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.:
WCR-2018-10286

December 6, 2018

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 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Roanoke Reef Houseboat Owners Association Floats, Ramp, and Piling Replacement Project, King County, Washington, COE Number: NWS-2018-132, HUC: 171100120400 – Lake Union.

Dear Ms. Walker:

Thank you for your letter of July 11, 2018, 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 Roanoke Reef Houseboat Owners Association Floats, Ramp, and Piling Replacement 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 NMFS pursuant to section 7(a)(2) of the ESA on the effects of the proposed action. In this Opinion, NMFS concludes that the proposed action is likely to adversely affect but not likely to jeopardize the continued existence of Puget Sound (PS) Chinook salmon and PS Sound steelhead. 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. As required by section 7 of the ESA, NMFS has provided an incidental take statement with this Opinion. The incidental take statement describes reasonable and prudent measures NMFS considers necessary or appropriate to minimize the impact of 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.

This document also includes the results of our analysis of the action's likely effects on essential fish habitat (EFH) pursuant to Section 305(b) of the MSA. NMFS reviewed the likely effects of the proposed action on EFH, and concluded that the action would adversely affect designated EFH for Pacific Coast Salmon. Therefore, we have included the results of that review in Section 3 of this document.

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: Rory Lee, COE

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

Roanoke Reef Houseboat Owners Association Floats, Ramp, and Piling Replacement Project
King County, Washington
(COE Number: NWS-2018-132)

NMFS Consultation Number: WCR-2018-10286

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

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	Yes

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: December 6, 2018

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LIST OF ACRONYMS

ACZA – Ammoniacal Copper Zinc Arsenate
BE – Biological Evaluation
BMP – Best Management Practices
COE – Corps of Engineers, US Army
DIP – Demographically Independent Population
DO – Dissolved Oxygen
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
HAPC – Habitat Area of Particular Concern
HUC – Hydrologic Unit Code
Hz – Hertz (or cycles per second)
ITS – Incidental Take Statement
MPG – Major Population Group
MSA – Magnuson-Stevens Fishery Conservation and Management Act
NMFS – National Marine Fisheries Service
NTU – Nephlometric Turbidity Units
OHWM – Ordinary High Water Mark
OWCO – Oregon Washington Coastal Office
PAH – Polycyclic Aromatic Hydrocarbons
PBF – Primary Biological Feature
PCB – Polychlorinated Biphenyl
PCE – Primary Constituent Element
PFMC – Pacific Fishery Management Council
PS – Puget Sound
PSSTRT – Puget Sound Steelhead Technical Recovery Team
PSTRT – Puget Sound Technical Recovery Team
PTS – Permanent Threshold Shift
RL – Received Level
RMS – Root Mean Square
RPM – Reasonable and Prudent Measure
SAV – Submerged Aquatic Vegetation
SL – Source Level
SMS – Sediment Management Standards
TSS – Total Suspended Solids
TTS – Temporary Threshold Shift
VSP – Viable Salmonid Population
WCR – Westcoast Region (NMFS)
WDFW – Washington State Department of Fish and Wildlife
WDOE – Washington State Department of Ecology

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 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.

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 (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). A complete record of this consultation is on file at the Oregon Washington Coastal Office.

1.2 Consultation History

The NMFS received a letter from the US Army Corps of Engineers (COE) on July 11, 2018 requesting informal consultation for the proposed action (COE 2018a). That letter also stated that it would serve as the COE's request for formal consultation should NMFS determine that the project is likely to adversely affect species or critical habitat under our jurisdiction. The consultation request also included enclosed project drawings (Marine Floats 2018) and a biological evaluation (BE, MSA 2018a), and for the proposed action.

On August 21, 2018, NMFS informed the COE that formal consultation was required for the proposed action, and requested additional information, including clarification of the effects determination in the BE. However, because the original request contained adequate information to consult, formal consultation was initiated on July 11, 2018. The COE provided the requested information on September 24, 2018 (COE 2018b; MSA 2018b).

This Opinion is based on the review of the information and project drawings identified above; recovery plans, status reviews, and critical habitat designations for ESA-listed PS Chinook salmon and PS steelhead; published and unpublished scientific information on the biology and ecology of those species; and relevant scientific and gray literature (see Literature Cited). A complete record of this consultation is on file at the Oregon Washington Coastal Office (OWCO) in Lacey, Washington.

1.3 Proposed Action

"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). "Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02).

The COE proposes to authorize the Roanoke Reef Houseboat Owners Association (the applicant) to replace a commercial pier in Lake Union, Washington (Figure 1). The life of the proposed replacement structure would exceed the remaining life of the existing structure by several decades. Further, vessel activity in the vicinity of the new structure would be interrelated and interdependent with the proposed action.

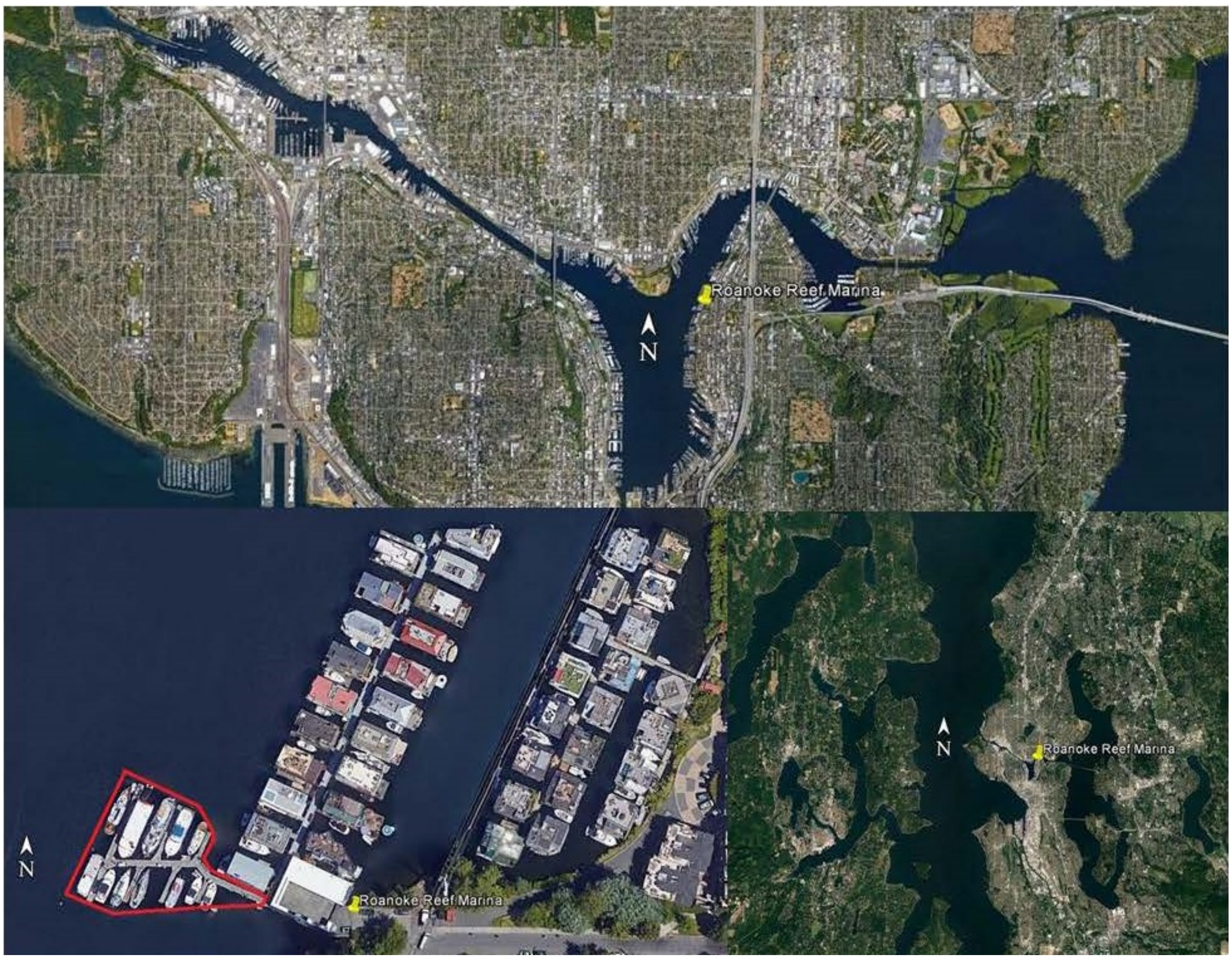

Figure 1. Google satellite photographs of the Roanoke Reef Marina in Lake Union, Washington. The red polygon outlines the mooring structure to be replaced.

The structure to be replaced is a solid-decked, pile-supported pier and ramp with a combined surface area of 2,803 square feet. Its shoreward-most point is about 107 feet offshore from the ordinary high water mark (OHWM), where it connects to an existing concrete pier that would remain unchanged, and is not otherwise considered part of the proposed action. The existing structure consists of 7 finger piers attached to a central walkway. The structure is supported by 133 creosote-treated timber piles between 10- and 12-inches in diameter. The applicant would also remove a dolphin that consists of 9 10- to 12-inch diameter creosote-treated timber piles.

