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

Refer to NMFS No:
WCRO-2020-00645

February 16, 2022

Laura Boerner
Planning Chief
Environmental and Cultural Resources Branch
Corps of Engineers, Seattle District
Post Office Box 3755
Seattle, Washington 98124-3755

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the U.S. Army Corps of Engineers' Proposed Port of Tacoma's Harbor Navigation Improvement Project in the Blair Waterway of Tacoma Harbor, Pierce County, Washington (HUC 171100190204).

Dear Ms. Boerner:

Thank you for your letter of March 20, 2020, requesting initiation of consultation with the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the Port of Tacoma's Harbor Navigation Improvement Project. This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).[1]

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 a biological opinion prepared by NMFS pursuant to section 7 of the ESA on the effects of the proposed action. In this opinion, NMFS concludes that the proposed action would adversely affect but is not likely to jeopardize the continued existence of Puget Sound (PS) Chinook salmon, PS steelhead, Puget Sound Georgia Basin (PS/GB) bocaccio, and PS/GB yelloweye rockfish. NMFS also concludes that the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon but is not likely to result in the destruction or adverse modification of that designated critical habitat. This opinion also documents our rationale and conclusion that the proposed action is not likely to adversely affect green sturgeon, eulachon, and Southern Resident killer whales (SRKW) or designated critical habitat for SRKW.

[1] For purposes of this consultation, we also considered whether the substantive analysis and its conclusions regarding the effects of the proposed actions articulated in the Biological Opinion and its Incidental Take Statement would be any different under the 50 CFR part 402 regulations as they existed prior to the 2019 Rule. We have determined that they would not be any different.

This opinion includes an incidental take statement (ITS) that describes reasonable and prudent measures (RPMs) NMFS considers necessary or appropriate to minimize the incidental take associated with this action, and sets forth terms and conditions that the COE must comply with in order to be exempt from the prohibitions of section 9 of the ESA.

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 and Pacific Coast groundfish. Therefore, we have included the results of that review in Section 3 of this document. NMFS also provides Conservation Recommendations to minimize adverse effects to EFH. Section 305(b)(4)(B) of the MSA requires that an action agency provide a detailed response in writing to the NMFS within 30 days after receiving an EFH Conservation Recommendation.

Please contact David Price in the Central Puget Sound Branch of the Oregon/Washington Coastal Office by email at David.Price@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: Kaitlin Whitlock, USACE
Fred Goetz, USACE
Kristine Ceragioli, USACE

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

Port of Tacoma Navigation Improvements

NMFS Consultation Number: WCRO-2020-00645

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

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely to Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely to Destroy or Adversely Modify Critical Habitat?
Puget Sound Chinook Salmon (*Oncorhynchus tshawytscha)*	Threatened	Yes	No	Yes	No
Puget Sound Steelhead (*O. mykiss*)	Threatened	Yes	No	NA	NA
Puget Sound/Georgia Basin boccacio rockfish (*Sebastes paucispinis*)	Endangered	Yes	No	No	NA
Puget Sound/Georgia Basin yelloweye rockfish (*S. ruberrimus*)	Threatened	Yes	No	NA	NA
Southern Resident Killer Whale (*Orcinus orca*)	Endangered	No	No	No	No
Green Sturgeon (*Acipenser medirostris*)	Threatened	No	No	NA	NA
Eulachon (*Thaleichthys pacificus*)	Threatened	No	No	NA	NA
Humpback whale, Central America DPS (*Megaptera novaeangliae*)	Endangered	No	No	NA	NA
Humpback whale, Mexico DPS (*Megaptera novaeangliae*)	Threatened	No	No	NA	NA

Fishery Management Plan That Identifies 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	No	No

Issued By:

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

Date: February 16, 2022

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

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600.

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

1.2 Consultation History

On March 20, 2020, the U.S. Army Corps of Engineers Seattle District (Corps) requested formal ESA section 7 consultation on the effects of authorizing proposed deepening and widening of the Blair Waterway in the Port of Tacoma. The Corps proposes this authorization under Section 209 of the Rivers and Harbors Act of 1962, Public Law 87-874 which allows for the evaluation of alternatives for navigation improvement and consideration of ecosystem restoration in the form of beneficial use of dredge material at Tacoma Harbor. In addition, evaluation of beneficial use of dredged material as part of this study is authorized by Section 204 of the Water Resources Development Act of 1992, as amended by Section 1038(2) of the Water Resources Reform and Development Act of 2014 and Section 1122(i)(2) of the Water Resources Development Act of 2016 – Regional Sediment Management. Section 204(d), as amended, provides that, in developing and carrying out a federal water resources development project involving the disposal of dredged material, the Assistant Secretary of the Army for Civil Works (ASA(CW)) may select, with the consent of the non-federal interest, a disposal method that is not the least cost option, if the ASA(CW) determines that the incremental costs of the disposal method are reasonable in relation to the environmental benefits. The action also triggers MSA consultation because EFH for Pacific Coast salmon, Pacific Coast groundfish, and coastal pelagic species in the Puget Sound (a Habitat Area of Particular Concern (HAPC)) may be affected. The request for consultation included a biological assessment (BA) and multiple supplemental documents.

Since March 2020, correspondence regarding the proposed action subject to the ESA Section 7 consultation occurred between staff at NMFS and the Corps. This includes, but is not limited to clarification on the scope of potential side-slope stabilization methods via email on May 12, 2020; June 24, 2020; and December 9, 2021.

On September 11, 2020, NMFS requested additional information regarding the analysis and effects described in the BA. On December 8, 2020, the Corps responded to the technical questions in a memorandum to NMFS. Within that memorandum, the Corps revised its effects determination for Puget Sound Georgia Basin (PS/GB) rockfish from may affect, but is not likely to adversely affect (NLAA) to may affect, likely to adversely affect (LAA). As indicated in Table 1, NMFS was unable to concur with the Corps determination that the proposed action may affect, but is not likely to adversely affect PS steelhead. This species is included in formal consultation on the proposed action.

On February 22 2021, NMFS asked the Corps to specify the discretion it has in maintaining the currently authorized federal navigation channel at Blair Waterway, as well as what discretion it will have if an improved navigation channel is authorized by Congress at that location. The Corps provided that information on March 29, 2021, in a letter to NMFS. The information provided in the March 29, 2021, letter has been used to help define the environmental baseline and effects of the action considered in this consultation. NMFS acknowledges and accepts the following rationale to define the environmental baseline for this consultation:

> "Congress authorized the Blair Waterway in its current configuration, in a maintained state, and it is not within the Corps' discretion to alter its current configuration without seeking further congressional authorization. The ongoing consequences to the environment of the existing operation and configuration of the federal navigation channel, in a maintained state, as well as the effects of placing dredged material in the open-water disposal site at Commencement Bay (as addressed as part of a previous consultation), are therefore, within the "environmental baseline" considered." [2]

On January 3, 2022, the Corps confirmed with NMFS that side slope stabilization measures would be necessary at four locations to accommodate the proposed widening. On January 4, 2022, via phone, NMFS requested additional information regarding the slope stabilization measures currently in place at each of the four locations. The Corps provide pictures and a written description of current shoreline conditions via email on January 4, 2022. On January 5, 2022, NMFS asked the Corps to clarify the extent of shoreline armoring existing throughout the entire Blair Waterway. The Corps responded on January 6, indicating that, with the exception of mitigation/restoration sites, the entire Blair Waterway was armored. On January 12, 2022, NMFS requested clarification of the resulting channel slopes following installation of stabilization measures. The Corps responded informing NMFS that the channel slope waterward of the proposed secant walls at areas 2 and 3 would be maintained at 2H:1V and riprap at areas 1 and 4 would be 1.5H:1V. Based on these conversation regarding the design of the shoreline stabilization components of the proposed action NMFS analyzed the effects of secant walls with waterward 2H:1V slopes at areas 2 and 3 and riprap on a 1.5H:1V slope at areas 1 and 4.

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[2] Page 3 of the March 29, 2021, letter from Alexander "Xander" L. Bullock, Colonel, Corps of Engineers, District Commander to Barry Thom, Regional Administrator, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, West Coast Region.

NMFS initiated formal ESA and MSA consultation with the Corps on August 18, 2021.

Table 1. Effects determinations made by the Corps and NMFS for the ESA-listed species and critical habitat in the project area.

Species	Status	Corps Species Determination	Corps Critical Habitat Determination	NMFS Species Determination	NMFS Critical Habitat Determination	Species Listing	Critical Habitat Listing
Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*)	T	LAA	LAA	LAA	LAA	06/28/05 (70 FR 37160)	09/02/05 (70 FR 52630)
Puget Sound steelhead (*O. mykiss*)	T	NLAA	NLAA	LAA	N/A	05/11/07 (72 FR 26722)	02/24/16 (81 FR 9252)
Puget Sound/Georgia Basin yelloweye rockfish (*Sebastes ruberrimus*)	T	LAA	N/A	LAA	N/A	04/28/10 (75 FR 22276)	02/11/15 (79 FR 68041)
Puget Sound/Georgia Basin bocaccio (*Sebastes paucispinis*)	E	LAA	N/A	LAA	N/A	04/28/10 (75 FR 22276)	02/11/15 (709 FR 68041)
Southern Resident Killer Whales (*Orcinus orca*)	E	NLAA	NLAA	NLAA	NLAA	11/18/05 (70 FR 57565)	11/29/06 (71 FR 69054)
Green Sturgeon (*Acipenser medirostris*)	T	NLAA	N/A	NLAA	N/A	04/07/06 (71 FR 17757)	11/09/09 (74 FR 52299)
Eulachon (*Thaleichthys pacificus*)	T	NLAA	N/A	NLAA	N/A	3/18/10 (75 FR 13012)	10/20/11 (76 FR 65323)
Humpback whale, Central America DPS (*Megaptera novaeangliae*)	E	Did not address	Did not address	NLAA	N/A	10/11/16 (81 FR 62259)	04/21/21 (86 FR 21082)
Humpback whale, Mexico DPS (*Megaptera novaeangliae*)	T	Did not address	Did not address	NLAA	N/A	10/11/16 (81 FR 62259)	04/21/21 (86 FR 21082)

T = Threatened E = Endangered 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.

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies (50 CFR 402.02).

The U.S. Army Corps of Engineers (Corps) has developed a General Investigations study (GI), and integrated feasibility report and environmental assessment (IFR/EA), which provides the results of a deep draft navigation feasibility study undertaken to identify and evaluate alternatives to improve the navigation system's efficiency in Tacoma Harbor, Washington. This study is authorized by Section 209 of the Rivers and Harbors Act of 1962, as amended (Public Law 87-874). The Corps has undertaken this study in partnership with the Port of Tacoma (Port) as the non-federal sponsor. A recommended plan has been selected (described below) from four alternatives. Because the recommended plan forms the basis of a Chief's Report to Congress and is not a final design, NMFS is required to make assumptions in components of the action in order to complete an effects analysis. Where necessary, we identify our assumptions throughout this Opinion.

The Corps and the Port are proposing to deepen and widen the Blair Waterway to improve shipping capability and efficiency (Figure 1). The work is anticipated to take approximately four years. The Corps has determined the deepest channel that is economically justified is 57 feet below Mean Lower Low Water (MLLW). A deeper harbor would eliminate transit delays due to tidal changes and allow larger, fully loaded ships to more efficiently and cost-effectively visit the Port. Tide restrictions, light loading, or other operational inefficiencies created by inadequate channel depth currently limits the Port's capacity to accommodate increased vessel shipping loads. The proposed action would improve navigation in the Blair Waterway by deepening and widening the existing federal channel. Specific components of the proposed action include:

- Deepening the existing Blair Waterway from a depth of -51 MLLW to -57 MLLW along its entire length (approximately 2.75 miles).
- Widening the channel from 450 feet to 865 feet at specific locations (Table 2). Armoring the waterway is not proposed.
- Install slope stabilization structures to accommodate channel widening along four sections of the waterway.
    - Areas 1 and 4 would be stabilized using riprap on a 1.5H:1V slope.
    - Areas 2 and 3 would be stabilized using secant walls with a 2H:1V waterward slope.
- Expanding the existing turning basin boundary at the end of the Blair Waterway to a diameter of 1,935 feet from 1,682 and deepening the turning basin to -57 feet MLLW.

Dredging of the Blair waterway would result in approximately 2.8 million cubic yards of sediment material. 1.85 million cubic yards of suitable[3] dredged material would be placed at the Saltchuk beneficial use site; 550,000 cubic yards of material would be placed at the Commencement Bay open water disposal site; and approximately 400,000 cubic yards of material deemed unsuitable for open water disposal or beneficial use would be transported to an upland disposal site.

[3] See https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll11/id/5397 for more information on suitable vs. unsuitable dredged materials.

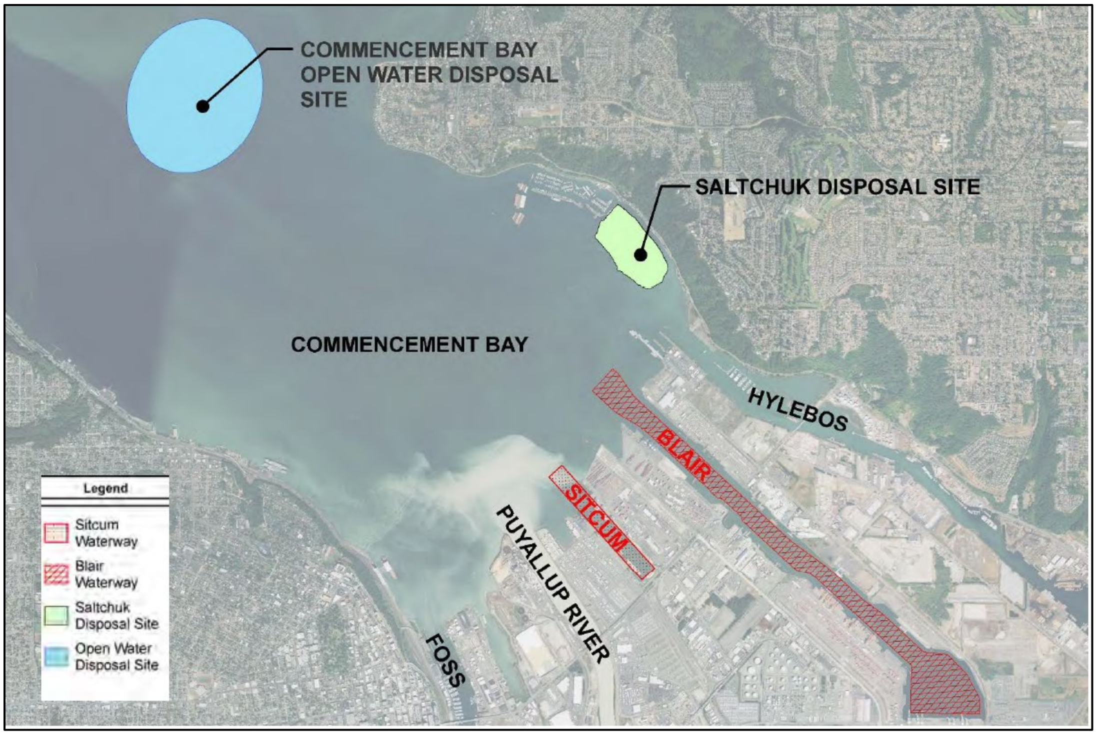

Table 2. Federally authorized and proposed widths by channel station (STA) at Blair Waterway.

