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-2018-10331

December 7, 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 Elliott Bay Marina's Floating Breakwater Replacement Project, King County, Washington, (COE Number: NWS-2012-423), (Sixth Field HUC: 171100191200 – Elliott Bay)

Dear Ms. Walker:

Thank you for your letter of July 17, 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 Elliott Bay Mariana's Floating Breakwater 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 Puget Sound/Georgia Basin (PS/GB) bocaccio. NMFS also concludes that the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon and PS/GB bocaccio but is not likely to result in the destruction or adverse modification of those designated critical habitats. In this Opinion, we also conclude that the proposed action is not likely to adversely affect PS steelhead, PS/GB yelloweye rockfish and their designated critical habitat, and southern resident (SR) killer whales and their designated critical habitat.

As required by section 7 of the ESA, NMFS has provided an incidental take statement (ITS) with the Opinion. The ITS describes reasonable and prudent measures (RPM) 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, Pacific Coast Groundfish, and Coastal Pelagic Species. 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

Elliott Bay Mariana's Floating Breakwater Replacement Project
King County, Washington
(COE Number: NWS-2012-423), (Sixth Field HUC: 171100191200 – Elliott Bay)

NMFS Consultation Numbers: WCR-2018-10331

Action Agency: U.S. Army Corps of Engineers

Affected Species and Determinations:

ESA-Listed Species	Stat us	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	No	No	N/A	N/A
Bocaccio (*Sebastes paucispinis*) Puget Sound /Georgia Basin (PS/GB)	Endangered	Yes	No	Yes	No
Yelloweye rockfish (*S. ruberrimus*) PS/GB	Threatened	No	No	No	No
Killer whales (*Orcinus orca*) Southern resident (SR)	Endangered	No	No	No	No

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

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

Fishery Management Plan That Describes EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes
Pacific Coast Groundfish	Yes	Yes
Coastal Pelagic Species	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 7, 2018

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LIST OF ACRONYMS and ABREVIATIONS

BE – Biological Evaluation
BMP – Best Management Practices
CFR – Code of Federal Regulations
COE – Corps of Engineers, U.S. Army
dB – Decibel
DIP – Demographically Independent Population
DPS – Distinct Population Segment
DQA – Data Quality Act
EBM – Elliott Bay Marina
EFH – Essential Fish Habitat
ESA – Endangered Species Act
ESU – Evolutionarily Significant Unit
HPA – Hydraulic Project Approval
HUC – Hydrologic Unit Code
ITS – Incidental Take Statement
mg/L – Milligrams per Liter
MPG – Major Population Group
MSA – Magnuson-Stevens Fishery Conservation and Management Act
NMFS – National Marine Fisheries Service
NTU – Nephlometric Turbidity Units
Opinion – Biological Opinion
OWCO – Oregon Washington Coastal Office
PAH – Polycyclic Aromatic Hydrocarbons
PBF – Physical or 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
RL – Received Level
RMS – Root Mean Square
RPA – Reasonable and Prudent Alternative
RPM – Reasonable and Prudent Measure
SEL – Sound Exposure Level
SL – Source Level
TSS – Total Suspended Sediment
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 (OWCO) in Lacey, Washington.

1.2 Consultation History

The NMFS received a letter from the U.S. Army Corps of Engineers (COE) on July 17, 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 an enclosed biological evaluation (BE, EBM 2018a) and project drawings for the proposed action (EBM 2018b).

On August 21, 2018, NMFS responded to the COE via electronic mail (e-mail), stating that formal consultation would be required for the proposed action. NMFS also requested additional information. NMFS, the COE, and the applicant's agent (Moffatt and Nichol) exchanged multiple e-mails until August 24, 2018, when NMFS received the last of the requested information, and initiated formal consultation. On October 24, 2018, the applicant requested a change of the in-water work window. The consultation initiation date remained unchanged.

This Opinion is based on the review of the information in the BE and project drawings; supplemental materials and responses to NMFS questions; recovery plans, status reviews, and critical habitat designations for ESA-listed PS Chinook salmon and PS/GB bocaccio; published and unpublished scientific information on the biology and ecology of those species; and relevant scientific and gray literature (see Literature Cited).

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 Elliott Bay Marina (the applicant) to remove and replace its eastern floating breakwater at the applicant's existing marina along the northwest shoreline of Elliott Bay, Seattle, Washington (Figure 1). The COE's action would authorize the installation of a replacement mooring structure that would exist in the nearshore marine environment for several decades beyond the useful life of the existing structure. Vessel activity at the new breakwater would be interrelated with the proposed action.

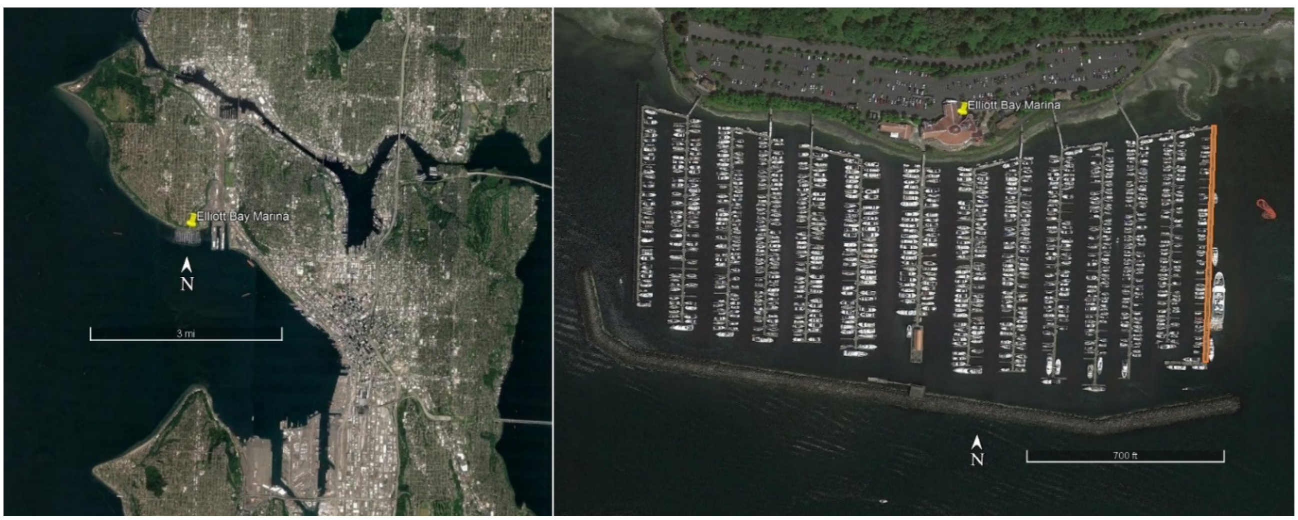

Figure 1. Google satellite photographs of the Elliott Bay Marina. The left image shows the marina on the north shore of Elliott Bay, with the City of Seattle Washington extending from north and south of the site. The right image is a close-up of the marina. The breakwater to be replaced is on the east side and outlined in orange.

The existing breakwater is 924 feet long and 14 feet wide, with a surface area of about 13,200 square feet. It is moored to about 17 concrete piles. Twenty-seven floating finger piers are attached along its western side, and a 152-foot long 14-foot wide floating ell is attached to its southern end (Figures 1 and 2). The breakwater consists of modular concrete float sections with treated-wood wave-attenuation panels attached to the sides. The wood panels extend 4.5 to 7.5 feet below the water's surface (Figure 2).

The replacement breakwater would be constructed off-site and barged to the marina in sections. It would have the same footprint, but its float modules would be deeper (4 to 8 feet below the water's surface), and no wave-attenuation panels would be attached to their sides (Figure 2). The modules would have 12-inch tall and 3.5-inch thick ACZA-treated timber rubboards mounted above the waterline along their sides (M&N 2018a).