The new structure would be a floating dock system with the same configuration and surface area, but half of the float decking would consist of fiberglass grating with 69 percent open area, and the ramp would be fully grated (Figures 2 and 3). The floats would be attached to 10 12-inch, and 5 18-inch diameter steel piles.

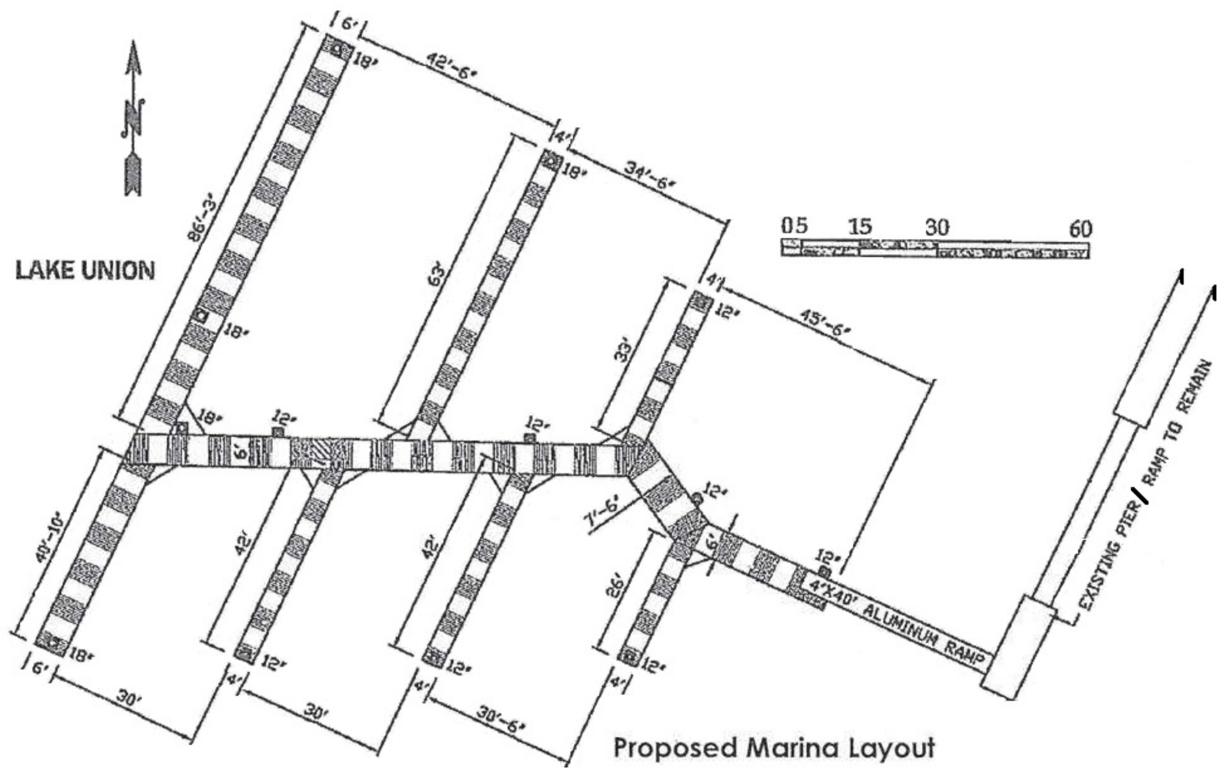

Figure 2. Overhead drawing of the applicant's proposed mooring structure (Adapted from Marine Floats 2018, Figure 3).

Work would be performed from work and supply/waste barges or from on-site structures. The barges would likely hold position with spuds. The applicant's contractor would use hand-held tools to disconnect the existing pier from its support piles, and a barge-mounted crane to place the old pier sections on a disposal barge. They would also use the barge-mounted crane, with a vibratory pile extractor, to pull the 142 old timber piles, and to place them on the disposal barge.

The applicant gave no estimate for pile extraction. However, based on the applicant's estimate that 20 minutes of vibratory diving would be required to install a single pile, and adding 10 minutes per pile for transition between sequential piles, about 2 piles could be extracted per hour. Depending on the length of the work day (up to 10 hours), and with no delays, about 20 piles could be extracted per day. Therefore, this opinion assumes that about 7 days of work would be required for vibratory extraction of the 142 existing timber piles.

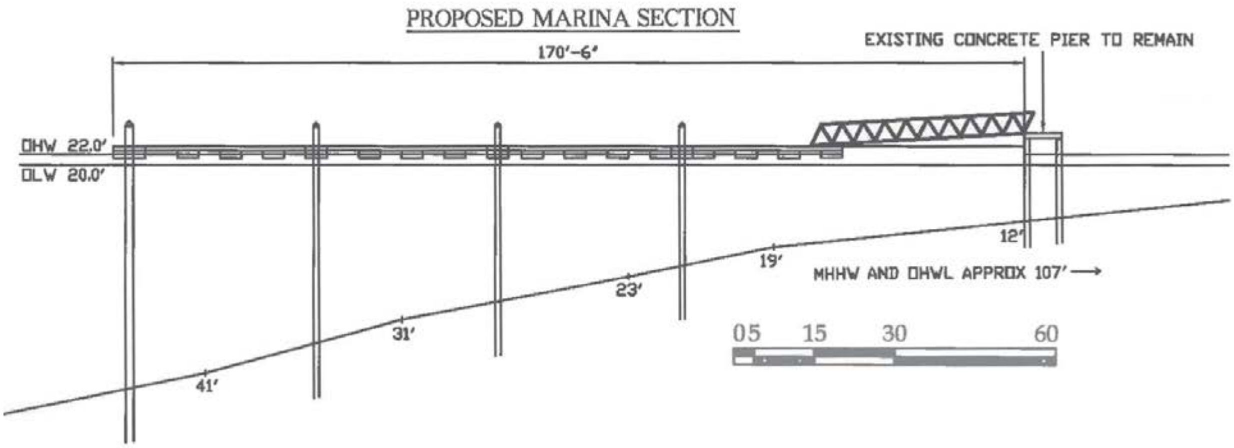

Figure 3. Profile drawing of the applicant's proposed mooring float and ramp. Depths are in feet (Adapted from Marine Floats 2018, page 4).

Following demolition, the contractor would use the barge-mounted vibratory pile extractor/driver to install 15 steel piles. They predict that 4 days would be required for this work, with 20 minutes of vibratory work required per pile, and up to 4 piles being installed per day. The new float sections would be constructed off-site, and towed into position. Hand tools would be used to join the float sections into a single piece and to connect them to the supporting piles.

The project would take 3 weeks to complete. To minimize exposure of protected species' to construction, the contractor would comply with the conservation measures identified in the project's BE, including preforming all in-water work between July 15 and February 15. The contractor would also commits to comply with the impact minimization measures identified in the provisions listed in the Washington State Department of Fish and Wildlife (WDFW) Hydraulic Project Approval (HPA) for this project when issued.

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, NMFS provides an opinion stating how the agency's actions would affect listed species and their critical habitat. 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.

As described above in Section 1.2, the COE determined the proposed action is not likely to adversely affect all of the species and critical habitats identified in Table 1, but also requested formal consultation for any species and critical habitats under NMFS jurisdiction that we determined would be adversely affected by the proposed action. NMFS did not concur that the proposed action is not likely to adversely affect PS Chinook salmon, PS steelhead, and designated critical habitat for PS Chinook salmon, and thus have proceeded with formal consultation for those species and critical habitat.

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	LAA	N/A	05/11/07 (72 FR 26722) / 02/24/16 (81 FR 9252)

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 biological opinion includes both a jeopardy analysis and/or an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of “to jeopardize the continued existence of” a listed species, which is “to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species” (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

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

Past critical habitat designations have used the terms primary constituent element (PCE) or essential feature (EF) to identify important habitat qualities. However, the new critical habitat regulations (81 FR 7414; February 11, 2016) replace those terms with physical or biological features (PBF). This shift in terminology does not change the approach used in conducting our analysis, whether the original designation identified PCE, EF, or PBF. For simplicity, we universally apply the term PBF in this Opinion for all critical habitat, regardless of the term used in the specific critical habitat designation.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or to cause the destruction or adverse modification of designated critical habitat:

- Identify the range-wide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.
- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.
- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.
- If necessary, suggest a reasonable and prudent alternative (RPA) to the proposed action.

2.2 Range-wide Status of the Species and Critical Habitat

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

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: http://www.nmfs.noaa.gov/pr/species/fish/, 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 (Table 1) 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: 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 fresh water for a year or more before entering marine waters. Conversely, ocean-type juveniles typically migrate out of their natal streams early in their first year of life. 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).

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

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).

<u>Abundance and Productivity:</u> 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 2017a).