Stations along the channel	Currently Authorized widths (feet)	Proposed width (feet)
STA -5 to STA 0	NA	865
STA 0 to STA 12	520	800
STA 12 to STA 44	520, narrowing to 343	520
STA 44 to STA 52	520	520
STA 52 to STA 79	520, narrowing to 330	520
STA 79 to STA 100	330	450
STA 100 to STA 116	330, widening to 1,682	525
STA 116 to STA 140 (turning basin)	1,682	1,935

1.3.1 Channel Deepening and Material Disposal

Under the recommended plan, disposal of dredged sediments would occur in three locations, including the Saltchuk beneficial use site, the Dredged Material Management Program (DMMP) open-water non-dispersive disposal site in Commencement Bay, and an upland disposal site. A mechanical clamshell bucket dredge would be used to remove suitable materials from the Blair Waterway and place approximately 1.8 million cubic yards (cy) of beneficial use sediment at the Saltchuk site and approximately 562,000 cubic yards (cy) of dredged material would be placed at the Dredged Material Management Program (DMMP) Commencement Bay open water disposal site (Figure 1). A Feasibility-level advisory suitability determination by the DMMP Agencies (U.S. Army Corps of Engineers, Washington State Department of Ecology, Washington State

Department of Natural Resource, and the Environmental Protection Agency) evaluated the potential in-water placement of 2.5 million cubic yards of dredged material from the Blair waterway at the Commencement Bay disposal site or potential beneficial use. This analysis involved the characterization of sediment core testing and indicates that approximately 392,000 cy of sediment dredged from the Blair Waterway may be unsuitable for in-water disposal, and would be transported to an upland disposal site. These quantities assume that the dredging contractor would remove the two-foot allowable over-depth during dredging. To ensure unsuitable material remains isolated during dredging, a vertical and horizontal buffer would be used in the final dredging prism design. The DMMP agencies also indicated that to ensure that unsuitable material would be separated from unsuitable material during dredging, a minimum one-foot vertical buffer and an appropriate horizontal buffer would be added to the unsuitable portions of the final dredge prism. Material deemed unsuitable for placement at Saltchuk or the Commencement Bay in-water disposal site would be removed from the channel using an environmental clamshell bucket to limit the amount of suspended and potentially unsuitable sediments.

During construction, several pieces of in-water equipment would be operating up to 24 hours per day including the dredge tugboat, barge, skiff, and survey boat. Only one dredge would be operating at a time, but would be running nearly continuously. Equipment would primarily be operating within the Blair Waterway, but the barge would travel to the open-water disposal site and the Saltchuk site to dispose of dredged materials. One or two tugboats would be used to transport barges between construction and disposal sites. Dredged materials would be placed on a barge adjacent to the site where material is actively being removed. The estimated amount of time required to complete dredging work is approximately four years, which results in roughly one-fourth to one-third of the waterway being dredged each year. A survey vessel would slowly transit the area to monitor dredging progress.

Washington Administrative Code (WAC 220-660-330) requires in-water work in commencement bay to occur between July 15 and February 15. However, to be more protective, the Corps proposed an in-water work window of August 16 to February 15, which also adheres to the in-water work window for material disposal at the Commencement Bay open-water disposal site (NMFS 2015a).

Consultations with NMFS and the U.S. Fish and Wildlife Service (USFWS) on disposal of dredged material at the DMMP open-water disposal sites in Puget Sound, including the Commencement Bay site, were conducted separately (USACE 2015; NMFS 2015a). The effects of sediment disposal at DMMP open-water disposal sites have already been considered in the programmatic formal consultation for their continued use through 2040 (NMFS 2015a), and as such, the use of the DMMP open-water disposal site for disposal of sediments are considered part of the environmental baseline for this consultation. 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. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

Future maintenance dredging is not part of the proposed action, and is not considered in this Opinion. Therefore, future operation and maintenance dredging, including manner and timing, would be subject to separate, future, ESA Section 7 consultation(s).

1.3.2 Waterway Width Expansion and Slope Stabilization Measures

As proposed, the Corps will install additional side slope stabilization measures at select areas (Areas 1-4). Additional evaluation of slope stabilization measures, including no additional stabilization measures, will be considered in the Pre-construction Engineering and Design (PED) phase along the following stationing (Figure 2):

- Area 1: STA 44+00.00 to STA 48+00.00
- Area 2: STA 74+50.00 to STA 82+00.00
- Area 3: STA 94+50.00 to STA 97+50.00
- Area 4: STA 118+00.00 to STA 125+50.00

Stabilization measures include a secant wall at sites 2 and 3, which includes the existing 2:1 slope waterward of the wall, and replacement riprap at 1.5:1 slopes at sites 1 and 4[4]. The greatest extent of slope stabilization would be riprap from +10 MLLW to -57 MLLW (about 7.52 acres among four possible locations) with a secant wall (1,130 feet in length at two locations; about 4% of the total Blair Waterway shoreline: 28,566 linear feet). Where used, the proposed method for secant pile installation is augering and vibratory pile driving. Vibratory pile driving may be used to install steel casings prior to drilling. Vibratory driving may also be used to install temporary sheetpile cofferdams prior to pouring concrete. Impact pile driving would not be used at any point in the secant wall installation process. Dredging may occur before or after shoreline stabilization measures are installed. Because shoreline stabilization designs are not finalized the Corps estimates that installation of secant walls may take between 44 and 157 days depending on the diameter and height of the finalized structures. The Corps expects piles to range between 2-4 feet in diameter and 20-50 feet tall. Existing riprap would be removed prior to beginning construction.

NMFS evaluated both stabilization methods (riprap and secant stabilization) and assumed that each would be used as described in the January 12 and 20, 2022, emails from the Corps. Changes to those designs, described in detail below, would require reinitiating consultation with NMFS, except that if no armoring were determined to be necessary, reinitiation of consultation would not be necessary for that element of the proposed action.

Area 1 (STA 44+00.00 to STA 48+00.00) is about a third of the way into the channel on the southwestern side (Figure 2). Slopes extend to the edge of the adjacent upland facilities, which consist of an asphalt-paved parking lot. NMFS assumes that replacement stabilization measures in the form of 1.5H:1V slope-rock toe combination would be required at this location after conferring with the Corps. Once the design is further refined with additional analysis in PED, the

[4] Corps email on January 12, 2022 from Kaitlin Whitlock.

final engineering solution at this location may change to include a secant wall or an alternative slope stabilization measure. A change in stabilization methods from a 1.5 H:1 V slope-rock toe combination will require re-initiation, except that if no armoring were determined to be necessary, reinitiation of consultation would not be necessary for that element of the proposed action.

Area 2 (STA 74+50.00 to STA 82+00.00) is about midway into the channel on the north side. A 2H:1V slope reaches well into the uplands in Area 2, prompting the need for proposed stabilization measures. A secant wall is proposed to protect this location (January 12, 2022 email from the Corps). Once the design is further refined with additional analysis in PED, the final engineering solution at this location may change to include an alternative slope stabilization measure, which would require re-initiation of this Opinion, except that if no armoring were determined to be necessary, reinitiation of consultation would not be necessary for that element of the proposed action.

Area 3 (STA 94+50.00 to STA 97+50.00) is on the north side of the channel and is Puyallup Tribe property (Figure 2). As with Area 2, a 2H:1V slope extends into the uplands. A secant wall is proposed to protect this location (January 12, 2022 email from Kaitlin Whitlock, COE). Once the design is further refined with additional analysis in PED, the final engineering solution at this location may change to include an alternative slope stabilization measure, which would require re-initiation of this Opinion., except that if no armoring were determined to be necessary, reinitiation of consultation would not be necessary for that element of the proposed action..

Area 4 (STA 118+00.00 to STA 125+50.00) is on the north side of the channel within the entrance to the turning basin (Figure 2). It is similar to Area 1, where a 2H:1V slope marginally extends into the uplands. This area does not include upland facilities or major infrastructure, the land here is owned by the Port, and it is used for storage. The Corps proposes that replacement stabilization measures in the form of a 1.5 H:1V slope-rock toe revetment would be required at this location. Once the design is further refined with additional analysis in PED, the final engineering solution at this location may change to include a secant wall or an alternative slope stabilization measure. A change in stabilization methods from a 1.5 H:1 V slope-rock toe combination will require re-initiation, except that if no armoring were determined to be necessary, reinitiation of consultation would not be necessary for that element of the proposed action.

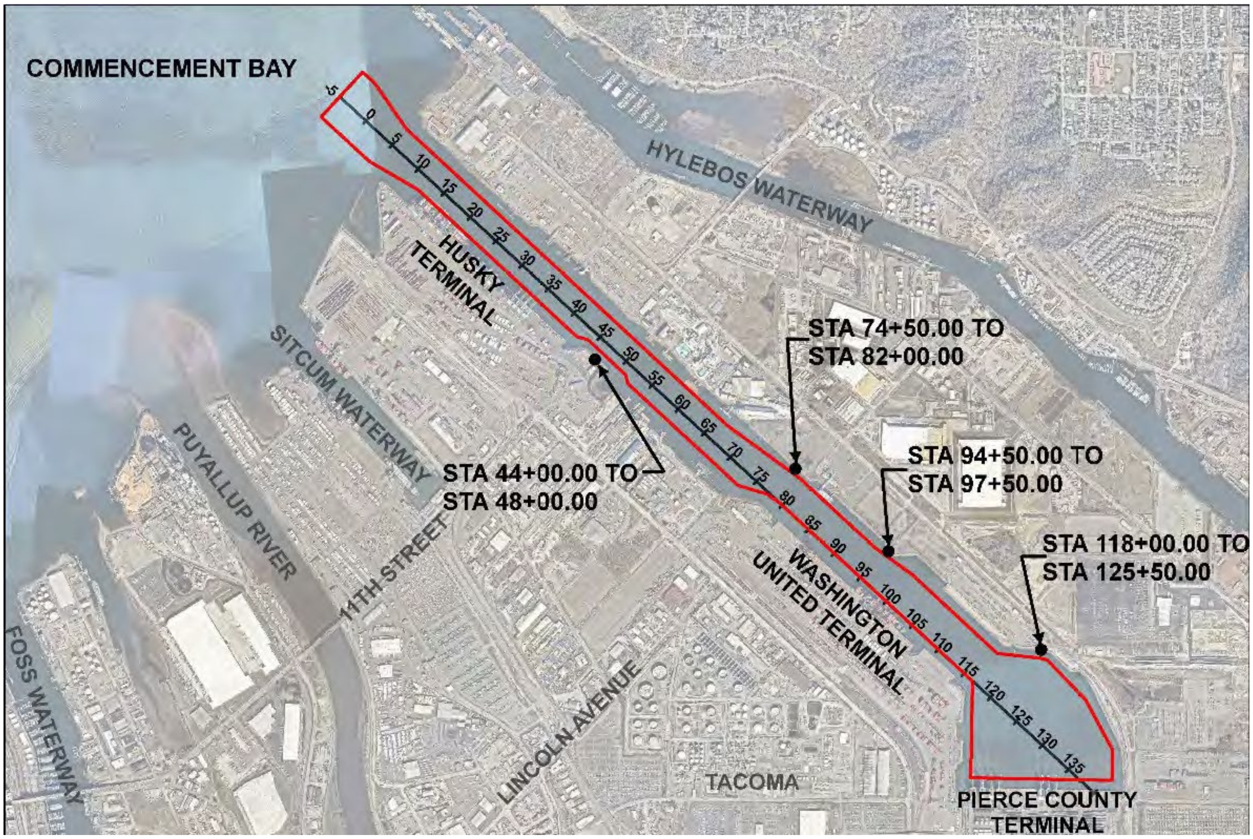

Figure 2. Potential side slope stabilization areas, Blair Waterway. Map from COE, 2020.

1.3.3 Material Placement at Saltchuk

The Saltchuk site, located north of the Blair Waterway (Figure 1), is where dredged material would be placed to restore nearshore intertidal and subtidal habitat substrate for juvenile and adult Chinook salmon, steelhead, bull trout, larval and juvenile rockfish, forage fish, and epibenthic and benthic invertebrates. The final design of the Saltchuk beneficial use site would be developed in the pre-construction engineering design (PED) phase. A full sediment characterization by DMMP agencies in PED would provide additional information to verify assumptions about in-water disposal. In addition, once further design and information is developed in PED, coordination would occur with NMFS, other natural resource agencies, and tribes to specify the criteria used to determine suitability of in-water disposal for restoration of intertidal and subtidal habitat at this location. NMFS assumes that a fully developed Saltchuk site plan is reasonably likely to occur; however, insofar as the project details are unavailable for analysis, we assume that the deposit of beneficial use sediment will occur at Saltchuk, but we do not assume that the site will develop into a fully restored site without future efforts. This is conservative assumption. The actions at Saltchuk may yield greater beneficial effects than are considered here, but a precautionary approach gives any benefit of doubt to listed species and critical habitat.

During Saltchuk disposal of dredged material, a bottom-dump barge would be used for the first bench for material deeper than -20 MLLW. A flat deck barge with a mounted excavator would be needed to place material at shallower depths. The Corps assumes a 1,200 to 3,000 cubic yard barge would be used to transport material from the Blair Waterway to the disposal sites. Based on the estimated amount of dredged material going to the disposal sites between 600 and 1,500 trips would be made over about four years depending on the size of barge.

1.3.4 Conservation Measures and Best Management Practices

Conservation measures and best management practices (BMP) described in the biological assessment that are part of the proposed action and intended to minimize adverse effects to ESA-listed species and their designated critical habitats include the following:

1. Comply with all applicable water quality standards and enforceable conditions issued in the water quality certification and adhere to monitoring protocols in the water quality monitoring plan.
2. Dredge and place material at Saltchuk only within the designated in-water work window of August 16 through February 15.
3. Prior to dredging, the entire footprint of the Blair waterway project area would undergo additional sediment testing to determine suitability for aquatic disposal, and all material determined unsuitable for in-water disposal would be transported for upland disposal at an appropriate facility.
4. An environmental clamshell bucket would be used in all areas in which sediment has been determined unsuitable for aquatic disposal to minimize resuspension of contaminated sediment.
5. The side slopes of the navigation channel would be graded to ensure that no sloughing would occur.
6. All equipment would be inspected daily to ensure that it is in proper working condition and has no leaks of fuel or hydraulic fluids. Each vessel would have a spill kit on board at all times.

NMFS also considered whether or not the proposed action would cause any other activities. We determined that the proposed action would alter the future shipping in Puget Sound. The deeper depth would allow for Post-Panamax vessels currently calling on the port to transport more cargo more efficiently. The Draft Integrated Feasibility Report/Environmental Assessment (IFR/EA; COE, 2021) prepared for this project reports that channel deepening does not increase the Port's landside capacity or decrease transportation costs by enough to increase the Port's container market share. As a result, the analysis assumes channel deepening does not induce additional cargo volume or vessel calls. Instead, deepening to -57 MLLW allows vessels to load to their full draft and carry more cargo in each transit. The greater efficiency provided at the terminals results in shipping services requiring fewer total trips to transport the same cargo volume (thereby reducing transportation costs). The analysis in the IFR/EA (COE, 2021) shows a channel deepening in the Blair Waterway to -57 MLLW would lead to a reduction of 150 and 163 vessel calls in 2030 and 2035, respectively (Table 3). This represents a 27 percent reduction in total vessel calls as a result of the proposed action. Additionally, channel deepening can reduce or eliminate the practice of ships sitting idle in Commencement Bay waiting for appropriate tide conditions to transit the waterway. By lowering and eliminating wait times at the Port the total time each vessel is emitting underwater noise in central Puget Sound would be reduced.

