

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

Pacific Fishermen Shipyard and Electric, LLC's Dry Dock #3 Maintenance Dredging Project
King County, Washington (COE Number: NWS-2019-1049)

NMFS Consultation Number: WCRO-2020-02559

Action Agency: U.S. Army Corps of Engineers

Affected Species and 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?
Chinook salmon (Oncorhynchus tshawytscha) Puget Sound (PS)	Threatened	Yes	No	Yes	No
Steelhead (O. mykiss) PS	Threatened	Yes	No	N/A	N/A
Killer whales (Orcinus orca) Southern resident (SR)	Endangered	No	No	No	No

N/A = not applicable. The action area is outside designated critical habitat, or critical habitat has not been designated.

Affected Essential Fish Habitat (EFH) and NMFS' Determinations:

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	No

Consultation Conducted By: National Marine Fisheries Service
West Coast Region

Issued By:

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

Date: March 19, 2021

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LIST OF ABREIVIATIONS

BE – Biological Evaluation
BMP – Best Management Practices
CFR – Code of Federal Regulations
COE – Corps of Engineers, U.S. Army
DIP – Demographically Independent Population
DMMP – Dredged Material Management Program
DPS – Distinct Population Segment
DQA – Data Quality Act
EF – Essential Feature
EFH – Essential Fish Habitat
ESA – Endangered Species Act
ESU – Evolutionarily Significant Unit
FR – Federal Register
FMP – Fishery Management Plan
HAPC – Habitat Area of Particular Concern
HUC – Hydrologic Unit Code
HPA – Hydraulic Project Approval
ITS – Incidental Take Statement
mg/L – Milligrams per Liter
MLLW – Mean Lower Low Water
MPG – Major Population Group
MSA – Magnuson-Stevens Fishery Conservation and Management Act
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
NTU – Nephlometric Turbidity Units
PAH – Polycyclic Aromatic Hydrocarbons
PBF – Physical or Biological Feature
PCB – Polychlorinated Biphenyl
PCE – Primary Constituent Element
PFMC – Pacific Fishery Management Council
PS – Puget Sound
PSTRT – Puget Sound Technical Recovery Team
PSSTRT – Puget Sound Steelhead Technical Recovery Team
RL – Received Level
RPA – Reasonable and Prudent Alternative
RPM – Reasonable and Prudent Measure
SAV – Submerged Aquatic Vegetation
SEL – Sound Exposure Level
SL – Source Level
SR – Southern Resident (Killer Whales)
TSS – Total Suspended Sediments
VSP – Viable Salmonid Population
WCR – West Coast Region (NMFS)
WDFW – Washington State Department of Fish and Wildlife
WDOE – Washington State Department of Ecology
WQMP – Water Quality Monitoring Plan

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 USC 1531 et seq.), and implementing regulations at 50 CFR 402, as amended.

We also completed an essential fish habitat (EFH) consultation on the proposed action, 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 600.

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 within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the Oregon Washington Coastal Office.

1.2 Consultation History

On September 11, 2020, the NMFS received a letter from the U.S. Army Corps of Engineers (COE) requesting formal consultation for the proposed action (COE 2020a). The request included Pacific Fishermen Shipyard and Electric, LLC's (PFSE's) project drawings and biological evaluation (BE) for the proposed action (PFSE 2019; 2020a).

On September 25, 2020, the NMFS requested additional information. On September 29, 2020, the COE responded by email (COE 2020b), answering most of the NMFS's questions and providing the applicant's Dredged Material Characterization report (PFSE 2020b). On October 01, 2020, the NMFS re-requested the missing additional information and requested amplifying information, most of which was provided on October 6, 2020 (COE 2020c), along with notification that the applicant had not yet requested a Hydraulic Project Approval (HPA) from Washington State Department of Fish and Wildlife (WDFW), but that that they were now doing so. The NMFS initiated formal consultation on September 29, 2020.

On March 10, 2021, the NMFS requested the COE to revise its affect determination for southern resident (SR) killer whales from no effect to may affect, but not likely to adversely affect because the proposed action is likely to adversely affect Puget Sound Chinook salmon, which is a primary prey resource for SR killer whales. On March 16, 2021, the COE declined to amend their original effects determination. However, in an abundance of caution, the NMFS analyzed the action's potential effects on SR killer whales in section 2.12 of this opinion.

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 (50 CFR 402.02), whereas under the MSA, Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

The COE proposes to authorize Pacific Fishermen Shipyard and Electric, LLC (the applicant) to conduct mechanical maintenance dredging under the applicant's existing Dry Dock #3 in the Lake Washington Ship Canal in Seattle, Washington (Figure 1). The proposed action would remove accumulated sediments that are limiting the full range of the dry dock's original range of vertical movement, and would cause no changes in the type or frequency of its use.

Figure 1. The Pacific Fishermen Shipyard dredging project site in the Lake Washington Ship Canal, Seattle Washington. The right image shows the dredging area outlined in red, and the full-depth sediment curtain location shown in orange.

The applicant's contractors would conduct about 45 days of in-water work during the October 1 through April 15 in-water work window for the area. The 45-day work duration includes about 16 days of dredging, 5 days to install a clean sand cap, 7 days for silt curtain installation and removal, and 17 contingency days for delays.

The applicant commits to require their contractors to comply with all protective measures and best management practices (BMPs) identified in the applicant's BE for this project, including working within a full-depth sediment curtain that would enclose the dredging area (COE 2020b), to adhere to a the project's Water Quality Monitoring Plan (WQMP) that limits dredging-related turbidity to no more than 5 NTUs above background levels at the point of compliance, 150 feet beyond the sediment curtain. Contractors would also be required to comply with all provisions of the Washington State Department of Fish and Wildlife (WDFW) Hydraulic Project Approval (HPA) permit for the project (WDFW 2020a).

Set up would include the use of tugboats to tow 3 barges from a site on the Duwamish River south of the 1st Avenue Bridge, thru Elliott Bay, and up through the Chittenden Locks to the project site. Prior to dredging, the dry dock platform would be dismantled and temporarily stored elsewhere in the shipyard. The contractors would install a full-depth sediment curtain to enclose the dredging area and a sediment transportation barge. They would operate a pier-based and/or barge-mounted excavator with a clamshell bucket to remove about 2,000 cubic yards of contaminated sediment from an area of about 4,860 square feet directly under Dry Dock #3. The excavator would place the dredged sediments onto a sediment transportation barge that would filter runoff water before releasing it within the full-depth sediment curtain.

After dredging is complete, they would use the excavator to install about 1,050 cubic yards of clean sand to create a 2-foot deep sand cap over the dredged area. After project completion, the barges would be towed back to their Duwamish River site, with the sediment transportation barge(s) first stopping at sediment offloading facility, also on the Duwamish River, for transportation to an upland facility authorized for disposal of contaminated sediments.

Water levels and bottom depths within the ship canal are typically referenced to the COE's 1919 Locks Datum (LD), which is 1 foot above mean lower low water (MLLW) for Puget Sound, or 20 feet below the target lowest water level in the ship canal (LWSC). The project's maximum post dredge depth, including 1 foot of allowable over-dredge depth, would not exceed 2 feet below LD or 22 feet below LWSC (-2 foot re. LD; -22 feet re LWSC). The finished depth after the sand cap has been installed would be 0 feet re. LD, or -20 feet re. LWSC (Figure 2).

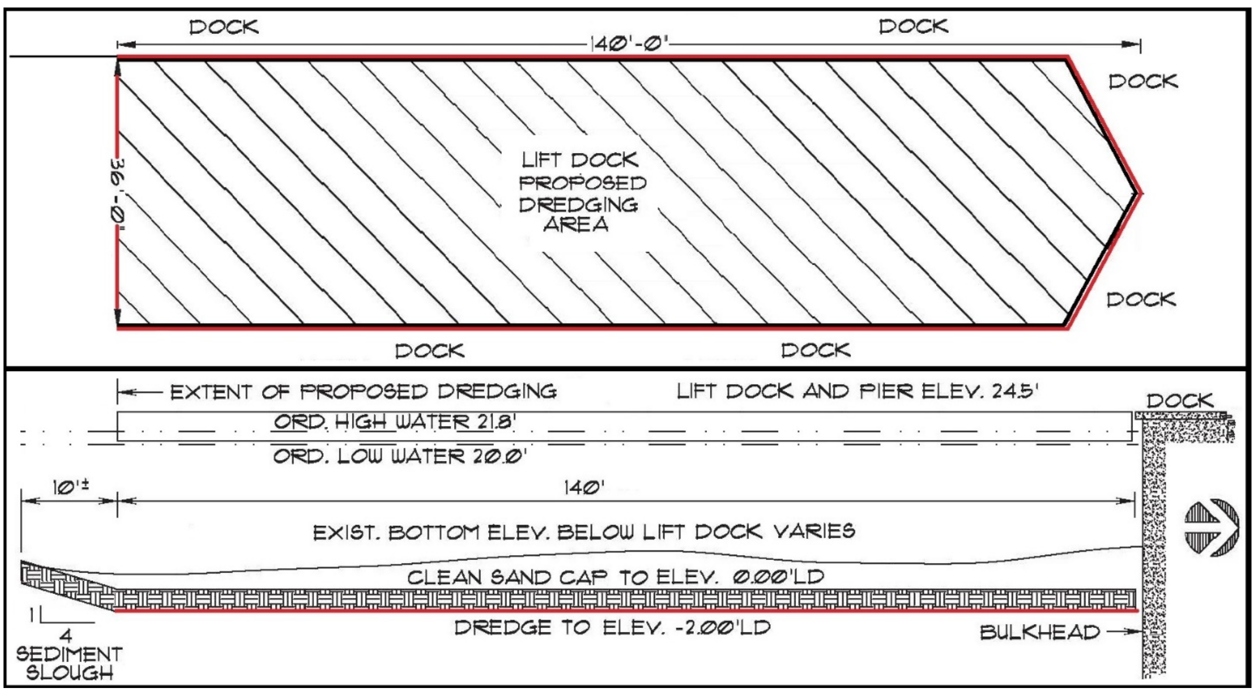

Figure 2. The proposed dredging area and elevations under Pacific Fishermen Shipyard's Dry Dock #3 in the Lake Washington Ship Canal, Seattle Washington.

The NMFS also considered whether or not the proposed action would cause any other activities. We determined that the action would extend, by several years, the usefulness of Dry Dock #3, thereby allowing continued vessel maintenance and repair work on the dry dock, including the associated in-water vessel activity. We believe that these activities would be consequences of the proposed action because the applicant's ability perform them would be lost over time if sediments were allowed to accumulate under the dry dock. Therefore, we have also analyzed the effects of the dry dock and its related activities in the effects section of this opinion.

Dry Dock #3 is a screw lift type dry dock that consists of a 4,860-square foot steel platform that is lowered and raised with 20 large screw jacks that are attached to the adjacent piers. Once the dry dock is lowered to a depth deeper than the client vessel's keel, the client vessel is moved over blocks that are arranged on the dry dock's deck. The screw jacks slowly raise the platform until the client vessel rests on the blocks, then the dock and the vessel are raised above the water level. With the client vessel on the blocks above the water, shipyard workers who can work in the dry and access all areas of the vessel, including the lower hull, rudders, and propellers. Typical work includes machinery repairs and replacement, cutting, welding, surface preparation, and application of coatings. The applicant reports that they would use the dry dock to work on about 20 108- to 135-foot long vessels annually.

To reduce the impacts of the shipyard activities, the applicant complies with the limits, control measures, and BMPs identified in their National Pollutant Discharge Elimination System (NPDES) Permit (WDOE 2020a), their County Industrial Wastewater Discharge Permit (King County 2018), and their Plan for Best Management Practices (PFSE 2018). Examples of control measures and BMPs include the required establishment and compliance with a spill control and stormwater pollution prevention plans, required procedures for the proper storage, use, and disposal of toxic chemicals and spill containment and clean-up, and requirements to enclose work areas where dusts, chips, and paint spray would be generated, and to routinely sweep, vacuum, and clean work areas, including the dry dock deck to reduce the accumulation of materials that could enter the water.

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, each Federal agency must ensure that its 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, the NMFS provide an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

The COE determined that the proposed action is likely to adversely affect PS Chinook salmon and PS steelhead, is likely to adversely affect designated critical habitat for PS Chinook salmon, and would have no effect on designated critical habitat for PS steelhead because the action area has been excluded from that designation (Table 1). The COE also determined that the proposed action would have no effect on SR killer whales and their critical habitat (COE 2021). However, because of the trophic relationship between PS Chinook salmon and SR killer whales, the NMFS analyzed the action's potential effects on SR killer whales and their designated critical habitat (Section 2.12).

Table 1. ESA-listed species and critical habitat that may be affected by the proposed action.

ESA-listed species and critical habitat likely to be adversely affected (LAA)				
Species	**Status**	**Species**	**Critical Habitat**	**Listed / CH Designated**
Chinook salmon (*Oncorhynchus tshawytscha*) Puget Sound	Threatened	LAA	LAA	06/28/05 (70 FR 37160) / 09/02/05 (70 FR 52630)
steelhead (*O. mykiss*) Puget Sound	Threatened	NLAA	N/A	05/11/07 (72 FR 26722) / 02/24/16 (81 FR 9252)
ESA-listed species and critical habitat not likely to be adversely affected (NLAA)				
Species	**Status**	**Species**	**Critical Habitat**	**Listed / CH Designated**
Killer whales (Orcinus orca) Southern resident (SR)	Endangered	NLAA	NLAA	11/18/05 (70 FR 57565) / 11/29/06 (71 FR 69054)

LAA = likely to adversely affect NLAA = not likely to adversely affect
N/A = not applicable. The action area is outside designated critical habitat, or critical habitat has not been designated.

2.1 Analytical Approach

This opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably 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 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 as a whole for the conservation of a listed species" (50 CFR 402.02).

The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 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.

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44977), that definition does not change the scope of our analysis and in this opinion we use the terms "effects" and "consequences" interchangeably.

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 range-wide 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 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' "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 function of the PBFs that are essential for the conservation of the species.

The summaries that follow describe the status of the ESA-listed species, and their designated critical habitats, that occur within the action area and are considered in this opinion. More detailed information on the biology, habitat, and conservation status and trend of these listed resources can be found in the listing regulations and critical habitat designations published in the Federal Register and in the recovery plans and other sources at: https://www.fisheries.noaa.gov/species-directory/threatened-endangered, and are incorporated here by reference.

Listed Species

Viable Salmonid Population (VSP) Criteria: For Pacific salmonids, we commonly use four VSP criteria (McElhany et al. 2000) to assess the viability of the populations that constitute the species. These four criteria (spatial structure, diversity, abundance, and productivity) encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment.

“Spatial structure” refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. A population’s spatial structure depends on habitat quality and spatial configuration, and the dynamics and dispersal characteristics of individuals in the population.
“Diversity” refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation in single genes to complex life history traits.

“Abundance” generally refers to the number of naturally-produced adults that return to their natal spawning grounds.

“Productivity” refers to the number of naturally-spawning adults produced per parent. When progeny replace or exceed the number of parents, a population is stable or increasing. When progeny fail to replace the number of parents, the population is in decline.

For species with multiple populations, we assess the status of the entire species based on the biological status of the constituent populations, using criteria for groups of populations, as described in recovery plans and guidance documents from technical recovery teams. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as metapopulations (McElhany et al. 2000).

The summaries that follow describe the status of the ESA-listed species, and their designated critical habitats, that occur within the geographic area of this proposed action and are considered in this opinion. More detailed information on the status and trends of these listed resources, and their biology and ecology, are in the listing regulations and critical habitat designations published in the Federal Register.

<u>Puget Sound (PS) Chinook Salmon:</u> The PS Chinook salmon evolutionarily significant unit (ESU) was listed as threatened on June 28, 2005 (70 FR 37160). We adopted the recovery plan for this ESU in January 2007. The recovery plan consists of two documents: the Puget Sound salmon recovery plan (SSPS 2007) and the final supplement to the Shared Strategy’s Puget Sound salmon recovery plan (NMFS 2006). The recovery plan adopts ESU and population level viability criteria recommended by the Puget Sound Technical Recovery Team (PSTRT) (Ruckelshaus et al. 2002). The PSTRT’s biological recovery criteria will be met when all of the following conditions are achieved:

- The viability status of all populations in the ESU is improved from current conditions, and when considered in the aggregate, persistence of the ESU is assured;
- Two to four Chinook salmon populations in each of the five biogeographical regions of the ESU achieve viability, depending on the historical biological characteristics and acceptable risk levels for populations within each region;
- At least one population from each major genetic and life history group historically present within each of the five biogeographical regions is viable;
- Tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations are functioning in a manner that is sufficient to support an ESU-wide

recovery scenario; Production of Chinook salmon from tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations occurs in a manner consistent with ESU recovery; and

- Populations that do not meet all the Viable Salmon Population (VSP) parameters are sustained to provide ecological functions and preserve options for ESU recovery.