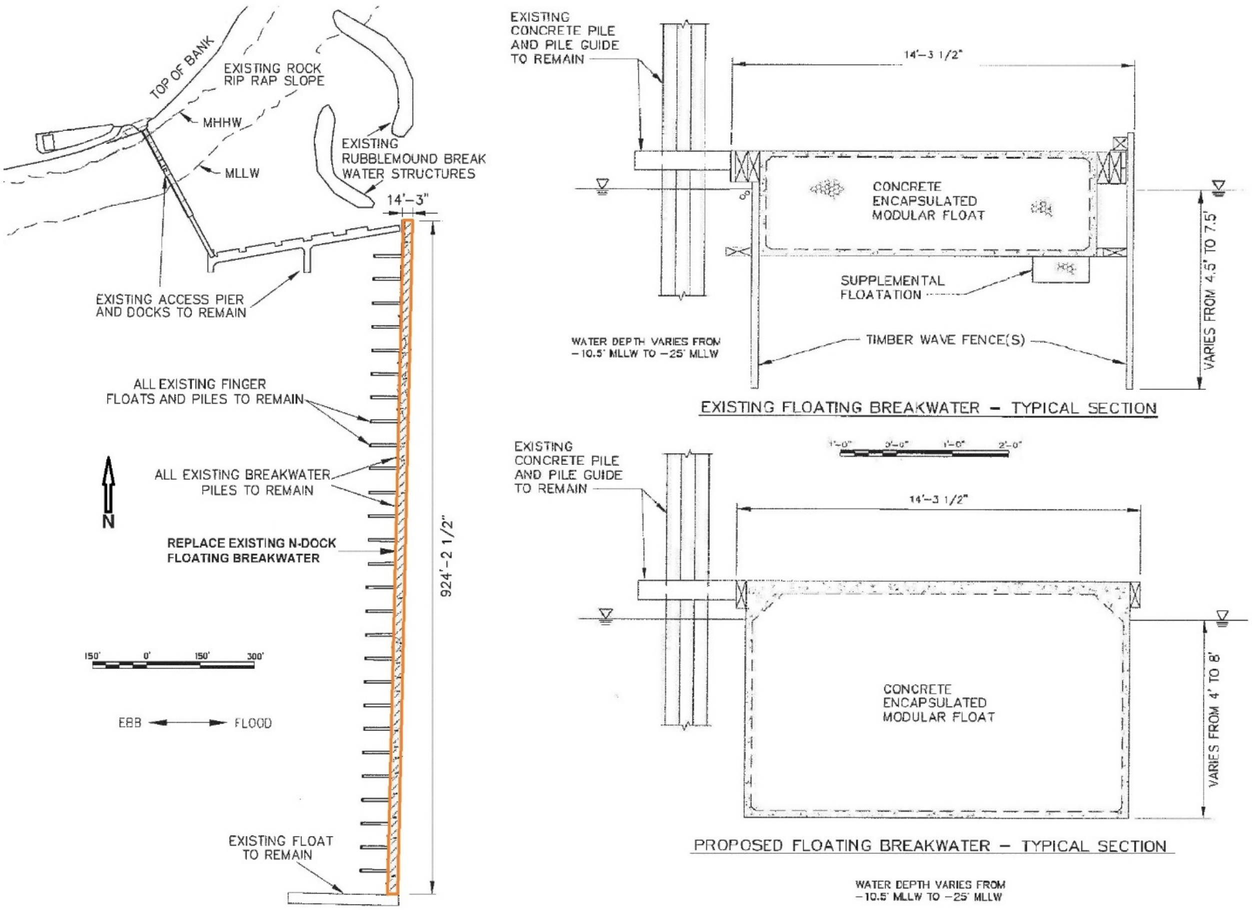

Figure 2. Drawings of Elliott Bay Marina's floating breakwater. The left image shows the breakwater to be replaced outlined in orange, with 27 finger piers along the west side, and a floating ell at the south end. The right image compares the cross-section of the existing and proposed float modules (adapted from EBM 2018b).

During construction, the existing breakwater would be removed and replaced in sections. The existing modules would be disconnected from their supporting piles, from the finger piers, and from the adjacent sections. Disconnected modules would likely be floated to a location where a barge-mounted crane could safely hoist them from the water and place them on a disposal barge. The replacement modules would be installed in a similar but reverse order. No dredging or pile removal or installation would be done. The only potential bottom disturbance would be from barge spuds or anchors if the barges are unable to moor against existing structures.

The project would be completed in the 2019/2020 fall/winter work window, with in-water work occurring intermittently over about 4 months. To minimize protected species' exposure to construction, all in-water work would be done between August 1 and February 16 (M&N 2018c & d). The contractor would also comply with the protective measures identified in the applicant's BE (EBM 2018a), and in the provisions listed in the Washington State Department of Fish and Wildlife Hydraulic Project Approval for this project (M&N 2018a; WDFW 2018a).

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 habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

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 and PS/GB bocaccio and designated critical habitat for both of those species, and thus have proceeded with formal consultation for those species and critical habitats. Our concurrence with the COE's "not likely to adversely affect" determinations for the remaining species and critical habitats is documented in the "Not Likely to Adversely Affect" Determinations section (2.12).

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

ESA-listed marine 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)
bocaccio (*Sebastes paucispinis*) Puget Sound/Georgia Basin	Endangered	LAA	LAA	04/28/10 (75 FR 22276) / 11/13/14 (79 FR 68041)
ESA-listed marine species and critical habitat not likely to be adversely affected (NLAA)				
Species	**Status**	**Species**	**Critical Habitat**	**Listed / CH Designated**
steelhead (*O. mykiss*) Puget Sound	Threatened	NLAA	N/A	05/11/07 (72 FR 26722) / 02/24/16 (81 FR 9252)
yelloweye rockfish (*S. ruberrimus*) PS/GB	Threatened	NLAA	NLAA	04/28/10 (75 FR 22276) / 11/13/14 (79 FR 68041)
killer whales (*Orcinus orca*) southern resident	Endangered	NLAA	NLAA	11/18/05 (70 FR 57565) / 11/29/06 (71 FR 69054)

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

2.1 Analytical Approach

This 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).

The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ‘‘destruction or adverse modification’’ analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or 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. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that conservation value.

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 recovery plans and other sources at: http://www.nmfs.noaa.gov/pr/species/fish/ and, and in the listing regulations and critical habitat designations published in the Federal Register and are incorporated here by reference.

2.2.1 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.

Puget Sound (PS) Chinook Salmon

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 a supplement by 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.

<u>General Life History:</u> 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 juveniles 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.

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.

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).

Abundance and Productivity: Available data on total abundance since 1980 indicate that abundance trends have fluctuated between positive and negative for individual populations, but productivity remains low in most populations, and hatchery-origin spawners are present in high fractions in most populations outside of the Skagit watershed. Available data now show that most populations have declined in abundance over the past 7 to 10 years. Further, escapement levels for all populations remain well below the PSTRT planning ranges for recovery, and most populations are consistently below the spawner-recruit levels identified by the PSTRT as consistent with recovery (NWFSC 2015). The current information on abundance, productivity, spatial structure and diversity suggest that the Whidbey Basin MPG is at relatively low risk of extinction. The other four MPGs are considered to be at high risk of extinction due to low abundance and productivity (NWFSC 2015). The most recent 5-year status review concluded that the ESU should remain listed as threatened (NMFS 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 that are likely to occur in the action area may belong one or more of the 6 populations from the Central/South Puget Sound Basin MPG. Those populations include spring, summer, and fall-run fish (WDFW 2018b; NWFSC 2015). Adults and juveniles from any of these populations may migrate through or past the action area. Juveniles are the life stage most likely to enter the action area because they would be largely shoreline obligated when they pass the area during their migration to the ocean.

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. Both stream- and ocean-type Chinook salmon are present, with the majority being ocean-types. 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.

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.

Puget Sound/Georgia Basin (PS/GB) Bocaccio

The PS/GB bocaccio distinct population segment (DPS) was listed as endangered on April 28, 2010 (75 FR 22276). In April 2016, we completed a 5-year status review that recommended the DPS retain its endangered classification (Tonnes *et al*. 2016), and we released a recovery plan in October 2017 (NMFS 2017b).

The VSP criteria described by McElhaney *et al*. (2000), and summarize at the beginning of Section 2.2, identified spatial structure, diversity, abundance, and productivity as criteria to assess the viability of salmonid species because these criteria encompass a species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. These viability criteria reflect concepts that are well founded in conservation biology and are generally applicable to a wide variety of species because they describe demographic factors that individually and collectively provide strong indicators of extinction risk for a given species (Drake *et al*. 2010), and are therefore applied here for PS/GB bocaccio.

<u>General Life History:</u> The life history of bocaccio includes a larval/pelagic juvenile stage that is followed by a juvenile stage, and subadult and adult stages. As with other rockfish, bocaccio fertilize their eggs internally and the young are extruded as larvae that are about 4 to 5 mm in length. Females produce from several thousand to over a million offspring per spawning (Love *et al*. 2002). The timing of larval parturition in PS/GB bocaccio is uncertain, but likely occurs within a five to six month window that is centered near March (Greene and Godersky 2012; NMFS 2017b; Palsson *et al*. 2009). Larvae are distributed by prevailing currents until they are large enough to actively swim toward preferred habitats, but they can pursue food within short distances immediately after birth (Tagal *et al*. 2002). Larvae are distributed throughout the water column (Weis 2004), but are also observed under free-floating algae, seagrass, and detached kelp (Love *et al*. 2002; Shaffer *et al*. 1995). Unique oceanographic conditions within Puget Sound likely result in most larvae staying within the basin where they are released rather than being broadly dispersed (Drake *et al*. 2010).

At about 3 to 6 months old and 1.2 to 3.6 inches (3 to 9 cm) long, juvenile bocaccio gravitate to shallow nearshore waters. Rocky or cobble substrates with kelp is most typical, but sandy areas with eelgrass are also utilized for rearing (Carr 1983; Halderson and Richards 1987; Hayden-Spear 2006; Love *et al*. 1991 & 2002; Matthews 1989; NMFS 2017b; Palsson *et al*. 2009). Young of the year rockfish may spend months or more in shallow nearshore rearing habitats before transitioning toward deeper water habitats (Palsson *et al*. 2009). As bocaccio grow, their habitat preference shifts toward deeper waters with high relief and complex bathymetry with rock and boulder-cobble complexes (Love *et al*. 2002), but they also utilize non-rocky substrates such as sand, mud, and other unconsolidated sediments (Miller and Borton 1980; Washington 1977). Adults are most commonly found between 131 to 820 feet (40 to 250 m) (Love *et al*. 2002; Orr *et al*. 2000). The maximum age of bocaccio is unknown, but may exceed 50 years, and they reach reproductive maturity near age six.

<u>Spatial Structure and Diversity:</u> The PS/GB bocaccio DPS includes all bocaccio from inland marine waters east of the central Strait of Juan de Fuca and south of the northern Strait of Georgia. The waters of Puget Sound and Straits of Georgia can be divided into five

interconnected basins that are largely hydrologically isolated from each other by relatively shallow sills (Burns 1985; Drake *et al*. 2010). The basins within US waters are: (1) San Juan, (2) Main, (4) South Sound, and (4) Hood Canal. The fifth basin consists of Canadian waters east and north of the San Juan Basin into the Straights of Georgia (Tonnes *et al*. 2016). Although most individuals of the PS/GB bocaccio DPS are believed to remain within the basin of their origin, including larvae and pelagic juveniles, some movement between basins occurs, and the DPS is currently considered a single population.

<u>Abundance and Productivity:</u> The PS/GB bocaccio DPS exists at very low abundance and observations are relatively rare. No reliable range-wide historical or contemporary population estimates are available for the PS/GB bocaccio DPS. It is believed that prior to contemporary fishery removals, each of the major PS/GB basins likely hosted relatively large, though unevenly distributed, populations of bocaccio. They were likely most common within the South Sound and Main Basin, but were never a predominant segment of the total rockfish abundance within the region (Drake *et al*. 2010). The best available information indicates that between 1965 and 2007, total rockfish populations have declined by about 70 percent in the Puget Sound region, and that bocaccio have declined by an even greater extent (Drake *et al*. 2010; Tonnes *et al*. 2016; NMFS 2017b).