For the purposes of the analysis in this Opinion, a reduction in vessel traffic in the navigation channel is considered a consequence of the proposed action. Current levels of vessel traffic are not considered a consequence of the proposed action because that traffic would likely continue to occur even without the proposed action. In other words, the proposed action is considered to reduce impacts, such as noise and risk of marine mammal strike, caused by vessels calling on the Port of Tacoma Blair Waterway.

Table 3. Vessel calls to the Port of Tacoma Blair Waterway by year (2030 and 2035), class, and channel depth (current vs. proposed). Vessel draft to and from the Port is indicated for each vessel class. Table adapted from the 2020 Corps Biological Assessment.

Vessel Class	Draft Depth, To (ft.)	Draft Depth, From (ft.)	Current Depth (-51 ft. MLLW)	Proposed Depth (-57 ft. MLLW)
2030				
Panamax – PX	30.8	44.8	0	0
Post Panamax – PPX1	35.4	47.6	49	0
Super Post-Panamax – PPX2	39.4	49.2	155	54
Ultra Post-Panamax – PPX3	40	53	229	229
New Post-Panamax – PPX4	45	54	116	116
		Total Calls	**549**	**399**
2035				
Panamax – PX	30.8	44.8	0	0
Post Panamax – PPX1	35.4	47.6	81	0
Super Post-Panamax – PPX2	39.4	49.2	132	50
Ultra Post-Panamax – PPX3	40	53	189	189
New Post-Panamax – PPX4	45	54	189	189
		Total Calls	**591**	**428**

1.4 Action Area

“Action area” means all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area is determined by the greatest extent of physical, chemical, and biological effects stemming from the project. The proposed action would cause a range of effects including temporary effects related to construction, intermittent effects caused by reduced marine vessels, and enduring effects related to deepening and widening of Blair Waterway and the placement of dredged sediment at Saltchuk.

The Corps defines the action area as a 3-mile radius surrounding the Blair Waterway to fully capture the effects within Commencement Bay and the lower Puyallup River, including potential noise and turbidity effects from dredging operations. We expect the low current velocity in the Blair Waterway would limit the distance fine particles would travel from dredging site based on available aerial imagery from the Puyallup River (see Figure 1). Likewise, we anticipate that sound effects (noise) would attenuate within 3 miles of dredging operations due to the use of a clamshell bucket. We expanded the action area to include the shipping lanes of Puget Sound leading to Blair Waterway (Figure 3). The proposed action is expected to reduce the number of vessels utilizing the Port because the deeper depth would allow vessels currently using the Port to be loaded to full capacity per trip (as described above in Section 1.3).

The greater efficiency for each vessel would lead to a reduction in vessel calls on the Port for the foreseeable future. While the reduction in vessel use at the Port would be most concentrated around the Port itself, each vessel travels through Puget Sound via shipping lanes to reach Commencement Bay; meaning impacts from reduced vessel trips extend beyond the Blair Waterway in Commencement Bay, to include transit through Puget Sound. Only a portion of effects are expected to extend into the shipping lanes of the Puget Sound (described more thoroughly in Section 2.4) and these effects are expected to be entirely positive on listed species and critical habitat. The action area overlaps with the geographic ranges of the ESA-listed species and the boundaries of some designated critical habitats identified in Table 1. The action area also overlaps with areas that have been designated, under the MSA, as EFH for Pacific Coast salmon, Pacific Coast groundfish, and coastal pelagic species.


US-Canada
Pacific Coast
Puget Sound Shipping Lanes
Puget Sound
Commencement Bay Open Water Disposal Site
Commencement Bay
Dash Point State Park
Saltchuk Site
Approximation of Action Area 3-mile radius
King
Pierce
Hylebos Waterway
Blair Waterway
Blair Waterway
Sitcum Waterway
Puyallup River
Port of Tacoma Manufacturing/Industrial Center
Middle Waterway
Tacoma
Wheeler Osgood

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

The Corps determined that the proposed action is likely to adversely affect PS Chinook salmon, PS/GB yelloweye rockfish, and PS/GB bocaccio, and is likely to adversely affect designated critical habitat for PS Chinook salmon (Table 1). The Corps determined that the proposed action is not likely to adversely affect PS steelhead, SRKW, green sturgeon, or Eulachon or SRKW and PS steelhead critical habitat (Corps 2020a, 2020b).

NMFS considered effects of the proposed action on the species listed in Table 1. NMFS included humpback whales, Central America and Mexico DPSs, in this Opinion given the action area includes large portions of the Puget Sound including areas where humpback whales have been observed and are periodically known to occur.

2.1 Analytical Approach

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

This Opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The designation(s) of critical habitat for (species) use(s) the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this Opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the final rule revising the definition and adding this term (84 FR 44976, 44977; August 27, 2019), that revision does not change the scope of our analysis, and in this Opinion we use the terms "effects" and "consequences" interchangeably.

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

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

The following analysis evaluates a 50-year period to determine project effects on ESA-listed species and critical habitat. The 50-year period was derived from the economic analysis completed by the Corps as part of the Integrated Feasibility Report and Environmental Assessment (IFR/EA), which examines the economic impacts of widening and deepening the channel over a 50-year period. We utilized the same 50-year time period to evaluate project effects because it is difficult to anticipate how baseline conditions may change beyond 50-years. Moreover, given the dynamic economic and industrial nature of the Port of Tacoma, uncertainty associated with the response of species and habitats to climate change, and expected population growth and industrial and residential development in the Puget Sound (discussed in more detail in Section 2.5), it would be impossible to analyze effects of the proposed action past 50-years.

The following effects analysis of the proposed action on ESA-listed species and critical habitats was limited due to the feasibility phase-level design information provided by the Corps. As part of the Corps' planning process, further work would occur should Congress authorize the recommended plan and provide appropriations to conduct further engineering and final designs. Therefore assumptions were made in order to complete the effects analysis included in this Opinion. Specifically, we assume that placement of dredged material at the Saltchuk beneficial use site is reasonably likely to occur, but would not result in a fully restored site without future efforts. Additionally, we assume that slope stabilization measures as described in Section 1.3.2 are reasonably likely to occur as part of the proposed channel widening; if slope stabilization methods or locations change as a result of final engineering analysis in PED, future reinitiation of consultation with NMFS would likely be required. Vessel traffic is anticipated to decrease as a result of the proposed action, but, as discussed in the effects section, we lack sufficient information to evaluate changes from the environmental baseline from some aspects of the larger vessels. Finally, we assume that all conservation measures and BMPs would be implemented as described in the Proposed Action section above (Section 1.3.3) and the BA.

2.2 Rangewide Status of the Species and Critical Habitat

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

One factor affecting the status of ESA-listed species considered in this Opinion, and aquatic habitat at large, is climate change. Climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species, and the conservation value of designated critical habitats in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. The largest hydrologic responses are expected to occur in basins with significant snow accumulation, where warming decreases snowpack, increases winter flows, and advances the timing of spring melt (Mote et al. 2014; Mote et al 2016). Rain-dominated watersheds and those with significant contributions from groundwater may be less sensitive to predicted changes in climate (Tague et al. 2013; Mote et al. 2014).

During the last century, average regional air temperatures in the Pacific Northwest increased by 1-1.4°F as an annual average, and up to 2°F 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. 2014). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10°F, with the largest increases predicted to occur in the summer (Mote et al. 2014).

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

The combined effects of increasing air temperatures and decreasing spring through fall flows are expected to cause increasing stream temperatures; in 2015 this resulted in 3.5-5.3°C increases in Columbia Basin streams and a peak temperature of 26°C in the Willamette (NWFSC 2015).

Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al. 2009).

The Northwest Fishery Science Center (NWFSC 2015) reported that model projections of climate conditions affecting Puget Sound salmonids were not optimistic, and recent and unfavorable environmental trends are expected to continue. A negative pattern in the Pacific Decadal Oscillation[5] has recently emerged, which adds uncertainty to the short-term duration of warming trends. However, the long-term trends of climate change and other environmental indicators suggest the continuation of warming ocean temperatures; fragmented or degraded freshwater spawning and rearing habitat; reduced snowpack; altered hydrographs producing reduced summer river flows and warmer water; and low marine survival for salmonids in the Salish Sea (NWFSC 2015). Overall, the marine heat wave in 2014-2016 had the most drastic impact on marine ecosystems in 2015, with lingering effects into 2016 and 2017. Conditions had somewhat returned to "normal" in 2018, but another marine heat wave in 2019 again set off a series of marine ecosystem changes across the North Pacific (Ford, in press). One reason for lingering effects of ecosystem response is due to biological lags. These lags result from species impacts at larval or juvenile stages, which are typically most sensitive to extreme temperatures or changes in food supply. It is only once these species grow to adult size or recruit into fisheries that the impact of the heat wave is apparent.

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

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

In addition to changes in freshwater conditions, predicted changes for coastal waters in the Pacific Northwest as a result of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Mote et al. 2014). Elevated ocean temperatures already documented for the Pacific Northwest are highly likely to continue during the next century, with sea surface temperature projected to increase by 1.0-3.7°C by the end of the century (IPCC 2014). Habitat loss, shifts in species' ranges and

[5] https://www.ncdc.noaa.gov/teleconnections/pdo/.

abundances, and altered marine food webs could have substantial consequences to anadromous, coastal, and marine species in the Pacific Northwest (Tillmann and Siemann 2011; Reeder et al. 2013).

Moreover, as atmospheric carbon emissions increase, increasing levels of carbon are absorbed by the oceans, changing the pH of the water. A 38 percent to 109 percent increase in acidity is projected by the end of this century in all but the most stringent CO_2 mitigation scenarios, and is essentially irreversible over a time scale of centuries (IPCC 2014). Regional factors appear to be amplifying acidification in the Northeast Pacific Ocean, which is occurring earlier and more acutely than in other regions and is already impacting important local marine species (Barton et al. 2012; Feely et al. 2012). Acidification also affects sensitive estuary habitats, where organic matter and nutrient inputs further reduce pH and produce conditions more corrosive than those in offshore waters (Feely et al. 2012; Sunda and Cai 2012).

Global sea levels are expected to continue rising throughout this century, reaching likely predicted increases of 10-32 inches by 2081-2100 (IPCC 2014). These changes will likely result in increased erosion and more frequent and severe coastal flooding, and shifts in the composition of nearshore habitats (Tillmann and Siemann 2011; Reeder et al. 2013). Estuarine-dependent salmonids such as chum and Chinook salmon are predicted to be impacted by significant reductions in rearing habitat in some Pacific Northwest coastal areas (Glick et al. 2007). Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances, and therefore these species are predicted to fare poorly in warming ocean conditions (Scheuerell and Williams 2005; Zabel et al. 2006). This is supported by the recent observation that anomalously warm sea surface temperatures off the coast of Washington from 2013 to 2016 resulted in poor coho and Chinook salmon body condition for juveniles caught in those waters (NWFSC 2015). Changes to estuarine and coastal conditions, as well as the timing of seasonal shifts in these habitats, have the potential to impact a wide range of listed aquatic species (Tillmann and Siemann 2011; Reeder et al. 2013).

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

2.2.1 Status of ESA-Listed Fish Species

For Pacific salmon, steelhead, and certain other listed fish species, we commonly use the four "viable salmonid population" (VSP) criteria (McElhany et al. 2000) to assess the viability of the populations that, together, 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, populations can adapt to various environmental conditions and sustain 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 quality and spatial configuration critical habitat, and the dispersal characteristics and dynamics 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 (McElhany et al. 2000).

“Abundance” generally refers to the number adults in the naturally produced (i.e., the progeny of naturally spawning parents) in the environment (e.g., on spawning grounds).
“Productivity,” as applied to viability factors, refers to the entire life cycle (i.e., 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 declining. McElhany et al. (2000) use the terms “population growth rate” and “productivity” interchangeably when referring to production over the entire life cycle. They also refer to “trend in abundance,” which is the manifestation of long-term population growth rate.

For species with multiple populations, once the biological status of a species’ populations has been determined, we assess the status of the entire species 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 ESA-listed PS Chinook salmon, PS steelhead, and PS/GB yelloweye and bocaccio rockfish that occur within the geographic area of the proposed action analyzed 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 (Table 1).

Status of Puget Sound Chinook Salmon

The PS Chinook salmon evolutionarily significant unit (ESU) was listed as threatened on June 28, 2005 (70 FR 37160) (Table 1). NMFS adopted a recovery plan for this ESU in January 2007. The recovery plan consists of two documents: the Puget Sound salmon recovery plan (Shared Strategy for Puget Sound 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 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 the viability criteria for all VSP parameters are sustained to provide ecological functions and preserve options for ESU recovery.

On October 4, 2019, NMFS published notice of NMFS' intent to initiate a new 5-year status review for 28 listed species of Pacific salmon and steelhead and requesting updated information from the public to inform the status review (84 FR 53117). On March 24, 2020, NMFS extended the public comment period, from the original March 27, 2020, through May 26, 2020 (85 FR 16619). The Northwest Fishery Science Center (NWFSC), and NMFS' West coast Regional Office (WCRO) are currently preparing the final status review documents. In this section, we utilize some of the information in the draft viability risk assessment (Ford, in press), in order to provide the most recent information for our evaluation in this Opinion.

Where possible, particularly as new material becomes available, the latest final status review information (NMFS 2016) is supplemented with more recent information and other population specific data that may not have been available during the status review, so that NMFS is assured of using the best available information for this Opinion.

Spatial Structure and Diversity: The Puget 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 (MPG), that are based on similarities in hydrographic, biogeographic, and geologic characteristics.

Three of the five MPGs (Strait of Juan de Fuca, Georgia Basin, and Hood Canal) contain only two populations, both of which must be recovered to viability to recover the ESU (NMFS 2006b). Under the Puget Sound Salmon Recovery Plan, the Suiattle and one each of the early, moderately early, and late run-timing populations in the Whidbey Basin Region, as well as the

White and Nisqually (or other late-timed) populations in the Central/South Sound Region must also achieve viability (NMFS 2006b).

The Technical Recovery Team (TRT) did not define the relative roles of the remaining populations in the Whidbey and Central/South Sound Basins for ESU viability. Therefore, NMFS developed additional guidance which considers distinctions in genetic legacy and watershed condition, among other factors, in assessing the risks to survival and recovery of the listed species by the proposed actions across all populations within the PS Chinook ESU. In doing so, it is important to take into account whether the genetic legacy of the population is intact or if it is no longer distinct within the ESU. Populations are defined by their relative isolation from each other and by the unique genetic characteristics that evolve, as a result of that isolation, and adaption to their specific habitats. If these populations still retain their historic genetic legacy, then the appropriate course, to ensure their survival and recovery, is to preserve that genetic legacy and rebuild those populations. Preserving that legacy requires both a sense of urgency and the actions necessary and appropriate to preserve the legacy that remains. However, if the genetic legacy is gone, then the appropriate course is to recover the populations using the individuals that best approximate the genetic legacy of the original population, reduce the effects of the factors that have limited their production, and provide the opportunity for them to readapt to the existing conditions.