General Life History: Chinook salmon are anadromous fish that require well-oxygenated water that is typically less than 63º F (17º C), but some tolerance to higher temperatures is documented with acclimation. Adult Chinook salmon spawn in freshwater streams, depositing fertilized eggs in gravel "nests" called redds. The eggs incubate for three to five months before juveniles hatch and emerge from the gravel. Juveniles spend from three months to two years in freshwater before migrating to the ocean to feed and mature. Chinook salmon spend from one to six years in the ocean before returning to their natal freshwater streams where they spawn and then die.

Chinook salmon are divided into two races, stream-types and ocean-types, based on the major juvenile development strategies. Stream-type Chinook salmon tend to rear in freshwater for a year or more before entering marine waters. Conversely, ocean-type juveniles tend to leave their natal streams early during their first year of life, and rear in estuarine waters as they transition into their marine life stage. Both stream- and ocean-type Chinook salmon are present, but ocean-type Chinook salmon predominate in Puget Sound populations.

Chinook salmon are further grouped into "runs" that are based on the timing of adults that return to freshwater. Early- or spring-run chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and finally spawn in the late summer and early autumn. Late- or fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas, and spawn within a few days or weeks. Summer-run fish show intermediate characteristics of spring and fall runs, without the extensive delay in maturation exhibited by spring-run Chinook salmon. In Puget Sound, spring-run Chinook salmon tend to enter their natal rivers as early as March, but do not spawn until mid-August through September. Returning summer- and fall-run fish tend to enter the rivers early-June through early-September, with spawning occurring between early August and late-October.

Yearling stream-type fish tend to leave their natal rivers late winter through spring, and move relatively directly to nearshore marine areas and pocket estuaries. Out-migrating ocean-type fry tend to migrate out of their natal streams beginning in early-March. Those fish rear in the tidal delta estuaries of their natal stream for about two weeks to two months before migrating to marine nearshore areas and pocket estuaries in late May to June. Out-migrating young of the year parr tend to move relatively directly into marine nearshore areas and pocket estuaries after leaving their natal streams between late spring and the end of summer.

Spatial Structure and Diversity: The PS Sound Chinook salmon ESU includes all naturally spawning populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington. The ESU also includes the progeny of numerous artificial propagation programs (NWFSC 2015). The PSTRT identified 22 extant populations, grouped into five major geographic regions, based on consideration of historical distribution, geographic isolation, dispersal rates, genetic data, life history information, population dynamics, and environmental and ecological diversity. The PSTRT distributed the 22 populations among five major biogeographical regions, or major population groups (MPGs), that are based on similarities in hydrographic, biogeographic, and geologic characteristics (Table 2).

Hatchery-origin spawners are present in high fractions in most populations within the ESU, with the Whidbey Basin the only MPG with consistently high fractions of natural-origin spawners. Between 1990 and 2014, the fraction of natural-origin spawners has declined in many of the populations outside of the Skagit watershed (NWFSC 2015).

Table 2. Extant PS Chinook salmon populations in each biogeographic region (Ruckelshaus et al. 2002, NWFSC 2015).

Biogeographic Region	Population (Watershed)
Strait of Georgia	North Fork Nooksack River
	South Fork Nooksack River
Strait of Juan de Fuca	Elwha River
	Dungeness River
Hood Canal	Skokomish River
	Mid Hood Canal River
Whidbey Basin	Skykomish River
	Snoqualmie River
	North Fork Stillaguamish River
	South Fork Stillaguamish River
	Upper Skagit River
	Lower Skagit River
	Upper Sauk River
	Lower Sauk River
	Suiattle River
	Upper Cascade River
Central/South Puget Sound Basin	Cedar River
	North Lake Washington/ Sammamish River
	Green/Duwamish River
	Puyallup River
	White River
	Nisqually River

Abundance and Productivity: Available data on total abundance since 1980 indicate that abundance trends have fluctuated between positive and negative for individual populations, but productivity remains low in most populations, and hatchery-origin spawners are present in high fractions in most populations outside of the Skagit watershed. Available data now show that most populations have declined in abundance over the past 7 to 10 years. Further, escapement levels for all populations remain well below the PSTRT planning ranges for recovery, and most populations are consistently below the spawner-recruit levels identified by the PSTRT as consistent with recovery (NWFSC 2015). The current information on abundance, productivity, spatial structure and diversity suggest that the Whidbey Basin MPG is at relatively low risk of extinction. The other four MPGs are considered to be at high risk of extinction due to low abundance and productivity (NWFSC 2015). The most recent 5-year status review concluded that the ESU should remain listed as threatened (NMFS 2017).

<u>Limiting Factors:</u> Factors limiting recovery for PS Chinook salmon include:

- Degraded floodplain and in-river channel structure
- Degraded estuarine conditions and loss of estuarine habitat
- Riparian area degradation and loss of in-river large woody debris
- Excessive fine-grained sediment in spawning gravel
- Degraded water quality and temperature
- Degraded nearshore conditions
- Impaired passage for migrating fish
- Severely altered flow regime

<u>PS Chinook Salmon within the Action Area:</u> The PS Chinook salmon that are likely to occur in the action area would be fall-run Chinook salmon from the Cedar River population and from the North Lake Washington / Sammamish River population (NWFSC 2015; WDFW 2020b). Both stream- and ocean-type Chinook salmon are present in these populations, with the majority being ocean-types.

The Cedar River population is relatively small, with a total annual abundance fluctuating at close to 1,000 fish (NWFSC 2015; WDFW 2020c). Between 1965 and 2019, the total abundance for PS Chinook salmon in the basin has fluctuated between about 133 and 2,451 individuals, with the average trend being slightly negative. The 2015 status review reported that the 2010 through 2014 5-year geometric mean for natural-origin spawner abundance had shown a positive change since the 2010 status review, with natural-origin spawners accounting for about 82% of the population. WDFW data suggest that natural-origin spawners accounted for about 71% of a combined total return of 855 fish in 2019 (WDFW 2020c).

The North Lake Washington / Sammamish River population is also small, with a total abundance that has fluctuated between about 33 and 2,223 individuals from 1983 through 2019. Natural-origin spawners make up a small proportion of the total population, accounting for about 30% of the 365 total return in 2019, and the trend is rather flat to slightly negative (NWFSC 2015; WDFW 2020c).

All returning adults and out-migrating juveniles of these two populations, as well as individuals that spawn in the numerous smaller streams across the basin, must pass through the action area to complete their life cycles. Adult Chinook salmon pass through Chittenden Locks (aka Ballard Locks) between mid-June through September, with peak migration occurring in mid-August (City of Seattle 2008). Spawning occurs well upstream of the action area between early August and late October. Juvenile Chinook salmon are found in Lake Washington and Lake Sammamish between January and July, primarily in the littoral zone (Tabor et al. 2006). Outmigration through the ship canal and past the action area to the locks occurs between late-May and early-July, with the peak in June (City of Seattle 2008).

Puget Sound (PS) steelhead: The PS steelhead distinct population segment (DPS) was listed as threatened on May 11, 2007 (72 FR 26722). The NMFS adopted the recovery plan for this DPS in December 2019. In 2013, the Puget Sound Steelhead Technical Recovery Team (PSSTRT) identified 32 demographically independent populations (DIPs) within the DPS, based on genetic, environmental, and life history characteristics. Those DIPs are distributed among three geographically-based major population groups (MPGs); Northern Cascades, Central and South Puget Sound; and Hood Canal and Strait de Fuca (Myers et al. 2015) (Table 3).

Table 3. PS steelhead Major Population Groups (MPGs), Demographically Independent Populations (DIPs), and DIP Viability Estimates (Modified from Figure 58 in Hard *et al.* 2015).

Geographic Region (MPG)	**Demographically Independent Population (DIP)**	**Viability**
Northern Cascades	Drayton Harbor Tributaries Winter Run	Moderate
	Nooksack River Winter Run	Moderate
	South Fork Nooksack River Summer Run	Moderate
	Samish River/Bellingham Bay Tributaries Winter Run	Moderate
	Skagit River Summer Run and Winter Run	Moderate
	Nookachamps River Winter Run	Moderate
	Baker River Summer Run and Winter Run	Moderate
	Sauk River Summer Run and Winter Run	Moderate
	Stillaguamish River Winter Run	Low
	Deer Creek Summer Run	Moderate
	Canyon Creek Summer Run	Moderate
	Snohomish/Skykomish Rivers Winter Run	Moderate
	Pilchuck River Winter Run	Low
	North Fork Skykomish River Summer Run	Moderate
	Snoqualmie River Winter Run	Moderate
	Tolt River Summer Run	Moderate
Central and South Puget Sound	Cedar River Summer Run and Winter Run	Low
	North Lake Washington and Lake Sammamish Winter Run	Moderate
	Green River Winter Run	Low
	Puyallup River Winter Run	Low
	White River Winter Run	Low
	Nisqually River Winter Run	Low
	South Sound Tributaries Winter Run	Moderate
	East Kitsap Peninsula Tributaries Winter Run	Moderate
Hood Canal and Strait de Fuca	East Hood Canal Winter Run	Low
	South Hood Canal Tributaries Winter Run	Low
	Skokomish River Winter Run	Low
	West Hood Canal Tributaries Winter Run	Moderate
	Sequim/Discovery Bay Tributaries Winter Run	Low
	Dungeness River Summer Run and Winter Run	Moderate
	Strait of Juan de Fuca Tributaries Winter Run	Low
	Elwha River Summer Run and Winter Run	Low

In 2015, the PSSTRT concluded that the DPS is at "very low" viability; with most of the 32 DIPs and all three MPGs at "low" viability based on widespread diminished abundance, productivity, diversity, and spatial structure when compared with available historical evidence (Hard et al. 2015). Based on the PSSTRT viability criteria, the DPS would be considered viable when all three component MPG are considered viable. A given MPG would be considered viable when: 1) 40 percent or more of its component DIP are viable; 2) mean DIP viability within the MPG exceeds the threshold for viability; and 3) 40 percent or more of the historic life history strategies (i.e., summer runs and winter runs) within the MPG are viable. For a given DIP to be considered viable, its probability of persistence must exceed 85 percent, as calculated by Hard et al. (2015), based on abundance, productivity, diversity, and spatial structure within the DIP.

General Life History: PS steelhead exhibit two major life history strategies. Ocean-maturing, or winter-run fish typically enter freshwater from November to April at an advanced stage of maturation, and then spawn from February through June. Stream-maturing, or summer-run fish typically enter freshwater from May to October at an early stage of maturation, migrate to headwater areas, and hold for several months prior to spawning in the following spring. After hatching, juveniles rear in freshwater from one to three years prior to migrating to marine habitats (two years is typical). Smoltification and seaward migration typically occurs from April to mid-May. Smolt lengths vary between watersheds, but typically range from 4.3 to 9.2 inches (109 to 235 mm) (Myers et al. 2015). Juvenile steelhead are generally independent of shallow nearshore areas soon after entering marine water (Bax et al. 1978, Brennan et al. 2004, Schreiner et al. 1977), and are not commonly caught in beach seine surveys. Recent acoustic tagging studies (Moore et al. 2010) have shown that smolts migrate from rivers to the Strait of Juan de Fuca from one to three weeks. PS steelhead feed in the ocean waters for one to three years (two years is again typical), before returning to their natal streams to spawn. Unlike Chinook salmon, most female steelhead, and some males, return to marine waters following spawning (Myers et al. 2015).

Spatial Structure and Diversity: The PS steelhead DPS includes all naturally spawned anadromous steelhead populations in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive). The DPS also includes six hatchery stocks that are considered no more than moderately diverged from their associated natural-origin counterparts (USDC 2014). PS steelhead are the anadromous form of *O. mykiss* that occur below natural barriers to migration in northwestern Washington State (NWFSC 2015). Non-anadromous ''resident'' *O. mykiss* (a.k.a. rainbow trout) occur within the range of PS steelhead but are not part of the DPS due to marked differences in physical, physiological, ecological, and behavioral characteristics (Hard et al. 2015). As stated above, the DPS consists of 32 DIP that are distributed among three geographically-based MPG. An individual DIP may consist of winter-run only, summer-run only, or a combination of both life history types. Winter-run is the predominant life history type in the DPS (Hard et al. 2015).

Abundance and Productivity: Available data on total abundance since the late 1970s and early 1980s indicate that abundance trends have fluctuated between positive and negative for individual DIP. However, low productivity persists throughout the 32 DIP, with most showing downward trends, and a few showing sharply downward trends (Hard et al. 2015, NWFSC 2015). Since the mid-1980s, trends in natural spawning abundance have also been temporally variable for most DIP but remain predominantly negative, and well below replacement for at least 8 of the DIP (NWFSC 2015). Smoothed abundance trends since 2009 show modest increases for 13 DIP. However, those trends are similar to variability seen across the DPS, where brief periods of increase are followed by decades of decline. Further, several of the upward trends are not statistically different from neutral, and most populations remain small. Nine of the evaluated DIP had geometric mean abundances of fewer than 250 adults, and 12 had fewer than 500 adults (NWFSC 2015). Over the time series examined, the over-all abundance trends, especially for natural spawners, remain predominantly negative or flat across the DPS, and general steelhead abundance across the DPS remains well below the level needed to sustain natural production into the future (NWFSC 2015). The PSSTRT recently concluded that the PS steelhead DPS is currently not viable (Hard et al. 2015). The DPS's current abundance and productivity are considered to be well below the targets needed to achieve delisting and recovery. Growth rates are currently declining at 3 to 10% annually for all but a few DIPs, and the extinction risk for most populations is estimated to be moderate to high. The most recent 5-year status review concluded that the DPS should remain listed as threatened (NMFS 2017).

Limiting Factors: Factors limiting recovery for PS steelhead include:

- The continued destruction and modification of steelhead habitat
- Widespread declines in adult abundance (total run size), despite significant reductions in harvest in recent years
- Threats to diversity posed by use of two hatchery steelhead stocks (Chambers Creek and Skamania)
- Declining diversity in the DPS, including the uncertain but weak status of summer run fish
- A reduction in spatial structure
- Reduced habitat quality through changes in river hydrology, temperature profile, downstream gravel recruitment, and reduced movement of large woody debris
- In the lower reaches of many rivers and their tributaries in Puget Sound where urban development has occurred, increased flood frequency and peak flows during storms and reduced groundwater-driven summer flows, with resultant gravel scour, bank erosion, and sediment deposition
- Dikes, hardening of banks with riprap, and channelization, which have reduced river braiding and sinuosity, increasing the likelihood of gravel scour and dislocation of rearing juveniles

PS Steelhead within the Action Area: The PS steelhead populations that occur in the action area consist of winter-runs from the Cedar River and North Lake Washington / Lake Sammamish DIPs (NWFSC 2015; WDFW 2020b). Both DIPs are among the smallest within the DPS. WDFW reports that the total PS steelhead abundance in the Cedar River basin has fluctuated between 0 and 900 individuals between 1984 and 2018, with a strong negative trend. Since 2000, the total annual abundance has remained under 50 fish (WDFW 2020d). NWFSC (2015) suggests that the returns may have been above 1,000 individuals during the 1980s, but agrees with the steep decline to less than 100 fish since 2000. It is unclear what proportion of the returns are natural-origin spawners, if any, and a total of only 4 adults are thought to have returned in 2018 (WDFW 2020d). The Sammamish River population is even smaller. WDFW reports that the total abundance for PS steelhead in the North Lake Washington / Lake Sammamish basin fluctuated between 0 and 916 individuals between 1984 and the last survey in 1999, with a strong negative trend. Abundance never exceeded 45 fish after 1992, and was only 4 in 1999 (WDFW 2020d). NWFSC (2015) disagrees with WDFW in that returns may have been above 1,500 individuals during the mid-1980s, but NWFSC agrees with the steep decline to virtually no steelhead in the basin since 2000.

All returning adults and out-migrating juveniles of these two populations must pass the action area to complete their life cycles. Adult steelhead pass through Chittenden Locks (aka Ballard Locks) and the Lake Washington Ship Canal between January and May, and may remain within Lake Washington through June (City of Seattle 2008). The timing of steelhead spawning in the basin is uncertain, but occurs well upstream of the action area. Juvenile steelhead enter Lake Washington in April, and typically migrate through the ship canal and past the action area to the locks between April and May (City of Seattle 2008).