<u>Limiting Factors</u>: Factors limiting recovery for PS/GB bocaccio include:
- Fisheries Removals (commercial and recreational bycatch)
- Derelict fishing gear in nearshore and deep-water environments
- Degraded water quality (chemical contamination, hypoxia, nutrients)
- Climate change
- Habitat disruption

<u>PS/GB Bocaccio within the Action Area:</u> Very little specific information is available to describe PS/GB bocaccio in the action area. The habitat within the area of affect for fish consists of shallow nearshore waters with a low-relief substrate that consists mostly of unconsolidated sediments that support eelgrass, and the water column above that substrate. This habitat is suitable for juvenile bocaccio settlement and early growth. Deep water habitat with steep banks that may support adult bocaccio is present in nearby areas that are outside of the area of affect for fish. Therefore, the bocaccio that may be present at the project site would likely be limited to pelagic larvae that may be carried in by the currents and young of the year juveniles that may rear in the eelgrass at the site. Based on bocaccio life history characteristics, larva and/or young of the year juvenile bocaccio could be present at the project site almost year round, but are most likely to be present between March and October. The best available information suggests that bocaccio were never very common near the action area, and they are now considered rare in Puget Sound, including in the areas where they were historically most common, such as the South Sound (Palsson *et al*. 2009).

2.2.2. 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 and PS steelhead critical habitat are listed in Table 3.

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 woody debris (LWD) from the waterways, intense urbanization, agriculture, alteration of floodplain and stream morphology (*i.e*., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, dredging, armoring of shorelines, marina and port development, road and railroad construction and maintenance, logging, and mining. Changes in habitat quantity, availability, and diversity, and flow, temperature, sediment load and channel instability are common limiting factors of critical habitat throughout the basin.

Table 3. Physical or biological features (PBFs) of PS Chinook salmon critical habitat, and corresponding life history events. Although the final rule identified offshore marine areas as a PBF, none was designated as critical habitat.

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

Land use practices have likely accelerated the frequency of landslides delivering sediment to streams. Fine sediment from unpaved roads also contributes to stream sedimentation. Unpaved roads are widespread on forested lands in the Puget Sound basin, and to a lesser extent, in rural residential areas. Historical logging removed most of the riparian trees near stream channels. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys, leaving either no trees, or a thin band of trees. The riparian zones along many agricultural areas are now dominated by alder, invasive canary grass and blackberries, and provide substantially reduced stream shade and 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 LWD. The loss of side-channels, oxbow lakes, and backwater habitats has resulted in a significant loss of juvenile salmonid rearing and refuge habitat.

Wetlands play an important role in hydrologic processes, as they store water which ameliorates high and low flows. The interchange of surface and groundwater in complex stream and wetland systems helps to moderate stream temperatures. Thousands of acres of lowland wetlands across the region have been drained and converted to agricultural and urban uses, and forest wetlands are estimated to have diminished by one-third in Washington State (FEMAT 1993; Spence *et al*. 1996; SSPS 2007).

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

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

Dams constructed for hydropower generation, irrigation, or flood control have substantially affected PS Chinook salmon populations in a number of river systems. The construction and operation of dams have blocked access to spawning and rearing habitat (*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 head gates 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).

Puget Sound/Georgia Basin Bocaccio Critical Habitat

NMFS designated critical habitat for PS/GB bocaccio on November 13, 2014 (79 FR 68042). That critical habitat includes marine waters and substrates of the US in Puget Sound east of Green Point in the Strait of Juan de Fuca. Nearshore critical habitat is defined as areas that are contiguous with the shoreline from the line of extreme high water out to a depth no greater than 98 feet (30 m) relative to mean lower low water. The PBF of nearshore critical habitat include settlement habitats with sand, rock, and/or cobble substrates that also support kelp. Important site attributes include: (1) Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; and (2) Water quality and sufficient levels of dissolved oxygen (DO) to support growth, survival, reproduction, and feeding opportunities. Deepwater critical habitat is defined as areas at depths greater than 98 feet (30 m) that possess or are adjacent to complex bathymetry consisting of rock and/or highly rugose habitat. Important site attributes include: (1) Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; (2) Water quality and sufficient levels of DO to support growth, survival, reproduction, and feeding opportunities; and (3) The type and amount of structure and rugosity that supports feeding opportunities and predator avoidance. Both nearshore and deepwater critical habitat include the entire water column above those substrates. Table 4 lists the PBF and corresponding life history events for PS/GB bocaccio critical habitat.

Table 4. Physical or biological features (PBFs) of designated critical habitat for PS/GB bocaccio, and corresponding life history events.

Physical or Biological Features		
Site Type	**Site Attributes**	**Species Life History Event**
Nearshore habitats with substrate that supports kelp	Prey quantity, quality, and availability Water quality and sufficient DO	Juvenile settlement, growth, and development
Deepwater habitats with Complex bathymetry	Prey quantity, quality, and availability Water quality and sufficient DO	Adult growth and reproduction,

Designated critical habitat for PS/GB bocaccio includes about 1,083 square miles (1,743 sq. km) of marine habitat in Puget Sound. Of which, about 438 square miles (706 sq. km) is deepwater habitat. Overall, nearshore critical habitat has been degraded in many areas by shoreline development. Both nearshore and deepwater critical habitat has been degraded by the presence of derelict fishing gear and reduced water quality that is widespread throughout Puget Sound. As of the late 1990s, shoreline development had impacted about 30 percent of the Puget Sound

(Broadhurst 1998), and has increased since then (Cornwall and Mayo 2008). Shoreline development has been linked to reductions in invertebrate abundance and diversity, reduced forage fish reproduction, and reductions in eelgrass and kelp.

Thousands of lost fishing nets and shrimp and crab pots (derelict fishing gear) have been documented within Puget Sound. Most derelict gear is found in waters less than 100 feet deep, but several hundred derelict nets have also been documented in waters deeper than 100 feet (NRC 2014). Derelict fishing gear degrades rocky habitat by altering bottom composition and killing encrusting organisms. It also kills rockfish, salmon, and marine mammals, as well as numerous species of fish and invertebrates that are rockfish prey resources (Good *et al*. 2010).

Over the last century, human activities have impacted the water quality in Puget Sound predominantly though the introduction of a variety of pollutants. Pollutants enter via direct and indirect pathways, including surface runoff; inflow from fresh and salt water, aerial deposition, discharges from wastewater treatment plants, oil spills, and migrating biota. In addition to shoreline activities, fourteen major river basins flow into Puget Sound and deliver contaminants that originated from upland activities such as industry, agriculture, and urbanization. Pollutants include oil and grease, heavy metals such as zinc, copper, and lead, organometallic compounds, chlorinated hydrocarbons, phenols, polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), and Polycyclic Aromatic Hydrocarbons (PAHs) (WDOE 2010; COE 2015). Some of these contaminants are considered persistent bioaccumulative toxics (PBTs) that persist in the environment and can accumulate in animal tissues or fat. The Washington State Department of Ecology (WDOE) estimates that Puget Sound receives between 14 and 94 million pounds of toxic pollutants annually (WDOE 2010).

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 sections 2.5 and 2.12, detectable direct effects from elevated noise would be the project-related stressor with the greatest range of effect. All other project-related effects, including indirect effects would be undetectable beyond the range of acoustic effects. The area where detectable effects may occur in marine mammals would be limited to the marine waters within 3.4 miles (5,412 m) of the project site. For fish, the maximum range of effects would be limited to the marine waters and substrates within about 177 feet (54 m) around the marina. Therefore, for the purposes of this consultation, the action area is limited to the marine waters and substrates within 3.4 miles around the Elliott Bay Marina. The action area described above 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, Pacific Coast Groundfish, and Coastal Pelagic Species.

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).

Environmental conditions at the project site and the surrounding area: The Elliott Bay Marina is located in marine waters of Puget Sound, along the northwest shoreline of Elliott Bay, in the City of Seattle Washington (Figure 1).

Elliott Bay has a surface area of about 7.7 square miles (20 km^2). Shoreline depths range from 0 feet relative to the ordinary high water mark (OHWM) in areas where it hasn't been armored, to about -30 feet (-9 m) relative to mean lower low water (MLLW) along some of the bulkheads that line much of the Seattle waterfront. Near the center of the bay, depths approach 500 feet (152 m). The average tidal fluctuation is 11.3 feet (3.4 m), and a generally counter-clockwise, low velocity circulation pattern exists in the bay. However, currents during flood tides tend to flow clockwise and be stronger than the ebb tide currents that tend to flow counterclockwise. The bay opens toward the west and is exposed to wind-driven waves and wakes from large ocean-going vessels that regularly operate in the bay. The substrate along the shoreline of the bay consists of a mix of shell hash, scattered cobbles and boulders, and silts and clays that slopes relatively gently for varying distances before steepening and falling to depths exceeding 300 feet near the center of the bay (NOAA 2018).

The bay and the surrounding upland areas have been heavily impacted by more than 100 years of development. The southern half of the bay is occupied by the Port of Seattle, and many other waterfront users. Nearly continuous and heavy urban and industrial development extends to the waterline from the Duwamish Waterway to just east of the applicant's marina. A narrow green belt of trees and shrubs runs along the much of the shoreline from the western boundary of the marina to West Point. Inland areas are covered by nearly continuous residential and commercial properties, and supporting roads for miles north and south of the project site. Water and sediment quality within the bay have been impaired by decades of urban and industrial discharges. These include sewage discharges from wastewater treatment facilities, such as the nearby West Point Wastewater Treatment Plant, and numerous point and non-point stormwater discharges around the bay.