In keeping with this approach, NMFS further classified PS Chinook populations into three tiers based on a systematic framework that considers the population's life history and production and watershed characteristics (NMFS 2010) (Figure 4). This framework, termed the Population Recovery Approach, carries forward the biological viability and delisting criteria described in the Supplement to the Puget Sound Salmon Recovery Plan (Ruckelshaus et al. 2002; NMFS 2006b). The assigned tier indicates the relative role of each of the 22 populations comprising the ESU to the viability of the ESU and its recovery. Tier 1 populations are most important for preservation, restoration, and ESU recovery. Tier 2 populations play a less important role in recovery of the ESU. Tier 3 populations play the least important role. When we analyze proposed actions, we evaluate impacts at the individual population scale for their effects on the viability of the ESU. We expect that impacts to Tier 1 populations would be more likely to affect the viability of the ESU, as a whole, than similar impacts to Tier 2 or 3 populations, because of the relatively greater importance of Tier 1 populations to overall ESU viability and recovery. NMFS has incorporated this and similar approaches in previous ESA section 4(d) determinations and Opinions on Puget Sound salmon fisheries and regional recovery planning (NMFS 2005b; 2005d; 2008f; 2008e; 2010a; 2011a; 2013b; 2014b; 2015c; 2016f; 2017b; 2018c; 2019b; 2021e).

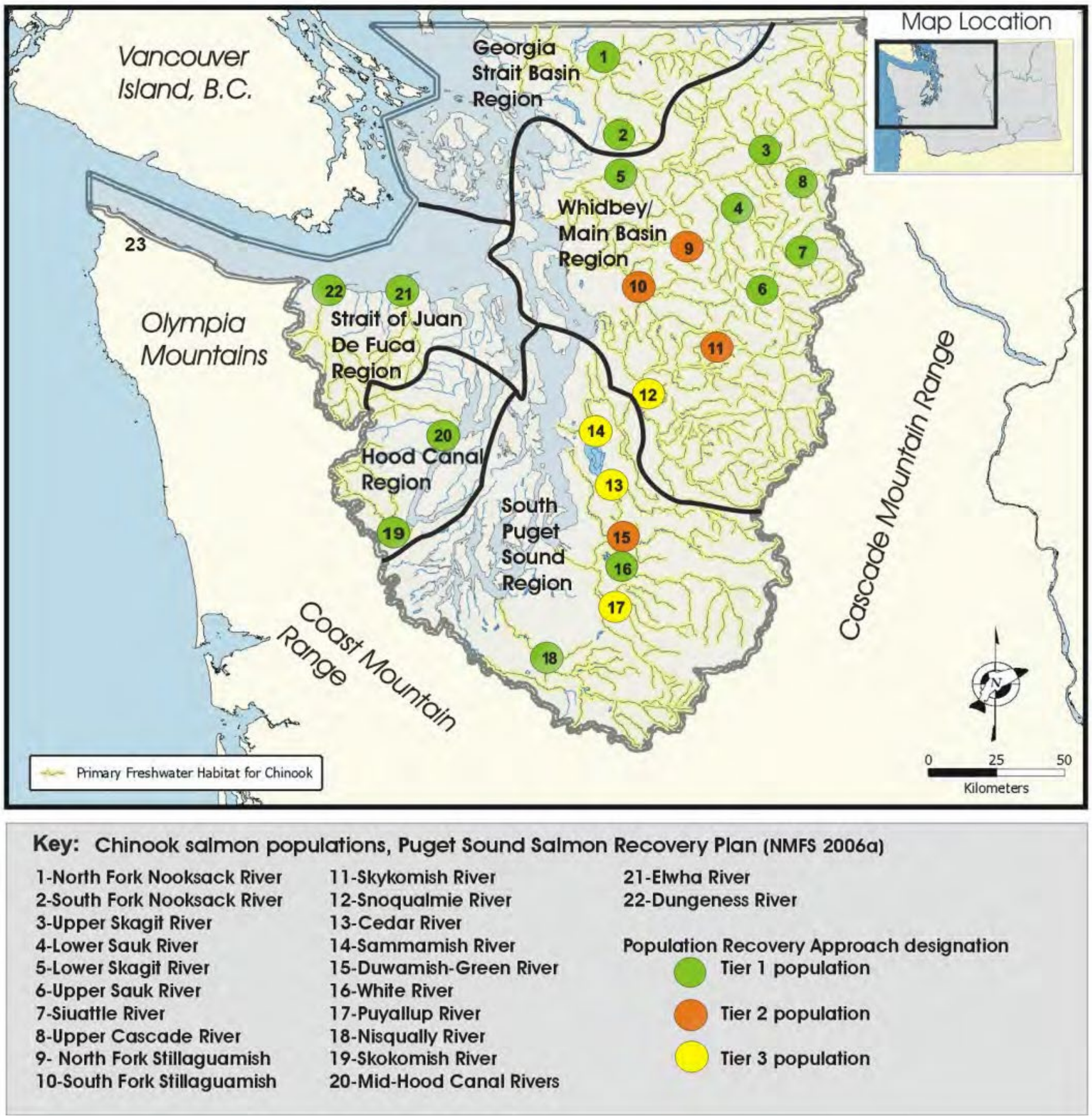

Figure 4. Puget Sound Chinook populations with tiered recovery designations.

The ESU also includes Chinook salmon from certain artificial propagation programs. Artificial propagation (hatchery) programs (26) were added to the listed Chinook salmon ESU in 2005, as part of the final listing determinations for 16 ESUs of West Coast Salmon and Final 4(d) Protective Regulations for Threatened Salmonid ESUs (70 FR 37160). In October of 2016, NMFS proposed revisions to the hatchery programs included as part of some Pacific salmon ESUs and steelhead DPSs listed under the ESA (81 FR 72759). NMFS issued its final rule in December of 2020, which includes 25 hatchery programs as part of the listed Puget Sound Chinook salmon ESU (85 FR 81822).

Since 1999, most PS Chinook populations have mean natural-origin spawner escapement levels well below levels identified as required for recovery to low extinction risk. Long-term, natural-origin mean escapements for eight populations are at or below their critical thresholds.[6] Both populations in three of the five biogeographical regions are below or near their critical threshold: Georgia Strait, Hood Canal and Strait of Juan de Fuca. When hatchery spawners are included, aggregate average escapement is over 1,000 for one of the two populations in each of these three regions, reducing the demographic risk to the populations in these regions. Additionally, hatchery spawners help two of the remaining three of these populations achieve total spawner abundances above their critical threshold, reducing demographic risk. Nine populations are above their rebuilding thresholds,[7] seven of them in the Whidbey/Main Basin Region. In 2018 NMFS and the NWFSC updated the rebuilding thresholds for several key Puget Sound populations. These thresholds represent the Maximum Sustained Yield estimate of spawners based on available habitat. The new spawner-recruit analyses for several populations indicated a significant reduction in the number of spawners that can be supported by the available habitat when compared to analyses conducted 10 to 15 years ago. This may be due to further habitat degradation or improved productivity assessment or, more likely, a combination of the two. For example, the updated rebuilding escapement threshold for the Green River is 1,700 spawners compared to the previous rebuilding escapement threshold of 5,523 spawners[8]. So, although several populations are above the updated rebuilding thresholds, indicating that escapement is sufficient for the available habitat in many cases, the overall abundance has declined.

Measures of spatial structure and diversity can give some indication of the resilience of a population to sustain itself. Spatial structure can be measured in various ways, but here we assess the proportion of natural-origin spawners (wild fish) vs. hatchery-origin spawners on the spawning grounds (Ford, in press).

Since 1990, there is a general declining population trend in the proportion of natural-origin spawners across the ESU (Table 4). While there are several populations that have maintained high levels of natural-origin spawner proportions, mostly in the Skagit and Snohomish basins, many others maintain high proportions of hatchery-origin spawners (Table 4). It should be noted that the pre-2005-2009 estimates of mean natural-origin fractions occurred prior to the widespread adoption of mass marking of hatchery produced fish. Estimates of hatchery and natural-origin proportions of fish since the implementation of mass marking are considered more robust. Several of these populations have long-standing or more recent conservation hatchery programs associated with them—North Fork (NF) and South Fork (SF) Nooksack, NF and SF

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[6] After taking into account uncertainty, the critical threshold is defined as a point below which: (1) depensatory processes are likely to reduce the population below replacement; (2) the population is at risk from inbreeding depression or fixation of deleterious mutations; or (3) productivity variation due to demographic stochasticity becomes a substantial source of risk (NMFS 2000).

[7] The rebuilding threshold is defined as the escapement that will achieve Maximum Sustainable Yield (MSY) under current environmental and habitat conditions (NMFS 2000), and is based on an updated spawner-recruit assessment in the Puget Sound Chinook Harvest Management Plan, December 1, 2018. Thresholds were based on population-specific data, where available.

[8] The historic Green River escapement goal was established in 1977 as the average of estimated natural spawning escapements from 1965-1974. This goal does not reflect the lower productivity associated with the current condition of habitat. Reference the source for the historical objective from MUP (PSIT and WDFW 2017)(Green River MUP).

Stillaguamish, White River, Mid-Hood Canal, Dungeness, and the Elwha. These conservation programs are in place to maintain or increase the overall abundance of these populations, helping to conserve the diversity and increase the spatial distribution of these populations in the absence of properly functioning habitat. With the exception of the Mid-Hood Canal program, these conservation hatchery programs culture the extant, native Chinook salmon stock in these basins. With the exception of the NF and SF Stillaguamish, the remainder of the populations included in these conservation programs are identified in NMFS (2006b) as essential for the recovery of the Puget Sound Chinook salmon ESU (Table 4).

Table 4. Five-year mean of fraction of natural-origin spawners[9] (sum of all estimates divided by the number of estimates) (Ford, in press).

Population	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
NF Nooksack R. spring	0.28	0.11	0.19	0.14	0.13
SF Nooksack R. spring	0.26	0.55	0.57	0.42	0.45
Low. Skagit R. fall	0.94	0.91	0.86	0.92	0.84
Up. Skagit R. summer	0.91	0.87	0.84	0.95	0.91
Cascade R. spring	0.98	0.92	0.89	0.94	0.86
Low. Sauk R. summer	0.94	0.97	0.95	0.91	0.98
Up. Sauk R. spring	0.99	1.00	0.98	0.97	0.99
Suiattle R. spring	0.99	0.97	0.99	0.99	0.97
NF Stillaguamish R. summer/fall	0.59	0.70	0.40	0.43	0.45
SF Stillaguamish R. summer/fall	0.59	0.70	0.40	0.54	0.46
Skykomish R. summer	0.49	0.52	0.76	0.69	0.62
Snoqualmie R. fall	0.81	0.89	0.81	0.78	0.75
Sammamish R. fall	0.29	0.36	0.16	0.07	0.16
Cedar R. fall	0.61	0.59	0.82	0.78	0.71
Green R. fall	0.55	0.47	0.43	0.39	0.30
White R. spring	0.54	0.79	0.43	0.32	0.15
Puyallup R. fall	0.88	0.79	0.52	0.41	0.32
Nisqually R. fall	0.80	0.61	0.30	0.30	0.47
Skokomish R. fall	0.40	0.46	0.45	0.10	0.16
Mid-Hood Canal fall	0.76	0.79	0.61	0.33	0.89
Dungeness R. summer	1.00	0.32	0.43	0.25	0.25
Elwha R. fall	0.41	0.53	0.35	0.06	0.05

In addition, spatial structure, or geographic distribution, of the White, Skagit, Elwha,[10] and Skokomish populations has been substantially reduced or impeded by the loss of access to the upper portions of those tributary basins due to flood control activities and hydropower development. Habitat conditions conducive to salmon survival in most other watersheds have been reduced significantly by the effects of land use, including urbanization, forestry, agriculture, and development (NMFS 2005a; SSPS 2005; NMFS 2008c; 2008d; 2008b). It is

[9] Estimates of hatchery and natural-origin spawning abundances, prior to the 2005-2009 period are based on pre-mass marking of hatchery-origin fish and, as such, may not be directly comparable to the 2005-2009 forward estimates.

[10] Removal of the two Elwha River dams and restoration of the natural habitat in the watershed began in 2011.

likely that genetic and life history diversity has been significantly adversely affected by this habitat loss.

Between 1990 and 2021, the proportion of natural-origin spawners has trended downward across the ESU, with the Whidbey Basin the only MPG with consistently high fractions of natural-origin spawner abundance. All other MPG have either variable or declining spawning populations with high proportions of hatchery-origin spawners (NWFSC 2015, Ford, in press). Overall, the new information on abundance, productivity, spatial structure and diversity since the 2015 status review supports no change in the biological risk category (NWFSC 2015; Ford, in press).

Abundance and Productivity: The abundance of the PS Chinook salmon over time shows that individual populations have varied with increasing or decreasing abundance. Generally, many populations experienced increases in total abundance during the years 2000-2008, and more recently in 2015-2017, but general declines during 2009-2014, and a downturn again in the two most recent years available for the current status review, 2017-2018. Abundance across the Puget Sound ESU has generally increased since the last status review, with only 2 of the 22 populations (Cascade and North Fork and South Fork Stillaguamish) showing a negative percent change in the 5-year geometric mean natural- origin spawner abundances since the prior status review (Table 5). However, 15 of 20 populations with positive percent change in the 5-year geometric mean natural-origin spawner abundances since the prior status review have relatively low population abundances of <1000 fish, so some of these increases represent small changes in total abundance (Ford, in press). Also, given lack of high confidence in survey techniques, particularly with small populations, there is substantial uncertainty in quantifying fish and detecting trends in small populations (Gallagher et al. 2010).

Table 5. Extant PS Chinook salmon populations in each biogeographic region and percent change between the most recent two 5-year periods (2010-2014 and 2015-2019). Five-year geometric mean of raw natural-origin spawner counts. This is the raw total spawner estimate times the fraction natural-origin estimate, if available. In parentheses, 5-year geometric mean of raw total spawner estimates (i.e., hatchery and natural) are shown. A value only in parentheses means that a total spawner estimate was available but no (or only one) estimate of natural-origin spawners was available. The geometric mean was computed as the product of estimates raised to the power 1 over the number of counts available (2 to 5). A minimum of 2 values were used to compute the geometric mean. Percent change between the most recent two 5-year periods is shown on the far right (Ford, in press).