Critical Habitat

This section describes the status of designated critical habitat that would be affected by the proposed action by examining the condition and trends of physical or biological features (PBFs) that are essential to the conservation of the listed species throughout the designated areas. The PBFs are essential because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging). The proposed project would affect critical habitat for PS Chinook salmon.

The NMFS designated critical habitat for PS Chinook salmon on September 2, 2005 (70 FR 52630). That critical habitat is located in 16 freshwater subbasins and watersheds between the Dungeness/Elwha Watershed and the Nooksack Subbasin, inclusively, as well as in nearshore marine waters of the Puget Sound that are south of the US-Canada border and east of the Elwha River, and out to a depth of 30 meters. Although offshore marine is an area type identified in the final rule, it was not designated as critical habitat for PS Chinook salmon.

The PBFs of salmonid critical habitat include: (1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development; (2) Freshwater rearing sites with: (i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) Water quality and forage supporting juvenile development; and (iii) 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; (3) Freshwater migration corridors free of obstruction and excessive predation 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; (4) Estuarine areas free of obstruction and excessive predation with: (i) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation; (5) Nearshore marine areas free of obstruction and excessive predation with: (i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and (6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation. The PBF for PS Chinook salmon CH are listed in Table 4.

Major tributary river basins in the Puget Sound basin include the Nooksack, Samish, Skagit, Sauk, Stillaguamish, Snohomish, Lake Washington, Cedar, Sammamish, Green, Duwamish, Puyallup, White, Carbon, Nisqually, Deschutes, Skokomish, Duckabush, Dosewallips, Big Quilcene, Elwha, and Dungeness rivers and Soos Creek. Critical habitat throughout the Puget Sound basin has been degraded by numerous activities, including hydropower development, loss of mature riparian forests, increased sediment inputs, removal of large wood from the waterways, intense urbanization, agriculture, alteration of floodplain and stream morphology (i.e., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, dredging, armoring of shorelines, marina and port development, road and railroad construction and maintenance, logging, and mining. Changes in habitat quantity, availability, and diversity, and flow, temperature, sediment load and channel instability are common limiting factors of critical habitat throughout the basin.

Table 4. Physical or biological features (PBFs) of designated critical habitat for PS Chinook salmon, and corresponding life history events. Although offshore marine areas were identified in the final rule, none was designated as critical habitat.

Physical or Biological Features		
Site Type	**Site Attribute**	**Life History Event**
Freshwater spawning	Water quantity Water quality Substrate	Adult spawning Embryo incubation Alevin growth and development
Freshwater rearing	Water quantity and Floodplain connectivity Water quality and Forage Natural cover	Fry emergence from gravel Fry/parr/smolt growth and development
Freshwater migration	(Free of obstruction and excessive predation) Water quantity and quality Natural cover	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Estuarine	(Free of obstruction and excessive predation) Water quality, quantity, and salinity Natural cover Forage	Adult sexual maturation and "reverse smoltification" Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Nearshore marine	(Free of obstruction and excessive predation) Water quality, quantity, and forage Natural cover	Adult growth and sexual maturation Adult spawning migration Nearshore juvenile rearing
Offshore marine	Water quality and forage	Adult growth and sexual maturation Adult spawning migration Subadult rearing

Land use practices have likely accelerated the frequency of landslides delivering sediment to streams. Fine sediment from unpaved roads also contributes to stream sedimentation. Unpaved roads are widespread on forested lands in the Puget Sound basin, and to a lesser extent, in rural residential areas. Historical logging removed most of the riparian trees near stream channels. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys, leaving either no trees, or a thin band of trees. The riparian zones along many agricultural areas are now dominated by alder, invasive canary grass and blackberries, and provide substantially reduced stream shade and large wood recruitment (SSPS 2007).

Diking, agriculture, revetments, railroads and roads in lower stream reaches have caused significant loss of secondary channels in major valley floodplains in this region. Confined main channels create high-energy peak flows that remove smaller substrate particles and large wood. The loss of side-channels, oxbow lakes, and backwater habitats has resulted in a significant loss of juvenile salmonid rearing and refuge habitat. When the water level of Lake Washington was lowered 9 feet in the 1910s, thousands of acres of wetlands along the shoreline of Lake Washington, Lake Sammamish and the Sammamish River corridor were drained and converted to agricultural and urban uses. Wetlands play an important role in hydrologic processes, as they store water which ameliorates high and low flows. The interchange of surface and groundwater in complex stream and wetland systems helps to moderate stream temperatures. Thousands of acres of lowland wetlands across the region have been drained and converted to agricultural and urban uses, and forest wetlands are estimated to have diminished by one-third in Washington State (FEMAT 1993; Spence et al. 1996; SSPS 2007).

Loss of riparian habitat, elevated water temperatures, elevated levels of nutrients, increased nitrogen and phosphorus, and higher levels of suspended sediment, presumably from urban and highway runoff, wastewater treatment, failing septic systems, and agriculture or livestock impacts, have been documented in many Puget Sound tributaries (SSPS 2007).

Peak stream flows have increased over time due to paving (roads and parking areas), reduced percolation through surface soils on residential and agricultural lands, simplified and extended drainage networks, loss of wetlands, and rain-on-snow events in higher elevation clear cuts (SSPS 2007). In urbanized Puget Sound, there is a strong association between land use and land cover attributes and rates of coho spawner mortality likely due to runoff containing contaminants emitted from motor vehicles (Feist et al. 2011).

Dams constructed for hydropower generation, irrigation, or flood control have substantially affected PS Chinook salmon populations in a number of river systems. The construction and operation of dams have blocked access to spawning and rearing habitat, changed flow patterns, resulted in elevated temperatures and stranding of juvenile migrants, and degraded downstream spawning and rearing habitat by reducing recruitment of spawning gravel and large wood to downstream areas (SSPS 2007). These actions tend to promote downstream channel incision and simplification (Kondolf 1997), limiting fish habitat. Water withdrawals reduce available fish habitat and alter sediment transport. Hydropower projects often change flow rates, stranding and killing fish, and reducing aquatic invertebrate (food source) productivity (Hunter 1992).

Juvenile mortality occurs in unscreened or inadequately screened diversions. Water diversion ditches resemble side channels in which juvenile salmonids normally find refuge. When diversion headgates are shut, access back to the main channel is cut off and the channel goes dry. Mortality can also occur with inadequately screened diversions from impingement on the screen, or mutilation in pumps where gaps or oversized screen openings allow juveniles to get into the system. Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in many Puget Sound tributary basins (SSPS 2007).

The nearshore marine habitat has been extensively altered and armored by industrial and residential development near the mouths of many of Puget Sound's tributaries. A railroad runs along large portions of the eastern shoreline of Puget Sound, eliminating natural cover along the shore and natural recruitment of beach sand (SSPS 2007).

Degradation of the near-shore environment has occurred in the southeastern areas of Hood Canal in recent years, resulting in late summer marine oxygen depletion and significant fish kills. Circulation of marine waters is naturally limited, and partially driven by freshwater runoff, which is often low in the late summer. However, human development has increased nutrient loads from failing septic systems along the shoreline, and from use of nitrate and phosphate fertilizers on lawns and farms. Shoreline residential development is widespread and dense in many places. The combination of highways and dense residential development has degraded certain physical and chemical characteristics of the near-shore environment (HCCC 2005; SSPS 2007).

Critical Habitat within the Action Area: Critical habitat has been designated for PS Chinook salmon along the entire length of the Lake Washington Ship Canal, all of Lake Washington, about 950 yards upstream into in the Sammamish River, and well upstream into the Cedar River watershed. The critical habitat in the Lake Washington Ship Canal provides the Freshwater Migration PBF for PS Chinook (NOAA 2020; WDFW 2020a).

2.3 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).

The applicant's project site is located along the northern bank of the Lake Washington Ship Canal in Seattle, Washington (Figure 1). As described in sections 2.5, work-related water quality effects would be the stressor with the greatest range of direct and indirect effects on fish. The affected area would be limited to a 340-foot wide oblong that would extend about 415 feet south from the north end of the dredging area. However, trophic connectivity between PS Chinook salmon and the SR killer whales that feed on them extends the action area to the marine waters of Puget Sound. The described area overlaps with the geographic ranges of the ESA-listed species and the boundaries of designated critical habitats identified in Table 1. The action area also overlaps with areas that have been designated, under the MSA, as EFH for Pacific Coast salmon, Pacific Coast groundfish, and coastal pelagic species.

2.4 Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. 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 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

Environmental conditions at the project site and the surrounding area: The project site is located in Seattle, along the northern bank of the Lake Washington Ship Canal (Figure 1). Although the action area includes the marine waters of Puget Sound, all detectable effects of the action would be limited to the Lake Washington Ship Canal within a 340-foot wide oblong that would extend about 415 feet south from the north end of the dredging area (Sections 2.5 & 2.12). Therefore this section focuses on habitat conditions in the Lake Washington Ship Canal, and does not discuss Puget Sound habitat conditions.

The geography and ecosystems in and adjacent to the action area have been dramatically altered by human activity since European settles first arrived in the 1800s. Historically, a small stream flowed from Lake Union to Shilshole Bay, with no surface water connection between Lake Union and Lake Washington. The waters of Lake Washington flowed south to the Duwamish River via the now absent Black River. The canal was created by intense dredging and excavation that began in the 1880s to provide a navigable passage between Lake Washington and the marine waters of Shilshole Bay. The canal is 8.6 miles long, about 150 to 260 feet wide in the cuts, and widens at Portage Bay, Lake Union, and Salmon Bay. The averages depth in the navigational channel is about 30 feet. Depths along the edges are typically between 10 and 20 feet.

The canal was completed in 1916. As part of this, the Hiram M. Chittenden Locks (aka Ballard Locks) were constructed near the west end of the canal to maintain navigable water levels in the canal and lakes. This permanently converted Salmon Bay from an estuary to freshwater. Flows through canal are highly controlled by the locks, and are typically very slow, and the canal supports high levels of commercial and recreational vessel traffic.

Little natural shoreline exists in the ship canal, which was constructed during a time when little was known about the environmental needs of the ESA-listed salmonids that now depend on it. In cross-section, the canal closely resembles an elongated box culvert along most of its length, and about 96% of the canal's banks are armored (City of Seattle 2008). Instead of slopes that gently rise to the surface, as typically occurs along the banks of natural streams, the bank slope along most of the canal is vertical, with depths of tens of feet.

The vast majority of the shoreline from Lake Washington to Shilshole Bay is lined by shipyards, industrial properties, large marinas, and residential piers. Unbroken urban development extends north and south immediately landward of both shorelines. With the exception of the southern shoreline of Portage Bay, and along the armored banks of the Fremont and Mountlake Cuts, very little riparian vegetation exists along the banks of the canal.

Water quality within the area is influenced by the inflow of freshwater from Lake Washington, by point and non-point discharges all along the waterway, and by a saltwater lens that intrudes through the Ballard Locks, underlays the outflowing freshwater, and occasionally extends into Lake Union. Industrial, commercial, and residential development has impacted water quality in the canal since before the canal was completed in 1916. Lumber and plywood mills, machine shops, metal foundries, fuel and oil facilities, concrete and asphalt companies, and power plants were quickly developed along the shoreline of the waterway, along with numerous shipyards, marinas, commercial docks, and houseboats. Virtually all of the early industrial, commercial, and residential facilities discharged untreated wastes directly to the waterway, some of which persisted into the 1940s and beyond. Tomlinson (1977) cites a 1943 Washington State Pollution Commission report that indicated that the Seattle Gas Plant (now Gasworks Park) discharged oily wastes so routinely that the water surface was covered and fish kills occurred in its vicinity. The report also identified raw sewage discharge into the waterway from most of the residences, commercial establishments, and all of the houseboats that lined the shoreline. Stormwater drainage has also contributed to pollutant loading. Most of the direct discharge of raw sewage was stopped and the gas plant ceased operation during the 1960s.

The City of Seattle (1987) reported water quality problems in the canal that included saltwater intrusion, low dissolved oxygen, and elevated fecal coliform, as well as sediments that were contaminated with Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Biphenyls (PCBs), cadmium, chromium, lead, mercury, nickel, and zinc, particularly in the area off the former Seattle Gas Plant. Today, the overall water quality in the ship canal has improved substantially. However, Lake Union and the ship canal are included on the Washington State Department of Ecology's (WDOE) list of impaired and threatened water bodies for total phosphorus, fecal coliform bacteria, lead, and the insecticide aldrin in the water column, and for sediment bioassay (City of Seattle 2010). The most likely sources of phosphorus and fecal coliform are point and nonpoint stormwater discharges. Other sources of fecal coliform include wastes from domestic pets and waterfowl, and sewage from boats (City of Seattle 2010).

Although total copper and total lead concentrations have exceeded state water quality criteria for acute toxicity in the past (Herrera 1998), the mean concentrations of dissolved metals have typically been below the state water quality criteria for acute and chronic toxicity (Herrera 2005), and the concentrations of total and dissolved metals in the water are considered relatively low (City of Seattle 2010). Mercury is the primary metal of concern in Lake Union bottom sediments, with concentrations ranging from 0.35 to 9.18 mg/kg near certain South Lake Union discharges (City of Seattle 2010). Elevated concentrations of other pollutants also have been found in canal sediments along the north shoreline of the canal (metals, PAHs, PCBs, phthalates, and other organic compounds) (Herrera 1998; RETEC 2002).

Since 1979, water temperatures in the ship canal have increased an average of 1° Celsius (C, 1.8° F) per decade, with temperatures that can reach 20 to 22° C during the summer and early fall, and the number of days that temperatures are in that range is increasing (City of Seattle 2010). The preferred temperature limits for salmon are 13 to 18° C (55-64° F), and temperatures of 23 to 25° C (73-77° F) can be lethal. Saltwater intrusion through the locks creates a wedge of high-density saltwater that can extend into and past Lake Union during low flow periods. Freshwater typically floats over the saltwater with little mixing between the two water masses, and the saltwater wedge often becomes anoxic early in the summer as bacteria consume organics in the sediment. DO concentrations range from 9.5 to 12.6 mg/L during the winter and spring, but can decrease to as low as 1 mg/L during the summer months.

The artificial shorelines and widespread presence of overwater structures along the length of the canal and much of Lake Union provide habitat conditions that favor fish species that prey on juvenile salmonids, especially the non-native smallmouth bass. Other predators in the canal include the native northern pikeminnow and the non-native largemouth bass (Celedonia et al. 2008a and b; Tabor et al. 2004 and 2010). Tabor et al. (2004) estimated that about 3,400 smallmouth bass and 2,500 largemouth bass, large enough to consume salmon smolt (> 130 mm fork length), were in the ship canal. They also estimated that smallmouth bass consumed about 48,000 salmon smolts annually, while largemouth bass consumed about 4,200 smolts. Of those, over half were Chinook salmon smolts. Predation appeared to be highest in June, and near Portage Bay, when smolts made up approximately 50% of the diet for smallmouth bass, and about 45% for northern pikeminnow. Returning adult salmon and steelhead are often exposed to excessive predation by pinniped marine mammals (seals and sea lions) that feed on the fish that aggregate downstream of the fish ladder.

The applicant's dry dock is part of a shipyard that has operated since 1874, in a highly commercialized area in Salmon Bay, just upstream of the Chittenden Locks. The banks are fully armored and the upland areas consist of a mix of pavement, rail tracks, and large industrial buildings, with very little riparian vegetation.

The shoreline along the project site is armored with a vertical sheet pile and concrete bulkhead that eliminates the hydrologic and hyporheic functions at the site such as natural runoff and sediment exchange, wave energy attenuation, and large woody debris recruitment and retention. The east and west sides of the project area are bounded by walkways and piers supported by creosote-treated wood piles, and there is no riparian vegetation at the project site. The aquatic substrate within the action area consists of silty to very silty sands with trace amounts of gravel (PFSE 2020b) at depths of about +7 feet re. LD, or -13 feet re. LWSC. The applicant reports that submerged aquatic vegetation (SAV) at the site is limited to the non-native invasive Eurasian watermilfoil that has been observed throughout much of the project area.

The water and sediment quality within the action area has been severely reduced by historic and ongoing anthropogenic impacts. The waters of action area, along with the entire ship canal, are identified on the current WDOE 303(d) list of threatened and impaired water bodies (Category 5) for lead, pH, aldrin, and bacteria. Other listings in the area include invasive exotic species (Category 4C); temperature, dissolved oxygen, 4,4'-DDD, 4,4'-DDE, and zinc (Category 2); as well as endosulfan I, chromium, and total phosphorus (Category 1) (WDOE 2020b).

The project site is listed on the State of Washington's Confirmed and Suspected Contaminated Sites. The applicant conducted sediment testing under the State's Dredged Material Management Program (DMMP) and found concentrations of metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc), PAHs, PCBs, and total petroleum hydrocarbons (as diesel and heavy oil) all exceeded the freshwater Sediment Management Standards screening criteria. Dioxins and furans were also detected in the sediment (PFSE 2020b).