Limiting Factors: 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

PS Chinook Salmon within the Action Area: The PS Chinook salmon populations that occur in the action area consist of fall-run Chinook salmon from the Cedar River population and the North Lake Washington / Sammamish River population (NWFSC 2015; WDFW 2018a). The Cedar River population is relatively small, with a total annual abundance fluctuating at close to 1,000 fish (NWFSC 2015; WDFW 2018b). Between 1965 and 2016, 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. However, WDFW data through 2016 suggest that natural-origin spawners account for a diminishing proportion of the total, with natural-origin spawners accounting for about 60% of a combined total return of 1,025 fish in 2016 (WDFW 2018b). The Sammamish River population is also small, with a total abundance that has fluctuated between about 33 and 2,223 individuals from 1983 through 2016. Natural-origin spawners comprise a small proportion of the total population, and the trend in natural-origin spawners is negative (NWFSC 2015; WDFW 2018b). Natural-origin spawners accounted for only about 12% of the 1,247 total return in 2016 (WDFW 2018b).

All returning adults and out-migrating juveniles of these two populations, as well as the individuals that spawn in the numerous smaller streams across the basin, must pass 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. Both stream- and ocean-type Chinook salmon are present in the basin, with the majority being ocean-types. Stream-type fish 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. 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 recovery plan for this DPS is under development. 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 2017a).

<u>Limiting Factors:</u> 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

<u>PS Steelhead within the Action Area:</u> The PS steelhead populations that occur in the action area consist of winter-runs from the Cedar River and North Lake Washington / Lake Sammamish populations. Both populations are among the smallest within the DPS (NWFSC 2015; WDFW 2018c). WDFW reports that the total PS steelhead abundance in the Cedar River basin has fluctuated between 0 and 900 individuals between 1984 and 2016, with a strong negative trend. Since 2000, the total annual abundance has remained under 50 fish. 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 10 adults returned in 2016 (WDFW 2018c). 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 (WDFW 2018c). 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 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 and PS/GB bocaccio. Nearshore marine areas were not designated as critical habitat for PS steelhead.

Puget Sound Chinook Salmon Critical Habitat: 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. The PBF of PS Chinook salmon critical habitat that may be affected by the proposed action is limited to freshwater migration.

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

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 (LW) 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.

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 LW 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 LW. 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. 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 (*e.g*., Elwha River dams block anadromous fish access to 70 miles of potential 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 LW 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).

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). As described in Section 2.5, elevated turbidity and impacted water quality within about 100 yards (91 m) around the project site would be the project-related stressor with the greatest range of effect. All other project-related effects, including indirect effects would be undetectable beyond that range. Therefore, for the purposes of this consultation, the action area for NMFS trust resources is limited to the waters of the Lake Washington Ship Canal within 100 yards of the project site. This action area overlaps with the geographic ranges and boundaries of the ESA-listed species and designated critical habitat identified earlier in Table 1. The action area also overlaps with areas that have been designated, under the MSA, as EFH for Pacific Coast salmon.

2.4 Environmental Baseline

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

<u>Environmental conditions at the project site and the surrounding area:</u> The project site is located in Seattle, along the northeastern shore of Lake Union, adjacent to the Lake Washington Ship Canal (Figure 1). The project site is located about 107 feet offshore from a bulkhead shoreline,

where the water depth ranges from about -12 feet to more than -40 feet relative to the ordinary high water mark. A large pier that supports about 20 house boats and other water craft is installed shoreward of the project site. Some riparian trees and shrubs exist along about 100 yards of shoreline adjacent to the applicant's pier.

The ship canal is 8.6 miles long and averages 30 feet deep in the navigational channel. The canal is about 100 feet wide in the cuts, but widens at Portage Bay, Lake Union, and Salmon Bay. Lake Union covers just less than 1 square mile (581 acres) and has an average depth of 33 feet and a maximum depth of 50 feet (City of Seattle 2010). 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 existing ship 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. It 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 Lake Union and 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, with about 96% of the canal's banks being armored (City of Seattle 2008). Water depths along the armored banks of the canal and parts of Lake Union are typically measured in tens of feet instead of the slopes that gently rise to the surface along the banks of natural streams.

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. Very little riparian vegetation exists along the banks of Lake Union and the ship canal. With the exception of the southern shoreline of Portage Bay, and along the Fremont and Mountlake Cuts, both of which are armored with bulkheads.

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 (DO), 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 (FL)), 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 accumulate downstream of the fish ladder.

The action area provides migratory habitat for adult and juvenile PS Chinook salmon and PS steelhead. In fact, it is located along the only route to and from marine waters for those fish, as well as for all other anadromous salmonids in the Lake Washington and Lake Sammamish watersheds, which must pass by or through the action area twice to reproduce; first as out-migrating juveniles, then again as returning adults. The area has also been designated as critical habitat for PS Chinook salmon. The past and ongoing anthropogenic impacts described above have established conditions that maintain low current velocities, as well as salinity and temperature gradients that hinder migration of both juvenile and adult salmonids, and expose PS Chinook salmon and PS steelhead to high levels of predation.

<u>Climate Change:</u> 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 °C), and up to 2° F (1.1 °C) 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 5.6° 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 3.5-5.3°C increases in Columbia Basin streams and a peak temperature of 26°C 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 on Species and Designated Critical Habitat

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Direct effects are caused by exposure to action-related stressors that occur at the time of the action. Indirect effects are effects caused by the proposed action that occur later in time but are still reasonably certain to occur.

As described in Section 1.3, between July 15 and February 15, the applicant's contractors would conduct about 3 weeks of in- and above-water work in the Lake Washington Ship Canal, at the northeast end of Lake Union. They would replace a 2,803-square foot, solid-decked, pile-supported pier and ramp with a floating structure of the same size and configuration. Using barge-mounted vibratory equipment, they would also remove 142 10- to 12-inch diameter creosote-treated timber piles, and install 15 steel piles between 12 and 18 inches in diameter. Pile removal and installation is reasonably likely to occur over 11 days or more. This assessment is based on the expectation that up to 3 weeks (15 workdays) of pile work may occur.

PS Chinook salmon and/or PS steelhead are most commonly present in the action area when adults return from marine waters to spawn upstream of the action area, and when ocean-bound juveniles head downstream to begin the marine phase of their lifecycle. Designated critical habitat for PS Chinook salmon is also present at the site.

As described earlier, adult Chinook salmon are typically migrate through the action area mid-June through September, and outbound juveniles are likely between late-May and early-July. Adult steelhead typically migrate through the action area between January and May, while outbound juveniles are likely between April and May. However, low numbers of juveniles of both species occasionally remain in freshwater when the rest of their cohort transition to the marine phase. As such, individuals of either species may be present in the action area year-round, but in extremely low numbers except during typical migrate periods. The proposed work window would avoid the typical migration periods for the juveniles of both species, but it overlaps with the migrations of adult PS Chinook salmon and PS steelhead, and it may expose low numbers of residual fish of either species.

The proposed action is COE authorization to replace a mooring structure. The planned work is likely to cause direct effects on PS Chinook salmon, PS steelhead, and on the PBFs of critical habitat for PS Chinook salmon through exposure to construction-related elevated noise, degraded water quality, and artificial lighting. It may also cause indirect effects through reduced submerged aquatic vegetation (SAV), reduced forage resources, and exposure to contaminated forage. The new mooring structure is expected to remain on the landscape for decades. The structure and the vessel activities that would be interrelated with it are reasonably certain to cause effects through impacts on water quality, altered lighting, noise, and propeller wash.

2.5.1 Effects on List Species

Construction-related Elevated Noise: Exposure to construction-related elevated noise would cause minor effects in PS Chinook salmon and PS steelhead. Elevated in-water noise at levels capable of causing detectable effects in exposed fish is likely to result from the vibratory extraction and installation of piles, as well as from the vessels that are used to perform that work, such as the tugs used to position the barge-mounted equipment, and the spuds that are used to hold the barge in place.

The planned work window avoids the expected out-migration periods for juvenile Chinook salmon and steelhead in this watershed, but overlaps with run times for retuning adults of both species. Therefore, it is extremely unlikely that juveniles of either species would be exposed to construction-related noise, but adults may be exposed to this stressor.

The effects of exposure to noise vary with the frequency, intensity, and duration of the exposure, the hearing characteristics of the exposed fish, and the context under which the exposure occurs. At low levels, effects may include the onset of behavioral disturbances such as temporary masked communications or acoustic environmental cues, modified behaviors, and temporarily hearing damage (a.k.a. temporary threshold shift or TTS). At higher intensities and/or longer exposure durations, the effects may include physical injury that can range from the onset of permanent hearing damage (a.k.a. permanent threshold shift or PTS) to mortality.

Sound is a mechanical disturbance consisting of vibrations that travel through a medium, such as air or water, and is generally characterized by several variables. Frequency describes the sound's pitch and is measured in hertz (Hz) or cycles per second. Sound level describes the sound's loudness. Loudness can be measured and quantified in several ways, but the decibel (dB) is the most commonly used unit of measure, and sound pressure level (SPL) is a common and convenient term used to describe intensity. Root mean square (RMS) is the quadratic mean sound pressure over the duration of a single impulse. RMS includes both positive and negative values so that they may be accounted for in the summation of pressure levels (Hastings and Popper 2005). RMS units are often used in the context of predicting behavioral effects in marine mammals. Sound exposure level (SEL) is a term that is used to describe the amount of sound energy a receiver is exposed to over time.