Biogeographic Region	Population (Watershed)	2010-2014	2015-2019	Population trend (% change)
Strait of Georgia	**North Fork Nooksack River**	136 (1205)	137 (1553)	Positive 1% (29)
	South Fork Nooksack River	13 (35)	42 (106)	Positive 223% (203)
Strait of Juan de Fuca	**Elwha River**	71 (1349)	134 (2810)	Positive 89% (108)
	Dungeness River	66 (279)	114 (476)	Positive 73% (71)
Hood Canal	**Skokomish River**	136 (1485)	265 (2074)	Positive 95% (40)
	Mid Hood Canal River	80 (295)	196 (222)	Positive 145% (-25)
Whidbey Basin	Skykomish River	1698 (2462)	1736 (2806)	Positive 3% (14)
	Snoqualmie River	839 (1082)	856 (1146)	Positive 2% (6)
	North Fork Stillaguamish River	417 (996)	302 (762)	Negative 28% (-23)
	South Fork Stillaguamish River	34 (68)	37 (96)	Positive 9% (41)
	Lower Skagit River	1416 (1541)	2130 (2640)	Positive 50% (71)
	Upper Sauk River	854 (880)	1318 (1330)	Positive 54% (51)
	Lower Sauk River	376 (416)	635 (649)	Positive 69% (56)
	Suiattle River	376 (378)	640 (657)	Positive 70% (74)
	Upper Cascade River	298 (317)	185 (223)	Negative 38% (-30)
Central/South Puget Sound Basin	North Lake Washington/ Sammamish River	82 (1289)	126 (879)	Positive 54% (-32)
	Green/Duwamish River	785 (2109)	1822 (6373)	Positive 132% (202)
	Puyallup River	450 (1134)	577 (1942)	Positive 28% (71)
	White River	652 (2161)	895 (6244)	Positive 37% (189)
	Cedar River	699 (914)	889 (1253)	Positive 27% (37)
	Nisqually River	481 (1823)	766 (1841)	Positive 59% (1)

Trends in abundance over longer time periods are generally slightly negative. Fifteen-year trends in log natural-origin spawner abundance were computed over two time periods (1990-2005 and 2004- 2019) for each Puget Sound Chinook salmon population. Trends were negative in the latter period for 16 of the 22 populations and for four of the 22 populations (SF Nooksack, SF Stillaguamish, Green and Puyallup) in the earlier period. Thus, there is a general decline in natural-origin spawner abundance across all MPGs in the recent fifteen years. Upper Sauk and Suiattle (Whidbey Basin MPG), Nisqually (Central/South MPG) and Mid-Hood Canal (Hood Canal MPG) are the only populations with positive trends, though Mid-Hood Canal has an extremely low population size. Further, no change in trend between the two time periods was detected in SF Nooksack (Strait of Georgia MPG), Green and Nisqually (Central/South MPG). The average trend across the ESU for the 1990-2005 15-year time period was 0.03 (Figure 5). The average trend across the ESU for the later 15-year time period (2004-2019) was -0.02. The previous status review in 2015 (NWFSC 2015) concluded there were widespread negative trends for the total ESU despite that escapements and trends for individual populations were variable. The addition of the data to 2018 now also shows even more substantially either flat or negative trends for the entire ESU in natural-origin Chinook salmon spawner population abundances (Ford, in press).

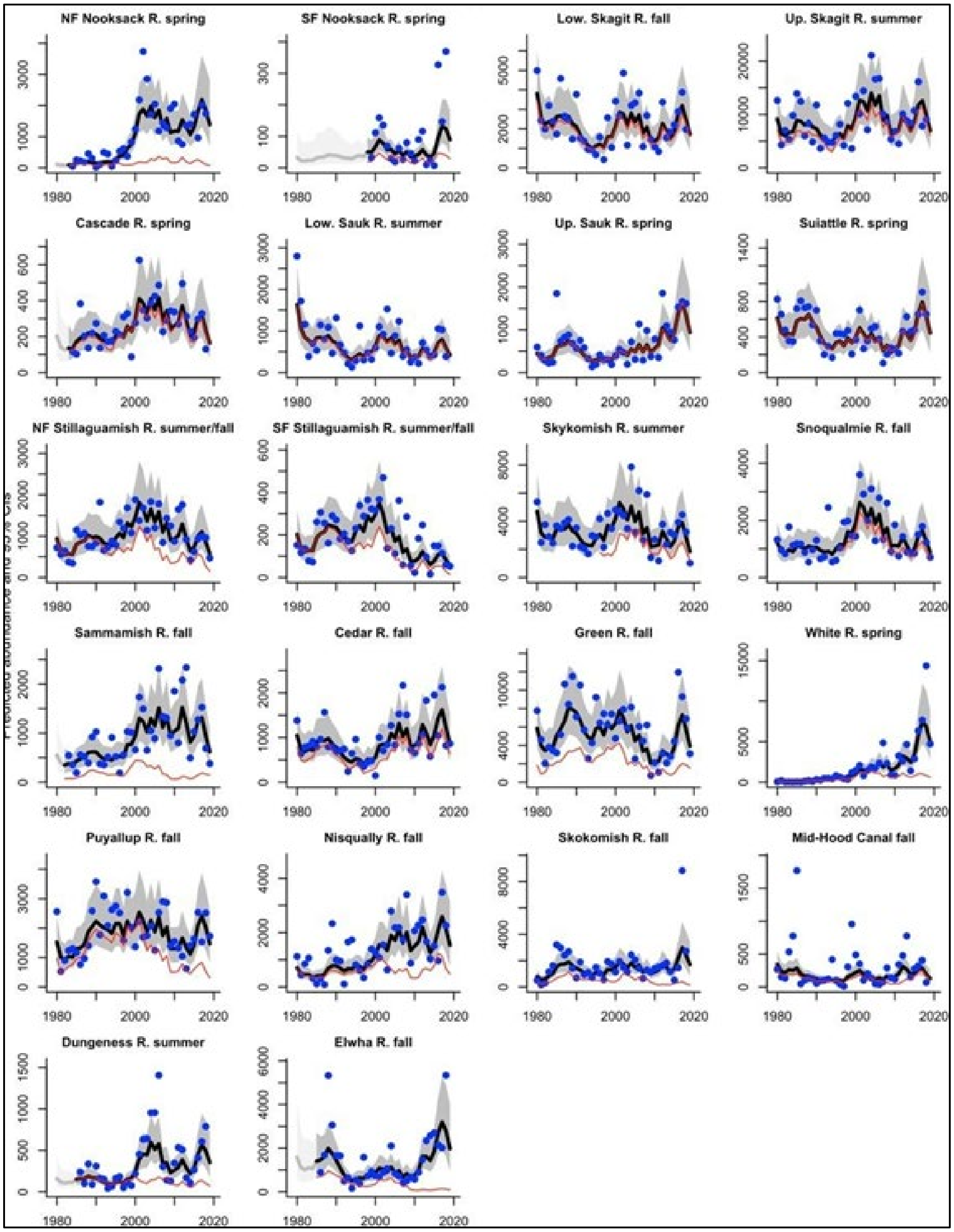

Figure 5. Smoothed trend in estimated total (thick black line, with 95 percent confidence internal in gray) and natural (thin red line) PS Chinook salmon population spawning abundance. In portions of a time series where a population has no annual estimate but smoothed spawning abundance is estimated from correlations with other populations the smoothed estimate is shown in light gray. Points show the annual raw spawning abundance estimates. For some trends the smoothed estimate may be influenced by earlier data points not included in the plot (Ford, in press).

Across the Puget Sound ESU, 10 of 22 Puget Sound populations show natural productivity below replacement in nearly all years since the mid-1980's (Figure 5). These include the North and South Forks Nooksack in the Strait of Georgia MPG, North and South Forks Stillaguamish and Skykomish in Whidbey Basin MPG, Sammamish, Green and Puyallup in the Central/South MPG, the Skokomish in the Hood Canal MPG, and Elwha in the Strait of Juan de Fuca MPG. Productivity in the Whidbey Basin MPG populations was above zero the mid-late 1990's, with the exception of Skykomish and North and South Forks Stillaguamish populations. White River population in the Central/South MPG was above replacement from the early 1980's to 2001, but has dropped in productivity consistently since the late 1980's. In recent years, only 5 populations have had productivities above zero. These are Lower Skagit, Upper Skagit, Lower Sauk, Upper Sauk, and Suiattle, all Skagit River populations in the Whidbey Basin MPG. This is consistent with, and continues the decline reported in the 2015 Status Review (NWFSC 2015).

All Puget Sound Chinook salmon populations continue to remain well below recovery levels (Ford, in press). Most populations also remain consistently below the spawner-recruit levels identified by the TRT as necessary for recovery. Across the ESU, most native-origin populations have slightly increased in abundance since the last status review in 2016, but have small negative trends over the past 15 years (Figure 6). Productivity remains low in most populations. Hatchery-origin spawners are present in high fractions in most populations outside the Skagit watershed, and in many watersheds the fraction of spawner abundances that are natural-origin have declined over time. Habitat protection, restoration and rebuilding programs in all watersheds have improved stream and estuary conditions despite record numbers of humans moving into the Puget Sound region in the past two decades. Bi-annual four-year work plans document the many completed habitat actions that were initially identified in the Puget Sound Chinook salmon recovery plan. However, the expected benefits from restoration actions is likely to take years or decades to produce significant improvement in natural population viability parameters (see Roni et al. 2010).

Development of a monitoring and adaptive management program was required by NMFS in the 2007 Supplement to the Shared Strategy Recovery Plan (NMFS 2006b), and since the last review the Puget Sound Partnership has completed this, but this program is still not fully functional for providing an assessment of watershed habitat restoration/recovery programs, nor does it fully integrate the essentially discrete habitat, harvest and hatchery programs. A recent white paper produced by the Salmon Science Advisory Group, of the Puget Sound Partnership concludes there has been "a general inability of monitoring to link restoration, changes in habitat conditions, and fish response at large-scales" (PSP 2021). A number of watershed groups are in the process of updating their Recovery Plan Chapters and this includes prioritizing and updating recovery strategies and actions, as well as assessing prior accomplishments. Overall, recent information on PS Chinook salmon abundance and productivity since the 2016 status review indicates a slight increase in abundance but does not indicate a change in biological risk to the ESU despite moderate inter-annual variability among populations and a general decline in abundance over the last 15 years (Ford, in press).

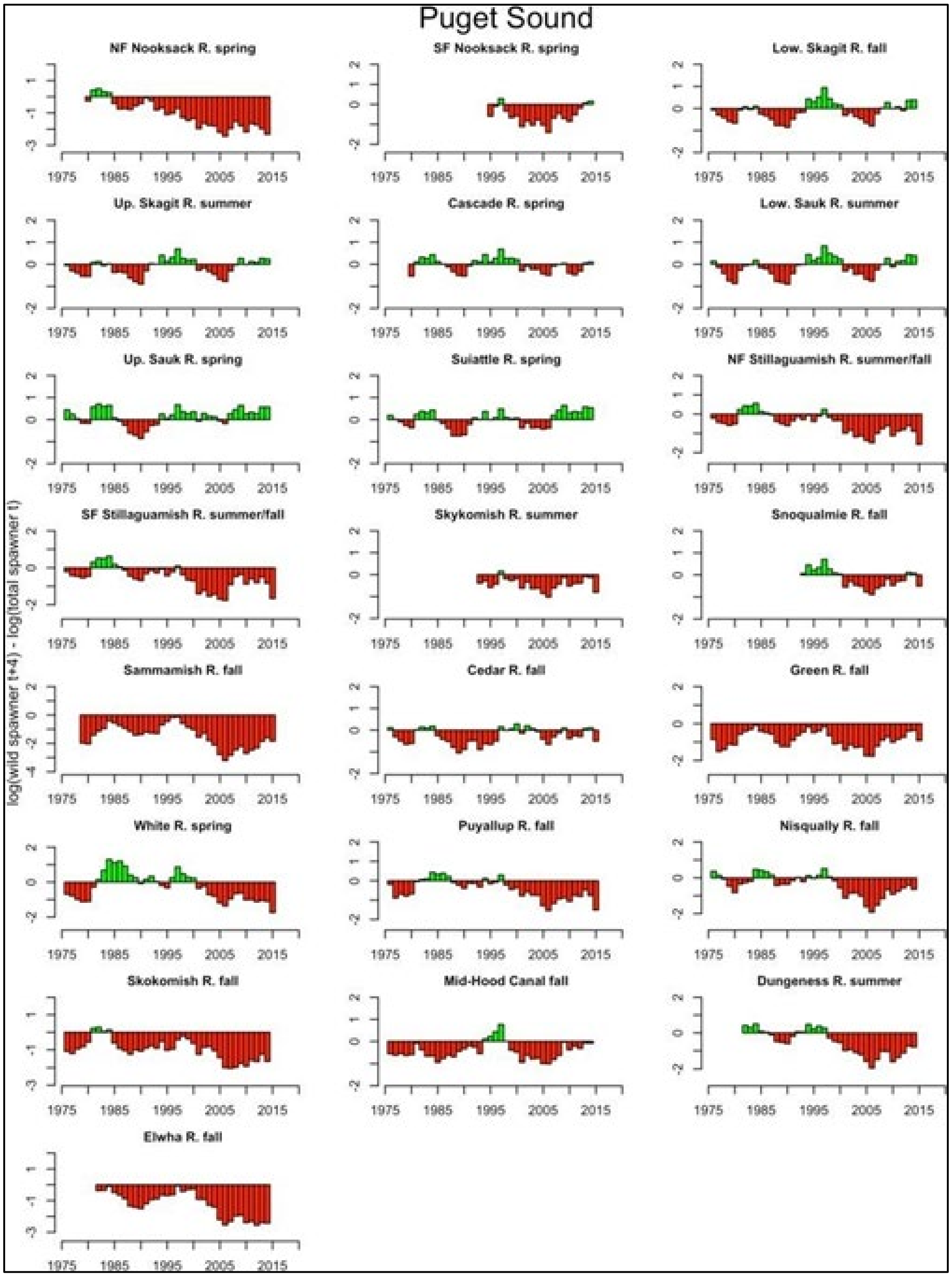

Figure 6. Trends in Chinook salmon population productivity, estimated as the log of the smoothed natural-origin spawning abundance in year t – smoothed natural-origin spawning abundance in year (t – 4) (Ford, in press).

<u>Limiting Factors</u>: Limiting factors for this species 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
- Altered flow regime

PS Chinook Salmon Recovery Plan: Nearshore areas serve as the nursery for juvenile PS Chinook salmon. Riparian vegetation, shade and insect production, and forage fish eggs along marine shorelines and river deltas help to provide food, cover and thermoregulation in shallow water habitats. Forage fish spawn in large aggregations along shorelines with suitable habitat, which produce prey for juvenile PS Chinook salmon. Juvenile salmon commonly occupy "pocket estuaries" where freshwater inputs provide salinity gradients that make adjusting to the marine environment less physiologically demanding. Pocket estuaries also provide refugia from predators. As the juvenile salmon grow and adjust, they move out to more exposed shorelines such as eelgrass, kelp beds and rocky shorelines where they continue to grow and migrate into the ocean environment. Productive shoreline habitats of Puget Sound are necessary for the recovery of Puget Sound salmon (SSPS 2007).

The Puget Sound Recovery Plan (Volumes 1 and 2) includes specific recovery actions for each of the 22 extant populations of PS Chinook salmon. General protection and restoration actions summarized from the plan include:

- Aggressively protect functioning drift cells and feeder bluffs that support eelgrass bands and depositional features;
- Counties should pass strong regulations and policies limiting increased armoring of these shorelines and offering incentives for protection;
- Aggressively protect areas, especially shallow water/low gradient habitats and pocket estuaries, within 5 miles of river deltas;
- Protect the forage fish spawning areas;
- Conduct limited beach nourishment on a periodic basis to mimic the natural sediment transport processes in select sections where corridor functions may be impaired by extensive armoring;
- Maintain the functioning of shallow, fine substrate features in and near 11 natal estuaries for Chinook salmon (to support rearing of fry);
- Maintain migratory corridors along the shores of Puget Sound;
- Maintain the production of food resources for salmon;
- Maintain functioning nearshore ecosystem processes (i.e., sediment delivery and transport; tidal circulation) that create and support the above habitat features and functions;
- Increase the function and capacity of nearshore and marine habitats to support key needs of salmon;
- Protect and restore shallow, low velocity, fine substrate habitats along marine shorelines, including eelgrass beds and pocket estuaries, especially adjacent to major river deltas;
- Protect and restore riparian areas;
- Protect and restore estuarine habitats of major river mouths;

- Protect and restore spawning areas and critical rearing and migration habitats for forage fish;
- Protect and restore drift cell processes (including sediment supply, e.g., from feeder bluffs, transport, and deposition) that create and maintain nearshore habitat features such as spits, lagoons, bays, beaches.