The past and ongoing anthropogenic impacts described above have reduced the action area's ability to support migrating PS Chinook salmon and PS steelhead. However, the action area continues to provide migratory habitat for adults and juveniles of both species, and the area has been designated as critical habitat for PS Chinook salmon.

Climate Change: Climate change has affected the environmental baseline of aquatic habitats across the region and within the action area. However, the effects of climate change have not been homogeneous across the region, nor are they likely to be in the future. During the last century, average air temperatures in the Pacific Northwest have increased by 1 to 1.4° F (0.6 to 0.8 ºC), and up to 2° F (1.1 ºC) in some seasons (based on average linear increase per decade; Abatzoglou et al. 2014; Kunkel et al. 2013). Recent temperatures in all but two years since 1998 ranked above the 20th century average (Mote et al. 2013). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10° F (1.7 to 5.6º C), with the largest increases predicted to occur in the summer (Mote et al. 2014).

Decreases in summer precipitation of as much as 30% by the end of the century are consistently predicted across climate models (Mote et al. 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB 2007; Mote et al. 2013 and 2014). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007; Mote et al. 2014). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western United States (Dominguez et al. 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote et al. 2014).

The combined effects of increasing air temperatures and decreasing spring through fall flows are expected to cause increasing stream temperatures; in 2015, this resulted in 3.5-5.3ºC increases in Columbia Basin streams and a peak temperature of 26ºC in the Willamette (NWFSC 2015). Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al. 2009).

Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB 2007). Reduced flows will make it more difficult for migrating fish to pass physical and thermal obstructions, limiting their access to available habitat (Isaak et al. 2012; Mantua et al. 2010). Temperature increases shift timing of key life cycle events for salmonids and species forming the base of their aquatic foodwebs (Crozier et al. 2011; Tillmann and Siemann 2011; Winder and Schindler 2004). Higher stream temperatures will also cause decreases in dissolved oxygen and may also cause earlier onset of stratification and reduced mixing between layers in lakes and reservoirs, which can also result in reduced oxygen (Meyer et al. 1999; Raymondi et al. 2013; Winder and Schindler 2004). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier et al. 2008; Raymondi et al. 2013; Wainwright and Weitkamp 2013).

As more basins become rain-dominated and prone to more severe winter storms, higher winter stream flows may increase the risk that winter or spring floods in sensitive watersheds will damage spawning redds and wash away incubating eggs (Goode et al. 2013). Earlier peak stream flows will also alter migration timing for salmon smolts, and may flush some young salmon and steelhead from rivers to estuaries before they are physically mature, increasing stress and reducing smolt survival (Lawson et al. 2004; McMahon and Hartman 1989).

The adaptive ability of these threatened and endangered species is depressed due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. Without these natural sources of resilience, systematic changes in local and regional climatic conditions due to anthropogenic global climate change will likely reduce long-term viability and sustainability of populations in many of these ESUs (NWFSC 2015). New stressors generated by climate change, or existing stressors with effects that have been amplified by climate change, may also have synergistic impacts on species and ecosystems (Doney et al. 2012). These conditions will possibly intensify the climate change stressors inhibiting recovery of ESA-listed species in the future.

2.5 Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

The proposed dredging project would cause direct effects on the fish and habitat resources that are present during the in-water work through exposure to dredging-related elevated noise, bucket strike or entrainment, contaminated water, and propeller wash. The proposed dredging would also cause indirect effects on fish and habitat resources through forage contamination and altered benthic habitat. The COE's authorization of the dredging would have the additional effect of extending the operational life of the dry dock by decades beyond that of the existing conditions. Over that time, the dry dock's presence and normal uses would cause effects on fish and habitat resources through altered lighting, water contamination, forage contamination, elevated noise related to vessel repairs, and propeller wash from client vessels.

The action's October 1 through April 15 work window avoids the normal migration seasons for juvenile and adult PS Chinook salmon. As such, PS Chinook salmon are very unlikely to present during the proposed in-water work. The work window overlaps slightly with the normal migration seasons for juvenile and adult PS steelhead. However, PS steelhead are very rare in the Lake Washington watershed, supporting the expectation that it is also very unlikely that any PS steelhead would be within the action area during the proposed in-water work. Therefore, it is very unlikely that PS Chinook salmon and PS steelhead would be exposed to the direct effects of the proposed action. However, juveniles of both species that pass through the action area during their annual out-migration seasons would be exposed to the action's indirect effects, including the effects of the dry dock's continued presence and normal uses. The PBFs of PS Chinook salmon critical habitat would also be exposed to the action's direct and indirect effects.

2.5.1 Effects on Listed Species

Dredging-related Elevated Noise

Elevated in-water noise at levels capable of causing detectable effects in exposed fish would be caused by the in-water dredging and tugboat operations, including spud deployment. However, exposure to that noise is not likely to adversely affect PS Chinook salmon or PS steelhead because it is extremely unlikely that individuals of either species would be present during the proposed work window, and because the most likely effect of the exposure would be minor behavioral disturbances.

The effects caused by a fish's exposure to noise vary with the hearing characteristics of the fish, the frequency, intensity, and duration of the exposure, and the context under which the exposure occurs. At low levels, effects may include the onset of behavioral disturbances such as acoustic masking (Codarin et al. 2009), startle responses and altered swimming (Neo et al. 2014), abandonment or avoidance of the area of acoustic effect (Mueller 1980; Picciulin et al. 2010; Sebastianutto et al. 2011; Xie et al. 2008) and increased vulnerability to predators (Simpson et al. 2016). At higher intensities and/or longer exposure durations, the effects may rise to include temporary hearing damage (a.k.a. temporary threshold shift or TTS, Scholik and Yan 2002) and increased stress (Graham and Cooke 2008). At even higher levels, exposure may lead to physical injury that can range from the onset of permanent hearing damage (a.k.a. permanent threshold shift or PTS) and mortality. The best available information about the auditory capabilities of the fish considered in this opinion suggest that their hearing capabilities are limited to frequencies below 1,500 Hz, with peak sensitivity between about 200 and 300 Hz (Hastings and Popper 2005; Picciulin et al. 2010; Scholik and Yan 2002; Xie et al. 2008).

The NMFS uses two metrics to estimate the onset of injury for fish exposed to high intensity impulsive sounds (Stadler and Woodbury 2009). The metrics are based on exposure to peak sound level and sound exposure level (SEL), respectively. Both are expressed in decibels (dB). The metrics are: 1) exposure to 206 dB_{peak}; and 2) exposure to 187 dB SEL_{cum} for fish 2 grams or larger, or 183 dB SEL_{cum} for fish under 2 grams. Further, any received level (RL) below 150 dB_{SEL} is considered "Effective Quiet". The distance from a source where the RL drops to 150 dB_{SEL} is considered the maximum distance from that source where fishes can be affected by the noise, regardless of accumulation of the sound energy (Stadler and Woodbury 2009). Therefore, when the range to the 150 dB_{SEL} isopleth exceeds the range to the 187 dB SEL_{CUM} isopleth, the distance to the 150 dB_{SEL} isopleth is the range at which detectable effects would begin, with the 187 dB SEL_{CUM} isopleth identifying the distance within which sound energy accumulation would intensify effects. However, when the range to the 150 dB_{SEL} isopleth is less than the range to the 187 dB SEL_{CUM} isopleth, only the 150 dB_{SEL} isopleth would apply because fish would be extremely unlikely to detect or be affected by the noise outside of the 150 dB_{SEL} isopleth.

The discussion in Stadler and Woodbury (2009) indicate that these thresholds likely overestimate the potential effects of exposure to impulsive sounds. Further, Stadler and Woodbury's assessment did not consider non-impulsive sound, which is believed to be less injurious to fish than impulsive sound. Therefore, application of the criteria to non-impulsive sounds is also likely to overestimate the potential effects in fish. However, these criteria represent the best available information. Therefore, to avoid underestimating potential effects, this assessment applies these criteria to both impulsive and non-impulsive sounds to gain a conservative idea of the potential effects that fish may have experienced due to exposure to project-related sounds.

The estimated in-water source levels (SL, sound level at 1 meter from the source) used in this assessment are based on the best available information, as described in a recent acoustic assessment for a similar project (NMFS 2016a), and in other sources (Blackwell and Greene 2006; COE 2011a; Dickerson et al. 2001; Reine et al. 2012 & 2014; Richardson et al. 1995). The best available information supports the understanding that all of the SLs would be below the 206 dB_{peak} threshold for the onset of instantaneous injury in fish.

In the absence of location-specific transmission loss data, variations of the equation RL = SL – #Log(R) are often used to estimate the received sound level at a given range from a source (RL = received level (dB); SL = source level (dB, 1 m from the source); # = spreading loss coefficient; and R = range in meters (m). Numerous acoustic measurements in shallow water environments support the use of a value close to 15 for projects like this one (CalTrans 2015). This value is considered the practical spreading loss coefficient, and was used for all sound attenuation calculations in this assessment.

Application of the practical spreading loss equation to the expected SLs suggests that noise levels above the 150 dB_{SEL} threshold could extend to about 177 feet (54 m) around the barges when they deploy spuds, 72 feet (22 m) around tugboats, and about 13 feet (4 m) around dredging work (Table 5). Individuals that are beyond the 150 dB_{SEL} isopleth for any of these sources would be unaffected by the noise. However, fish within the 150 dB_{SEL} isopleth are likely to experience a range of impacts that would depend on their distance from the source and the duration of their exposure.

Table 5. Estimated in-water source levels for the loudest project-related sources with the estimated ranges to the source-specific effects thresholds for fish.

Source	Acoustic Signature	Source Level	Threshold Range
Spud Deployment	< 1.6 kHz Impulsive	201 dB_{peak}	206 @ N/A
		176 dB_{SEL}	150 @ 54 m
Tugboat Propulsion	< 1 kHz Combination	185 dB_{peak}	206 @ N/A
		170 dB_{SEL}	150 @ 22 m
Dredge Bucket Strike	< 370 Hz Impulsive	184 dB_{peak}	206 @ N/A
		167 dB_{SEL}	150 @ 4 m

Project-related dredging would likely require the use of 1 or 2 spud-barges and the periodic use of a tugboat. Spud-barges typically have 2 or more spuds (steel pipes or girders) that they drop to the substrate and lock in place to hold their position (instead of using anchors). Each time a spud strikes the substrate, it would cause a brief impulsive sound that would be detectable by fish up to 177 feet away. The exact per-day number spud deployments for this project is unknown and would be variable over time. However, they would be relatively infrequent and too few in number to be a concern for accumulated sound energy impacting listed fish.

The frequency and duration of project-related tugboat operations is uncertain, but would consist of relatively continuous periods during any day they are used. However, their frequent movement is expected to preclude any concern for impacts on fish from accumulated sound energy. Similarly, although in-water dredging would be source of continuous noise during the project, is extremely unlikely that any fish would remain within 13 feet of that work long enough for accumulated sound energy to be a concern. Further, the full-depth sediment curtain that would surround the project site would act as a fish exclusion device that would be installed more than 13 feet from the dredging area. Additionally, these three sound sources are very unlikely to have any additive effects with each other due the differences in the frequencies and other characteristics of their sound. At most, the combination of the various types of equipment noise during any given day would cause fish-detectable in-water noise levels across the entire workday.

Based on the best available information, in the very unlikely event that listed fish would be present during in-water work, the most likely effect of exposure to project-related noise would be minor behavioral disturbances, such as mild acoustic masking, brief startle responses and altered swimming patterns, and temporary avoidance of the source. These responses would cause no meaningful effects on the fitness or normal behaviors of an exposed fish.

Dredging-related Bucket Strike or Entrainment

The applicant's contractors would conduct 16 days of dredging and 5 days of sand installation. Both would be done with a clamshell bucket that could strike or capture (entrain) fish. However, action-related bucket strike and entrainment is not likely to adversely affect PS Chinook salmon or PS steelhead because it is extremely unlikely that individuals of either species would be present during the proposed work window, and because the occurrence of bucket strike and entrainment is very rare even when fish are present.

Fish that become captured within a digging bucket (entrainment) or that are struck by the bucket as it descends would likely be killed. However, the documented occurrence of these events for mobile fish species are extremely rare. In the Southeast Region of the US, where closely monitored heavy dredging operations occur regularly in areas inhabited by sturgeon and sea turtles, only two live sturgeon (NMFS 2012) and two live sea turtles (NMFS 2011) are known to have been taken by clamshell dredging since 1990.

The rarity of these occurrences is likely due to a combination of factors. In order to be entrained in a clamshell bucket, a fish must be directly under the bucket when it drops. The relatively small size of the bucket, compared against the scattered and low-density distribution of the fish across the available habitat within the project area strongly suggest that the potential for overlap between fish and bucket presence is very low, and that potential would decrease after the first few bucket cycles because mobile organisms such as salmon are likely to move quickly away from the noise and turbid water. Further, mechanical dredges typically stay within an area limited to the range of the crane/excavator arm for many minutes to several hours before moving to an adjacent area. The risk of bucket strike and entrainment would lowered further by conducting the work within a full-depth sediment curtain that would act as a fish exclusion device. Therefore, based on the best available information, in the very unlikely event that listed fish would be present during in-water work, it would be extremely unlikely that any individuals would be struck by or entrained in the clamshell bucket.

Dredging-related Contaminated Water

The proposed in-water work would temporarily affect water quality through increased turbidity and mobilized contaminated sediments. It may also temporarily reduce dissolved oxygen concentrations, and may also temporarily introduce toxic materials from equipment-related spills and discharges. The NMFS estimates that all detectable water quality impacts would limited to the extent of the project-related turbidity, which wouldn't exceed 150 feet beyond the full-depth sediment curtain that would surround the work area.

Exposure to work-related water quality impacts is not likely to adversely affect PS Chinook salmon or PS steelhead because it is extremely unlikely that individuals of either species would be present during the proposed work window, and as described below, the in-water concentrations of turbidity or toxic pollutants, or reduced oxygen levels, outside of the full-depth sediment curtain would be too low to cause meaningful effects in exposed individuals.

Turbidity: Dredging and project-related tugboat propeller wash would mobilize bottom sediments and cause turbidity plumes with relatively low concentrations of total suspended sediments (TSS). The intensity of turbidity is typically measured in Nephlometric Turbidity Units (NTU) that describe the opacity caused by the suspended sediments, or by the concentration of TSS as measured in milligrams per liter (mg/L). A strong positive correlation exists between NTU values and TSS concentrations. Depending on the particle sizes, NTU values roughly equal the same number of mg/L for TSS (i.e. 10 NTU = ~ 10 mg/L TSS, and 1,000 NTU = ~ 1,000 mg/L TSS) (Campbell Scientific Inc. 2008; Ellison et al. 2010). Therefore, the two units of measure are easily compared.

Water quality is considered adversely affected by suspended sediments when turbidity is increased by 20 NTU for a period of 4 hours or more (Berg and Northcote 1985; Robertson et al. 2006). The effects of turbidity on fish are somewhat species and size dependent. In general, severity typically increases with sediment concentration and duration of exposure, and decreases with the increasing size of the fish. Bjornn and Reiser (1991) report that adult and larger juvenile salmonids appear to be little affected by the high concentrations of suspended sediments that may be mobilized during storm and snowmelt runoff episodes. However, empirical data from numerous studies report the onset of minor physiological stress in juvenile and adult salmon after one hour of continuous exposure to suspended sediment concentration levels between about 1,100 and 3,000 mg/L, or to three hours of exposure to 400 mg/L, and seven hours of exposure to concentration levels as low as 55 mg/L (Newcombe and Jensen 1996). The authors reported that serious non-lethal effects such as major physiological stress and reduced growth were reported after seven hours of continuous exposure to 400 mg/L and 24 hours of continuous exposures to concentration levels as low as about 150 mg/L.

Mechanical dredging in areas containing high levels of fine-grained material is likely to cause suspended sediment plumes that could extend 200 to 500 feet down-current from the point of dredging, and may take hours after work has stopped to return to background levels. LaSalle et. al. (1991) reported suspended sediment concentrations of about 700 mg/L at the surface, and 1,100 mg/L near the bottom, about 300 feet from clamshell dredging in areas containing high levels of fine-grained material. During monitored clamshell dredging of inner Grays Harbor, the suspended sediment concentrations exceeded 500 mg/L in 23 of 600 samples, and seven of those samples were for tests of ambient conditions (COE 2011b). The single highest reported concentration was 3,000 mg/L when the ambient TSS concentration was 700 mg/L. The full-depth sediment curtain around the dredging area would limit the spread of turbidity, and the contractors would be required to monitor and limit turbidity such that turbidity at 150 feet outside of the sediment curtain would not exceed 5 NTU (~5 mg/L) above background levels (PFSE 2020a).