Ambient in-water noise levels at the site are unreported, but likely routinely exceed 120 dB_{RMS}. Typical sources of noise near the project site include high levels of daily vessel traffic that include ocean-going commercial and military vessels, tug boats, commercial fishing boats, tour boats and ferries, and numerous recreational vessels. Strong tidal movement through Admiralty Inlet and Possession Sound is another contributor to ambient noise. Blackwell (2005) reported ambient noise in the frequency spectrum of 10 to 10,000 Hz were between 95 to over 120 dB in the absence of strong currents, but up to 133 dB during strong tidal movements in Alaska. Measured ambient noise in the frequency spectrum of 16 to 30,000 Hz in Admiralty Inlet, Puget Sound ranged from 94 to 144 dB, with ambient noise exceeding 100 dB 99% of the time (Bassett *et al*. 2010).

The applicant's privately owned marina was originally constructed in 1989. Ten acres of intertidal substrate was covered with fill and rip rap armoring. The marina's offices and parking lots were constructed on that fill. Eleven acres of intertidal substrate was dredged to create a 60-

acre moorage basin. Ten acres of subtidal substrate was filled south of the basin to create an offshore breakwater. Floating concrete mooring piers and breakwaters were installed within the basin to provide moorage for about 1,200 vessels that range in size from 32 to 150 feet. The piers and breakwaters are supported by concrete piles. The marina owners installed 4.7 acres of coarse-grained beach material to create sloping intertidal habitat between the shoreline rip rap and the moorage basin. They also installed 4.7 acres of subtidal gravel, cobbles, and boulders just east of the marina to replace similar habitat that was lost due to construction.

Currently, shoreline vegetation at the marina consists mostly of landscaped areas with grasses, trees, and invasive English Ivy. Kelp and several species of macroalgae grow on the offshore breakwater and the subtidal mitigation site. Eelgrass beds are documented of either side of the marina, and spawning of Pacific Herring is documented western eelgrass bed (WDFW 2018c). Macroalgae also grows on the substrate and concrete structures within the marina. As with all of the other overwater structures in the marina, the breakwater to be replaced is solid-decked. It has a footprint of about 13,200 square feet, and provides mooring for over 50 vessels. It floats above shallow subtidal substrate at depths of about -10.5 to -25 feet relative to MLLW.

Adult PS Chinook salmon from the Central/South Puget Sound Basin MPG are likely to migrate past the project site to reach their spawning habitats. Juveniles from those MPGs are likely to shelter and forage in the action area as they migrate and continue to adapt to the marine environment. Larval PS/GB bocaccio could drift though the action area on the currents, and some juveniles may utilize the kelp, eelgrass, and macroalgae beds as rearing habitat before moving into deep-water habitats offshore. The action area has also been designated as critical habitat for PS Chinook salmon, PS/GB bocaccio, and SR killer whales.

The past and ongoing anthropogenic impacts described above have impacted these species and critical habitats through reduced quantity and quality of the migratory and rearing habitat, including reduced water quality caused by the introduction of low levels of pollutants related to upland development and vessel operations.

Climate Change: Climate change has affected the environmental baseline of aquatic habitats across the region and within the action area. However, the effects of climate change have not been homogeneous across the region, nor are they likely to be in the future. During the last century, average air temperatures in the Pacific Northwest have increased by 1 to 1.4° F (0.6 to 0.8 °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).
The largest hydrologic responses to climate change have occurred outside of the action area, in upstream basins historically dominated by significant snow accumulation. In those areas, warming has decreased snow pack, increased winter flows, and advanced the timing of spring melt (Mote *et al*. 2014 & 2016). Summer precipitation has also decreased (Mote *et al*. 2014).

In coastal marine waters, temperatures and sea levels have risen over the last century. Snover (*et al*. 2005) report decadal-scale fluctuations and a long-term warming trend of 1.7° F (0.9° C) since 1921, and 1.8° F (1.0°C) since 1950 in the Strait of Juan de Fuca near Victoria, BC, and sea surface temperatures are projected to increase by 6.8° F (3.8° C) by the end of the century (IPCC 2014). Although influenced by many factors, including uplift or subsidence of the adjacent landmass, sea levels have risen in most parts of Puget Sound. Between 1900 and 2008 the sea level rose by 8.6 inches (0.8 inch per decade) at Seattle. Whereas at Neah Bay, where uplift is occurring, the sea level dropped by 5.2 inches between 1934 and 2008 (-0.7 inches per decade) (Mauger *et al*. 2015). Global sea levels are expected to rise by 10 to 32 inches by the end of the century (IPCC 2014).

Globally, the uptake of CO^2 since the beginning of the industrial era, has increased ocean acidification by about 26%, and acidification is expected to increase by 38% to 109% by the end of this century (IPCC 2014). Poorly understood regional factors may be causing ocean acidification to occur earlier and more acutely in marine and estuarine waters of the northwest than in other regions (Barton *et al*. 2012; Feely *et al*. 2012; Sunda and Cai 2012). NMFS knows of no information that describes action area-specific climate change impacts, nor any information that would suggest that conditions within the action area are notably different from the general understanding of regional effects from climate change in the Puget Sound.

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 16 and February 15, the applicant’s contractors would conduct intermittent in-water work over 4 months to sequentially remove and replace a floating concrete breakwater in the marine waters of Elliott Bay. The new modules would be constructed off site and barged to the marina. The old modules would be disconnected and removed from the water by a barge-mounted crane for disposal at an approved site. The new modules would be craned into position and attached. The new structure would have the same surface area and footprint as the existing structure. No other in-water work would be done, but substrate may be impacted by barge spuds or anchors if the barges can’t moor against existing structures. The applicant would require their contractors to comply with the provisions and BMPs identified in their BE and in the WDFW HPA for the project.

PS Chinook salmon utilize the action area. PS steelhead, PS/GB bocaccio, PS/GB yelloweye rock fish, and SR killer whales may also be present in the action area. Also, critical habitat has been designated in the action area for PS Chinook salmon, PS/GB bocaccio, and SR killer whales. As discussed in Section 2.12, the project is not likely to adversely affect PS steelhead, PS/GB yelloweye rock fish, and SR killer whales. It is also not likely to adversely affect designated critical habitat for PS/GB yelloweye rockfish and SR killer whales.

Some PS Chinook salmon reside in Puget Sound year-round, but they are most plentiful when ocean-going adults return to spawn, and when smolts leave their natal streams. Returning adults may migrate through the action area between March and early-September. Juvenile PS Chinook salmon pass through the action area between March and the end of summer. PS/GB bocaccio larvae and young of the year juveniles may be present at the project site year-round but are most likely to be present between March and October (Greene and Godersky 2012; NMFS 2017b; Palsson *et al*. 2009). Larvae may be carried in by the currents and young of the year juveniles may rear in the kelp, eelgrass, and macro algae at the site.

The planned work may cause direct effects on PS Chinook salmon and PS/GB bocaccio, and on the PBFs of their critical habitats through exposure to construction-related elevated noise, degraded water quality, and propeller wash. The replacement of breakwater would also extend the useful life of that overwater structure several decades beyond that of the existing structure. The new structure and its interrelated vessel activities are reasonably certain to cause effects on PS Chinook salmon and PS/GB bocaccio, and their critical habitats through impacts on water quality, altered lighting, noise, and propeller wash.

2.5.1 Effects on Listed Species

Construction-related Noise and Activity:

Exposure to construction-related noise would cause adverse effects in PS Chinook salmon and PS/GB bocaccio. Tugboats and power tools used during construction are likely to cause elevated in-water noise.

The effects of a fishes' exposure to noise vary with the hearing characteristics of the exposed fish, the frequency, intensity, and duration of the exposure, and the context under which the exposure occurs. At low levels, effects may include the onset of behavioral disturbances such as acoustic masking (Codarin *et al*. 2009), startle responses and altered swimming (Neo *et al*. 2014), abandonment or avoidance of the area of acoustic effect (Picciulin *et al*. 2010; Mueller 1980; Sebastianutto *et al*. 2011; Xie *et al*. 2008) and increased vulnerability to predators (Simpson *et al*. 2016). At higher intensities and/or longer exposure durations, the effects may rise to include temporary hearing damage (a.k.a. temporary threshold shift or TTS, Scholik and Yan 2002) and increased stress (Graham and Cooke 2008). At even higher levels, exposure may lead to physical injury that can range from the onset of permanent hearing damage (a.k.a. permanent threshold shift or PTS) and mortality.

The best available information about the auditory capabilities of the fish considered in this Opinion suggest that their hearing capabilities are limited to frequencies below 1,500 Hz, with peak sensitivity between about 200 and 300 Hz (Hastings and Popper 2005; Picciulin *et al*. 2010; Scholik and Yan 2002; Xie *et al*. 2008).

The 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 received level (RL) below 150 dB_{SEL} is considered "Effective Quiet". The distance from a source where the RL drops to 150 dB_{SEL} is considered the maximum distance from that source where fishes can be affected by the noise, regardless of accumulation of the sound energy (Stadler and Woodbury 2009). Therefore, when 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 of exposure to impulsive sounds. Further, the assessment did not consider non-impulsive sound because it is believed to be less injurious to fish than impulsive sound. Therefore, any application of the criteria to non-impulsive sounds is also likely to overestimate the potential effects in fish. However, this assessment applies the criteria 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 the majority of this project.

Based on the best available information, as described in recent acoustic assessments for similar work (NMFS 2017c, 2018) and other sources (FHWA 2006), barge spud deployment would cause impulsive noise that would be the loudest construction-related source. Assuming two barges with 4 spuds each, being moved once every day, spud deployment would cause 8 impulses per day. Power saws are likely to be would be the loudest power tools used. Saw noise would likely consist of brief episodes of non-impulsive sound that would total less than 1 hour of cumulative sound per day. Tugboat-related noise would likely consist of episodic 1 to 2 hour events when a tugboat is present to move barges. Most of the acoustic energy from all of these sources would be under 2,500 Hz.

The expected source levels (SL, sound level at 1 meter from the source) for all construction-related sources are below the 206 dB_{peak} threshold for instantaneous injury in fish. However, the 150 dB_{SEL} isopleth would extend to about 177 feet (54 m) around the project site during power saw use, and for very brief periods (seconds) during the episodic placement of barge spuds. The 150 dB_{SEL} isopleth would extend to about 72 feet (22 m) around other in-water work. Table 5 summarizes the expected SLs, sound characteristics, and ranges to effects thresholds for fish.