In the absence of location-specific transmission loss data, the equation RL = SL – #Log(R) – α is often used to estimate the received level at a given range from the source (RL = received level (dB); SL = source level (dB); # = spreading loss coefficient; R = range in meters (m); and α = absorption coefficient in the water in dB(R/km). Spherical spreading loss is estimated with spreading coefficient of 20, and cylindrical spreading loss is estimated with spreading coefficient of 10. Acoustic measurements in shallow-water environments support the use of a value close to 15, which is considered the practical spreading loss coefficient.

The absorption coefficient (α) is related to frequency. The absorption coefficient approaches 0 for frequencies below 10,000 Hz (1 kHz), so it is often left off of the equation. As discussed below, the highest levels of sound energy from all action-related sound sources are well below 10,000 Hz. Therefore, the effect that frequency would have on absorption would be virtually undetectable, and the simplified practical spreading loss formula (RL = SL – 15Log(R)) is used to estimate ranges for the acoustic sources considered in this Opinion.

Based on the best available information, as described in recent acoustic assessments for similar work (NMFS 2017b, 2018) and other sources, the frequency ranges of all of the construction-related sources would be under 2,500 Hz, and the source levels for all sources would be well below the 206 dB_{peak} threshold for the onset of injury in fish (Stadler and Woodbury 2009). The expected SLs, sound characteristics, and ranges to effects thresholds for fish are summarized below in Table 5.

Spud deployment is expected to be the loudest source, and the only impulsive noise. Spuds are expected to cause a maximum of 8 impulses during any day that barges are moved. The loudest non-impulsive sound is likely to be caused by vibratory driving of piles. Vibratory driving and extraction and of piles would also cause the most sustained noise, with a combined total of 240 minutes of work that may occur over no more than 7 days. Tugboat-related noise would likely consist of episodic events of 1 to 2 hours when the tugboat is present to move barges.

The best available information about the auditory capabilities of fish suggest that the hearing in the species considered in this Opinion is 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). Studies indicate that exposure to elevated noise may cause physiological effects in fish that may include temporary hearing loss (Scholik and Yan

2002), increased stress (Graham and Cooke 2008), and increased vulnerability to predators (Simpson *et al*. 2016). It may also cause behavioral effects such as acoustic masking (Codarin *et al*. 2009), startle responses and altered swimming (Neo *et al*. 2014), and abandonment or avoidance of the area of acoustic effect (Mueller 1980; Picciulin *et al*. 2010; Sebastianutto *et al*. 2011; Xie *et al*. 2008).

Table 5. Estimated in-water dB_{peak} and dB_{SEL} Source Levels for construction-related sound sources, along with source-specific ranges to the appropriate effects thresholds for fish. Applicable thresholds for each source are highlighted in grey.

Source	Acoustic Signature	Source Level	Threshold Range
Spuds	**< 1,600 Hz Impulsive**	**201 dB_{peak}**	**206 @ N/A**
Episodic, 4 to 8 episodic impulses per day when barges are present		176 dB_{SEL}	183 @ N/A
		176 dB_{SEL}	187 @ N/A
		176 dB_{SEL}	150 @ 54 m
Vib. Install 18-inch Steel Pile	< 2,500 Hz Non-Impulsive	190 dB_{peak}	206 @ N/A
80 minutes of vibratory noise. The 183 and 187 ranges for accumulated noise is based on exposure to full day of pile noise.		175 dB_{SEL}	183 @ 83 m
		175 dB_{SEL}	187 @ 45 m
		175 dB_{SEL}	150 @ 46 m
Vib. Install 12-inch Steel Pile	< 2,500 Hz Non-Impulsive	186 dB_{peak}	206 @ N/A
80 minutes of vibratory noise. The 183 and 187 ranges for accumulated noise is based on exposure to full day of pile noise.		170 dB_{SEL}	183 @ 39 m
		170 dB_{SEL}	187 @ 21 m
		170 dB_{SEL}	150 @ 22 m
Tug Propulsion	< 1,000 Hz Combination	185 dB_{peak}	206 @ N/A
Episodic, 1 - 2 hours/day when the tug is present		170 dB_{SEL}	183 @ 51 m
		170 dB_{SEL}	187 @ 28 m
		170 dB_{SEL}	150 @ 22 m
Vib. Extract 14-inch Timber Pile	< 2,500 Hz Non-Impulsive	181 dB_{peak}	206 @ N/A
400 minutes of vibratory noise. The 183 and 187 ranges for accumulated noise is based on exposure to full day of pile noise.		171 dB_{SEL}	183 @ 132 m
		171 dB_{SEL}	187 @ 71 m
		171 dB_{SEL}	150 @ 22 m

The criteria currently used by NMFS to estimate the onset of injury for fish exposed to high intensity impulsive sounds uses two metrics: 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; or exposure above 150 dB_{SEL}. Any 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 there is a difference between the ranges to the isopleths for effective quiet and SEL_{cum}, the shorter range shall apply.

The discussion in Stadler and Woodbury (2009) makes it clear that the thresholds likely overestimate the potential effects on fish from exposure to impulsive sounds. Further, non-impulsive sounds, such as those that predominate this action, are believed to be less injurious to fish than impulsive sounds, and they were not considered in the thresholds. Therefore, any application of the criteria to non-impulsive sounds would likely overestimate the potential for effects in fish. The criteria are applied here to both impulsive and non-impulsive sounds for continuity, and as a tool to gain a conservative idea of the sound energies that fish may be exposed to during project work.

The SL for all construction-related sources are below the threshold for instantaneous injury. However, the 150 dB_{SEL} isopleth would extend to about 177 feet (54 m) around the project site for very brief periods (fractions of a second) during episodic placement of barge spuds. The 150 dB_{SEL} isopleth would extend to about 151 feet (46 m) during installation of 18-inch piles, and to about 72 feet (22 m) around all other in-water work.

Fish beyond the 150 dB_{SEL} isopleth would be unaffected by the exposure. 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. Those at the far limit of the range are likely to experience the onset of temporary behavioral disturbances such as mild acoustic masking, alerting behaviors, and altered swimming patterns. The intensity of effect would increase with proximity to the source and duration of exposure, such that alerting and altered swimming may include avoidance or abandonment of an area, release of stress hormones, and reduced predator avoidance. Prolonged exposure to the sound, such that accumulated sound energy exceeds the 183/187 dB SEL_{cum} thresholds, is likely to cause injuries to auditory tissues. Non-auditory tissue injury is also possible.

Adult Chinook salmon and steelhead are much larger than 2 grams, independent of shoreline waters, highly mobile, and extremely unlikely to remain near enough to the project site to accumulate injurious levels of sound energy. The most likely effect of exposure to project-related noise would be temporary minor behavioral effects, such as avoidance of the area within about 177 feet around the project site. The exposure would cause no measurable effects on the fitness of exposed individuals. Further, it is extremely unlikely that any avoidance of the project site would prevent adult fish from moving past the area, nor would it prevent them from accessing important habitat resources.

<u>Construction-related Degraded Water Quality:</u> Exposure to construction-related degraded quality would cause minor effects in PS Chinook salmon and PS steelhead. Water quality would be temporarily affected by increased turbidity that may also reduce dissolved oxygen (DO) levels, and may mobilize toxic materials into the water column.

The planned work window avoids the expected out-migration periods for juvenile Chinook salmon and steelhead in this watershed, but overlaps with run times for retuning adults of both species. Therefore, it is extremely unlikely that juveniles of either species would be exposed to construction-related water quality impacts, but adults may be exposed to this stressor.

<u>Turbidity</u>

Turbidity plumes would be caused by bottom sediments that are mobilized by pile removal, spud lifting, and by propeller wash from the contractor’s tugboat. Those plumes would be localized and short-lived, and consist of low concentrations of total suspended solids (TSS). The intensity of turbidity is typically measured in Nephlometric Turbidity Units (NTU), which describes the opacity caused by the suspended sediments. Whereas, TSS concentrations are typically measured in milligrams per liter (mg/L). A strong positive correlation exists between turbidity and the concentration of TSS (mg/L). Depending on the particle sizes, NTU values roughly equate to the same number of mg/L for TSS concentration (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 can be 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 on fish exposed to suspended sediments 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. At concentration levels of about 700 to 1,100 mg/l, minor physiological stress is reported in juvenile salmon only after about three hours of continuous exposure (Newcombe and Jensen 1996).

Vibratory removal of hollow 30-inch steel piles in Lake Washington mobilized sediments that adhered to the piles as they were drawn through the water column, with much of the mobilized sediments being material that fell out of the hollow piles (Bloch 2010). Turbidity reached a peak of about 25 NTU (~25 mg/L) above background levels at 50 feet from the pile, and about 5 NTU (~5 mg/L) above background at 100 feet. Turbidity returned to background levels within 30 to 40 minutes. Pile installation created much lower turbidity. The proposed vibratory extraction of 4 8-inch timber piles is likely to mobilize far less sediment than the piles described above, because the timber piles are less than a third of the size (less surface area for sediments to adhere to) and they are solid (no tube to hold packed-in sediments). Therefore, the mobilization of bottom sediments, and resulting turbidity from the planned pile removal is likely to be less than that reported by Bloch. Lifting barge spuds would also mobilize sediments, likely at levels similar to pile removal.