Tugboat propeller wash would also mobilize bottom sediments. The intensity and duration of the resulting turbidity plumes are uncertain, and would depend on a combination of the tugboat's thrust, the water depth under it, and the type of substrate. The higher the thrust and the finer the sediment, the more sediment that is likely to be mobilized. Fine material (silt) remains mobilized longer than coarse material (sand). The shallower the water, the more thrust energy that would reach the substrate. A recent study described the turbidly caused by large tugboats operating in Navy harbors (ESTCP 2016). At about 13 minutes, the plume extended about 550 yards (500 m), where the TSS concentration was about 80 mg/L. The plume persisted for hours and extended far from the event, but the TSS concentration fell to 30 mg/L within 1 hour and to 15 mg/L within 3 hours. At its highest concentration, the plume was below the concentrations required to elicit physiological responses reported by Newcombe and Jensen (1996). The exact extent of turbidly plumes from tugboat operations for this project are unknown, but it is extremely unlikely that would exceed those described above. Based on that information, and on the consultations for similar projects in the region, sediment mobilization from tugboat propeller wash would likely consist of relatively low-concentration plumes that could extend to about 300 feet from the site, and last a low number of hours after the disturbance. However, work-related tugboat turbidity would be indistinguishable from the turbidity caused by the high levels of routine vessel operations in and around the project site.

Therefore, based on the best available information, in the very unlikely event that listed fish would be present during in-water work, work-related turbidity concentrations would be too low and short-lived to cause more than temporary, non-injurious behavioral effects such as avoidance of the plume, mild gill flaring, and slightly reduced feeding rates in any individuals that may be exposed to it. None of the potential responses, individually, or in combination would meaningfully affect the fitness or normal behaviors of an exposed fish. No detectable effects from exposure to turbidity would occur beyond 150 feet of the sediment curtain.

<u>Dissolved Oxygen:</u> Mobilization of anaerobic sediments can decrease dissolved oxygen levels (Hicks et al., 1991; Morton 1976). The impact on dissolved oxygen is a function of the oxygen demand of the sediments, the amount of material suspended in the water, the duration of suspension, and the water temperature (Lunz and LaSalle 1986; Lunz et al. 1988). Reduced dissolved oxygen can affect salmonid swimming performance (Bjornn and Reiser 1991), as well as cause avoidance of water with low dissolved oxygen levels (Hicks 1999).

The intensity of the dredging-related oxygen reductions are uncertain, but the vast majority of the mobilized sediments would be contained within the full-depth sediment curtain that would surround the dredging area. Therefore, in the very unlikely event that listed fish would be present during in-water work, work-related reduced oxygen concentrations outside of the sediment curtain would be too low and short-lived to cause more than temporary, non-injurious behavioral effects such as avoidance of the plume, which would not meaningfully affect the fitness or normal behaviors of an exposed fish. No detectable effects from exposure to reduced dissolved oxygen would occur beyond 150 feet of the sediment curtain.

Toxic Materials: Toxic materials would enter the water through mobilization of contaminated sediments and may also enter the water through work-related spills and discharges. Sediment contaminants at the site include metals, PAHs, PCBs, heavy oil and diesel petroleum hydrocarbons, dioxins, and furans (PFSE 2020b). Many of the fuels, lubricants, and other fluids commonly used in construction equipment are petroleum-based hydrocarbons that also contain PAHs. Fish can uptake contaminants directly through their gills, and through dietary exposure (Karrow et al. 1999; Lee and Dobbs 1972; McCain et al. 1990; Meador et al. 2006; Neff 1982; Varanasi et al. 1993). Depending on the pollutant, its concentration, and/or the duration of exposure, exposed fish may experience effects that can range from avoidance of an affected area, to reduced growth, altered immune function, and mortality (Beitinger and Freeman 1983; Brette et al. 2014; Feist et al. 2011; Gobel et al. 2007; Incardona et al. 2004, 2005, and 2006; Mcintyre et al. 2012; Meadore et al. 2006; Sandahl et al. 2007; Spromberg et al. 2015).

The sediments at the site were sampled and analyzed in 2019. The analyses detected metals (arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc), PAHs, PCBs, heavy oil and diesel petroleum hydrocarbons, all at concentrations that exceeded the State's Sediment Management Standards screening criteria. Dioxins and furans were also detected in the sediment (PFSE 2020b). The planned dredging would mobilize these pollutants into the water column. The applicant estimates that the project would remove up to 2,000 cubic yards of sediment. The best available information suggest that sediment resuspension rates for clamshell dredging would be between 1 and 3 percent (Bridges et al. 2008; COE 2016). Assuming 3 percent resuspension suggests that up to 60 cubic yards of sediment would be temporarily re-suspended into the water column during dredging.

The in-water concentrations of dredge-mobilized contaminants would diminish back to pre-work levels within a few hours of stopping work. Some contaminants, such as such as lighter PAHs, would evaporate at the water's surface (Smith 2008; Werme et al. 2010), while most others would settling out of the water along with the mobilized sediments. The vast majority of the mobilized sediments would be contained within the full-depth sediment curtains that would surround the work area. Therefore, in the very unlikely event that listed fish would be present during in-water work, the in-water concentrations of dredge-mobilized pollutants outside of the sediment curtain would be too low and short-lived to cause more than temporary, non-injurious behavioral effects such as avoidance of the plume, which would not meaningfully affect the fitness or normal behaviors of an exposed fish. No detectable effects from exposure to dredge-mobilized pollutants would occur beyond 150 feet of the sediment curtain.

The risk and intensity of work-related equipment spills and discharges would be limited by project BMPs specifically intended to limit and correct spills and discharges, including working within a full-depth sediment curtain. If a work-related spill or discharge were to occur, it would likely be very small, and quickly contained and cleaned. Additionally, non-toxic and/or biodegradable lubricants and fluids are strongly encouraged by the State, and are commonly used by many of the local contractors. Based on the best available information, the in-water presence of spill and discharge-related contaminants would be very infrequent, very small, and very short-lived. Therefore, in the very unlikely event that listed fish would be present during in-water work, the in-water concentrations of work-related spills and/or discharges outside of the sediment curtain would be too low and too short-lived to cause more than temporary, non-injurious behavioral effects such as avoidance of the affected water, which would not meaningfully affect the fitness or normal behaviors of an exposed fish. No detectable exposure to work-related spills and/or discharges would occur beyond 150 feet of the sediment curtain.

Dredging-related Propeller Wash

Work-related tugboat operations would cause propeller wash within the action area. Spinning boat propellers kill fish and small aquatic organisms (Killgore et al. 2011; VIMS 2011). Spinning propellers also generate fast-moving turbulent water (propeller wash) that can displace and disorient small fish, as well as dislodge benthic aquatic organisms and SAV, particularly in shallow water and/or at high power settings (propeller scour).

However, work-related propeller wash is not likely to adversely affect PS Chinook salmon or PS steelhead because very few tugboat trips are planned, and it is extremely unlikely that individuals of either species would be present during the proposed work window. Further, any work-related propeller scour would likely affect a tiny portion of the SAV-supporting substrate within and the action area, and the disturbed benthic organisms would likely recover very quickly after the project is complete. Therefore, propeller scour's impacts on benthic resources would be too small and short-lived to cause meaningfully effects on the fitness or normal behaviors of juvenile salmonids within the action area.

Dredging-related Contaminated Forage

As described above under Work-related Degraded Water Quality, the planned dredging would mobilize about 60 cubic yards of contaminated sediment into the water column. The mobilized contaminated sediment would settle onto the top layer of the substrate, where for years after the project it would remain biologically available to juvenile PS Chinook salmon and PS steelhead through the trophic web. Therefore, work-related contaminated forage is likely to adversely affect juvenile PS Chinook salmon and PS steelhead.

The normal behaviors of juvenile Chinook salmon in the freshwater out-migration phase of their life cycle includes a strong tendency toward shoreline obligation, which means that they are biologically compelled to follow and stay close to streambanks and shorelines. Although the ship canal's heavily developed banksides tend to drive most migrating juvenile Chinook salmon toward the center of the channel, some subsets of each year's cohort are likely to migrate close to the shoreline within the action area. The normal behaviors of juvenile steelhead out-migrating through the ship canal tend toward swimming close to the center of the channel. However, over the decades-long life of the dry dock, some out-migrating juvenile steelhead are expected to pass through the action area. Therefore, both species are likely to pass through the action area.

The sediment analysis report indicates that sediment contaminants at the site include PAHs, metals, and dioxins (PFSE 2020b), which are known to be harmful to fish and other organisms. In addition to direct uptake of contaminants through their gills, salmonids can absorb contaminants through dietary exposure (Meador et al. 2006; Varanasi et al. 1993). Amphipods and copepods can uptake PAHs from contaminated sediments (Landrum and Scavia 1983; Landrum et al. 1984; Neff 1982), and pass them to juvenile Chinook salmon and other small fish through the food web. Varanasi et al. (1993) found high levels of PAHs in the stomach contents of juvenile Chinook salmon in a contaminated waterway (Duwamish). They also reported reduced growth, suppressed immune competence, as well as increased mortality in juvenile Chinook salmon that was likely caused by the dietary exposure to PAHs. Meador et al. (2006) demonstrated that dietary exposure to PAHs caused "toxicant-induced starvation" with reduced growth and reduced lipid stores in juvenile Chinook salmon. The authors surmised that these impacts could severely impact the odds of survival in affected juvenile Chinook salmon.

Romberg (2005) discusses the spread of contaminated sediments that were mobilized by the removal of creosote-treated piles from the Seattle Ferry Terminal, including digging into the sediment with a clamshell bucket to remove broken piles. Soon after the work, high PAH levels were detected 250 to 800 feet away, across the surface of a clean sand cap that had been installed less than a year earlier. Contaminant concentrations decreased with distance from the pile removal site, and over time. However, PAH concentrations remained above pre-contamination levels 10 years later. Lead and mercury values also increased on the cap, but the concentrations of both metals decreased to background levels after 3 years.

Most of the mobilized sediment, and therefore the highest concentrations of contaminants, would settle onto the top layer of the substrate within the full-depth sediment curtain, but small amounts may extend as far as 150 feet beyond the curtain (turbidity point of compliance for this project). The applicant would install a 2-foot deep clean sand layer to cap the dredged area. However, the mobilized sediments that settle to the bottom outside of the dredged area would remain biologically available to juvenile PS Chinook salmon and PS steelhead for years after project completion. While present, some of those contaminants are likely to be taken up by invertebrate prey organisms within the affected area.

Some subset of the juvenile PS Chinook salmon and PS steelhead that migrate through the ship canal are likely to pass through the action area each year. During their transit through the action area, at least some of those juveniles are likely to feed on the invertebrate resources within the action area, some of which may be contaminated by dredge-mobilized sediments. However, the annual number of juvenile PS Chinook salmon and PS steelhead that may be exposed to contaminated forage attributable to this action is unquantifiable with any degree of certainty and would be highly variable, as is the amount of contaminated prey that any individual fish may consume, or the intensity of any effects that an exposed individual may experience.

The affected area would be relatively small and offset well to the north of the typical juvenile salmonid migratory route in ship canal, which tends toward the center of the channel. This suggests that the juvenile salmonids that would be annually exposed to action-attributable contaminated prey would comprise a very small part of their cohort. Further, based on to the migratory behavior of the fish in this life stage, the time any individual would spend in the affected area would likely be very limited. There would also be a high degree of uncertainty that any individual invertebrate that is consumed within the affected area would be contaminated. Based on this information, the juvenile PS Chinook salmon and PS steelhead that would be measurably affected by consumption of action-attributable contaminated prey would likely comprise extremely small subsets of their cohort, and the numbers of measurably affected fish would be too low to cause detectable population-level effects.

Dredging-related Altered Benthic Habitat

The proposed dredging would maintain artificially deepened water along the north bank of the ship canal, and create a 36-foot wide swath of bankside habitat where the benthic substrate would be 20 to 22 feet below the water's surface (-20 feet re. LWSC) (Figure 2). It would also remove benthic organisms. As described above under contaminated forage, some subset of each year's cohort of out-migrating juvenile Chinook salmon, and to a lesser extent, out-migrating juvenile steelhead, are expected to pass through the action area. While swimming across the applicant's dredged area, juvenile salmonids are likely to experience increased exposure to piscivorous predators and increased energetic costs as compared to undisturbed shallow streambank habitats. Therefore, maintenance of the artificially deep bankside water is likely to adversely affect juvenile PS Chinook salmon and PS steelhead. The removal benthic organisms would cause only minor effects.

Deeper water favors freshwater predatory species, such as smallmouth bass and northern pikeminnow that are known to prey heavily on juvenile salmonids in the ship canal (Celedonia et al. 2008a; Tabor et al. 2010). The NMFS knows of no specific figures for freshwater, but Willette (2001) found that marine piscivorous predation of juvenile salmon increased fivefold when juvenile salmon left shallow shoreline habitats. Swimming through deeper water also negatively impacts the energy budget of shoreline obligated juvenile salmonids. Heerhartz and Toft (2015) report that the deepened water along armored shorelines decreases and/or alters prey availability, and that foraging in deeper water typically has higher energetic costs for juvenile salmon than foraging in shallow shoreline waters. Although the focus of the paper was shoreline armoring, the trophic impacts were caused by the deeper water that resulted from the armoring.

The dredging would maintain 36-foot wide swath (4,860-square feet) of 20-foot deep bankside habitat along the canal's north bank. If situated alone along a stretch of undisturbed shoreline, the dredged area's negative impacts on exposure to piscivorous predators and increased energetic costs would not be expected to measurably affect the fitness of migrating juvenile salmonids. However, because the applicant's dredged area is one of many long-standing similarly dredged areas that line this artificial waterway, its effects, in combination those of the adjacent deepened areas, would act to maintain an unbroken stretch of migratory habitat that consists of vertical banks and water depths measured in 10s of feet. Therefore, some out-migrating juvenile Chinook salmon that swim across the applicant's dredged area would experience mortality or reduced fitness that could reduce their overall likelihood of survival due to injury or stress-related effects from increased risk of predation and/or increased energetic costs that would be attributable to the dredged area.

The annual numbers of juvenile PS Chinook salmon that may be affected by depth-related increased predation and/or energetic costs is unquantifiable with any degree of certainty, but the numbers are likely to be extremely low. The expectation that only small subsets of a given cohort would approach the canal's banks combined with the very small size of the dredged area suggests that during any year, very few individuals would approach the dry dock. Further, because migrating juvenile salmonids tend to avoid the shade of over-water structures (Celedonia *et al*. 2008a and b; Kemp *et al*. 2005; Moore *et al*. 2013; Munsch *et al*. 2014; Nightingale and Simenstad 2001; Ono *et al*. 2010; Southard *et al*. 2006), only a small fraction of the fish that approach the dry dock would be expected to swim under it, and over the dredged area. Further, the complexities of predator/prey dynamics as well as variations in environmental conditions at the site support the understanding that the likelihood that any individual juvenile Chinook salmon or steelhead that swims over the dredged area would be exposed to a predator interaction would be low. However, over the life of the dry dock, it is extremely likely that at least some individuals would be exposed to predator interactions that would be attributable to the dredging. Those that fail to escape would be killed. Individuals that escape could experience reduced fitness due to increased energetic costs and stress-related effects that may reduce their overall likelihood of survival. Based on the best available information, the number of juvenile Chinook salmon and juvenile steelhead that would experience mortality or measurably reduced fitness attributable to dredge-related increased exposure to predators and increased energetic costs would be too low to cause detectable population-level effects.

The dredging would also reduce the abundance of benthic infaunal and epifaunal invertebrate organisms and SAV under the dry dock (Armstrong et al. 1981), and may reduce the availability of prey and cover resources for juvenile salmon. However, the entire dredged area is covered by a long-standing solid-decked platform that has limited primary production and the development of the aquatic community under it for many years. Therefore it is very unlikely that the invertebrate and SAV reductions that would be caused by the proposed dredging would cause any detectable effects on either species considered in this opinion.

Dry Dock-related Altered Lighting

During the day, the applicant's dry dock creates unnaturally harsh shade over the water and aquatic substrate along the north bank of the ship canal (Figure 1). The dry dock and the vessels on it also create artificial over-water illumination at night. The shade would continue to maintain conditions within and adjacent to the dry dock's foot print that limit aquatic productivity and increase juvenile salmonids' exposure and vulnerability to predators. The shade and artificial illumination would also continue to maintain conditions that alter juvenile salmonid migratory behaviors. As described above under contaminated forage, some subset of each year's cohort of out-migrating juvenile Chinook salmon, and to a lesser extent, out-migrating juvenile steelhead, are expected to pass through the action area. Therefore, over the dry dock's operational life, the altered lighting it causes is likely to adversely affect juvenile PS Chinook salmon and juvenile PS steelhead.