Development of shoreline and estuary areas of Puget Sound is expected to continue to adversely impact the quality of marine habitat for PS Chinook salmon. Projected changes in nearshore and estuary development based on documented rates of developed land cover change in Bartz et al. (2015) show that between 2008 and 2060, an additional 14.7 hectares of development of shoreline areas and 204 hectares of estuary development can be expected.

Status of Puget Sound Steelhead

The PS steelhead DPS was listed as a threatened species under the ESA on May 11, 2007 (72 FR 26722). Subsequent status assessments of the DPS after the ESA-listing decision have found that the status of PS steelhead regarding risk of extinction has not changed substantially (Ford et al. 2011a; NMFS 2016a) (81 FR 33468, May 26, 2016) (Ford, in press). On October 4, 2019 NMFS published a Federal Register notice (84 FR 53117), announcing NMFS' intent to initiate a new 5-year status review for 28 listed species of Pacific salmon and steelhead and requesting updated information from the public to inform the most recent five-year status review. On March 24, 2020, NMFS extended the public comment period, from the original March 27, 2020, through May 26, 2020 (85 FR 16619). The NWFSC and the NMFS' WCR are currently preparing the final five-year status review documents.

The PS Steelhead TRT produced viability criteria, including population viability analyses (PVAs), for 20 of 32 demographically independent populations (DIPs) and three major population groups (MPGs) in the DPS (Hard et al. 2015). It also completed a report identifying historical populations of the DPS (Myers et al. 2015). The DIPs are based on genetic, environmental, and life history characteristics. Populations display winter, summer, or summer/winter run timing (Myers et al. 2015). The TRT concludes that the DPS is currently at "very low" viability, with most of the 32 DIPs and all three MPGs at "low" viability.
The designation of the DPS as "threatened" is based upon the extinction risk of the component populations. For a DIP to be considered viable, it must have at least an 85 percent probability of meeting the viability criteria, as calculated by Hard et al. (2015).

At the time of listing the Puget Sound steelhead Biological Review Team (BRT) considered the major risk factors associated with spatial structure and diversity of PS steelhead to be: (1) the low abundance of several summer run populations; (2) the sharply diminishing abundance of some winter steelhead populations, especially in south Puget Sound, Hood Canal, and the Strait of Juan de Fuca; and (3) continued releases of out-of-ESU hatchery fish from Skamania-derived summer run and Chambers Creek-derived winter run stocks (Hard et al. 2007; Hard et al. 2015). Loss of diversity and spatial structure were judged to be "moderate" risk factors (Hard et al. 2007). In 2011 the BRT identified degradation and fragmentation of freshwater habitat, with consequential effects on connectivity, as the primary limiting factors and threats facing the PS steelhead DPS (Ford et al. 2011a). The BRT also determined that most of the steelhead populations within the DPS continued to show downward trends in estimated abundance, with a few sharp declines (Ford et al. 2011a). The 2015 status review concurred that harvest and hatchery production of steelhead in Puget Sound were at low levels and not likely to increase substantially in the foreseeable future, thus these risks have been reduced since the time of listing. However, unfavorable environmental trends previously identified (Ford et al. 2011a) were expected to continue (Hard et al. 2015).

In this Opinion, where possible, the 2015 status review information is supplemented with information and other population specific data available considered during the drafting of the 2020 five-year status review for PS steelhead.

On December 27, 2019, we published a recovery plan for PS steelhead (84 FR 71379) (NMFS 2019a). The Puget Sound steelhead Recovery Plan (Plan) (NMFS 2019a) provides guidance to recover the species to the point that it can be naturally self-sustaining over the long term. To achieve full recovery, steelhead populations in Puget Sound need to be robust enough to withstand natural environmental variation and some catastrophic events, and they should be resilient enough to support harvest and habitat loss due to human population growth. The Plan aims to improve steelhead viability by addressing the pressures that contribute to the current condition: habitat loss/degradation, water withdrawals, declining water quality, fish passage barriers, dam operations, harvest, hatcheries, climate change effects, and reduced early marine survival. NMFS is using the recovery plan to organize and coordinate recovery of the species in partnership with state, local, tribal, and federal resource managers, and the many watershed restoration partners in the Puget Sound. Consultations, including this one, will incorporate information from the Plan (NMFS 2019a).

In the Plan, NMFS and the PSSTRT modified the 2013 and 2015 PSSTRT viability criteria to produce the viability criteria for PS steelhead, as described below:

- All three MPGs (North Cascade, Central-South Puget Sound, and Hood Canal-Strait of Juan de Fuca) (Figure 6) must be viable (Hard et al. 2015). The three MPGs differ substantially in key biological and habitat characteristics that contribute in distinct ways to the overall viability, diversity, and spatial structure of the DPS.
- There must be sufficient data available for NMFS to determine that each MPG is viable.

The Plan (NMFS 2019h) also established MPG-level viability criteria. The following are specific criteria are required for MPG viability:

- At least 50 percent of steelhead populations in the MPG achieve viability.
- Natural production of steelhead from tributaries to Puget Sound that are not identified in any of the 32 identified populations provides sufficient ecological diversity and productivity to support DPS-wide recovery.
- In addition to the minimum number of viable DIPs (50 percent) required above, all DIPs in the MPG must achieve an average MPG-level viability that is equivalent to or greater than the geometric mean (averaged over all the DIPs in the MPG) viability score of at least 2.2 using the 1–3 scale for individual DIPs described under the DIP viability discussion in the PSSTRT Viability Criteria document (Hard et al. 2015). This criterion is intended to ensure that MPG viability is not measured (and achieved) solely by the strongest DIPs, but also by other populations that are sufficiently healthy to achieve

MPG-wide resilience. The Plan allows for an alternative evaluation method to that in Hard et al. (2015) may be developed and used to assess MPG viability.

The Plan (NMFS 2019h) also identified specific DIPs in each of the three MPGs which must attain viability. These DIPs, by MPG, are described as follows:

For the **North Cascades MPG** eight of the sixteen DIPs in the North Cascades MPG must be viable. The eight (five winter-run and three summer-run) DIPs described below must be viable to meet this criterion:

- Of the eleven DIPs with winter or winter/summer runs, five must be viable:
- Nooksack River Winter-Run;
- Stillaguamish River Winter-Run;
- One from the Skagit River (either the Skagit River Summer-Run and Winter-Run or the Sauk River Summer-Run and Winter-Run);
- One from the Snohomish River watershed (Pilchuck, Snoqualmie, or Snohomish/Skykomish River Winter-Run); and
- One other winter or summer/winter run from the MPG at large.

The rationale for this is that there are four major watersheds in this MPG, and one viable population from each will help attain geographic spread and habitat diversity within core extant steelhead habitat (NMFS 2019h). Of the five summer-run DIPs in this MPG, three must be viable, representing each of the three major watersheds containing summer-run populations (Nooksack, Stillaguamish, Snohomish rivers). Therefore, the priority summer-run populations are as follows:

- South Fork Nooksack River Summer-Run;
- One DIP from the Stillaguamish River (Deer Creek Summer-Run or Canyon Creek Summer-Run); and
- One DIP from the Snohomish River (Tolt River Summer-Run or North Fork Skykomish River Summer-Run).

As described, these priority populations in the North Cascades MPG include specific, winter or winter/summer-run populations from the Nooksack, Stillaguamish, Skagit or Sauk, and Snohomish River basins and three summer-run populations from the Nooksack, Stillaguamish, and Snohomish basins. These populations are targeted to achieve viable status to support MPG viability. Having viable populations in these basins assures geographic spread, provides habitat diversity, reduces catastrophic risk, and increases life-history diversity (NMFS 2019h).

For the **Central and South Puget Sound MPG** four of the eight DIPs in the Central and South Puget Sound MPG must be viable. The four DIPs described below must be viable to meet this criterion:

- Green River Winter-Run;
- Nisqually River Winter-Run;
- Puyallup/Carbon rivers Winter-Run, or the White River Winter-Run; and
- At least one additional DIP from this MPG: Cedar River, North Lake Washington/Sammamish Tributaries, South Puget Sound Tributaries, or East Kitsap Peninsula Tributaries.

The rationale for this prioritization is that steelhead inhabiting the Green, Puyallup, and Nisqually River watersheds currently represent the core extant steelhead populations and these watersheds contain important diversity of stream habitats in the MPG.

For the **Hood Canal and Strait of Juan de Fuca MPG** four of the eight DIPs in the Hood Canal and Strait of Juan de Fuca MPG must be viable. The four DIPs described below must be viable to meet this criterion:

- Elwha River Winter/Summer-Run (see rationale below);
- Skokomish River Winter-Run;
- One from the remaining Hood Canal populations: West Hood Canal Tributaries Winter-Run, East Hood Canal Tributaries Winter-Run, or South Hood Canal Tributaries Winter-Run; and
- One from the remaining Strait of Juan de Fuca populations: Dungeness Winter-Run, Strait of Juan de Fuca Tributaries Winter-Run, or Sequim/Discovery Bay Tributaries Winter-Run.

The rationale for this prioritization is that the Elwha and Skokomish rivers are the two largest single watersheds in the MPG and bracket the geographic extent of the MPG. Furthermore, both Elwha and Skokomish populations have recently exhibited summer-run life histories, although the Dungeness River population was the only summer/winter run in this MPG recognized by the PSSTRT in Hard et al. (2015). Two additional populations, one population from the Strait of Juan de Fuca area and one population from the Hood Canal area, are needed for a viable MPG to maximize geographic spread and habitat diversity.

Lastly, the Plan (NMFS 2019h) also identified additional attributes, or characteristics which should be associated with a viable MPG.

- All major diversity and spatial structure conditions are represented, based on the following considerations:
- Populations are distributed geographically throughout each MPG to reduce risk of catastrophic extirpation; and
- Diverse habitat types are present within each MPG (one example is lower elevation/gradient watersheds characterized by a rain-dominated hydrograph and higher elevation/gradient watersheds characterized by a snow-influenced hydrograph).

Federal and state steelhead recovery and management efforts will provide new tools and data and technical analyses to further refine PS steelhead population structure and viability, if needed, and better define the role of individual populations at the watershed level and in the DPS. Future consultations will incorporate information from the Plan (NMFS 2019h).

<u>Spatial Structure and Diversity:</u> The PS steelhead DPS is the anadromous form of *O. mykiss* that occur in rivers, below natural barriers to migration, in northwestern Washington State that drain to Puget Sound, Hood Canal, and the Strait of Juan de Fuca between the U.S./Canada border and the Elwha River, inclusive. Non-anadromous ‘‘resident’’ *O. mykiss* occur within the range of PS steelhead but are not part of the DPS due to marked differences in physical, physiological, ecological, and behavioral characteristics (Hard et al. 2007). In October of 2016, NMFS proposed revisions to the hatchery programs included as part of Pacific salmon ESUs and

steelhead DPSs listed under the ESA (81 FR 72759). NMFS issued its final rule in December of 2020 (85 FR 81822). This final rule includes steelhead from five artificial propagation programs in the PS steelhead DPS: the Green River Natural Program; White River Winter Steelhead Supplementation Program; Hood Canal Steelhead Supplementation Program; the Lower Elwha Fish Hatchery Wild Steelhead Recovery Program; and the Fish Restoration Facility Program. (85 FR 81822, December 17, 2020).

In 2013, the PSSTRT completed its evaluation of factors that influence the diversity and spatial structure VSP criteria for steelhead in the DPS. For spatial structure, this included the fraction of available intrinsic potential rearing and spawning habitat that is occupied compared to what is needed for viability[11]. For diversity, these factors included hatchery fish production, contribution of resident fish to anadromous fish production, and run timing of adult steelhead. Quantitative information on spatial structure and connectivity was not available for most PS steelhead populations, so a Bayesian Network framework was used to assess the influence of these factors on steelhead viability at the population, MPG, and DPS scales. The PSSTRT concluded that low population viability was widespread throughout the DPS and populations showed evidence of diminished spatial structure and diversity. Specifically, population viability associated with spatial structure and diversity was highest in the Northern Cascades MPG and lowest in the Central and South Puget Sound MPG (Puget Sound Steelhead Technical Recovery Team 2011). Diversity was generally higher for populations within the Northern Cascades MPG, where more variability in viability was expressed and diversity generally higher, compared to populations in both the Central and South Puget Sound and Hood Canal and Strait of Juan de Fuca MPG, where diversity was depressed and viabilities were generally lower (NWFSC 2015). Most PS steelhead populations were given intermediate scores for spatial structure and low scores for diversity because of extensive hatchery influence, low breeding population sizes, and freshwater habitat fragmentation or loss (NWFSC 2015). The PSSTRT concluded that the Puget Sound DPS was at very low viability, considering the status of all three of its constituent MPGs, and many of its 32 DIPs (Hard et al. 2015). For spatial structure there were a number of events that occurred in Puget Sound during the last review period (2015-2019) that are anticipated to improve status populations within several of the MPGs within the DPS.

Since the PSSTRT completed its 2013 review, the only additional spatial structure and diversity data that have become available have been estimates of the fraction of hatchery fish on the spawning grounds (NWFSC 2015). Since publication of the NWFSC report in 2015, reductions in hatchery programs founded from non-listed and out of DPS stocks (i.e., Skamania) have occurred. In addition, the fraction of out of DPS hatchery steelhead spawning naturally are low for many rivers (NWFSC 2015; NMFS 2016i; 2016h). The fraction of natural-origin steelhead spawners was 0.9 or greater for the 2005-2009 and 2010-2014 time periods for all populations where data were available, but the Snoqualmie and Stillaguamish Rivers. For 17 of 22 DIPs across the DPS, the five-year average for the fraction of natural-origin steelhead spawners exceeded 0.75 from 2005 to 2009; this average was near 1.0 for 8 populations, where data were available, from 2010 to 2014 (NWFSC 2015). However, the fraction of natural-origin steelhead spawners could not be estimated for a substantial number of DIPs during the 2010 to 2014 period, or for the most recent 2015 – 2019 timeframe (NWFSC 2015; 2020). In some river

[11] Where intrinsic potential is the area of habitat suitable for steelhead rearing and spawning, at least under historical conditions (Puget Sound Steelhead Technical Recovery Team 2011; PSSTRT 2013).

systems, such as the Green River, Snohomish/Skykomish Rivers, and the Stillaguamish Rivers these estimates were higher than some guidelines recommend (e.g., no more than 5percent hatchery-origin spawners on spawning grounds for isolated hatchery programs (HSRG 2009) over the 2005-2009 and 2010-2014 timeframes. The draft NWFSC viability risk assessment (Ford, in press) states that a third of the 32 PS steelhead populations continue to lack monitoring and abundance data, and in most cases, it is likely that abundances are very low.

Early winter-run fish produced in isolated hatchery programs are derived from Chambers Creek stock in southern Puget Sound, which has been selected for early spawn timing, a trait known to be inheritable in salmonids.[12] Summer-run fish produced in isolated hatchery programs were historically derived from the Skamania River summer stock in the lower Columbia River Basin (i.e., from outside the DPS). The production and release of hatchery fish of both run types (winter and summer) may continue to pose risk to diversity in natural-origin steelhead in the DPS, as described in Hard et al. (2007) and Hard et al. (2015). However, the draft NWFSC viability risk assessment (Ford, in press) states that risks to natural-origin PS steelhead that may be attributable to hatchery-related effects has decreased since the 2015 status review due to reductions in production of non-listed stocks, and the replacement with localized stocks. The three summer steelhead programs continuing to propagate Skamania derived stocks from outside of Puget Sound should be phased out completely by 2031 (NMFS 2019c; Ford, in press). Lastly, annual reporting from the operators and current science suggest that risks remain at the same low to negligible levels as evaluated in 2016 and 2019 (NMFS 2016b; 2019c; 2019g; 2019h).