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, may cause injuries to auditory tissues.

Table 5. Estimated in-water dB_{peak} and dB_{SEL} Source Levels for construction-related sound sources. The ranges to the applicable source-specific effects thresholds for fish 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
Power Saw Cutting Timber	< 2,500 Hz Non-Impulsive	191 dB_{peak}	206 @ N/A
Episodic, brief episodes, total of < 1 hour per day for about 1 week		176 dB_{SEL}	183 @ N/A
		176 dB_{SEL}	187 @ N/A
		176 dB_{SEL}	150 @ 54 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

The early part of planned work window, July 16 through the end of August, overlaps with the expected presence of adult and juvenile Chinook salmon in the action area. It also overlaps with the possible presence of juvenile bocaccio through the end of October.

Adult Chinook salmon would be far in excess of 2 grams, independent of shallow shoreline waters, highly mobile, migrating past the site in route to their natal streams, 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 fish from moving past the area, nor would it prevent them from accessing important habitat resources.

The juvenile Chinook salmon that would be present are likely to exceed 2 grams, but they are highly likely to be largely shoreline obligated and prone to hold in shallow shoreline areas with eelgrass and macro algae that provide shelter and forage resources. The bocaccio that may be present may include larvae and small juveniles that weigh less than 2 grams, and therefore are likely to be more sensitive to acoustic impacts than larger fish. Bocaccio larvae would likely pass through the area on the currents, and therefore only briefly exposed to project related noises. It is unlikely that the low-intensity noise would cause any detectable effects in exposed larvae. However, any juvenile bocaccio that may have settled into the eelgrass and macro algae rearing habitat that is present at the site are likely to remain close to that habitat over the duration of construction.

Juvenile Chinook salmon and/or bocaccio 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. Individuals that remain within the range where accumulated sound energy would exceed 183/187 dB SEL_{cum} may also experience some level of auditory- and non-auditory tissue injury, which could reduce their likelihood of survival.

The number of individuals of either species that may be impacted by this stressor is unquantifiable with any degree of certainty. However, the numbers of fish that may be affected by this stressor would comprise such small subsets of their respective cohorts, that their loss would cause no detectable population-level effects.

Construction-related Degraded Water Quality:

Exposure to construction-related degraded water quality would cause minor effects in PS Chinook salmon and PS/GB bocaccio. Water quality would be temporarily affected by increased turbidity. It may also be affected by the introduction of toxic materials.

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

Based on similar projects, tugboat trips to the site would be relatively infrequent, and brief. Assuming an average of about two trips per week over 16 weeks of work, about 32 trips could occur, causing a corresponding number of turbidity plumes. The intensity and duration of the resulting turbidity plumes are uncertain. They would depend on a combination of the tugboat's thrust, the water depth under it, and the type of substrate. The higher the thrust and the finer the sediment, the more mobilized sediment. Fine material (silt) remains mobilized longer than coarse material (sand). The shallower the water, the more thrust energy that would reach the substrate.

A recent study described the turbidly cause by tugboats operations in water about 40 feet (12 m) deep (ESTCP 2016). At about 13 minutes, the plume extended about 550 yards (500 m) and had a TSS concentration of about 80 mg/L. The plume persisted for many hours and extend far from the event. However, the TSS concentration fell to 30 mg/L within 1 hour and to 15 mg/L within 3 hours.

The effects of turbidity on fish are somewhat species and size dependent. In general, severity typically increases with sediment concentration and duration of exposure, and decreases with the increasing size of the fish. Newcombe and Jensen (1996) reported minor physiological stress in juvenile salmon only after about three hours of continuous exposure to concentration levels of about 700 to 1,100 mg/l. 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).

Based on the best available information, construction-related turbidity would be episodic, short-lived, and of TSS concentrations too low to cause more than temporary, non-injurious behavioral effects such as avoidance of the plume, minor gill flaring (coughing), and slightly reduced feeding rates and success. None of these potential responses, individually, or in combination would affect the fitness of exposed individuals.

Toxic Materials: Toxic materials may be introduced to the water through construction related spills and discharges. PS Chinook salmon and PS/GB bocaccio 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). Many of the pollutants that may enter the water column due to project activities can cause effects in exposed fish that range from avoidance of an affected area, to reduced growth, altered immune function, and immediate mortality in exposed individuals. The intensity of effects depends largely on the pollutant, its concentration, and/or the duration of exposure (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).

Many of the fuels, lubricants, and other fluids used by common construction-related equipment are petroleum-based hydrocarbons with PAHs that are known to be injurious to fish. However, the project includes comprehensive BMPs to reduce the risk and intensity of discharges and spills from construction-related equipment. In the unlikely event of a construction-related spill or discharge, the event would likely be very small, quickly contained and cleaned, and most of the fuels and lubricants that used for this type of work would evaporate relatively quickly, and/or be quickly diluted by the tidal currents at the site. Further, non-toxic and/or biodegradable lubricants and fluids are strongly encouraged in the WDFW HPA for this work, and are commonly used by many of the local contractors. Based on the best available information, the in-water presence of construction-related contaminants would be very infrequent, very short-lived, and at concentrations too low to cause detectable effects should a listed fish be exposed to them.

Based on the best available information, as described above, any fish that may be exposed to construction-related water quality impacts would experience no more than temporary low-level behavioral effects which, individually, or in combination would not affect the fitness of exposed individuals. Therefore, any PS Chinook salmon and PS/GB bocaccio would experience only minor effects from exposure to construction-related water quality impacts.

Construction-related Propeller Wash:

Construction-related propeller wash is likely to adversely affect juvenile PS Chinook salmon and PS/GB bocaccio, but would cause only minor effects in adults of both species. Spinning boat propellers kill fish and small aquatic organisms (Killgore *et al*. 2011; VIMS 2011). Spinning propellers also would generate fast-moving turbulent water that is known as propeller wash. Exposure to propeller wash can displace and disorient small fish. It can also mobilize sediments and dislodge aquatic organisms, including submerged aquatic vegetation (SAV), particularly in shallow water and/or at high power settings. This is called propeller scour.

During construction, the tugboat's spinning propeller and propeller wash may affect juvenile Chinook salmon and bocaccio that are near the breakwater. Individuals that are struck or very nearly missed by the propeller would be injured or killed by the exposure. Farther away, propeller wash would may displace and disoriented fish. Depending on the direction and strength of the thrust plume, displacement could increase energetic costs, reduce feeding success, and may increase the vulnerability to predators for individual that tumble stunned and/or disoriented in the wash.

The number of individuals that would be affected by propeller wash is unquantifiable with any degree of certainty. However, based on the timing and location of the work, and on the relatively low number of tugboat trips that would occur, the numbers of affected individuals would represent such small subsets of their respective cohorts that their loss would cause no detectable population-level effects.

Construction-related propeller scour may also reduce SAV and diminish the density and diversity of the benthic community around the breakwater. However, the affected area would be limited to a very small area immediately adjacent to the breakwater, and the resources would likely recover very quickly after work is complete. Therefore, the effects of reduced shelter and forage resources due to propeller scour would be too small to cause any detectable effects on the fitness and normal behaviors of juvenile Chinook salmon and bocaccio in the action area.

<u>Structure-related Impacts on Water Quality:</u>

Moored vessels are likely to discharge pollutants that would adversely affect juvenile PS Chinook salmon. However, dissolved copper from ACZA-treated timber and anti-fouling hull paints would cause minor effects.

<u>Petroleum-based fuels and lubricants:</u> Infrequent and relatively small discharges of petroleum-based fuels and lubricants would occur from some of the 1,200 vessels that moor in the marina. As discussed above, fish can uptake contaminants directly through their gills, and through dietary exposure. Although some of the pollutants may evaporate relatively quickly (Werme *et al*. 2010), and tidal currents would help disperse pollutants, discharged pollutants would float and tend to collect within the marina, which is highly enclosed at the surface. Over the decades-long life of the new breakwater, some juvenile PS Chinook salmon would be directly exposed to petroleum-based pollutants, and/or exposed to contaminated prey resources, at concentrations capable of causing reduced growth, increased susceptibility to infection, and increased mortality. The number of individuals that would be affected by exposure to fuels and lubricants is unquantifiable with any degree of certainty. However, based on the expected infrequency and small volumes of discharge, the numbers of affected individuals would represent such small subsets of their respective cohorts that their loss would cause no detectable population-level effects.

<u>Copper:</u> Wet ACZA-treated wood used in this project may leach 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 in the marine environment compared to arsenic and zinc (Poston 2001). Anti-fouling hull paints also leach copper (Schiff *et al*. 2004).
In freshwater, exposure to dissolved copper concentrations between 0.3 and 3.2 µg/L above background levels can cause avoidance of an area, reduce salmonid olfaction, and induce behaviors that increase juvenile salmon's vulnerability to predators (Giattina *et al*. 1982; Hecht *et al*. 2007; McIntyre *et al*. 2012; Sommers *et al*. 2016; Tierney *et al*. 2010). However, dissolved

copper's olfactory toxicity in salmon diminishes quickly with increased salinity. Baldwin (2015) reports no toxicity at copper concentrations below 50 µg/L in estuarine waters with a salinity of 10 parts per thousand (ppt). Sommers *et al*. (2016) report no copper-related impairment of olfactory function in salmon in saltwater. Sub-lethal copper toxicity in bocaccio is not yet understood, but may be similar to that of salmonids.