Shade: Shade limits primary productivity and can reduce the diversity of the aquatic communities under over-water structures (Nightingale and Simenstad 2001; Simenstad et al. 1999). Juvenile salmon feed on planktonic organisms such as amphipods, copepods, and euphausiids, as well as the larvae of many benthic species and fish (NMFS 2006). Because the 4,860-square foot, solid-decked dry dock casts a hard shadow over water and substrate that would otherwise be supportive of SAV and benthic invertebrates, it reduces the quantity and diversity of natural cover and prey organisms for juvenile salmonids.

If situated alone along a stretch of undisturbed shoreline, the dry dock's negative impacts on aquatic productivity might not be expected to measurably affect the fitness of migrating juvenile salmonids. However, because the applicant's dry dock is one of many long-standing bankside over-water structures that line this artificial waterway (Figure 1), its shadow, in combination with the shadows of the adjacent structures, act to maintain an unbroken stretch of migratory habitat with inadequate shelter and forage resources for juvenile salmonids. Therefore, juvenile Chinook salmon and juvenile steelhead within the action area are likely to experience some degree of reduced fitness due to reduced availability of cover and prey that would be attributable to the applicant's dry dock.

The shade of over-water structures also negatively affects juvenile salmonid migration. Numerous studies demonstrate that juvenile salmonids, in both freshwater and marine habitats, are more likely to avoid an overwater structure's shadow than to pass through it (Celedonia et al. 2008a and b; Kemp et al. 2005; Moore et al. 2013; Munsch et al. 2014; Nightingale and Simenstad 2001; Ono et al. 2010; Southard et al. 2006). Swimming around overwater structures increases the migratory distance, which has been positively correlated with increased mortality in juvenile Chinook salmon (Anderson et al. 2005).

If situated alone along a stretch of undisturbed shoreline, the shadow from the applicant's dry dock would alter the migratory behavior of most of the juvenile salmon that encounter it, by delaying their passage under the structure, or by inducing them to swim around it. However, the applicant's dry dock is one of many long-standing over-water structures that line this artificial waterway. The dry dock's shadow, in combination with the shadows of the adjacent over-water structures, creates a long series of individual obstacles that migrating juvenile salmonids must swim around, and that eventually act to force most juvenile Chinook salmon to migrate away from the bank, over deep water near the middle of the canal, which is well documented (Celedonia et al. 2008a and b; Tabor et al. 2000 and 2010) and contrary to normal migratory behavior for juvenile Chinook salmon at this life stage. As described above under altered benthic habitat, swimming in deep water increases the risk of predation and increases the energetic costs for migrating juvenile salmonids (Heerhartz and Toft 2015; Willette 2001).

Dry dock shade is also likely to increase juvenile salmonid exposure and vulnerability to predators. Shade and deep water both favor freshwater predatory species, such as smallmouth bass and northern pikeminnow that are known to prey heavily on juvenile salmonids (Celedonia et al. 2008a; Tabor et al. 2010). The dry dock would cast about 4,860 square feet of shade that would extend 140 feet from the shoreline over 20-foot deep water. The shadow would not increase the population of predatory fish in the action area, but it is likely to concentrate predatory fish within it. Therefore, juvenile Chinook salmon and juvenile steelhead are more likely to encounter predatory fish at the project site with the dry dock than they would in its absence. The depth of the water at the project site further increases the risk of predation because the increased water volume allows predators to attack from below and from the sides instead of from just one side as would be the case in shallow water along the shore. Note that the individuals that would be exposed to shade-related predator interactions would include all of the individuals discussed above under depth-related increased predation, with the addition of any individuals that would experience a shade-related predator interaction immediately adjacent to the dry dock, but outside of the dredged area.

The annual numbers of juvenile PS Chinook salmon that may be affected by shade-related effects are unquantifiable with any degree of certainty, but the numbers are likely to be extremely low. As described under depth-related effects, over the life of the dry dock, it is extremely likely that at least some individuals would be exposed to predator interactions that would be attributable to dry dock, but very few individuals of either species would be likely to approach the dry dock during any migration season, and it is relatively unlikely that any given individual would be exposed to a predator interaction near the dry dock. Based on the best available information, the number of juvenile Chinook salmon and juvenile steelhead that would experience mortality or measurably reduced fitness attributable to dry dock shade, including those considered under depth-related increased predation would be too low to cause detectable population-level effects.

<u>Artificial Lighting:</u> The dry dock and the vessels that use it have lighting systems that would cause nighttime artificial illumination of canal waters. Artificial lighting attracts fish (positive phototaxis) and often shifts nocturnal behaviors toward more daylight-like behaviors. It may also affect light-mediated behaviors such as migration timing.

Tabor and Piaskowski (2002) report that juvenile Chinook salmon in lacustrine environments typically feed and migrate during the day, and are inactive at night, residing at the bottom in shallow waters. They tend to move off the bottom and become increasingly active at dawn when light levels reach 0.8 to 2.1 lumens per square meter. Tabor et al. (2017) found that sub-yearling Chinook, coho, and sockeye salmon exhibit strong nocturnal phototaxic behavior when exposed to levels of 5.0 to 50.0 lumens per square meter, with phototaxis positively correlated with light intensity. Celedonia and Tabor (2015) found that juvenile Chinook salmon in the Lake Washington Ship Canal were attracted to artificially lit areas at 0.5 to 2.5 lumens per square meter. The authors also reported that attraction to artificial lights may delay the onset of morning migration by up to 25 minutes for some juvenile Chinook salmon migration through the Lake Washington Ship Canal.

The lighting systems for the dry dock and the vessels that would use it are undescribed. However, current satellite imagery of the shipyard shows numerous tall light poles lining the edges of the dry dock. The NMFS recently completed a consultation for a bridge replacement project that included a lighting system designed to limit illumination of the water yet still meet roadway safety standards (NMFS 2019). That system was predicted to illuminate the water's surface along the sides of the bridge at 1.08 lumens per square meter, which exceeds the 0.5 lumen per square meter level where phototaxis has been documented in Chinook salmon (Celedonia and Tabor 2015). Given the industrial nature and age of the shipyard, the NMFS expects that the overwater illumination caused by the existing lighting systems would be above the threshold where the onset of daylight activities and phototaxis would occur. Therefore, juvenile salmonids that are near the dry dock are likely experience some level of nocturnal phototaxis, and may experience other altered behaviors, such as delayed resumption of migration in the morning. Over the life of the dry dock, it is likely that a small subset of the exposed individuals would experience reduced fitness and/or altered behaviors that could reduce their overall likelihood of survival.

In summary, dry dock-related altered lighting would cause a combination of altered behaviors and increased risk of predation that would reduce fitness or cause mortality for some juvenile PS Chinook salmon and juvenile PS steelhead that pass the site. The annual numbers of either species that would be impacted by this stressor is unquantifiable with any degree of certainty, and the numbers are likely to vary greatly over time. However, the available information suggests that very few individuals from an out-migrating cohort would enter the action area. For any individual fish that enters the action area, the probability of exposure would be very low, and only a subset of the exposed individuals would be measurably affected. Therefore, for both species, the proportion of any year's cohort that would be killed or experience measurably reduced fitness due to altered lighting would be too low to cause any detectable population-level effects.

Dry Dock-related Contaminated Water

Extending the operational life of the dry dock would perpetuate the ongoing year-round shipyard work on it. That work includes the use of many materials that contain hazardous substances that episodically enter the water year-round. Because these discharges could occur while listed fish are present, dry dock-related contaminated water is likely to adversely affect juvenile PS Chinook salmon and PS steelhead.

The most common pollutants from shipyard work include petroleum-based fuels and lubricants, paints, solvents, and heavy metals. To reduce the likelihood of contaminants entering the water, the applicant is required to comply with the limits, measures, and BMPs identified in its NPDES Permit (WDOE 2020a), and its Industrial Wastewater Discharge Permit (King County 2018). Examples of control measures include procedures for the proper storage, use, and disposal of toxic chemicals; spill containment and clean-up procedures; requirements to enclose work areas where dusts and paint spray would be generated, and requirements to routinely sweep, vacuum, and clean work areas, including the dry dock deck to reduce the accumulation of materials that could enter the water.

Despite these measures, small amounts of contaminants would episodically enter canal waters from spills, overspray, fugitive dusts, and through stormwater runoff from the dry dock's deck. Those discharges would contain varying concentrations of PAH-containing oil and grease, solvents, and fine particulates that would include a mix of pulverized paint chips and metal dusts that would contain copper and other heavy metals. Additionally, vessels that moor at the applicant's facility before or after dry dock work would periodically discharge relatively small amounts of petroleum-based fuels and lubricants, and leach copper from anti-fouling hull paints into canal waters (Schiff *et al*. 2004). WDOE (2017) reports that dissolved copper concentrations from anti-fouling paints can be above 5 μg/L in protected moorages, but below 0.5 μg/L in open moorages with high flushing rates.

In freshwater, exposure to dissolved copper at concentrations between 0.3 to 3.2 µg/L above background levels has been shown to cause avoidance of an area, to reduce salmonid olfaction, and to induce behaviors that increase juvenile salmon's vulnerability to predators (Giattina et al. 1982; Hecht et al. 2007; McIntyre et al. 2012; Sommers et al. 2016; Tierney et al. 2010). The potential effects of exposure to many of the other toxic materials that would be in dock-related contaminated water were discussed earlier under dredging-related contaminated water.

The exact concentrations and distances from the dry dock that contaminants would be present in canal waters are unknown. However, the inputs are likely to occur year-round in an area where currents are slow. Along the banks, numerous vessels and over-water structures would act to slow it further, and to accumulate pollutants. Therefore, over the extended life of the dry dock, alone or in combination with discharges from adjacent similar facilities, the in-water concentrations of dry dock-related pollutants would occasionally exceed the threshold for the onset of meaningfully impacts on the fitness or normal behaviors of exposed fish during periods when listed fish would be present. The range of detectable effects that would be attributable to dry dock-related contaminated water are unlikely to extend beyond 300 feet from the dry dock.

The annual numbers of juveniles of either species that would be impacted by dry dock-related contaminated water are unquantifiable with any degree of certainty and are likely to vary greatly over time, as are the pollutant concentrations that any individual fish may be exposed to, or the intensity of effects that any exposed individual may experience. However, the affected area would be relatively small, and the available information suggests that very few individuals from an out-migrating cohort would enter the action area. Further, the occurrence of in-water pollutant concentrations above the threshold for the onset of meaningful effects would be infrequent and episodic, and the migratory behavior of the fish in this life stage suggests that the time any individual would spend within 300 feet of the dry dock would be very limited. Therefore, extremely few fish would be annually exposed to dry dock-related contaminated water at concentrations high enough to cause detectable effects, and the proportion of any year's cohort that would be meaningfully affected by dry dock-related contaminated water would be too low to cause any detectable population-level effects.

Dry Dock-related Contaminated Forage

Extending the operational life of the dry dock would perpetuate the ongoing year-round shipyard work on it. Hazardous substances generated by that work would be episodically discharged to the water and settle to the substrate where it would enter the salmonid trophic web through invertebrate prey organisms. Consumption of dry dock-related contaminated forage is likely to adversely affect juvenile PS Chinook salmon and PS steelhead.

The dry dock-generated contaminants discussed immediately above that sink would perpetually accumulate on and in the bottom sediments under and adjacent to the dry dock, where they would be biologically available into the foreseeable future. The potential effects of exposure to contaminated forage are described above at Work-related Degraded Contaminated Forage. Detectable effects would extend no more than 300 feet from the dry dock.

The annual numbers of juveniles of either species that may be exposed to dry dock-related contaminated forage are unquantifiable with any degree of certainty and are likely to vary greatly over time, as is the amount of contaminated prey that any individual fish may consume, or the intensity of any effects that an exposed individual may experience. However, the affected area would be relatively small, and the available information suggests that very few individuals from an out-migrating cohort would enter the action area. Further, based on to the migratory behavior of the fish in this life stage, the time any individual would spend in the affected area would likely be very limited, and there would be a high degree of uncertainty that any individual invertebrate that is consumed within the affected area would be contaminated. Based on this information, the annual numbers of juvenile Chinook salmon and steelhead that would be measurably affected by consumption of dry dock-related contaminated prey would comprise extremely small subsets of their cohorts that would be too small to cause detectable population-level effects.

Dry Dock-related Noise

Extending the operational life of the dry dock would perpetuate the ongoing episodic year-round operation of client vessels arriving and leaving the dry dock, and the use of power tools related to the vessel repair work that would be done on the dry dock. The vessels and power tool noise would radiate into the water where it would increase the risk of predation at the site and modify migratory behaviors, both of which could reduce the likelihood of survival for exposed individuals. Therefore, over the dry dock's operational life, the related vessel noise is likely to adversely affect juvenile PS Chinook salmon and PS steelhead.

The applicant reports that they would use the dry dock to work on about 20 vessels between 108 and 135 feet long annually. Shipyard-related vessel operations typically consist of episodic brief periods of relatively low-speed propulsion noise from client vessels or the tugs that deliver them to the shipyard. Propulsion noise would typically last several minutes to a low number of hours. Occasionally, the vessels' auxiliary systems would also cause continuous in-water noises while they are moored at an adjacent pier. Dry dock-related vessel noise would occur year-round. The estimated in-water SLs identified below are based on the best available information, as described in a recent acoustic assessments for projects with similar sources (NMFS 2016a & b), and in other sources (Blackwell and Greene 2006; FHWA 2001; McKenna *et al*. 2012; NoiseMeters 2020; Picciulin *et al*. 2010; Reine *et al*. 2014; Richardson *et al*. 1995). Table 6 summarizes the expected propulsion sound levels for some representative vessels with ranges to applicable effects thresholds for fish.

Table 6. In-water Source Levels for vessels with noise levels similar to those likely to utilize the dry dock, with estimated ranges to effects thresholds for fish.

Vessel Type	Acoustic Signature	Source Level	Threshold Range
85-foot long tourist ferry	< 2 kHz Combination	187 dB_{peak}	206 @ N/A
Episodic periods measured in minutes to a few hours		177 dB_{SEL}	150 @ 63 m
Tugboat	< 2 kHz Combination	185 dB_{peak}	206 @ N/A
Episodic periods measured in minutes to a few hours		170 dB_{SEL}	150 @ 22 m

Vessel repair work on the dry dock would involve the operation of equipment such as pumps and power tools such as pneumatic hammers, impact wrenches, chipping guns, grinders and saw. That equipment would be in operation relatively frequently throughout any given work day.

Some of the equipment noise would transfer into the water via the dry dock's platform. Table 7 summarizes the expected source levels for representative power tools, with ranges to applicable effects thresholds for fish.

It is extremely unlikely that client vessels and tugs would operate at anything approaching maximum speeds when near the dry dock. However, they may briefly use high power settings while maneuvering, and some of the vessels' auxiliary systems could be very loud and operated continuously while moored. To be conservative, the NMFS estimates that in-water noise levels approaching that of tugboat operations would be present at the dry dock anytime ships are present and in the water.

Similarly, not all power tool noise would radiate into the water. Sound transfer into the water would be highest in situations where a direct connection exists between the tool and the dry dock deck, and lowest when there is a lot of separation, such as working within a ship's upper spaces. To be conservative, the NMFS estimates that in-water noise levels approaching that of pneumatic tools would be present at the dry dock anytime ships are aboard the dry dock.

Table 7. In-water Source Levels for common shipyard equipment and power tools, with estimated ranges to effects thresholds for fish.