Tugboats would also mobilize bottom sediments. Based on similar projects, only a few round trips of the tugboat would be needed. Therefore, the resulting propeller wash turbidity plumes would be episodic and low in number. The intensity and duration of these plumes are uncertain. However, given the low speeds of the tug when positioning the barge near the project site, and the water depths where the tug would operate (likely 20 to 40+ feet), sediment mobilization from propeller wash would likely consist of relatively low-concentration plumes that would extend no more than 200 to 300 feet from the site, and last less than an hour.

The adult PS Chinook salmon or PS steelhead that may be exposed to construction-related turbidity would most likely be moving past the site, and the duration of their exposure would likely be measured in minutes. Further, construction-related turbidity would be very short-lived and at concentrations too low to cause more than temporary, non-injurious behavioral effects such as avoidance of the plume, mild gill flaring (coughing), and slightly reduced feeding rates and success. None of these potential responses, individually, or in combination would affect the fitness or normal behaviors in exposed fish.

Dissolved Oxygen (DO)

Mobilization of anaerobic sediments can decrease dissolved oxygen (DO) levels (Hicks *et al*. 1991; Morton 1976). The impact on DO is a function of the oxygen demand of anaerobic sediments that may be present, the amount of material suspended in the water, the duration of suspension, and the water temperature (Lunz and LaSalle 1986; Lunz *et al*. 1988), with impacts tending to be more severe lower in the water column (LaSalle 1988). Avoidance of water with DO levels below 5.5 mg/l has been observed in salmon (Hicks 1999), which could drive fish from preferred forage areas, or may drive them away from shelter and thereby increase the risk of predation. Reduced DO can also affect swimming performance in salmonids (Bjornn and Reiser 1991), which may reduce an affected fish's ability to forage and to escape predation.

The most likely source of anaerobic sediment mobilization would be pile removal. As described above, relatively small amounts of subsurface sediment are likely to be mobilized by that activity, and those sediments until they settle out of the water quickly. This suggests that any impacts on DO would be too small and very short-lived. The duration of exposure for adult PS Chinook salmon or PS steelhead that may be exposed to impacted waters would most likely be measured in minutes as they move past the site. At most, exposure to construction-related reduced DO may cause low level avoidance of the affected area, with no measurable impacts on the fitness or normal behaviors of exposed individuals.

Toxic Materials

Toxic materials may be introduced to the water through construction related spills and discharges. Pile removal may mobilize contaminated sediments and/or release creosote-related toxins directly from the timber piles. 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).

Petroleum-based fuels, lubricants, and other fluids commonly used by construction-related equipment contain Polycyclic Aromatic Hydrocarbons (PAHs). Sediment contaminants can include metals, pesticides, PAHs, Polychlorinated Biphenyls (PCBs), phlalates, and other organic compounds. 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 (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 project includes BMPs to reduce the risk and intensity of construction-related discharges. In the unlikely event of a construction-related spill or discharge, the amount of material released would likely be very small, and it would be quickly contained and cleaned up. Also, many of the petroleum-based fuels and lubricants that are used for this type of work tend to float to the surface and evaporate relatively quickly, so their residence time in the water would be brief. Further, non-toxic and/or biodegradable lubricants and fluids are strongly encouraged by the State, and are commonly used by many of the local contractors.

The sediments around the creosote-treated piles very likely contain PAHs that would be released into the water through sediment mobilization during pile removal. PAHs may also be released directly from any piles that may break during their removal (Evans *et al*. 2009; Parametrix 2011; Smith 2008; Werme *et al*. 2010). As described above, sediment mobilization would likely be small, and any PAHs that may be mobilized would likely dissipate within a few hours, through evaporation at the surface, dilution in the water column (Smith 2008; Werme *et al*. 2010), or by settling out of the water with the sediments.

Therefore, the concentrations of water-borne pollutants is expected to be extremely low, and their duration in the water would be very brief (no more than a low number of hours). In the unlikely event of fish exposure to construction-related pollutants, the in-water concentrations would be too low, and exposure too brief to cause detectable effects on the fitness or normal behaviors of exposed individuals.

<u>Construction-related Artificial Lighting:</u> Exposure to construction-related artificial lighting would cause minor effects in PS Chinook salmon and PS steelhead. No after-dark work is planned. However, the contractor's work barge(s) may be partially illuminated at night. Although not specifically described, safety and security lighting on the barge(s) would likely consist of a low number of relatively low-intensity light fixtures.

The planned work window avoids the expected out-migration periods for juvenile Chinook salmon and steelhead in this watershed, but overlaps with run times for retuning adults of both species. Therefore, it is extremely unlikely that juveniles of either species would be exposed to construction-related artificial lighting, but adults may be exposed to this stressor.

Barge lighting may slightly increase in-water illumination in the area immediately around the work barge (measured in low numbers of feet) over a 3-week period, but this illumination would be virtually undetectable against the high level of background artificial lighting that exists at the project site and the surrounding area. Therefore, the intensity of construction-related artificial lighting is expected to be too low to cause detectable effects on the fitness or normal behaviors in any adult Chinook salmon or steelhead that may be exposed.

<u>Construction-related Reduced Submerged Aquatic Vegetation (SAV) and Forage:</u> Construction-related impacts on SAV and forage would cause minor effects in PS Chinook salmon and PS steelhead. The placement of spuds and new piles would damage or kill some SAV, along with invertebrate organisms living in the substrate (infauna) within the impacted footprint.

Based on the project description and numerous similar projects, the work barges would likely hold position with 2 to 4 spuds that are between 18 and 24 inches in diameter. Assuming that two barges would be present during all 3 weeks of construction (1 construction barge and 1 supply barge), that both would hold position with 4 24-inch-diameter spuds, and that they would both hold two positions per week, about 48 widespread 0.35-square yard (yd^2) impact points could be temporarily impacted by spuds (about 17 yd^2 total). Installation of 5 18-inch and 10 12-inch diameter piles would permanently fill about 1.9 yd^2 of substrate. However, the removal of 142 10- to 12-inch piles would make about 8.6 yd^2 of substrate available for SAV and invertebrate organisms.

The total size of the affected area (about 27.5 yd^2) would be tiny fraction of the similar available substrate in the area. Further, SAV and infauna would begin to recolonize about 93 percent of the affected area soon after construction ends. Therefore, construction-related reduced SAV and forage would likely be too small and short-lived to cause detectable effects on the fitness or normal behaviors in any Chinook salmon or steelhead that pass through the action area.

Contaminated Forage: Exposure to contaminated forage is likely to adversely affect juvenile PS Chinook salmon and PS steelhead, but cause no detectable effects in adults of either species. The removal of creosote-treated piles is likely to mobilize contaminated subsurface sediments that would settle onto the top layer of sediments, where contaminants such as PAHs and PCBs would remain biologically available for years.

Romberg (2005) discusses two projects in the Seattle area where creosote-contaminated sediments were mobilized during the removal and/or repair of creosote-treated piles that included the use of clamshell buckets and water jetting. Sediments with high PAH levels settled on to previously clean substrates up to about 800 feet away. Contaminant concentrations decreased with distance from the removal site, and decreased further over time. Although PAH concentrations fell to below the State Sediment Management Standards (SMS) within 3 years, PAH concentrations remained above pre-contamination levels over 10 years of monitoring. Lead and mercury values also initially increased, but decreased to background levels after 3 years.

Fish can absorb contaminants through dietary exposure (Meador *et al*. 2006; Varanasi *et al*. 1993). Amphipods and copepods uptake PAHs from contaminated sediments (Landrum and Scavia 1983; Landrum *et al*. 1984; Neff 1982), and pass them to juvenile Chinook salmon and other 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. Juvenile PS steelhead were not specifically addressed in the available literature, but it is reasonable to expect that they may be similarly affected by dietary uptake of contaminants.

Sediment mobilization due to the planned work would likely be much less severe than was described in Romberg (2005). The applicant’s project would carefully remove 142 small-diameter piles. Based on this, a relatively small amount of contaminated sediment would be brought to the surface. As discussed above, the turbidity plume from pile removal could extend as far as 100 feet from an individual pile, and tugboat propeller wash may remobilize and spread some of those sediments 200 to 300 feet. Most of the sediment, and therefore the highest concentrations of contaminants would likely remain in the areas close to the pile removal sites, where they would be biologically available for years, but at steadily decreasing levels.

While present, contaminants such as PAHs are likely to be taken up by benthic invertebrates, some of which would be consumed by juvenile Chinook salmon and steelhead that forage in the action area. The effects on individuals that consume contaminated prey may include reduced growth, increased susceptibility to infection, and increased mortality.

The annual number of juvenile PS Chinook salmon and PS steelhead that may be exposed to PAH-contaminated forage that would be attributable to this action is unquantifiable with any degree of certainty, 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 small affected area and the low volume of contaminated sediment that would be brought to the surface suggest that the probability of trophic connectivity to the contamination would be very low for any individual fish. Therefore, for both species, the numbers of fish that may be annually exposed to contaminated prey would likely comprise extremely small subsets of the cohorts from their respective populations, and the numbers of exposed fish would be too low to cause detectable population-level effects.