More information on PS steelhead spatial structure and diversity can be found in NMFS's PSSTRT viability report and NMFS's status review update on salmon and steelhead (NWFSC 2015) and recent viability risk assessment (Ford, in press).

Abundance and Productivity: The viability of the PS steelhead DPS has improved somewhat since the Puget Sound Steelhead TRT concluded that the DPS was at very low viability, as were all three of its constituent MPGs, and many of its 32 DIPs (Hard et al. 2015). Increases in spawner abundance have been observed in a number of populations over the last five years; however, these improvements were disproportionately found within the South and Central Puget Sound and Strait of Juan de Fuca and Hood Canal MPGs, and primarily among smaller populations. The recent positive trends among winter-run populations in the White, Nisqually, and Skokomish rivers improve the demographic risks facing those populations. The abundance, productivity, spatial structure, and diversity of Elwha River steelhead winter and summer-runs has dramatically improved following the removal of the Elwha River dams improved. Improvements in abundance have not been as widely observed in the Northern Puget Sound MPG. The declines of summer and winter-run populations in the Snohomish Basin are especially concerning. These populations figure prominently as sources of abundance for the MPG and DPS (NMFS 2019a). Additionally, the decline in the Tolt River summer-run steelhead population was especially alarming given that it is the only summer-run population for which we have abundance estimates. The demographic and diversity risks to the Tolt River summer-run DIP are very high. In fact, all summer-run steelhead populations in the North Cascades MPG are likely at a very high demographic risk. In spite of improvements in some areas, most populations

[12] The native-origin Chambers Creek steelhead stock is now extinct.

are still at relatively low abundance levels, with about a third of the DIPs unmonitored and presumably at very low levels (Ford, in press).

As described in the recovery plan, recovery targets were calculated using a two-tiered approach adjusting for years of low and high productivity (NMFS 2019a). Abundance information is unavailable for approximately one-third of the DIPs, disproportionately so for summer-run populations. In most cases where no information is available it is assumed that abundances are very low. Some population abundance estimates are only representative of part of the population (index reaches, etc.). Where recent five-year abundance information is available, 30 percent (6 of 20 populations) are less than 10 percent of their high productivity recovery targets (lower abundance target), 65 percent (13 of 20) are between 10 and 50 percent, and 5 percent (1 of 20) are greater than 50 percent of their low abundance targets (Table 6). A key element to achieving recovery is recovering a representative number of both winter- and summer-run steelhead populations, and the restoration of viable summer-run DIPs is a long-term endeavor (NMFS 2019a). Fortunately, the relatively rapid reestablishment of summer-run steelhead in the Elwha River does provide a model for potentially re-anadromizing summer-run steelhead sequestered behind impassable dams.

Table 6. Recent (2015-2019) 5-year geometric mean of raw wild spawner counts for Puget Sound steelhead populations and population groups compared with Puget Sound Steelhead Recovery Plan high and low productivity recovery targets (NMFS 2019). (SR) – Summer-run. Abundance is compared to the high productivity individual DIP targets. Colors indicate the relative proportion of the recovery target currently obtained: red (<10%), orange (10%>x<50%), yellow (50%>x<100%), green (>100%). "*" denotes an interim recovery target.

Major Population Group	Demographically Independent Population	Abundance (2015-2019)	Recovery Target	
			High Productivity	Low Productivity
Northern Cascades	Drayton Harbor Tributaries	N/A	1,100	3,700
	Nooksack River	1,906	6,500	21,700
	South Fork Nooksack River (SR)	N/A	400	1,300
	Samish River & Independent Tributaries	1,305	1,800	6,100
	Skagit River	7,181	15,000 *	
	Sauk River	N/A		
	Nookachamps River	N/A		
	Baker River	N/A		
	Stillaguamish River	487	7,000	23,400
	Canyon Creek (SR)	N/A	100	400
	Deer Creek (SR)	N/A	700	2,300
	Snohomish/Skykomish River	690	6,100	20,600
	Pilchuck River	638	2,500	8,200
	Snoqualmie River	500	3,400	11,400
	Tolt River (SR)	40	300	1,200
	North Fork Skykomish River (SR)	N/A	200	500
Central and South Sound	Cedar River	N/A	1,200	4,000
	North Lake Washington Tributaries	N/A	4,800	16,000
	Green River	1,282	5,600	18,700
	Puyallup/Carbon River	136	4,500	15,100
	White River	130	3,600	12,000
	Nisqually River	1,368	6,100	20,500
	East Kitsap Tributaries	N/A	2,600	8,700
	South Sound Tributaries	N/A	6,300	21,200
Strait of Juan de Fuca	Elwha River	1,241	2,619	
	Dungeness River	408	1,200	4,100
	Strait of Juan de Fuca Independent Tributaries	95	1,000	3,300
	Sequim and Discovery Bay Tributaries	N/A	500	1,700
	Skokomish River	958	2,200	7,300
	West Hood Canal Tributaries	150	2,500	8,400
	East Hood Canal Tributaries	93	1,800	6,200
	South Hook Canal Tributaries	91	2,100	7,100

There are a number of planned, ongoing, and completed actions that will likely benefit steelhead populations in the near term, but have not yet influenced adult abundance. Among these, the removal of the diversion dam on the Middle Fork Nooksack River, the Pilchuck Dam removal, passage improvements at Mud Mountain Dam, the ongoing passage program in the North Fork

Skokomish River, and the planned passage program at Howard Hanson Dam. Dam removal in the Elwha River, and the resurgence of the endemic winter and summer-run steelhead populations have underscored the benefits of restoring fish passage. The Elwha River scenario is somewhat unique in that upstream habitat is in pristine condition and smolts emigrate into the Strait of Juan de Fuca and not Puget Sound or Hood Canal.

Improvements in spatial structure can only be effective if done in concert with necessary improvements in habitat. Habitat restoration efforts are ongoing, but land development and habitat degradation concurrent with increasing human population in the Puget Sound corridor may results in a continuing net loss of habitat. Recovery efforts in conjunction with improved ocean and climatic conditions have resulted in improved viability status for the majority of populations in this DPS; however, absolute abundances are still low, especially summer-run populations, and the DPS remains at high to moderate risk of extinction. However, since 2015, fifteen of the 21 populations indicate small to substantive increases in abundance.[13] Nevertheless, most steelhead populations remain small. From 2015 to 2019, nine of the 21 steelhead populations had fewer than 250 natural spawners annually, and 12 of the 21 steelhead populations had 500 or fewer natural spawners (Table 7).

[13] Nooksack River, Samish River/Bellingham Bays Tributaries, Skagit River, Stillaguamish River, Pilchuck River, Cedar River, Green River, Puyallup River, Nisqually River, White River, S. Hood Canal, Eastside Hood Canal Tributaries, Westside Hood Canal Tributaries, Skokomish River and Elwha River winter-run populations. The Skagit River and Elwha River summer-run steelhead are also showing increasing trends (Ford, in press).

Table 7. Five-year geometric mean of raw natural spawner counts for Puget Sound steelhead. This is the raw total spawner count times the fraction natural estimate, if available. Percent change between the most recent two 5-year periods is shown on the far right. (W=winter run; S=summer run).

Biogeographic Region	Population	2010-2014	2015-2019	Population trend (% Change)
North Cascades	Samish R./ Bellingham Bay Tribs. (W)	748	1305	Positive (74)
	Nooksack R. (W)	1745	1906	Positive (9)
	Skagit R. (S and W)	6391	7181	Positive (12)
	Stillaguamish R. (W)	386	487	Positive (26)
	Snohomish/ Skykomish R. (W)	975	690	Negative (-29)
	Pilchuck R. (W)	626	638	Positive (2)
	Snoqualmie R. (W)	706	500	Negative (-29)
	Tolt R. (S)	108	40	Negative (-63)
Central/South Puget Sound Basin	N. Lake WA Tribs. (W)	-	-	-
	Cedar R. (W)	4	6	Positive (50)
	Green R. (W)	662	1289	Positive (95)
	White R. (W)	514	451	Negative (-12)
	Puyallup R. (W)	85	201	Positive (136)
	Carbon R. (W)	(290)	(735)	Positive (153)
	Nisqually R. (W)	477	1368	Positive (187)
Hood Canal/Strait of Juan de Fuca	S. Hood Canal (W)	69	91	Positive (32)
	Eastside Hood Canal Tribs (W)	60	93	Positive (55)
	Skokomish R. (W)	533	958	Positive (80)
	Westside Hood Canal Tribs (W)	138	150	Positive (9)
	Dungeness R. (S and W)	517	448	Negative (-13)
	Strait of Juan de Fuca Independents (W)	151	95	Negative (-37)
	Elwha R. (W)	680	1241	Positive (82)

Limiting factors. In our 2013 proposed rule designating critical habitat for this species (USDC 2013), we noted that the following factors for decline for PS steelhead persist as limiting factors:

- The continued destruction and modification of steelhead habitat
- Widespread declines in adult abundance (total run size), despite significant reductions in harvest in recent years
- Threats to diversity posed by use of two hatchery steelhead stocks (Chambers Creek and Skamania)

- Declining diversity in the DPS, including the uncertain but weak status of summer run fish
- A reduction in spatial structure
- Reduced habitat quality through changes in river hydrology, temperature profile, downstream gravel recruitment, and reduced movement of large woody debris
- In the lower reaches of many rivers and their tributaries in Puget Sound where urban development has occurred, increased flood frequency and peak flows during storms and reduced groundwater-driven summer flows, with resultant gravel scour, bank erosion, and sediment deposition
- Dikes, hardening of banks with riprap, and channelization, which have reduced river braiding and sinuosity, increasing the likelihood of gravel scour and dislocation of rearing juveniles

<u>PS steelhead Recovery Plan</u>: Juvenile Puget Sound steelhead are less dependent on nearshore habitats for early marine rearing than Chinook or Chum salmon; nevertheless, nearshore, estuarine, and shoreline habitats provide important features necessary for the recovery of steelhead. Puget Sound steelhead spend only a few days to a few weeks migrating through the large fjord, but mortality rates during this life stage are critically high (Moore et al. 2010; Moore and Berejikian 2017). Early marine mortality of Puget Sound steelhead is recognized as a primary limitation to the species' survival and recovery (NMFS 2019a). Factors in the marine environment influencing steelhead survival include predation, access to prey (primarily forage fish), contaminants (toxics), disease and parasites, migration obstructions (e.g., the Hood Canal bridge), and degraded habitat conditions which exacerbate these factors.

The PS steelhead recovery plan identifies ten ecological concerns that directly impact salmon and steelhead:

- Habitat quantity (anthropogenic barriers, natural barriers, competition);
- Injury and mortality (predation, pathogens, mechanical injury, contaminated food);
- Food (altered primary productivity, food-competition, altered prey species composition and diversity);
- Riparian condition (riparian condition, large wood recruitment);
- Peripheral and transitional habitats (side channel and wetland condition, estuary conditions, nearshore conditions);
- Channel structure and form (bed and channel form, instream structural complexity);
- Sediment conditions (decreased sediment quantity, increased sediment quantity);
- Water quality (temperature, oxygen, gas saturation, turbidity, pH, salinity, toxic contaminants);
- Water quantity (increased water quantity, decreased water quantity, altered flow timing); and
- Population-level effects (reduced genetic adaptiveness, small population effects, demographic changes, life history changes).

The Puget Sound steelhead recovery plan and its associated appendix 3 includes specific recovery actions for the marine environment. General protection and restoration actions summarized from the plan include:

- Continue to improve the assessments of harbor seal predation rates on juvenile steelhead;
- Remove docks and floats which act as artificial haul-out sites for seals and sea lions;
- Consistent with the MMPA, test acoustic deterrents and other hazing techniques to reduce steelhead predation from harbor seals;
- Develop non-lethal actions for "problem animals and locations" to deter predation;
- Increase forage fish habitat to increase abundance of steelhead prey;
- Remove bulkheads and other shoreline armoring to increase forage fish;
- Acquire important forage fish habitat to protect high forage fish production areas;
- Add beach wrack to increase forage fish egg survival;
- Protect and restore aquatic vegetation (e.g., eelgrass and kelp);
- Remove creosote pilings to reduce mortality of herring eggs;
- Increase the assessment of migratory blockages, especially the Hood Canal bridge, where differential mortality has been documented;
- Identify and remedy sources of watershed chemical contaminants (e.g., PBDEs and PCBs).

Status of Puget Sound Georgia Basin Rockfish

NMFS adopted a recovery plan for both PS/GB bocaccio and yelloweye rockfish in 2017. There are no estimates of historic or present-day abundance of yelloweye rockfish, or PS/GB bocaccio across the full DPSs area. In 2013, the WDFW published abundance estimates from a remotely operated vehicle survey conducted in 2008 in the San Juan Island area (Pacunski et al. 2013). This survey was conducted exclusively within rocky habitats and represents the best available abundance estimates to date for one basin of the DPS. The survey produced estimates of 47,407 (25 percent variance) yelloweye rockfish, and 4,606 (100 percent variance) PS/GB bocaccio in the San Juan area (Tonnes et al. 2016). Though the WDFW has produced other ROV-based estimates of rockfish biomass in Washington waters of the DPSs, none have both covered the entirety of the DPSs and had sufficient sample size to accurately estimate population size for rare species, such as yelloweye rockfish and bocaccio.

Using several available, but spatiotemporally patchy, data series on rockfish occurrence and abundance in Puget Sound, Tolimieri et al. (2017) determined that total rockfish declined at a rate of 3.1 to 3.8 percent per year from 1977 to 2014 or a 69 to 76 percent total decline over that period. The two listed DPSs declined over-proportional compared to the total rockfish assemblage. Therefore, long-term population growth rate for the listed species was likely even lower (more negative) than that for total rockfish. While there is little to no evidence of recent recovery of total groundfish abundance in response to protective measures enacted over the last 25 years (Essington et al. 2013; 2021; van Duivenbode 2018), increases in the prevalence of several life stages of the more common rockfish species have been observed (Pacunski et al. 2020; LeClair et al. 2018). Given the slow maturation rate, episodic recruitment success, and rarity of yelloweye rockfish and bocaccio, combined with targeted fisheries being closed for over a decade, insufficient data exist to assess the recent recovery trajectory of these species.

Mature females of each listed species produce from several thousand to over a million eggs annually (Love et al. 2002). In rockfish the number of embryos produced by the female increases with size. For example, female copper rockfish that are 20 cm in length produce 5,000 eggs while a female 50 cm in length may produce 700,000 eggs (Palsson et al. 2009). These specific observations come from other rockfish, not the two listed species. However, the generality of maternal effects in *Sebastes spp*. suggests that some level of age or size influence on reproduction is likely for all species (Haldorson and Love 1991).