Power Tool	Acoustic Signature	Source Level	Threshold Range
Jackhammer	Est. < 2 kHz Impulsive	189 dB_{peak}	206 @ N/A
Daily multiple episodic periods measured in minutes to hours		169 dB_{SEL}	150 @ 19 m
Pneumatic Tools	Est. < 2 kHz Impulsive	185 dB_{peak}	206 @ N/A
Daily multiple episodic periods measured in minutes to hours		165 dB_{SEL}	150 @ 10 m
Impact Wrench	Est. < 2 kHz Impulsive	185 dB_{peak}	206 @ N/A
Daily multiple episodic periods measured in minutes to hours		165 dB_{SEL}	150 @ 10 m
Pumps	Est. < 2 kHz Impulsive	181 dB_{peak}	206 @ N/A
Daily multiple episodic periods measured in minutes to hours		161 dB_{SEL}	150 @ 5 m
Chipping Gun	Est. < 2 kHz Impulsive	179 dB_{peak}	206 @ N/A
Daily multiple episodic periods measured in minutes to hours		159 dB_{SEL}	150 @ 4 m
Air Compressor	Est. < 2 kHz Impulsive	178 dB_{peak}	206 @ N/A
Daily multiple episodic periods measured in minutes to hours		158 dB_{SEL}	150 @ 3 m

The best available information suggests that no dry dock-related sound sources would exceed the 206 dB_{peak} exposure threshold. However, the 150 dB_{SEL} isopleth may extend as far as 72 feet (22 m) around a vessel while near the dock, and as far as 33 feet (10 m) around the dry dock whenever a vessel is aboard. Any juvenile Chinook salmon and steelhead that are within those isopleths would likely experience behavioral disturbance, such as acoustic masking, startle responses, altered swimming patterns, avoidance, and increased risk of predation. The intensity of these effects would increase with increased proximity to the source and/or duration of exposure.

The annual number of individuals that may be impacted by this stressor is unquantifiable with any degree of certainty. However, the episodic nature of the noise events, the small size of the affected area, and the low numbers of juvenile PS Chinook salmon and PS steelhead that may be present at the project site at any given time, support the expectation that the numbers of individuals that may be annually exposed to dry dock-related noise would comprise extremely small subsets of their cohorts that would be too small to cause detectable population-level effects.

Dry Dock-related Propeller Wash
Extending the operational life of the dry dock would perpetuate the ongoing episodic year-round operation of client vessels arriving and leaving the dry dock. Those vessel operations would involve spinning propellers and propeller wash that is known to injure or kill aquatic organisms. Therefore, over the dry dock's operational life, the related propeller wash is likely to adversely affect juvenile PS Chinook salmon and PS steelhead.

Spinning propellers can kill fish and small aquatic organisms (Killgore *et al*. 2011; VIMS 2011). Spinning propellers also generate fast-moving turbulent water known as propeller wash that can displace and disorient small fish. Propeller wash can also mobilize sediments and dislodge aquatic organisms and SAV, particularly in shallow water and/or at high power settings. This is called propeller scour. Therefore, dry dock-related propeller scour may also reduce SAV and diminish the density and diversity of the benthic community at the project site.

The juvenile Chinook salmon and steelhead that migrate past the dry dock are likely to be relatively small and swimming close to the surface where they may be exposed to spinning propellers and propeller wash. Those juveniles would be too small to effectively swim against the wash. Individuals that are struck or very nearly missed by propeller blades would be injured or killed by the exposure. Those that are caught in the propeller wash, are likely to experience displacement that could increase energetic costs and reduce feeding success. Some may experience increased vulnerability to predators as they tumble stunned or disoriented in the wash. Although the likelihood of this interaction is very low for any individual fish or any individual vessel trip, it is likely that over the life of the dry dock, at least some juvenile Chinook salmon and steelhead would experience reduced fitness or mortality from exposure to spinning propellers and/or propeller wash at the site.

The annual number of individuals that may be impacted by this stressor is unquantifiable with any degree of certainty. However, the number of vessel movement events during the juvenile out-migration seasons for both species would be very low (typically less than 5 roundtrips) and very few individuals from an out-migrating cohort are likely to enter the action area. Based on this information, the annual numbers of juvenile Chinook salmon and steelhead that would be measurably affected by dry dock-related propeller wash would comprise extremely small subsets of their cohorts that would be too small to cause detectable population-level effects.

Dry dock-related propeller scour is unlikely to cause any detectable effects on the fitness and normal behaviors of Chinook salmon and steelhead. The combination of the low numbers of annual vessel transits, the expectation that low power settings would be used when maneuvering near the dry dock, and that the water depth is 20 feet or more near the dry dock suggest that propeller scour would have negligible effects on benthic resources at the site.

2.5.2 Effects on Critical Habitat

This assessment considers the intensity of expected effects in terms of the change they would cause in affected Primary Biological Features (PBFs) from their baseline conditions, and the severity of each effect, considered in terms of the time required to recover from the effect. Ephemeral effects are those that are likely to last for hours or days, short-term effects would likely last for weeks, and long-term effects are likely to last for months, years or decades.

Puget Sound Chinook Salmon Critical Habitat: The proposed action, including full application of the planned conservation measures and BMPs, is likely to adversely affect designated critical habitat for PS Chinook salmon as described below.

1. Freshwater spawning sites – None in the action area.
2. Freshwater rearing sites – None in the action area.

3. Freshwater migration corridors free of obstruction and excessive predation:
   a. Obstruction and excessive predation – The proposed project would cause minor long-term adverse effects on this attribute. The combination of maintaining bankside deep water, and the continued presence of the dry dock and its related altered light and in-water noise levels would maintain conditions at the site that prevent normal migration behaviors, and increase the risk of predation for juvenile Chinook salmon that approach the dry dock.
   b. Water quantity – The proposed project would cause no effect on this attribute.
   c. Water quality – The proposed action would cause minor long-term effects on this attribute. Dredging would cause short-term adverse effects on water quality that would be minor outside of the full-depth sediment curtains. However, continuing shipyard work on the dry dock would maintain persistent input of low levels of contaminants. Detectable effects would extend no more than 415 feet from the dry dock. The action would cause no measurable changes in water temperature or salinity.
   d. Natural Cover – The proposed action would cause minor long-term adverse effects on this attribute. Dredging would remove any SAV that is growing under the dry dock, and extending the useful life of the dry dock would maintain previously altered habitat conditions that act to greatly limit the growth of SAV.

4. Estuarine areas free of obstruction and excessive predation – None in the action area.

5. Nearshore marine areas free of obstruction and excessive predation – None in the action area.

6. Offshore marine areas – None in the action area.

2.6 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 and 402.17(a)). 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.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4).

The current conditions of ESA-listed species and designated critical habitat within the action area are described in the Rangewide Status of the Species and Critical Habitat and Environmental Baseline sections above. The non-federal activities in and upstream of the action area that have contributed to those conditions include past and on-going bankside development, vessel activities, and upland urbanization, as well as upstream forest management, agriculture, road construction, water development, subsistence and recreational fishing, and restoration activities. Those actions were, and continue to be, driven by a combination of economic conditions that characterized traditional natural resource-based industries, general resource demands associated with settlement of local and regional population centers, and the efforts of conservation groups dedicated to restoration and use of natural amenities, such as cultural inspiration and recreational experiences.

The NMFS is unaware of any specific future non-federal activities that are reasonably certain to affect the action area. However, the NMFS is reasonably certain that future non-federal actions such as the previously mentioned activities are all likely to continue and increase in the future as the human population continues to grow across the region. Continued habitat loss and degradation of water quality from development and chronic low-level inputs of non-point source pollutants will likely continue into the future. Recreational and commercial use of the waters within the action area are also likely to increase as the human population grows.

The intensity of these influences depends on many social and economic factors, and therefore is difficult to predict. Further, the adoption of more environmentally acceptable practices and standards may gradually reduce some negative environmental impacts over time. Interest in restoration activities has increased as environmental awareness rises among the public. State, tribal, and local governments have developed plans and initiatives to benefit ESA-listed PS Chinook salmon and PS steelhead within many of the watersheds that flow into the action area. However, the implementation of plans, initiatives, and specific restoration projects are often subject to political, legislative, and fiscal challenges that increase the uncertainty of their success.

2.7 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 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), 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) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

As described in more detail above in Section 2.4, climate change is likely to increasingly affect the abundance and distribution of the ESA-listed species considered in the opinion. It is also likely to increasingly affect the PBF of designated critical habitats. The exact effects of climate change are both uncertain, and unlikely to be spatially homogeneous. However, climate change is reasonably likely to cause reduced instream flows in some systems, and may impact water quality through elevated in-stream water temperatures and reduced dissolved oxygen, as well as by causing more frequent and more intense flooding events.

Climate change may also impact coastal waters through elevated surface water temperature, increased and variable acidity, increasing storm frequency and magnitude, and rising sea levels. The adaptive ability of listed-species is uncertain, but is likely reduced due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. The proposed action will cause direct and indirect effects on the ESA-listed species and critical habitats considered in the opinion well into the foreseeable future. However, the action's effects on water quality, substrate, and the biological environment are expected to be of such a small scale that no detectable effects on ESA-listed species or critical habitat through synergistic interactions with the impacts of climate change are expected.

2.7.1 ESA-listed Species

PS Chinook salmon and PS steelhead are both listed as threatened, based on declines from historic levels of abundance and productivity, loss of spatial structure and diversity, and an array of limiting factors as a baseline habitat condition. Both species will be affected over time by cumulative effects, some positive – as recovery plan implementation and regulatory revisions increase habitat protections and restoration, and some negative – as climate change and unregulated or difficult to regulate sources of environmental degradation persist or increase. Overall, to the degree that habitat trends are negative, the effects on viability parameters of each species are also likely to be negative. In this context we consider how the proposed action's impacts on individuals would affect the listed species at the population and ESU/DPS scales.

PS Chinook salmon

The long-term abundance trend of the PS Chinook salmon ESU is slightly negative. Reduced or eliminated accessibility to historically important habitat, combined with degraded conditions in available habitat due to land use activities appear to be the greatest threats to the recovery of PS Chinook salmon. Commercial and recreational fisheries also continue to impact this species.

The PS Chinook salmon most likely to occur in the action area would be fall-run Chinook salmon from the Cedar River and the North Lake Washington/Sammamish River populations, and part of the South Puget Sound MPG. Both populations are considered at high risk of extinction due to low abundance and productivity.

The project site is located along the north bank of the Lake Washington Ship Canal, which provides the only freshwater migration route to and from marine waters for adult and juvenile PS Chinook salmon from both affected populations. The environmental baseline within the action area has been degraded by the effects of nearby intense bankside development and maritime activities, and by nearby and upstream industry, urbanization, agriculture, forestry, water diversion, and road building and maintenance.

The timing of the proposed dredging avoids the presence of juvenile and adult Chinook salmon. However, over the next several decades, low numbers of out-migrating juveniles that pass close to the project site would be exposed to low levels of contaminated forage and other altered habitat conditions, that both individually and collectively, would cause some combination of altered behaviors, reduced fitness, and mortality in some of the exposed individuals. The annual numbers of individuals that would be detectably affected by action-related stressors would be extremely low.

Based on the best available information, the scale of the direct and indirect effects of the proposed action, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause detectable effects on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for the affected PS Chinook salmon populations. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

PS Steelhead

The long-term abundance trend of the PS steelhead DPS is negative, especially for natural spawners. Growth rates are currently declining at 3 to 10% annually for all but a few DIPs. The extinction risk for most DIPs is estimated to be moderate to high, and the DPS is currently considered "not viable". Reduced or eliminated accessibility to historically important habitat, combined with degraded conditions in available habitat due to land use activities appear to be the greatest threats to the recovery of PS steelhead. Fisheries activities also continue to impact this species.

The PS steelhead most likely to occur in the action area would be winter-run fish from the Cedar River and North Lake Washington/Lake Sammamish DIPs. The abundance trends between 1984 and 2016 was strongly negative for both DIPs, and ten or fewer adult natural-spawners are estimated to return to the DIPs annually.

The project site is located along the north bank of the Lake Washington Ship Canal, which provides the only freshwater migration route to and from marine waters for adult and juvenile PS steelhead from both affected DIPs. The environmental baseline within the action area has been degraded by the effects of nearby intense bankside development and maritime activities, and by nearby and upstream industry, urbanization, agriculture, forestry, water diversion, and road building and maintenance.

It is extremely unlikely that any PS steelhead would be directly exposed to the proposed dredging. However, over the next several decades, low numbers of out-migrating juveniles that pass close to the project site would be exposed to low levels of contaminated forage and other altered habitat conditions, that both individually and collectively, would cause some combination of altered behaviors, reduced fitness, and mortality in some of the exposed individuals. The annual numbers of individuals that would be detectably affected by action-related stressors would be extremely low.

Based on the best available information, the scale of the direct and indirect effects of the proposed action, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause detectable effects on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for the affected PS steelhead DIPs. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

2.7.2 Critical Habitat

Critical habitat was designated for PS Chinook salmon to ensure that specific areas with PBFs that are essential to the conservation of that listed species are appropriately managed or protected. The critical habitat for PS Chinook salmon will be affected over time by cumulative effects, some positive – as restoration efforts and regulatory revisions increase habitat protections and restoration, and some negative – as climate change and unregulated or difficult to regulate sources of environmental degradation persist or increase. Overall, to the degree that trends are negative, the effects on the PBFs of critical habitat for PS Chinook salmon are also likely to be negative. In this context we consider how the proposed action's impacts on the attributes of the action area's PBFs would affect the designated critical habitat's ability to support the conservation of PS Chinook salmon as a whole.

Past and ongoing land and water use practices have degraded salmonid critical habitat throughout the Puget Sound basin. Hydropower and water management activities have reduced or eliminated access to significant portions of historic spawning habitat. Timber harvests, agriculture, industry, urbanization, and shoreline development have adversely altered floodplain and stream morphology in many watersheds, diminished the availability and quality of estuarine and nearshore marine habitats, and reduced water quality across the region.

Global climate change is expected to increase in-stream water temperatures and alter stream flows, possibly exacerbating impacts on baseline conditions in freshwater habitats across the region. Rising sea levels are expected to increase coastal erosion and alter the composition of nearshore habitats, which could further reduce the availability and quality of estuarine habitats. Increased ocean acidification may also reduce the quality of estuarine habitats.

In the future, non-federal land and water use practices and climate change are likely to increase. The intensity of those influences on salmonid critical habitat is uncertain, as is the degree to which those impacts may be tempered by adoption of more environmentally acceptable land use practices, by the implementation of non-federal plans that are intended to benefit salmonids, and by efforts to address the effects of climate change.

The PBF for PS Chinook salmon critical habitat in the action area is limited to freshwater migration corridors free of obstruction and excessive predation. The site attributes of that PBF that would be affected by the action are obstruction and excessive predation, water quality, and natural cover. As described above, the project site is located along a heavily impacted waterway, and all three of these site attributes currently function at greatly reduced levels as compared to undisturbed freshwater migratory corridors. The continuation of the preferred substrate depth and the presence of the applicant's dry dock, along with the continuation of shipyard work on the dry dock bulkhead would cause minor long term effects on the identified site attributes.

Based on the best available information, the scale of the proposed action's effects, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause any detectable long-term negative changes in the quality or functionality of the freshwater migration corridors PBF in the action area. Therefore, this critical habitat will maintain its current level of functionality, and retain its current ability for PBFs to become functionally established, to serve the intended conservation role for PS Chinook salmon.

2.8 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, the effects of other activities caused by the proposed action, and cumulative effects, it is the NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of PS Chinook salmon and PS steelhead, nor is it likely to destroy or adversely modify designated critical habitat for PS Chinook salmon.

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).

This ITS provides an exemption for any take that would result from the indirect effects that would be caused by the dredging (dredging-related contaminated forage and altered benthic habitat), by the indirect effects that would be caused by the continued physical presence of the existing dry dock in its current location (dry dock-related altered lighting), and by some of the indirect effects that would be caused by the applicant's continued shipyard work that would be done on the dry dock (dry dock-related contaminated water and forage, and work noise).

However, although identified as take in the opinion and below, this ITS includes no exemption for take caused by the movement of third-party client vessels (dry dock-related vessel noise and propeller wash) because the COE has no jurisdiction over the vessel activities at the applicant's dry dock, and because there is no way to accurately predict the identity of third-party vessel operators and their specific operations en route to and from the dry dock. Therefore, we cannot mandate reasonable and prudent measures or terms and conditions to minimize the impacts of take caused by dry dock-related vessel noise and propeller wash.

2.9.1 Incidental Take Statement

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:
Harm of PS Chinook salmon and PS steelhead from exposure to:

- Dredging-related Contaminated Forage,
- Dredging-related Altered Benthic Habitat,
- Dry Dock-related Altered Lighting,
- Dry Dock-related Contaminated Water,
- Dry Dock-related Contaminated Forage,
- Dry Dock-related Noise, and
- Dry Dock-related Propeller Wash.

The NMFS cannot predict with meaningful accuracy the number of PS Chinook salmon and PS steelhead that are reasonably certain to be injured or killed annually by exposure to any of these stressors. The distribution and abundance of the fish that occur within an action area are affected by habitat quality, competition, predation, and the interaction of processes that influence genetic, population, and environmental characteristics. These biotic and environmental processes interact in ways that may be random or directional, and may operate across far broader temporal and spatial scales than are affected by the proposed action. Thus, the distribution and abundance of fish within the action area cannot be attributed entirely to habitat conditions, nor can the NMFS precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by the proposed action. Additionally, the NMFS knows of no device or practicable technique that would yield reliable counts of individuals that may experience these impacts.