<u>Structure-related Impacts on Water Quality:</u> Structure-related impacts on water quality would cause minor effects in PS Chinook salmon and PS steelhead. The some structural framing of the new floats would be constructed with timber that has been treated with ammoniacal copper zinc arsenate (ACZA). Also, some of the boats that moor at the new structure may be painted with anti-fouling paints that contain copper, and some boats may discharge fuels and lubricants to the water while moored at the structure.

<u>ACZA-treated wood and anti-fouling hull paints</u>

Wet ACZA-treated wood leaches some of the metals used for wood preservation. Of these metals, dissolved copper is of most concern to fish because of its higher leaching rate compared to arsenic and zinc (Poston 2001). Anti-fouling hull paints also leach copper (Schiff *et al*. 2004). Exposure to dissolved copper 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 in freshwater (Giattina *et al*. 1982; Hecht *et al*. 2007; McIntyre *et al*. 2012; Sommers *et al*. 2016; Tierney *et al*. 2010).

The dissolved copper concentration from ACZA-treated wood depends on many factors, including the amount of treated wood present and its contact with the water, and the wood's leaching rate, which is affected by the post-treatment procedures that are applied to the wood, and water chemistry. Copper leaching is highest when the treated wood is immersed in freshwater. The leaching rate decreases with reduced contact with the water. Further, the copper leaching rate from ACZA-treated wood decreases sharply to low levels during the first few weeks after installation, and industry-recommended post-treatment BMPs further reduce the intensity and duration of leaching. The Corps requires that any ACZA-treated wood used in this project must comply with the approved post-treatment BMPs. The brief episodic exposures of over-water ACZA-treated wood to rain and wave action would greatly limit the potential for preservative agents to enter the water.

Copper-based anti-fouling paints leach copper into the water at fairly constant levels and can be a significant source of dissolved copper in harbors and marinas (Schiff *et al*. 2004). This is most notable under conditions of high boat occupancy in enclosed moorages where water flows are restricted. 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. The project site is an open area, and vessel occupancy is relatively low (fewer than 20 boats). Further, the vessels that are likely to have anti-fouling hull paint few, if any, would likely be only a small subset of the total. Based on the available information, dissolved copper concentrations that would be attributable to the new float are expected to be below the threshold of effect in salmonids.

Petroleum-based fuels and lubricants

Vessels that utilize the moorage may discharge fuels and lubricants. However, those discharges are likely to be very infrequent and very small. The fuels and lubricants that would be used tend to evaporate quickly. Further, the moorage is open and exposed to lake currents that would facilitate evaporation, dilution, and bioremediation of any discharges that may be occur. Based on the available information, the concentrations and residence times of vessel-related petroleum-based substances would be too low to cause detectable effects in PS Chinook salmon and PS steelhead.

Based on the best available information, as described above, any fish that may be exposed to structure-related water quality impacts would experience no more than temporary low-level behavioral effects which, individually, or in combination would not affect the fitness or normal behaviors of exposed individuals.

Structure-related Altered Lighting: Structure-related altered lighting is likely to adversely affect juvenile PS Chinook salmon and PS steelhead, but cause no detectable effects in adults of either species because the adults are independent of shoreline habitats. The applicant’s structure will maintain unnatural lighting conditions at the project site. The new float and moored boats would create shade during the day. They may also cause artificial in-water illumination at night. Structure-related shade may reduce SAV and forage resources. It may also increase migratory distances and increase vulnerability to predators as may artificial illumination at night.

Half of the new 2,803-square foot mooring float would be decked with fiberglass grating with 69 percent open area (Figure 2). Water depth under the new float ranges from about -12 to over -40 feet re. OHWM (Figure 3). The new float would cause dappled shading with less than 50 percent light transmittance over relatively deep substrate, and the vessels that moor there would add to the size and intensity of the shade.

The impact of structure-related shade on SAV and forage resources is likely to be very small due to the depth of the water under the float. Therefore the effects of structure-related prey reduction would be too small to cause detectable effects on the fitness and normal behaviors of juvenile salmonids in the area. However, the shade from the float and moored boats is likely to alter migration for some juvenile Chinook salmon and may increase the vulnerability of some juvenile Chinook salmon and steelhead to predators. The intensity of shadow effects on migration and risk of predation are likely to vary based on the brightness and angle of the sun. They would be most intense on sunny days, and less pronounced to possibly inconsequential on cloudy days.

Altered Migration

The float's shadow would be about 170 feet long and 133 feet wide at its offshore end. This shadow would begin about 107 feet from shore, where the new float would be connected to an existing pier, and extend perpendicular to the shoreline along the route likely to be followed by juvenile Chinook salmon that are migrating along the south side of the canal.

Numerous studies demonstrate that juvenile salmonids, in both freshwater and marine habitats, are more likely to avoid the shadow of an overwater structure 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 float's shadow would likely alter the migratory behavior of juvenile salmon by delaying their passage under the structure, or by inducing them to swim around it. However, because the applicant's structure is but one of many long-standing similar structures that line this artificial waterway, the float's shadow would not "alter" the behavior of juvenile salmonids. Instead, the float's shadow, in combination with the shadows of the adjacent structures, would continue to prevent juvenile Chinook salmon from migrating along the shoreline, which is typical for juvenile Chinook salmon at this life stage, and effectively force those fish to migrate in the open and relatively deep waters near the middle of the canal, which is well documented (Celedonia *et al*. 2008a and b; Tabor *et al*. 2000 and 2010).

Off-bank migration of juvenile Chinook salmon places them in relatively deep water where foraging is likely to have higher energetic costs than shallow shoreline waters (Heerhartz and Toft 2015). Therefore, the juvenile Chinook salmon that swim around the mooring float are likely to experience some degree of reduced fitness due to increased energetic costs.

Predator Exposure

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 applicant's float and the boats that would moor alongside it would cast shadows that would extend more than 200 feet from the shoreline to where bottom depths exceed -40 feet re. OHWM. The shadows themselves would not increase the population of predatory fish in the action area, but predatory fish are likely to concentrate in the shadows.

Therefore, it is likely that juvenile Chinook salmon and steelhead would be more likely to encounter predatory fish at the project site than they would in the absence of the structure. The risk of predation would be further increased for the juvenile Chinook salmon that swim around the float simply due the increased distance traveled in proximity to its predator-friendly shadow. Also, a juvenile salmonid's vulnerability to attack increase with water depth because the increased water volume allows predators to attack from below and from all sides instead of from just one side as is the case in shallow water along the shore. Further, predator avoidance would increase energetic costs for the juveniles that escape.

The likelihood that any juvenile Chinook salmon or steelhead would be injured or killed due to increased exposure to predators at the site is expected to be very low, and that likelihood would vary greatly over time due to the complexities of predator/prey dynamics as well as variations in environmental conditions at the site. However, over the life of the new float, it is extremely likely that at least some individuals would be killed due to the increased risk of predation that would be caused by the float's shadow.

In summary, structure-related altered lighting would cause a combination of altered migratory 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 individuals that may be impacted by this stressor is unquantifiable with any degree of certainty. However, based the small affected area and on the expectation that the affected individuals would be a small subset of the cohorts that would migrate through action area each year, the numbers of exposed fish would be too low to cause detectable population-level effects.

Structure-related Noise: Exposure to structure-related noise is likely to adversely affect juvenile PS Chinook salmon and PS steelhead, but have minor effects on adults of both species. Unlike juvenile salmon and steelhead in the action area, adults of both species are independent of shoreline habitats. Therefore, they are unlikely to approach or remain close enough to the applicant's piers to be measurably affected by structure-related noise.

In-water noise at levels capable of causing detectable effects in juvenile fish would be caused by the recreational boats that would moor at the float. Unlike construction noises, recreational boat noise could occur year-round. Based on satellite imagery of the applicant's existing pier and on the consulting biologist's personal observations of many residential piers and recreational marinas in the region, the boats most likely to moor at the applicant's float would be power boats and sailboats between 20 to 65 feet in length. The best available information for source levels for powerboats close to those sizes is described in the acoustic assessment done for a similar project (NMFS 2018). However, the available information describes vessels running at or close to full-speed, and tugboat noise is used here to conservatively estimate the noise from the larger recreational powerboats that would moor at the float.

Individual vessel operations around a mooring structure typically consists of brief periods of relatively low-speed movement as boats are driven to the float and tied up, with their engines being shut off within minutes of arrival. The engines of departing vessels are typically started shortly before the boats are untied and driven away. As describe earlier, exposure to noise may cause a range of physiological effects in fish that are largely dependent on the intensity of the sound and the duration of exposure. The source levels for tugboat-sized boats and for 23-foot long powerboats suggests that noise levels would be well below the thresholds for the onset of injury in fish, and that fish would be unaffected by boating noise beyond 72 feet (22 m; Table 6).

Table 6. In-water Source Levels, and ranges to effects thresholds for power boats with noise levels similar to those likely to moor at the applicant's structure.