Brooks (2004) reports that AZCA-treated wood used for in- and over-water marine structures caused no increase in copper concentrations in the water, sediments*, and benthic biota adjacent to those structures (* the in-sediment concentration of copper located within one multi-pile dolphin was higher than at control sites). WDOE (2017) reports that dissolved copper concentrations from anti-fouling paints can exceed 5 µg/L in protected moorages with high boat occupancy, but are typically below 0.5 µg/L in open moorages with high flushing rates. The marina uses floating breakwaters along its sides instead of solid rip rap jetties. Therefore, its flushing rates are probably relatively high. Further, the salinity at the project site is likely close to 30 ppt, and the maximum expected dissolved copper concentration is 5 µg/L. Therefore, the expected dissolved copper concentrations at the site would be well below the threshold of effect in salmonids and other fish like bocaccio.

<u>Structure-related Altered Lighting:</u>

Structure-related altered lighting is likely to adversely affect juvenile PS Chinook salmon and PS/GB bocaccio and adults of both species. The applicant's new breakwater and the vessels that moor alongside it would cast shadows during the day. The breakwater would be illuminated at night, as may some of the boats that moor there. Therefore, the action may also alter nighttime in-water illumination.

<u>Shade</u>: The 13,200-square foot (1,467 yd^2) replacement breakwater would be installed in a north-south orientation over nearshore marine substrate between about -10.5 and -25 feet MLLW. It would be solid-decked, and would extend about 4 to 8 feet below the surface (Figure 2). Its shadow would sweep across an area close to three times its footprint as the sun moves east to west. The boats that would moor along it would add to the size and intensity of the shade. The shadow would reduce productivity. It is also likely to alter the migratory patterns, and may increase vulnerability to predators for juvenile salmon that encounter it. The intensity of shade effects 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.

Shade limits primary production and can reduce the diversity of the aquatic communities under over-water structures (Nightingale and Simenstad 2001; Simenstad *et al*. 1999). The exact amount that productivity would be reduced by the breakwater's shade is uncertain. However, the breakwater would be installed adjacent to 13 other similar structures that are installed within a 60-acre mooring basin along about 2,100 feet of nearshore habitat (Figure 1). The structure-related shade reduces SAV growth under and adjacent to the structures, which in turn reduces the production and diversity of invertebrate organisms that are prey for juvenile salmonids and rockfish. Across the marina, structure-related shade likely reduces productivity enough to reduce the fitness of juvenile Chinook salmon and of juvenile bocaccio, and the breakwater would contribute measurably to that impact.

Shade also affects juvenile salmon migration. Many of the juvenile Chinook salmon that migrate through the action area would still be largely shoreline obligated, which means that they are biologically compelled to follow the shoreline and would encounter the applicant's breakwater and/or other marina structures as they that migrate past the site on their way to the ocean. The breakwater would create a 924-foot long by 14-foot wide (or wider depending on the angle of the sun) shadow across the shallow water routes likely to be followed by juvenile salmon migrating along this section of shoreline. Swimming around overwater structures increases the migratory distance, which is positively correlated with increased mortality in juvenile Chinook salmon (Anderson *et al*. 2005).

Numerous studies demonstrate that juvenile salmonids, in both marine and freshwater habitats, are more likely to avoid the shadow of an overwater structure than to pass through the shadow (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). The intensity of the effect increases with proximity of the structure to the water and the increased contrast between light and dark areas. Celedonia *et al*. (2008a) report that two thirds of the juvenile Chinook salmon tracked during their study experienced a detectable delay in their migration under the SR 520 Bridge, where there is no option to go around. One-third of the fish experienced an average delay of 15-minutes. One-third experienced delays of under 1 minute, and one-third showed no delay. Although the SR-520 Bridge is an imperfect analog for the applicant's structure, the authors' findings support the understanding that at least some of the juvenile PS Chinook salmon that migrate past the project site would swim around the breakwater to avoid its shadow.

The degree to which breakwater-related altered migration would affect individual juvenile PS Chinook salmon is uncertain, but swimming around the structure would increase the energetic cost for affected fish. Given that a fish would travel about 14 feet to pass the breakwater's location if it was not present, and that the fish would instead swim up to about 1,848 feet to swim around it, avoiding the breakwater's shadow could increase the distance required to pass the project site by over 13,000 percent. Conservatively assuming that a juvenile fish would simply swim around the entire marina instead of swimming between and around the multiple piers within it, avoiding structure-related shade would more than double the required distance. Nearly all of the additional distance would be in relatively deep water where foraging is likely to have higher energetic costs than shallow shoreline waters (Heerhartz and Toft 2015). Therefore, juvenile PS Chinook salmon that swim around the breakwater are likely to experience reduced fitness due to increased energetic costs.

NMFS is unaware of marine analogs to the much-studied under-structure freshwater ambush predators, such as northern pikeminnow and smallmouth bass that prey heavily on juvenile PS Chinook salmon. However, swimming around the breakwater would force juvenile salmon into deeper water as well as increase their migratory distance (discussed above). Predators such as flatfish, sculpin, and larger salmonids generally avoid the shallow shoreline waters that juvenile salmonids prefer. Willette (2001) found that marine piscivorous predation of juvenile salmon increased fivefold when juvenile salmon were forced to leave shallow nearshore habitats. The increased migratory distance also adds to risk of predation by increasing the time spent in hi-risk conditions. Further, swimming around the breakwater and/or the entire marina would drives the juvenile salmon toward rip rap structures that also increase the risk of predation in both freshwater and marine habitats (Edwards and Cunjak 2007; Peters *et al*. 1998; Willette 2001). Therefore, some juvenile PS Chinook salmon are likely to experience mortality that would be attributable to swimming around the breakwater. Individuals that escape predation would experience reduced fitness due to increased energetic costs and stress-related effects related to their avoidance behaviors, which may reduce their overall likelihood of survival.

In summary, structure-related altered lighting would cause a combination of altered migratory behaviors and increased risk of predation that would reduce fitness and/or cause mortality for some juvenile PS Chinook salmon that pass the site. The annual numbers of individuals that would be impacted by this stressor is unquantifiable with any degree of certainty. However, the affected individuals would represent such small subsets of their respective cohorts that the numbers of exposed fish would be too low to cause detectable population-level effects.

<u>Artificial Lighting</u>: The breakwater would likely be lit at night by an unspecified number of low-wattage safety lights. Some of the boats that moor there may also be periodically illuminated after dark. The type, intensity, and duration of vessel lighting would be variable, but most of the boat illumination would likely be limited to low-intensity navigation lights that would be on only for short periods (minutes) just before leaving the pier, or after arriving. Artificial lighting can attract fish and cause other behavioral modifications (Celedonia and Tabor 2015; Mazur and Beauchamp 2003; Tabor and Piaskowski 2002; Tabor *et al*. 1998, 2017). The exact intensity of in-water illumination that may along the breakwater is uncertain. However, NMFS expects that the in-water light levels at the site that would be attributable to the proposed action would be only minimally detectable against the current lightscape in the action area, and too low to cause meaningful effects in the fitness or normal behaviors in juvenile PS Chinook salmon and PS/GB bocaccio that may be exposed to it.

<u>Structure-related Noise:</u>

Structure-related noise would cause adverse effects in juvenile PS Chinook salmon and PS/GB bocaccio, and minor effects in adults of both species. Between 50 and about 70 boats can moor at the breakwater, depending on the size of the vessels, especially along the east side of the structure where large vessels can moor. Most of the vessels would be powerboats between 20 and 40 feet in length, but vessels as large as 230 feet in length and larger can moor along the east side of the breakwater. Boat operation would typically consist of brief periods of relatively low-speed operations as boats are driven to and from the breakwater. Engine operations typically begin or end within minutes of departure or arrival.

Numerous sources describe the source levels for powerboats similar to those that are likely to moor at the breakwater operating at or close to full-speed (Blackwell and Green 2002; Codrin *et al*. 2009; Matzner *et al*. 2010; Picciulin *et al*. 2010; Richardson *et al*. 1995). Table 6 summarizes the expected sound levels for those vessels, with ranges to applicable effects thresholds.

Table 6. Estimated in-water dB_{peak} and dB_{SEL} Source Levels for powerboats of increasing size running at full speed, and ranges to effects thresholds for fish.

Source	Acoustic Signature	Source Level	Threshold Range
85 foot Tourist Ferry	< 2 kHz Combination	187 dB_{peak}	206 @ N/A
Infrequent brief periods measures in minutes		177 dB_{SEL}	150 @ 63 m
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
16 foot Boat w/ 40 HP Outboard Engine*.	< 2 kHz Combination	172 dB_{peak}	206 @ N/A
* Undocumented, but likely a 2~ engine based on noise level		162 dB_{SEL}	150 @ 10 m

It is extremely unlikely that boats within the marina would be run at anything close to full speed, and most boats would be smaller than a typical tugboat. Therefore, no fish are likely to be injured from exposure to peak sound levels, and the 150 dB_{SEL} isopleth would likely remain well within 72 feet (22 m) around the breakwater. Although boating noise levels would be non-injurious, juvenile Chinook salmon and bocaccio 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.

The annual numbers of individual PS Chinook salmon and PS/GB bocaccio that would be affected by this stressor is unquantifiable with any degree of certainty. However, the affected individuals would represent such small subsets of their respective cohorts that the numbers of exposed fish would be too low to cause detectable population-level effects.

Structure-related Propeller Wash:

Structure-related propeller wash is likely to adversely affect PS Chinook salmon, but would cause only minor effects in juvenile PS/GB bocaccio and adults of both species. The effects of propeller wash is described above for construction. The only difference between that discussion and this is that the vessels that regularly moor at the breakwater would typically be much smaller and operated at much lower power settings than the tugboats that would be used during construction. Therefore, structure-related propeller wash is far less likely to impact the substrate, and juvenile bocaccio that may be rearing in SAV at the site.