In such circumstances, the NMFS uses the causal link established between the activity and the likely extent and duration of changes in habitat conditions to describe the extent of take as a numerical level of habitat disturbance. The most appropriate surrogates for take are action-related parameters that are directly related to the magnitude of the expected take. For this action, the timing of in-water work, the volume of dredged sediment, the turbidity plume, and the size and depth of the dredged area are the best available surrogates for the extent of take of juvenile PS Chinook salmon and PS steelhead

The timing of in-water work is applicable because the proposed in-water work window avoids the expected presence of PS Chinook salmon in the action area. Therefore, working outside of the proposed work windows would increase the potential that PS Chinook salmon would be exposed to work-related stressors that they otherwise would not be exposed to.

The total volume of dredged sediment and the lateral extent of the visible turbidity plume around the dredge are the best available surrogates for the extent of take of juvenile PS Chinook salmon and PS steelhead from exposure to dredging-related contaminated forage. The volume of dredged sediment is appropriate because the amount of contaminated sediment that would be mobilized and then settle onto the top layer of the substrate is directly related to the volume of the dredged material, and because the amount of biologically available contaminants would increase as the amount of mobilized contaminated sediments increases. The lateral extent of the turbidity plume is appropriate because the size the affected area would be positively correlated with the extent of the plume, and the numbers of contaminated prey organisms and/or exposed fish would be positively correlated with the size the affected area. Therefore, as the amount of mobilized contaminated sediment increases, the intensity of prey contamination would increase, and as the size of the visible turbidity plumes increase, the number of prey organisms that may become contaminated and then eaten by juvenile PS Chinook salmon PS steelhead would increase. Consequently, despite the low density and random distribution of these juveniles in the action area, any increase in these surrogates would increase in the intensity of the contamination and/or the number of listed fish that would be exposed.

The size and location of the dredged area is the best available surrogate for the extent of take of juvenile PS Chinook salmon and PS steelhead from exposure to dredging-related altered benthic habitat because dredging a larger area would increase the size of the area where supportive benthic resources would be removed, and in the case of dredging anywhere but directly under the dry dock, would remove resources from areas outside of the dry dock’s shadow where SAV and invertebrate productivity would likely be higher than in the described dredging area. Therefore, dredging beyond the described boundaries would increase the impact on benthic resources and/or the size of the affected area. Consequently, despite the low density and random distribution of juvenile PS Chinook salmon and PS steelhead in the action area, any dredging outside of the described area would increase the intensity of effect from habitat value reduction, and increase the number of listed fish that would be exposed to the altered habitat.

The current size and location of the dry dock is the best available surrogate for the extent of take of juvenile PS Chinook salmon and PS steelhead from exposure to dry dock-related altered lighting because a larger dry dock would increase the size of the area where the shade would affect salmonid migratory behaviors and reduce the productivity of supportive benthic resources. Relocation of the dry dock anywhere from its current location would cast shade over previously unshaded benthic substrates where SAV and invertebrate productivity would likely be higher than at the dry dock’s current location. Therefore, increasing the size of the dry dock and/or relocating it to any area beyond its current location would increase the impact on benthic resources and/or increase the size of the affected area. Consequently, despite the low density and random distribution of juvenile PS Chinook salmon and PS steelhead in the action area, any size increase or movement of the dry dock from its current location would increase the intensity of shade-related negative effects on migration and aquatic productivity, and increase the number of exposed listed fish.

The current size and location of the dry dock is the best available surrogate for the extent of take of juvenile PS Chinook salmon and PS steelhead from exposure to dry dock-related contaminated water, contaminated forage, and work noise. The size is appropriate for exposure to contaminated water and forage because a larger dry dock could increase the size and/or the number of vessels that would be serviced on it, either of which would increase the volume of pollutants that would be generated. Increasing the size of the dry dock would also increase the size of the area where work-related pollutants would accumulate and enter canal waters through stormwater runoff and/or submergence of the dock. Therefore, increasing the size of the dry dock would increase the pollutant discharge to canal waters, which would intensify the effects of exposure to contaminated water and prey. Relocation of the dry dock is appropriate because any movement closer to the channel would place the dry dock in an area where greater numbers of listed fish are likely to be exposed to dry dock-related contaminated water, contaminated forage, and work noise.

In summary, the extent of PS Chinook salmon and PS steelhead take for this action is defined as:

- 45 days of dredging-related in-water work between October 1 and April 15;
- Clamshell removal of 2,000 cubic yards of sediment, with turbidity not to exceed 5 NTU above background at 150 feet from the surrounding full-depth sediment curtain;
- Dredging of the 4,860-square foot area directly under Dry Dock #3; and
- The current size and position of Dry Dock #3 as described in the proposed action section of this biological opinion.

Exceedance of any of the exposure limits described above would constitute an exceedance of authorized take that would trigger the need to reinitiate consultation.

Although these take surrogates could be construed as partially coextensive with the proposed action, they nevertheless function as effective reinitiation triggers. If any of these take surrogates exceed the proposal, it could still meaningfully trigger reinitiation because the Corps has authority to conduct compliance inspections and to take actions to address non-compliance, including post-construction (33 CFR 326.4).

2.9.2 Effect of the Take

In the biological opinion, the 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 COE shall require the applicant to:

1. Ensure the implementation of monitoring and reporting to confirm that the take exemption for the proposed action is not exceeded.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary. The COE or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). The COE 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 implement reasonable and prudent measure 1:
    a. The COE shall require the applicant to develop and implement plans to collect and report details about the take of listed fish. That plan shall:
        i. Require the applicant and/or their contractor to maintain and submit records to verify that all take indicators are monitored and reported. Minimally, the records should include:
            1. Documentation of the timing and duration of in-water work to ensure that it is accomplished between October 1 and April 15;
            2. Documentation of the dates and location of full-depth sediment curtain installation and removal;
            3. Documentation of the dates, GPS locations, and description of dredging and sand cap installation work to confirm that it does not exceed the dimensions and/or characteristics described in this opinion;
            4. Documentation of the daily and cumulative sediment removal totals to confirm that it does not exceed the volumes described in this opinion;
            5. Documentation of the lateral extent of the turbidity plume, and measures taken to maintain it at no more than 5 NTU above background at the point of compliance as described in this opinion; and
            6. Documentation of the location and dimensions of the reinstalled dry dock to confirm that it does not exceed the dimensions and location as described in this opinion.
        ii. Require the applicant to establish procedures for the submission of the construction records and other materials to the appropriate COE office, and to submit an electronic post-construction report to the NMFS within six months of project completion. Send the report to: projectreports.wcr@noaa.gov. Be sure to include Attn: WCRO-2020-02559 in the subject line.

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

1. The COE and the applicant should encourage contracted tugboat operator(s) and client vessel operators to use the lowest safe maneuvering speeds and power settings when maneuvering near their facility, with the intent to minimize propeller wash effects and mobilization of sediments at the site.
2. The COE should encourage the applicant to develop a long-term plan to reduce the environmental impacts of their shipyard. Suggested measures include:
   a. Replacement or full encapsulation of all creosote-treated piles;
   b. Replacement of all creosote-treated timbers;
   c. Installation or adjustment of shipyard lighting systems to minimize nighttime illumination of canal waters while still meeting operational and safety needs;
   d. Transition the lubricants and fluids used in shipyard equipment to biodegradable fluids such as vegetable oils, synthetic esters, and polyalkylene glycols; and
   e. Institute or continue a program to improve the removal of pollutants from stormwater and dry dock discharges.

2.11 Reinitiation of Consultation

This concludes formal consultation for the U.S. Army Corps of Engineers' authorization of the Pacific Fishermen Shipyard and Electric, LLC Dry Dock #3 Maintenance Dredging Project in King County, Washington.

As 50 CFR 402.16 states, 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 if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) 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 (4) a new species is listed or critical habitat designated that may be affected by the action.

2.12 "Not Likely to Adversely Affect" Determinations

This assessment was prepared pursuant to section 7(a)(2) of the ESA, implementing regulations at 50 CFR 402 and agency guidance for preparation of letters of concurrence.

As described in Section 1.2 and below, the NMFS has concluded that the proposed action would be not likely to adversely affect southern resident (SR) killer whales and their designated critical habitat. Detailed information about the biology, habitat, and conservation status and trends of SR killer whales can be found in the listing regulations and critical habitat designations published in the Federal Register, as well as in the recovery plans and other sources at: https://www.fisheries.noaa.gov/species-directory/threatened-endangered, and are incorporated here by reference.

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. The effects analysis in this section relies heavily on the descriptions of the proposed action and project site conditions discussed in Sections 1.3 and 2.4, and on the effects analyses presented in Section 2.5.

2.12.1 Effects on Listed Species

SR killer whales are limited to marine water habitats, and would not be directly exposed to any project-related effects, but they could possibly be exposed to indirect effects through the trophic web. As described in Section 2.1 the PS Chinook population that would be affected by the proposed action is extremely small. Further, as described in Section 2.5, the proposed action would annually affect too few individuals to cause detectable population-level effects on the affected Chinook salmon populations. Therefore, any project-related reduction in Chinook salmon availability for SR killer whales would be undetectable. Similarly, although some juvenile Chinook salmon would be exposed to contaminated prey at the project site, their individual levels of contamination as well as the total numbers of annually exposed individuals would be too low to cause any detectable trophic link between the sediment contaminants and SR killer whales. Therefore, the action is not likely to adversely affect SR killer whales.

2.12.2 Effects on Critical Habitat

This assessment considers the intensity of expected effects in terms of the change they would cause in affected PBFs from their baseline conditions, and the severity of each effect, considered in terms of the time required to recover from the effect. Ephemeral effects are those that are likely to last for hours or days, short-term effects would likely to last for weeks, and long-term effects are likely to last for months, years or decades.

SR killer whale Critical Habitat: Designated critical habitat for SR killer whales includes marine waters of the Puget Sound that are at least 20 feet deep. The expected effects on SR killer whale critical habitat from completion of the proposed action, including full application of the conservation measures and BMP, would be limited to the impacts on the PBF as described below.

1. Water quality to support growth and development
   The proposed dredging would cause no detectable effects on marine water quality.

2. Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth
   The proposed action would cause long-term undetectable effects on prey availability and quality. Action-related impacts would annually injure extremely low numbers of individual juvenile Chinook salmon (primary prey), including exposing some individuals to contaminated prey. However, their numbers and levels of contamination would be too small

to cause detectable effects on prey availability, or to create any detectable trophic link between the sediment contaminants and SR killer whales. Therefore, it would cause no detectable reduction in prey availability and quality.

3. Passage conditions to allow for migration, resting, and foraging
   The proposed dredging would cause no detectable effects on passage conditions.

Therefore, the proposed action is not likely to adversely affect SR killer whale critical habitat.

For the reasons expressed immediately above, the NMFS concurs with the COE's determination that the proposed action is not likely to adversely affect ESA-listed SR killer whales and their designated critical habitat.

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

Section 305(b) of the MSA directs Federal agencies to consult with the NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). 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) of the MSA also requires the NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)].

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

3.1 Essential Fish Habitat Affected By the Project

The project site is located in Seattle, along the northern shore of the Lake Washington Ship Canal (Figure 1). The waters and substrate of the Lake Washington Ship Canal are designated as freshwater EFH for various life-history stages of Pacific Coast Salmon, which within the Lake Washington watershed include Chinook and coho salmon. The action area also overlaps with marine waters that have been designated, under the MSA, as EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species. However, the action would cause no detectable effects on any components of marine EFH. Therefore, the effects of the action would be limited to impacts on freshwater EFH for Pacific Coast Salmon, and it would not adversely affect marine EFH for Pacific Coast Salmon, or EFH for Pacific Coast groundfish and coastal pelagic species.

Freshwater EFH for Pacific salmon is identified and described in Appendix A to the Pacific Coast salmon fishery management plan, and consists of four major components: (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and holding habitat.

Those components of freshwater EFH for Pacific Coast Salmon depend on habitat conditions for spawning, rearing, and migration that include: (1) water quality (e.g., dissolved oxygen, nutrients, temperature, etc.); (2) water quantity, depth, and velocity; (3) riparian-stream-marine energy exchanges; (4) channel gradient and stability; (5) prey availability; (6) cover and habitat complexity (e.g., large woody debris, pools, aquatic and terrestrial vegetation, etc.); (7) space; (8) habitat connectivity from headwaters to the ocean (e.g., dispersal corridors); (9) groundwater-stream interactions; and (10) substrate composition.

As part of Pacific Coast Salmon EFH, five Habitat Areas of Particular Concern (HAPCs) have been defined: 1) complex channels and floodplain habitats; 2) thermal refugia; 3) spawning habitat; 4) estuaries; and 5) marine and estuarine submerged aquatic vegetation. The action area provides no known HAPC habitat features.

3.2 Adverse Effects on Essential Fish Habitat

The ESA portion of this document (Sections 1 and 2) describes the proposed action and its adverse effects on ESA-listed species and critical habitat, and is relevant to the effects on EFH for Pacific Coast Salmon. Based on the analysis of effects presented in Section 2.5 the proposed action will cause minor short- and long-term adverse effects on EFH for Pacific Coast Salmon as summarized below.

1. Water quality: – The proposed action would cause minor short- and long-term adverse effects on this attribute. The action would cause no changes in water temperature and salinity, but dredging and other in-water work would temporarily mobilize about 60 cubic yards of contaminated sediment that would increase in-water contaminant levels and turbidity, and may slightly reduce DO. Those effects would occur over a period of about 45 days, and be mostly limited to the area within a full-depth sediment curtain, but could be detectable up to 150 feet beyond the curtain; about 415 feet from the bank. Additionally, the year-round shipyard work that is done on the dry dock would perpetuate the episodic introduction of low levels of hazardous substances to canal waters. Detectable effects of dry dock-related contaminants would be limited to the area within about 300 feet around the dry dock.

2. Water quantity, depth, and velocity: – The proposed action would cause a long-term minor increase in the water depth directly under the dry dock. No changes in water quantity or velocity are expected.

3. Riparian-stream-marine energy exchanges: – No changes expected.

4. Channel gradient and stability: – No changes expected.

5. Prey availability: – The proposed action would cause long-term minor adverse effects on this attribute. The dredging and installation of clean sand would remove or cover benthic organisms and SAV under the dry dock, which would slightly reduce prey availability at the site. It would also maintain artificially deep bank-side water depths that limit SAV growth and reduces the density and diversity of the planktonic organisms such as amphipods, copepods, and larvae of many benthic species that are important prey resources for juvenile salmonids. Additionally, any dredging-mobilized contaminants that are not covered by the sand cap, combined with continued input of contaminants from shipyard work would contaminate some of the available prey resources. Detectable effects would be limited to the area within about 415 feet around the dry dock.

6. Cover and habitat complexity: – The proposed action would cause long-term minor adverse effects on this attribute. Dredging and installation of clean sand would temporarily eliminate SAV, and perpetuate simplified habitat conditions under the dry dock that consist of an unnaturally deep and flat mud bottom, and the dry dock's shadow would greatly limit and slow the recovery of the impacted SAV. Detectable effects would be limited to the area within the 4,860-square foot area directly under the dry dock.

7. Water quantity: – No changes expected.

8. Space: – No changes expected.

9. Habitat connectivity from headwaters to the ocean: – No changes expected.

10. Groundwater-stream interactions: – No changes expected.

11. Connectivity with terrestrial ecosystems: – No changes expected.

12. Substrate composition: – No changes expected.

3.3 Essential Fish Habitat Conservation Recommendations

The proposed action includes a comprehensive set of conservation measures and BMP that are expected to minimize dredge-related impacts on the quantity and quality of Pacific Coast salmon EFH. Additionally, the applicant's BMP plan for shipyard operations (PFSE 2018), and their State and County discharge permits (King County 2018; WDOE 2020a) comprise a set of conservation measures and requirements that are expected to minimize operational effects on EFH. The NMFS knows of no other practical measures that are available to further reduce the action's expected effects. Therefore, the NMFS makes no conservation recommendations pursuant to MSA (§305(b)(4)(A)).

3.4 Statutory Response Requirement

Section 305(b)(4)(B) of the MSA requires that an action agency provide a detailed response in writing to the NMFS within 30 days after receiving an EFH Conservation Recommendation. However, because the NMFS has made no EFH Conservation Recommendations, no EFH response is required from the COE for this action.

3.5 Supplemental Consultation

The COE must reinitiate EFH consultation with the 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 user of this opinion is the COE. Other interested users could include the applicant, WDFW, the governments and citizens of King County and the City of Seattle, and Native American tribes. Individual copies of this opinion were provided to the COE. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by the 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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