Source	Acoustic Signature	Source Level	Threshold Range
Tugboat	< 2 kHz Combination	185 dB_{peak}	206 @ N/A
Episodic brief periods measures in minutes		170 dB_{SEL}	150 @ 22 m
23 foot Boat w/ 2 4~ 100 HP Outboard Engines.	< 2 kHz Combination	175 dB_{peak}	206 @ N/A
Episodic brief periods measures in minutes		165 dB_{SEL}	150 @ 10 m

It is extremely unlikely that any of the boats would be operated at anything close to full speed in proximity to the mooring structure, and most boats would be smaller than a typical tugboat. Therefore, the 150 dB_{SEL} isopleth would likely remain well within 72 feet around the mooring float. Although boating noise levels would be non-injurious, juvenile Chinook salmon and steelhead that are within the 150 dB_{SEL} isopleth, are likely to 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.

Given the short duration and episodic nature of boating 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, the numbers of individuals that may be exposed to structure-related noise would likely comprise extremely small subsets of the cohorts from their respective populations, and the numbers of exposed fish would be too low to cause any detectable population-level effects.

<u>Structure-related Propeller Wash:</u> Propeller wash is likely to adversely affect juvenile PS Chinook salmon and PS steelhead, but have minor effects on adults of both species. A boat's spinning propeller generates a turbulent blast of moving water that is known as propeller wash. Propellers and propeller wash can strike the substrate and mobilize sediments and dislodge aquatic organisms, including SAV, particularly in shallow water and/or at high power settings. This is known as propeller scour. Propellers and propeller wash may also directly impact fish.

In shallow water areas with high levels of vessel traffic, propeller scour can dramatically reduce SAV and diminish the density and diversity of the benthic community. However, the mooring float would be situated over relatively deep water (about -12 to -41 feet re. OHWM; Figure 3), and the powerboats that would operate near it would likely do so at low power levels. Based on the water depths and low power levels expected near the float, propeller wash would be very unlikely to cause detectable effects on benthic resources.

Killgore *et al*. (2011) report that fish are killed by spinning boat propellers. Propeller-related turbulence has also been documented to kill small aquatic organisms (VIMS 2011). It also stands to reason that small fish that are exposed to propeller wash may be displaced by the fast-moving turbulent water. Propeller wash is unlikely to affect adults of either species because they are unlikely to approach close enough to operating boats to be exposed. Further, in the unlikely event of adult exposure, their increased size and swimming ability suggests that they would simply swim away from the propeller wash with no detectable effects other than a very brief avoidance behavior.

However, juvenile Chinook salmon and steelhead that migrate past the mooring float are likely to be relatively close to the surface where they may be exposed to spinning propellers and propeller wash, and would be too small to effectively swim against the turbulent water. Individuals that are struck or very nearly missed by propeller blades would be injured or killed by the exposure. Also, depending on the direction and strength of the thrust plume, exposure to propeller wash is likely to cause displacement of migrating individuals that could increase energetic costs, reduce feeding success, and may increase an individual's vulnerability to predators while they tumble stunned and/or disoriented in the wash.

Although the likelihood of this interaction is very low for any individual fish or any individual boat trip, it is likely that over the life of the new mooring float, 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, based on the expectation that exposed individuals would be very small subsets of the cohorts from their respective populations, the numbers of exposed fish would be too low to cause detectable population-level effects.

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 is likely to adversely affect critical habitat that has been designated for PS Chinook salmon. The essential PBFs of PS Chinook salmon critical habitat are listed below. The expected effects on those PBFs from completion of the planned project, including full application of the conservation measures and BMPs, would be limited to the impacts on the PBF of freshwater migration corridors free of obstruction and excessive predation 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:
   a. Free of obstruction and excessive predation – The proposed action would cause long-term minor effects on this PBF. The float's shadow is likely to cause short delays and/or slightly increase the migration distances for some of the juvenile Chinook salmon that encounter it. The action would cause no change in the abundance of predators, but the float's shadow is likely to slightly improve the success of piscivorous predators at the site. Boating noise at the float would cause episodic ephemeral conditions that may act synergistically to increase the intensity of these effects.

b. Water quantity – The proposed project would cause no effect on water quantity.
c. Water quality – The proposed action would cause minor ephemeral adverse effects, and long-term minor beneficial effects on this PBF. The action would cause no measurable changes in water temperature or salinity, but construction would briefly introduce contaminants and may slightly reduce DO. Detectable construction-related effects are expected to be limited to the area within 300 feet around the project site, and are not expected to persist past several hours after work stops. The removal of 142 creosote-treated timber piles would reduce PAH contamination at the site.
d. Natural Cover – The proposed action would cause long-term minor effects on this PBF. The float's shadow is likely to slightly limit the diversity and abundance of submerged aquatic vegetation at the project site. The project would cause no change in presence of large wood or rocks and boulders, nor would it affect bank conditions.

4. Estuarine areas – None in the action area.
5. Nearshore marine areas – 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 the consultation (50 CFR 402.02). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

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 (Section 2.4).

The current condition of ESA-listed species and designated critical habitat within the action area are described in the Status of the Species and Critical Habitat and the Environmental Baseline sections above. The contribution of non-federal activities to those conditions include past and on-going shoreline development in the action area, as well as upstream forest management, agriculture, urbanization, road construction, water development, and restoration activities. Those actions were 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 social groups dedicated to restoration and use of natural amenities, such as cultural inspiration and recreational experiences.

NMFS is unaware of any specific future non-federal activities that are reasonably certain to affect the action area. However, NMFS is reasonably certain that future non-federal actions such as the previously mentioned shoreline and upstream 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 lake waters within the action area is 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) appreciably reduce 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 for the conservation of the species.

As described in more detail above at 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 DO, 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, as described below, effects on viability parameters of each species are also likely to be negative. In this context we consider the effects of the proposed action's effect on individuals of the listed species at the population scale.

<u>PS Chinook salmon</u>

The long-term abundance trend of the PS Chinook salmon ESU is slightly negative, and the South Puget Sound MPG, which includes the Cedar River and North Lake Washington / Sammamish River PS Chinook salmon populations, is considered at high risk of extinction due to low abundance and productivity. 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 environmental baseline within the action area has been degraded by the effects of intense streambank and shoreline development and by maritime activities. The baseline has also been degraded by nearby and upstream industry, urbanization, agriculture, forestry, water diversion, and road building and maintenance.

The project site is located along the Lake Washington Ship Canal, which provides the only route to and from marine waters for adults and juveniles of the Cedar River and North Lake Washington / Sammamish River PS Chinook salmon populations. Project-related work would largely avoid the timing of out-migrating juveniles, but overlaps with the presence of returning adults. No injury or mortality of any individuals is expected due to direct effects of the action. However, over the next several decades, out-migrating juveniles that pass close to the project site are likely to be exposed to contaminated forage, altered lighting and acoustic conditions, and propeller wash as a result of this action. These stressors, both individually and collectively, are likely to cause a range of effects that would include some combination of altered behaviors, delayed migration, reduced fitness, and mortality in exposed individuals.

The annual number of juveniles that are likely to be injured or killed by exposure to action-related stressors is unknown, but is expected to be very low, and such a small fraction of an out-migrating cohort that it would have no detectable effect on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for either of the affected PS Chinook salmon populations.

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 populations. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

PS Steelhead

The PS steelhead DPS is currently considered “not viable”, and the extinction risk for most DIPs is estimated to be moderate to high. Long-term abundance trends have been predominantly negative or flat across the DPS, especially for natural spawners, and growth rates are currently declining at 3 to 10% annually for all but a few DIPs. The abundance trend between 1984 and 2016 is strongly negative for the Cedar River and North Lake Washington / Lake Sammamish DIPs. 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 environmental baseline within the action area has been degraded by the effects of intense streambank and shoreline development and by maritime activities. The baseline has also been degraded by nearby and upstream industry, urbanization, agriculture, forestry, water diversion, and road building and maintenance.

The project site is located along the Lake Washington Ship Canal, which provides the only route to and from marine waters for adults and juveniles of the Cedar River and North Lake Washington / Lake Sammamish PS steelhead DIPs. The timing of project-related work largely avoids juvenile out-migration, but may overlap with returning adult migration. No injury or mortality of any individuals is expected due to direct effects of the action. However, over the next several decades, out-migrating juveniles that pass close to the project site are likely to be exposed to contaminated forage, altered lighting and acoustic conditions, and propeller wash as a result of this action. These stressors, both individually and collectively, are likely to cause a range of effects that would include some combination of altered behaviors, delayed migration, reduced fitness, and mortality in exposed individuals.

The annual number of juveniles that are likely to be injured or killed by exposure to action-related stressors is unknown, but is expected to be very low, and such a small fraction of an out-migrating cohort that it would have no detectable effect on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for either of the affected PS steelhead DIPs.

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 populations. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

2.7.2 Critical Habitat

As described above at Section 2.5, the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon.