Juvenile Chinook salmon that migrate around the breakwater are likely to be relatively close to the surface where they may be exposed to spinning propellers and propeller wash, and they 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. Exposure to propeller wash alone 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 breakwater, at least some juvenile Chinook salmon would experience reduced fitness or mortality from exposure to spinning propellers and/or propeller wash at the site. The annual number of individuals that may be impacted by this stressor is unquantifiable with any degree of certainty. However, the affected individuals would represent such small subsets of their respective cohorts that 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 designated critical habitat 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 estuarine and nearshore marine areas 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 – None in the action area.
4. Estuarine areas free of obstruction and excessive predation
    a. Free of obstruction and excessive predation – The proposed action would cause long-term minor effects on obstruction and predation. The breakwater's shadow is likely to cause migratory delays and/or increase migration distances for some of the juvenile Chinook salmon that encounter it. The project would cause no change in the abundance of predators, but migratory impacts may increase the exposure and vulnerability to predators for some juvenile Chinook salmon. Construction and boating noise would cause ephemeral conditions that may act synergistically to increase the intensity of both of these effects.
    b. Water quality – The proposed action would cause long-term minor effects on water quality. It would cause no measurable changes in water temperature or DO, but construction would briefly mobilize sediments, and vessel operations would likely introduce small amounts of petroleum-based pollutants to marina waters into the foreseeable future. Detectable effects on water quality would be limited to the area within and immediately around the marina.
    c. Water quantity – The proposed action will cause no effect on water quantity, and no change in the quality and function of this PBF.
    d. Salinity – The proposed action will cause no effect on salinity, and no change in the quality and function of this PBF.

   e. Natural Cover – The proposed action would cause long-term minor effects on natural cover. The breakwater and moored boats would cause long-term shading that may slightly reduce SAV productivity under and near the structure.
   f. Forage – The proposed action would cause long-term e minor ffects on forage. The breakwater and moored boats would cause long-term shading that may slightly reduce the production and diversity of invertebrate organisms that are prey for juvenile salmonids under and near the structure. The action would not affect forage fish spawning.
5. Nearshore marine areas free of obstruction and excessive predation
   a. Free of obstruction and excessive predation – Same as above.
   b. Water quality – Same as above.
   c. Water quantity – Same as above.
   d. Forage – Same as above.
   e. Natural Cover – Same as above.
6. Offshore marine areas – Does not occur in the action area.

PS/GB Bocaccio Critical Habitat: The proposed action is likely to adversely affect designated critical habitat for PS/GB bocaccio. The essential PBFs of PS/GB bocaccio 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 nearshore juvenile settlement habitats PBF as described below. Benthic habitats and sites deeper than 98 feet (30 m) are outside of the range of expected effects from the proposed action. Therefore, it is highly unlikely that the action would cause any impacts on the deep-water benthic habitat PBF.

1. Juvenile settlement habitats located in the nearshore (shoreline to 98 feet (30 m) deep) with substrates such as sand, rock, and/or cobble compositions that support kelp
   a. Quantity, quality, and availability of prey species – The proposed action would cause long-term minor effects on prey species. The breakwater and moored boats would cause long-term shading that may slightly reduce the production and diversity of invertebrate organisms that are prey for juvenile bocaccio under and near the structure. The action would not affect forage fish spawning.
   b. Water quality – The proposed action would cause long-term minor effects on water quality. It would cause no measurable changes in water temperature, salinity, or DO, but construction would briefly mobilize sediments, and vessel operations would likely introduce small amounts of petroleum-based pollutants to marina waters into the foreseeable future. Detectable effects on water quality would be limited to the area within and immediately around the marina.
2. Benthic habitats and sites deeper than 98 feet (30 m) – Does not occur 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 habitats within the action area are described in the Status of the Species and Critical Habitats and Environmental Baseline sections above. The contribution of non-federal activities to those conditions include past and on-going shoreline development and maritime activities, 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 river 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 nearshore marine 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 within several watersheds around the action area. Similar activities are in development for PS/GB bocaccio in Puget Sound. 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 (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 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 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 through synergistic interactions with the impacts of climate change are expected.

Both of the species considered in this Opinion are 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.

PS Chinook Salmon:

The action area provides nearshore marine habitat that supports adult and juvenile migration, and juvenile growth and adaptation to marine waters for PS Chinook salmon, primarily from populations within the Central/South Puget Sound Basin MPGs. Those four MPGs are considered to be at high risk of extinction due to low abundance and productivity, and the long-term abundance trend for the ESU is slightly negative. Reduced or eliminated accessibility to historically important habitat, combined with degraded conditions in available habitat due to land use activities appear to be the greatest threats to the recovery of PS Chinook salmon. Commercial and recreational fisheries also continue to affect this species.

The project site is located along the northwest shoreline of Elliott Bay, in the City of Seattle Washington. More than 100 years of shoreline development, maritime activities, upland urbanization, and road building and maintenance has degraded the environmental baseline within the action area. However, the action area remains supportive of PS Chinook salmon, and provides migratory habitat for adults and juveniles. The planned work window overlaps with the later stages of out-migration by shoreline-obligated juvenile Chinook salmon that pass through the action area. In-migrating adults may also be present during construction, but they would be independent of the shoreline and unlikely to be measurably affected by the work or by the breakwater.

During construction, very low numbers of out-migrating juveniles would be exposed to noise and propeller wash. Following construction, very low numbers of juveniles may be exposed annually to structure-related altered lighting, noise, and exposure to propeller wash over the decades-long expected life of the breakwater. 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 some exposed individuals.

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/GB Bocaccio:

The action area provides nearshore marine habitat that supports juvenile PS/GB bocaccio. The action area provides habitat features that are supportive of juvenile rearing for PS/GB bocaccio. However, PS/GB bocaccio are relatively rare throughout the range of the DPS, and it is uncertain whether or not they currently utilize the habitat. No reliable population estimates are available for the DPS, but the best available information indicates that bocaccio were never a predominant segment of the total rockfish abundance in Puget Sound. The best information also suggest that abundance has declined by more than 70 percent since 1965. Fishing removals and derelict fishing gear, combined with degraded water quality appear to be the greatest threats to the recovery of the DPS.

The project site is located along the northwest shoreline of Elliott Bay, in the City of Seattle Washington. More than 100 years of shoreline development, maritime activities, upland urbanization, and road building and maintenance has degraded the environmental baseline within the action area. However, the action area remains supportive of PS/GB bocaccio, and provides rearing habitat for juveniles. No adult bocaccio-supportive habitat is present within the action area. The planned work window overlaps with the latter half of the period when benthic juveniles would be expected in shallow nearshore waters in the Puget Sound region.

Should they be present during construction, very low numbers of benthic juveniles may be exposed to noise and propeller wash. Following construction, very low numbers of benthic juveniles may be exposed annually to structure-related altered lighting, and noise over the decades-long expected life of the breakwater. These stressors, both individually and collectively, are likely to cause a range of effects that would include some combination of altered behaviors, reduced fitness, and mortality in some exposed individuals.

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 population (abundance, productivity, distribution, or genetic diversity) for the PS/GB bocaccio DPS. Therefore, the proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species.

Critical Habitat for PS Chinook Salmon:

As described above at Section 2.5, the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon. Past and ongoing land and water use practices have degraded salmonid critical habitat throughout the Puget Sound basin. Hydropower and water management activities have reduced or eliminated access to significant portions of historic spawning habitat. Timber harvests, agriculture, industry, urbanization, and shoreline development have adversely altered floodplain and stream morphology in many watersheds, diminished the availability and quality of estuarine and nearshore marine habitats, and reduced water quality across the region.

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

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

The PBF for PS Chinook salmon critical habitat in the action area are limited to estuarine and nearshore marine areas free of obstruction and excessive predation. The site attributes of those PBF that would be affected by the action are limited to water quality, natural cover, and forage that support juvenile growth and maturation, and juvenile and adult physiological transitions between fresh- and saltwater. As described above, past and ongoing human activity have degraded the environmental conditions within the action area, but the area remains supportive of PS Chinook salmon.

Construction and the presence of the new breakwater would cause conditions within and immediately around the marina that would cause long-term minor effects on obstruction and predation, water quality, natural cover, and forage. 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 estuarine and nearshore marine area PBFs 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.

Critical Habitat for PS/GB Bocaccio:

Past and ongoing shoreline development combined with upland land and water use practices have degraded nearshore critical habitat for PS/GB bocaccio throughout the Puget Sound basin. Agriculture, industry, urbanization, and maritime activities have reduced water quality throughout Puget Sound. Widespread derelict fishing gear in both nearshore and deep-water critical habitat areas has altered bottom composition, reduced prey availability, and it continues to kill rockfish. Rising sea levels, caused by climate change, will likely increase coastal erosion and alter the composition of nearshore critical habitat for PS/GB bocaccio. Elevated sea surface temperatures and increased ocean acidification may also reduce the quality of nearshore marine habitats, and reduce prey availability by reducing ocean productivity.

Future non-federal actions and climate change are likely to increase and continue acting against the quality of PS/GB bocaccio critical habitat. The intensity of those influences is uncertain, as is the degree to which those impacts may be tempered by adoption of more environmentally acceptable practices, by restoration activities such as efforts to remove derelict fishing gear, and by efforts to address the effects of climate change.

The PBF for PS/GB bocaccio critical habitat in the action area is limited to nearshore settlement habitats with sand, rock, and/or cobble substrates that also support kelp. The site attributes of that PBF that would be affected by the action are limited to prey quantity, quality, and availability, and water quality and sufficient DO to support individual growth, survival, reproduction, and feeding opportunities. As described above, past and ongoing human activity have degraded the environmental conditions within the action area, but the area remains supportive of PS/GB bocaccio.

Construction and the presence of the new breakwater would cause conditions within and immediately around the marina that would cause long-term minor effects on prey and water quality. 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 nearshore settlement 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/GB bocaccio.

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 or PS/GB bocaccio, nor is it likely to destroy or adversely modify designated critical habitat for either of these species.

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

NMFS has determined that incidental take is reasonably certain to occur as follows:

Harm of juvenile PS Chinook salmon from

- exposure to construction-related noise,
- exposure to construction-related propeller wash,
- exposure to structure-related noise,
- exposure to structure-related propeller wash,
- exposure to structure-related contaminated water,
- exposure to structure-related reduced forage, and
- exposure to structure-related altered migratory behaviors.