Chinook Salmon Critical Habitat

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 and continue acting against the quality of salmonid critical habitat. The intensity of those influences on salmonid habitats 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 limited to freedom from obstruction and excessive predation, water quality, and natural cover. As described above, the project site is located along a heavily impacted waterway, and all of these site attributes currently function at greatly reduced levels as compared to undisturbed freshwater migratory corridors. The construction and long-term presence of the new mooring float would cause long term minor effects on the three site attributes identified above. It would also cause long-term beneficial effects on water quality through the removal of 142 creosote-treated timber piles that are sources of PAH contamination at the site.

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 PBF 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, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent actions, and cumulative effects, it is NMFS’ 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).

2.9.1 Amount or Extent of Take

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

Harm of PS Chinook salmon from exposure to:

- contaminated forage,
- structure-related altered migratory behaviors,
- structure-related predation,
- structure-related boating noise, and
- structure-related propeller wash.

Harm of PS steelhead from exposure to:

- contaminated forage,
- structure-related altered migratory behaviors,
- structure-related predation,
- structure-related boating noise, and
- structure-related propeller wash.

The distribution and abundance of 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 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.

Therefore, we cannot predict with meaningful accuracy the number of juvenile PS Chinook salmon and juvenile PS steelhead that are reasonably certain to be injured or killed by exposure to any of these stressors. Additionally, NMFS knows of no device or practicable technique that would yield reliable counts of individuals that experience these impacts. In such circumstances, 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. The size of the visible turbidity plume is the best available surrogate for the extent of take of juvenile PS Chinook salmon and PS steelhead from exposure to contaminated forage. This is because the number of prey organisms that would uptake contaminants that are mobilized by this action would be proportional to the size of the area where contaminated sediments would settle back to the bottom. Therefore, as the size of the visible turbidity plume increases, the number of prey organisms that may become contaminated and then eaten by juvenile PS Chinook salmon and PS steelhead would increase, despite the low density and random distribution of juveniles of both of these species in the action area.

The size and configuration of the applicant's structure is the best available surrogate for the extent of take of juvenile PS Chinook salmon and PS steelhead from altered migratory behaviors, exposure to structure-related predation, and exposure to structure-related boating noise and propeller wash. This is because the likelihood of avoidance and the distance required to swim around the structure would both increase as the size of a structure and the intensity of its shadow increase. Similarly, as the size of the structure and the intensity of its shadow increase, the number of predatory fish that may hide beneith the structure would increase, and the potential for juvenile PS Chinook salmon and PS steelhead to be exposed to those predators would increase as the length of the structure's outline increases. Also, as the size of a structure increases, the number of boats that could moor there increases. As the number of boats increase, boating activity would likely increase, and the potential for juvenile PS Chinook salmon and PS steelhead to be exposed to the related noise and propeller wash effects also increases.

In summary, the extent of take for this action is defined as:

1. Puget Sound Chinook salmon:
    a. A visible turbidity plume not to exceed 300 feet from the project site during any portion of the project, including movement of the contractor's tugboat; and
    b. The size and configuration of the applicant's structure, as described in the proposed action section of this biological opinion.

2. Puget Sound steelhead:
    a. A visible turbidity plume not to exceed 300 feet from the project site during any portion of the project, including movement of the contractor's tugboat; and
    b. The size and configuration of the applicant's structure, 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.

Some of these take surrogates could be construed as partially coextensive with the proposed action but they nevertheless function as effective reinitiation triggers. In particular, take surrogates related to the size and configuration of the structure. If the size and configuration of the structure exceeds 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 Opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of 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 (Section 2.8).

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" (RPMs) are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02).

The COE shall:

1. Minimize incidental take of PS Chinook salmon and PS steelhead from exposure to contaminated forage.
2. Minimize incidental take of PS Chinook salmon and PS steelhead from exposure to structure-related altered migratory behaviors, predation, boating noise, and propeller wash.
3. Implement 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 RPM (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. To implement RPM Number 1, Minimize incidental take of PS Chinook salmon and PS steelhead from exposure to contaminated forage, the COE shall require the applicant to:
   a. Extract piles slowly by pulling, with or without vibratory work. No water-jetting or clamshell digging shall be done during pile extraction;

b. Ensure that extracted piles are not be shaken, hosed off, left hanging to dry, or that any other actions are taken that are intended to remove adhering material from piles while they are suspended over the water; and
c. Adjust work practices, including tugboat operations, to ensure that turbidity does not exceed 300 feet from the project site, and to halt work should the visible turbidity plume approach and that range.

2. To implement RPM Number 2, Minimize incidental take PS Chinook salmon and PS steelhead from exposure to structure-related altered migratory behaviors, predation, boating noise, and propeller wash, the COE shall require the applicant to:
   a. Ensure that the size and configuration of the mooring structure does not exceed the dimensions described in the proposed action section above. In particular:
      i. The float shall be no larger than 2,803-square feet; and
      ii. No less than 50 percent of the float's deck shall consist of grated decking with no less than 69 percent open area.

3. To implement RPM Number 3, implement a monitoring and reporting program to confirm that the take exemption for the proposed action is not exceeded, the COE shall require the applicant to collect and report details about the take of listed fish. That plan shall:
   a. Require the contractor to maintain and submit construction logs to verify that all take indicators are monitored and reported. Minimally, the logs should include:
      i. Documentation of the extent (feet) and duration of visible turbidity plumes around pile extraction, and during tugboat operations;
      ii. Documentation of the post-construction size and configuration of the new float; and
      iii. Documentation of the type and extend of grated decking on the new float.
   b. Require the contractor to establish procedures for the submission of the construction logs, and other materials, to the appropriate COE office, which will draft and submit a report to NMFS.
   c. Submit an electronic post-construction report to NMFS within six months of project completion. Send the report to: projectreports.wcr@noaa.gov. Be sure to include the NMFS Tracking number for this project in the subject line: Attn: WCR-2018-10286.

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) to use the lowest safe maneuvering speeds and power settings when maneuvering in shallow waters close to the shoreline, with the intent to minimize propeller wash and mobilization of sediments at the site.

2. The COE should encourage the applicant to require their contractor to use full-depth sediment containment during pile extraction.

3. The COE should encourage the applicant to install clean capping material over substrates where contaminated sediments may settle out after pile extraction.

4. The COE should encourage the applicant to develop a plan to reduce the environmental impacts at the mooring structure. Suggested measures include:
   a. Instruct patrons about the importance of the nearshore marine habitats at the site to migrating juvenile salmon;
   b. Require patrons to operate power boats at low speeds near the mooring float and other shallow shoreline areas;
   c. Require patrons to maintain and operate their vessels with the intent to reduce the potential for toxic chemicals to enter or remain in the water at the site; and
   d. Establish a system to prevent and/or remove litter and wastes from the area around the float.

5. The Corps should coordinate with other resource agencies and technical experts to address contaminated sediments in Lake Union and the ship canal.

6. The Corps should coordinate with NMFS, other resource agencies, and technical experts to address water quality issues in Lake Union and the ship canal.

7. The Corps should conduct or support continuing research to better understand the distribution, abundance, and habitat use of PS Chinook salmon, PS steelhead, and other species Lake Union and the ship canal.

2.11 Reinitiation of Consultation

This concludes formal consultation for the U.S. Army Corps of Engineers' authorization of the Roanoke Reef Houseboat Owners Association Floats, Ramp, and Piling Replacement Project King County, Washington. As 50 CFR 402.16 states, reinitiation of formal consultation is required 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 habitats in a manner or to an extent not considered in this Opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitats that was not considered in this Opinion, or (4) a new species is listed or critical habitat is designated that may be affected by the action.

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect essential fish habitat (EFH). The MSA (section 3) defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. This analysis is based, in part, on the description of EFH for Pacific Coast salmon contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC 2014) and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in section 1 of this document. The waters and substrate of Lake Union and the Lake Washington Ship Canal are designated as EFH for various life-history stages of Pacific Coast Salmon. EFH for Pacific salmon is identified and described in Appendix A to the Pacific Coast salmon fishery management plan (PFMC 2014).

3.2 Adverse Effects on Essential Fish Habitat

The ESA portion of this document describes the adverse effects of this proposed action on ESA-listed species and critical habitat, and is relevant to the effects on EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species. Based on the analysis of effects presented in Section 2.5 the proposed action will cause small scale adverse effects on this EFH through direct or indirect physical, chemical, or biological alteration of the water or substrate, and through alteration of benthic communities, and the reduction in prey availability. Therefore, we have determined that the proposed action would adversely affect the EFH identified above.

3.3 Essential Fish Habitat Conservation Recommendations

Implementation of the following conservation recommendation would minimize and/or avoid adverse effects on EFH for Pacific Coast Salmon that are likely to result from the proposed action.

1. To reduce adverse alteration of the physical, chemical, or biological characteristics of the water and substrate, the COE should:
    a. Require that the applicant’s contractors to use full-depth sediment containment during pile extraction; and
    b. Require that contractors and tugboat operators adjust work practices to ensure that turbidity does not exceed 300 feet from the project site, and to halt work should the visible turbidity plume approach and that range.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the COE must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

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

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this Opinion is the COE. Other users could include WDFW, and the citizens of Island County. Individual copies of this Opinion were provided to the COE. The format and naming adheres to conventional standards for style.

4.2 Integrity

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

4.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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