Harm of juvenile PS/GB bocaccio from

- exposure to construction-related noise,
- exposure to construction-related propeller wash,
- exposure to structure-related noise, and
- exposure to structure-related reduced forage,

The distribution and abundance of fish 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/GB bocaccio 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 directly relate to the magnitude of the expected take. For this action, the timing and duration of work are the best available surrogates for the extent of take of juvenile PS Chinook salmon and PS/GB bocaccio from exposure to construction-related noise and propeller wash. Timing and duration of work are applicable because the planned work windows were selected to reduce the potential for juvenile fish presence at the project site. Therefore, working outside of the planned work window and/or working for longer than planned would increase the number of fish likely to be exposed to construction-related impacts that are likley to cause injury or reduce fitness.

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/GB bocaccio from exposure to structure-related noise, propeller wash, contaminated water, reduced forage, and altered migration. This is because structure-related noise, propeller wash, and contaminated water are all positively correlated with the number of boats that moor at a structure, which is largely a function of the structure’s size. As the size of a structure increases, the number of boats that can moor there increases. As the number of boats increase, boating activity increases, and the potential for juvenile PS Chinook salmon and PS/GB bocaccio to be exposed to the related noise, propeller wash, and pollutants also increases.

Structure-related impacts on forage availability and migration are also positively correlated with the size and configuration of a structure. As the size and opacity of a structure increases, the size and intensity of its shadow increase, and aqautic productivity under and near that structure decrease. Similalry, the likelihood of avoidance and the distance required to swim around the structure both increase as the size of a structure and the intensity of its shadow increase.

In summary, the incidental take surrogates for this action are:

Puget Sound Chinook salmon:

- Intermittent in- and over-water work between August 1 and February 15.
- The size and configuration of the new breakwater, as described in the proposed action section of this biological opinion.

Puget Sound / Georgia Basin bocaccio:

- Intermittent in- and over-water work between August 1 and February 15.
- The size and configuration of the new breakwater, 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. These take surrogates will likely be monitored on a near-daily basis; thus any exceedance of the surrogates will be apparent in real-time and well before the project is completed. Further, if the size and configuration of the breakwater exceeds the proposal, it could still meaningfully trigger reinitiation because the COE 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/GB bocaccio, nor is it likely to destroy or adversely modify designated critical habitat for either of these species (Section 2.8).

2.9.3 Reasonable and Prudent Measures (RPM)

"Reasonable and prudent measures" 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/GB bocaccio from exposure to construction-related noise and propeller wash.

2. Minimize incidental take of PS Chinook salmon and/or PS/GB bocaccio from exposure to structure-related noise, propeller wash, contaminated water, reduced forage, and altered migration.

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 from construction-related noise and propeller wash, the COE shall require its contractors to conduct in- and over-water work only between August 1 and February 15.

2. To implement RPM Number 2, Minimize incidental take from structure-related noise, propeller wash, contaminated water, reduced forage, and altered migration, the COE shall ensure that the size and configuration of the new breakwater complies with the dimensions described in the proposed action section above. In particular, the breakwater shall be:
   a. No longer than 925 feet;
   b. No wider than 15 feet; and
   c. No deeper than 8 feet.

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. The dates and descriptions for all in- and over-water work;
      ii. The number and configuration of the modules; and
      iii. The final size and configuration of the new breakwater.
   b. 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-2018-10331.

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 tugboat operator(s) to minimize the number of trips, and to use the lowest safe 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 develop a plan to reduce the marina's migratory impacts on juvenile salmon. As repair or replacement of the bridging structures between the shore and the mooring floats becomes necessary, the marina should install replacements that minimize width, maximize height, and incorporate fully-grated decking.

3. The COE should encourage the applicant to develop a plan to reduce the environmental impacts at the marina. Suggested measures include:
   a. Continue or establish a system to instruct patrons about the importance of the nearshore marine habitats at the site to migrating juvenile salmon and rearing juvenile rockfish;

b. Continue or resume efforts at the marina to reduce the input of vessel-related pollutants;
c. Continue or establish a system to require patrons to operate power boats at low speeds in the marina and adjacent shallow shoreline areas; and
d. Continue or establish a system to prevent and/or remove litter, wastes, and floating pollutants from the waters within the marina.

2.11 Reinitiation of Consultation

This concludes formal consultation for the U.S. Army Corps of Engineers' authorization of the Elliott Bay Marina's Floating Breakwater Replacement Project in 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 habitat 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 habitat that was not considered in this Opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

2.12 Not Likely to Adversely Affect Determinations

This concurrence was prepared pursuant to section 7(a)(2) of the ESA, implementing regulations at 50 CFR 402 and agency guidance for preparation of letters of concurrence. Refer to the opinion for a description of the proposed action and action area. As described 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. However, as described in the Opinion above, NMFS did nor concur that the proposed action is not likely to adversely affect PS Chinook salmon and PS/GB bocaccio, and designated critical habitat for both of those species.

Our concurrence with the COE's "not likely to adversely affect" determinations for PS steelhead, PS/GB yelloweye rock fish, SR killer whales, and designated critical habitat for PS/GB yelloweye rockfish and SR killer whales follows. Detailed information on the biology, habitat, and conservation status and trend of these listed resources can be found in the recovery plans and other sources at: http://www.nmfs.noaa.gov/pr/species/fish/, http://www.nmfs.noaa.gov/pr/species/mammals/, and in the listing regulations and critical habitat designations published in the Federal Register. That information is incorporated here by reference.

The applicable standard to find that a proposed action is not likely to adversely affect listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur.

As described above in Section 2.5, the proposed action is likely to affect listed species and/or critical habitat features through construction, structure-related effects, and interrelated vessel activities. For simplicity, the effects analysis in this section relies heavily on the discussions in Section 2.5. As described earlier, action-related stressors would cause no measurable effects in fish beyond about 177 feet (54 m) around the marina. The maximum range to the onset of behavioral disturbance in whales would be about 3.4 miles (5,412 m) during episodic use power saws, should saws be used to cut timber siding from the existing breakwater during demolition.

2.12.1 Effects on Listed Species

It is extremely unlikely that PS steelhead and PS/GB yelloweye rockfish would be within 177 feet of the marina. 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. Returning adults typically migrate in relatively deepwater well away from shore until the near the entrance of their natal streams. Adult and juvenile PS/GB yelloweye rockfish typically inhabit rocky substrate at depths of 98 feet (30 m) or more. This habitat type is not within the project's action area for fish. In the unlikely event that individuals of either species enter the action area, it is extremely unlikely that they would approach close enough to experience measurable impacts on their fitness or normal behaviors.

SR killer whales may be present within 3.4 miles of the project site. However, project-related noise would be virtually undetectable against the ambient noise beyond low hundreds of yards from the project site. Should any SR killer whales approach close enough to hear project related noise, they would, at most, experience brief periods of low-level acoustic masking, and they may exhibit temporary minor avoidance of the area immediately around the marina. The exposure would cause no impacts on the fitness of exposed individuals, and it would cause no meaningful impacts on their normal behaviors. As described in section 2.5, the proposed action would cause no population-level effects on Chinook salmon, which is the main prey resource for SR killer whales. Therefore, the project is not likely to cause measurable trophic effects on these whales.

2.12.2 Effects on Critical Habitat

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

<u>PS/GB Yelloweye Rockfish Critical Habitat:</u> The proposed action is not likely to adversely affect critical habitat that has been designated for PS/GB yelloweye rockfish. The essential PBF of this critical habitat is limited to substrates at depths greater than 98 feet (30 m) and the waters above that substrate. That habitat occurs beyond the expected range of potential effects from the proposed action. Therefore, it is extremely unlikely that the action would cause any detectable effect on any PBF of this critical habitat.

SR killer whale Critical Habitat: The proposed action is not likely to adversely affect critical habitat that has been designated for SR killer whales. Designated critical habitat for SR killer whales includes marine waters of the Puget Sound that are at least 20 feet deep. The expected effects on SR killer whale critical habitat from completion of the proposed action, including full application of the conservation measures and BMP, would be limited to the impacts on the PBF as described below.

1. Water quality to support growth and development
   The proposed action would cause long-term minor effects on water quality. It would cause no measurable changes in water temperature and salinity. The presence of detectable levels of contaminants, including suspended sediments, would be very localized, and of such low concentrations that it cause no detectable changes in water quality outside of the marina.
2. Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth
   The proposed action would cause long-term minor effects on prey. Action-related impacts would be too small to cause population-level effects on prey resources (Chinook salmon). Therefore, it would cause no detectable reduction in prey availability.
3. Passage conditions to allow for migration, resting, and foraging
   The proposed action would cause ephemeral minor effects on passage conditions. Construction-related noise may radiate 3.4 miles around the project site. Exposure to this noise would, at most, cause brief episodic periods of low-level acoustic masking (virtually undetectable against the ambient noise in the area), and minor avoidance of the area immediately around the marina. However, the temporary areal avoidance would not hinder migration, or limit access to important habitat resources.

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

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. The analysis that follows is based, in part, on the description of EFH contained in the fishery management plans developed by the PFMC 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 action area includes areas designated as EFH for various life-history stages of Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species. The PFMC described and identified EFH for Pacific coast groundfish (PFMC 2005), Pacific salmon (PFMC 2014), and coastal pelagic species (PFMC 1998). In addition, the action area is designated as a habitat area of particular concern (HAPC) for estuarine habitat and for eelgrass.

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 recommendations would minimize and/or avoid adverse effects on EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species 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, require that tugboat operators remain in the deepest water practicable, avoid operating over eelgrass beds, and use the lowest safe power settings when maneuvering in shallow waters close to the shoreline.

2. To reduce adverse alteration of benthic communities and reduction in prey availability:
    a. Require compliance with the design plans provided with the consultation request for this action. Particularly, do not exceed the described length, width, and depth for the new breakwater; and
    b. Require compliance with the impact minimization measures identified in the applicant's BE (EBM 2018a), and in the provisions identified in the WDFW HPA for this project (WDFW 2018).

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 USFS 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 and the applicant. Other users could include WDFW, King County, and the citizens of King 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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