Larval rockfish rely on nearshore habitat. The nearshore is generally defined as habitats contiguous with the shoreline from extreme high water out to a depth no greater than 98 feet (30 m) relative to mean lower low water. This area generally coincides with the maximum depth of the photic zone and can contain physical or biological features essential to the conservation of many fish and invertebrate species, including PS/GB bocaccio. Approximately 27 percent of Puget Sound's shoreline has been modified by armoring (Simenstad et al. 2011). Nearshore habitats throughout the greater Puget Sound region have been affected by a variety of human activities, including agriculture, heavy industry, timber harvest, and the development of sea ports and residential property (Drake et al. 2010).

Juvenile yelloweye rockfish are not typically found in intertidal waters (Love et al. 1991; Studebaker et al. 2009). A few juveniles have been documented in shallow nearshore waters (Love et al. 2002; Palsson et al. 2009), but most settle in habitats along the shallow range of adult habitats in areas of complex bathymetry and rocky/boulder habitats and cloud sponges in waters greater than 98 feet (30 m) (Richards 1986; Love et al. 2002; Yamanaka et al. 2006). In British Columbia, juvenile yelloweye rockfish have been observed at a mean depth of 239 feet (73 m), with a minimum depth of 98 feet (30 m) (Yamanaka et al. 2006). Juvenile yelloweye rockfish occur in similar habitats as adults, though in areas with smaller crevices, including cloud sponge formations, crinoid aggregations on top of rocky ridges, and over cobble substrates (Weispfenning 2006; Yamanaka et al. 2006; Banks 2007).

Young-of-year juvenile bocaccio occur on shallow rocky reefs and nearshore areas (Moser 1967; Anderson 1983; Kendall and Lenarz 1986; Carr 1991; Love et al. 1991; Love 1996; Murphy et al. 2000; Love et al. 2002). Young bocaccio associate with macroalgae, especially kelps (*Laminariales*), and sandy areas that support seagrasses. They form aggregations near the bottom in association with drift algae and throughout the water column in association with canopy-forming kelps. It is likely that nearshore habitats used by juvenile bocaccio and other rockfish juveniles offer a beneficial mix of warmer temperatures, food, and refuge from predators (Love et al. 1991). Habitat formed by kelp provides structure for feeding, refuge from predators, and reduced currents that enable energy conservation for juvenile bocaccio. Juvenile bocaccio are exceptionally rare in greater Puget Sound, casting some doubt on whether the current population is capable of reproducing at a rate sufficient to support recovery (Palsson et al. 2009; Drake et al. 2010; NMFS 2017a).

The alteration of Puget Sound shorelines has been found to impact a variety of marine life, ranging from invertebrate fauna (Sobocinski 2003) to surf smelt egg viability (Rice 2006), but consequences of the alteration of Puget Sound shorelines on rockfish habitat such as kelp are less understood. Some areas around Puget Sound have shown a large decrease in kelp. Areas with floating and submerged kelp (families *Chordaceae*, *Alariaceae*, *Lessoniacea*, *Costariaceae*, and *Laminaricea*) support the highest densities of most juvenile rockfish species (Matthews 1989;

Halderson and Richards 1987; Carr 1983; Hayden-Spear 2006). Kelp habitat provides structure for feeding, predation refuge, and reduced currents that enable energy conservation for juveniles. Although loss of nearshore habitat quality is a threat to rockfish, the recovery plan for this species list the severity of this threat as low (NMFS 2017a). As such, the recovery plan lists the severity of this threat as very low in Canada, low in the San Juan Islands, moderate in Hood Canal, and high in the Main Basin and South Sound (NMFS 2017a).

A study of rockfish in Puget Sound found that larval rockfish appeared to occur in two peaks (early spring, late summer) that coincide with the main primary production peaks in Puget Sound. Both measures indicated that rockfish ichthyoplankton essentially disappeared from the surface waters by the beginning of November. Densities also tended to be lower in the more northerly basins (Whidbey and Rosario), compared to the Central and South Sound (Greene and Godersky 2012).

The U.S. portion of the Puget Sound/Georgia Basin that is occupied by yelloweye rockfish and PS/GB bocaccio can be divided into five areas, or Basins, based on the distribution of each species, geographic conditions, and habitat features. These five interconnected Basins are: (1) The San Juan/Strait of Juan de Fuca Basin, (2) Main Basin, (3) Whidbey Basin, (4) South Puget Sound, and (5) Hood Canal. See 79 FR 68041, Nov. 13, 2014 (Puget Sound/Georgia Basin Distinct Population Segments of yelloweye rockfish, Canary rockfish and Bocaccio; Designation of Critical Habitat).

Status of 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 2017a). Though PS/GB bocaccio were never a predominant segment of the multi-species rockfish population within the Puget Sound/Georgia Basin, their present-day abundance is likely a fraction of their pre-contemporary fishery abundance. Most PS/GB bocaccio within the DPS may have been historically spatially limited to several basins within the DPS. They were apparently historically most abundant in the Central and South Sound with no documented occurrences in the San Juan Basin until 2008 (Pacunski et al. 2013). The apparent reduction of populations of PS/GB bocaccio in the Main Basin and South Sound represents a further reduction in the historically spatially limited distribution of PS/GB bocaccio, and adds significant risk to the viability of the DPS (Tonnes et al. 2016).

The VSP criteria described by McElhaney et al. (2000), and summarized 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.

General Life History: The life history of PS/GB bocaccio includes a larval/pelagic juvenile stage that is followed by a juvenile stage, and subadult and adult stages. As with other rockfish, PS/GB 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 2017a; 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). Recent modeling of passive particles serving as larval rockfish analogs, however, has demonstrated that this assumption can be substantially violated under certain conditions, resulting in larval transport among basins as well out both into and out of the DPS (Andrews et al. 2020).

At about 3 to 6 months old and 1.2 to 3.6 inches (3 to 9 cm) long, juvenile PS/GB bocaccio gravitate to shallow nearshore waters where they settle and grow. 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 and 2002; Matthews 1989; NMFS 2017a; 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 PS/GB 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 PS/GB bocaccio is unknown, but may exceed 50 years, and they reach reproductive maturity near age six.

Spatial Structure and Diversity: 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. Research intended to assess this assumption using genetic techniques was unable to collect sufficient samples for analysis (Andrews et al. 2018), but is ongoing.

Abundance and Productivity: 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 PS/GB 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 PS/GB bocaccio have declined by an even greater extent (Drake et al. 2010; Tonnes et al. 2016; NMFS 2017a).

Limiting Factors: 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

Yelloweye Rockfish

Spatial Structure: PS/GB yelloweye rockfish occupy the waters of the Pacific coast from California to Alaska. Yelloweye rockfish in the waters of the Puget Sound/Georgia Basin were determined to be a Distinct Population Segment (DPS) (75 Fed. Reg. 22276). The Puget Sound/Georgia Basin DPS of yelloweye rockfish was listed as "threatened" under the ESA on April 28, 2010 (75 FR 22276). The DPSs include all yelloweye rockfish a found in waters of Puget Sound, the Strait of Georgia, and the Strait of Juan de Fuca east of Victoria Sill.

Diversity: New collection and analysis of PS/GB yelloweye rockfish tissue samples reveal significant genetic differentiation between the inland (DPS) and coastal samples. These new data are consistent with and further support the existence of a population of Puget Sound/Georgia Basin yelloweye rockfish that is discrete from coastal populations (Ford 2015; Tonnes et al. 2016). In addition, yelloweye rockfish from Hood Canal were genetically differentiated from other Puget Sound/Georgia Basin yelloweye rockfish, indicating a previously unknown degree of population differentiation within the DPS (Ford 2015; Tonnes et al. 2016). Other genetic analysis has found that yelloweye rockfish in the Georgia Basin had the lowest molecular genetic diversity of a collection of samples along the coast (Siegle et al. 2013). Although the adaptive significance of such microsatellite diversity is unclear, it may suggest low effective population size, increased drift, and thus lower genetic diversity in the PS/GB DPS.

Abundance: Yelloweye rockfish within the Puget Sound/Georgia Basin (in U.S. waters) are very likely the most abundant within the San Juan Basin of the DPS. Yelloweye rockfish spatial structure and connectivity is threatened by the apparent reduction of fish within each of the basins of the DPS. This reduction is probably most acute within the basins of Puget Sound proper. The severe reduction of fish in these basins may eventually result in a contraction of the DPS' range. Recent research has found evidence for two populations of yelloweye rockfish within the DPS—one in Hood Canal and one within the rest of the Puget Sound/Georgia Basin.

In Puget Sound, catches of PS/GB yelloweye rockfish have declined as a proportion of the overall rockfish catch (Figure 2 and Figure 3, from Drake et al. 2010). Analysis of SCUBA surveys, recreational catch, and WDFW trawl surveys indicated total rockfish populations in the Puget Sound region are estimated to have declined between 3.1 and 3.8 percent per year for the past several decades, which corresponds to a 69 to 76 percent decline from 1977 to 2014 (Tonnes et al. 2016)

Productivity: Life history traits of yelloweye rockfish and PS/GB bocaccio suggest generally low levels of inherent productivity because they are long-lived, mature slowly, and have sporadic episodes of successful reproduction (Musick 1999; Tolimieri and Levin 2005). Yelloweye rockfish productivity may also be impacted by an Allee effect. This situation arises when reproductive adults are removed from the population and remaining individuals are eventually unable to encounter mates. This process then further reduces population density and can lead to extinction. Adult PS/GB yelloweye rockfish typically occupy relatively small ranges (Love et al. 2002), and the extent to which they may move to find suitable mates is unknown. However, there is insufficient information to determine that this is currently occurring for yelloweye rockfish and further research is needed (Hutchings and Reynolds 2004).

2.2.2 Status of Critical Habitats

This section examines the status of designated critical habitat affected by the proposed action by examining the condition and trends of essential physical and biological features (PFBs) throughout the designated areas. Critical habitat expected to be adversely affected by the proposed action in the action area includes PS Chinook salmon. PS steelhead critical habitat is not designated within the action area and the magnitude of the action's effects on PS Chinook salmon is not expected to translate to measurable effects to SRKW critical habitat PBFs (effects to PS Chinook salmon discussed in section 2.3.5). As described previously (section 1.3.1) PS/GB rockfish critical habitat that overlaps with the open water disposal site was evaluated in a 2015 NMFS Biological Opinion and is considered as part of the environmental baseline for the purposes of this Opinion.

Based on the natural history of PS/GB bocaccio and their habitat needs, NMFS identified two physical or biological features, essential for their conservation: (1) Deepwater sites (>30 meters) that support growth, survival, reproduction, and feeding opportunities; and (2) Nearshore juvenile rearing sites with sand, rock and/or cobbles to support forage and refuge. NMFS has determined that there are no effects to rockfish critical habitat in the action area in deep-water habitats that are not already addressed by the 2015 opinion (NMFS 2015). Critical habitat features associated with nearshore juvenile rearing are not present in the action area.

Salmon and Steelhead Critical Habitat

For salmon and steelhead, NMFS ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC5) in terms of the conservation value they provide to each listed species they support. The conservation rankings are high, medium, or low. To determine the conservation value of each watershed to species viability, NMFS's critical habitat analytical review teams (CHARTs) evaluated the quantity and quality of habitat features (for example, spawning gravels, wood and water condition, side channels), the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area (NOAA Fisheries 2005). Thus, even a location that has poor quality of habitat could be ranked with a high conservation value if it were essential due to factors such as limited availability (e.g., one of a very few spawning areas), a unique contribution of the population it served (e.g., a population at the extreme end of geographic distribution), or if it serves another important role (e.g., obligate area for migration to upstream spawning areas).

The physical or biological features of nearshore marine areas that would be affected by the proposed action include, ample forage, areas free of artificial obstructions, sufficient natural cover, and adequate water quality and quantity to support adult growth, sexual maturation, and migration as well as nearshore juvenile rearing. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow juvenile fish to grow and mature before migrating to the ocean.

<u>CHART Salmon and Steelhead Critical Habitat Assessments</u>: The CHART for each recovery domain assessed biological information pertaining to occupied habitat by listed salmon and steelhead, determine whether those areas contained PCEs essential for the conservation of those species and whether unoccupied areas existed within the historical range of the listed salmon and steelhead that are also essential for conservation. The CHARTs assigned a 0- to 3-point score for the PCEs in each HUC5 watershed for:

- Factor 1: Quantity,
- Factor 2: Quality—Current Condition,
- Factor 3: Quality—Potential Condition,
- Factor 4: Support of Rarity Importance,
- Factor 5: Support of Abundant Populations, and
- Factor 6: Support of Spawning/Rearing.

Thus, the quality of habitat in a given watershed was characterized by the scores for Factor 2 (quality—current condition), which considers the existing condition of the quality of PCEs in the HUC5 watershed; and Factor 3 (quality—potential condition), which considers the likelihood of achieving PCE potential in the HUC5 watershed, either naturally or through active conservation/restoration, given known limiting factors, likely biophysical responses, and feasibility.

<u>Puget Sound Recovery Domain</u>: Critical habitat has been designated in Puget Sound for PS Chinook salmon, PS steelhead, and Hood Canal Summer Run chum salmon (HCSRC). 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 for PS Chinook salmon was designated on September 2, 2005 (70 FR 52630). Critical habitat includes 1,683 miles of streams, 41 square mile of lakes, and 2,182 miles of nearshore marine habitat in Puget Sounds. The Puget Sound Chinook salmon ESU has 61 freshwater and 19 marine areas within its range. Of the freshwater watersheds, 41 are rated high conservation value, 12 low conservation value, and eight received a medium rating. Of the marine areas, all 19 are ranked with high conservation value.

Critical habitat for PS steelhead was designated on February 24, 2016 (81 FR 9252). Critical habitat includes 2,031 stream miles. Nearshore and offshore marine waters were not designated for this species. There are 66 watersheds within the range of this DPS. Nine watersheds received a low conservation value rating, 16 received a medium rating, and 41 received a high rating to the DPS. Critical habitat for PS steelhead includes freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors.

Critical habitat is designated for PS Chinook salmon in estuarine and nearshore areas. Designated critical habitat for PS steelhead does not include nearshore areas, as this species does not make extensive use of these areas during juvenile life stage.

The following discussion is general to salmon and steelhead critical habitat in the Puget Sound basin. More specific information for each individual species' critical habitat is presented after the general discussion.

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

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

Loss of riparian habitat, elevated water temperatures, elevated levels of nutrients, increased nitrogen and phosphorus, and higher levels of turbidity, 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. 1996). Recent studies have shown that coho salmon show high rates of pre-spawning mortality when exposed to chemicals that leach from tires (McIntyre et al. 2015). Researchers have recently identified a tire rubber antioxidant as the cause (Tian et al. 2020). Although Chinook salmon did not experience the same level of mortality, tire leachate is still a concern for all salmonids. Traffic residue also contains many unregulated toxic chemicals such as pharmaceuticals, polycyclic aromatic hydrocarbons (PAHs), fire retardants, and emissions that have been linked to deformities, injury and/or death of salmonids and other fish (Trudeau 2017; Young et al. 2018).

Dams constructed for hydropower generation, irrigation, or flood control have substantially affected PS salmon and steelhead 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 large wood to downstream areas (SSPS 2007). These actions tend to promote downstream channel incision and simplification (Kondolf 1997), limiting fish habitat. Water withdrawals reduce available fish habitat and alter sediment transport. Hydropower projects often change flow rates, stranding and killing fish, and reducing aquatic invertebrate (food source) productivity (Hunter 1992).

Juvenile mortality occurs in unscreened or inadequately screened diversions. Water diversion ditches resemble side channels in which juvenile salmonids normally find refuge. When diversion 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 (WDFW 2009). 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).

In summary, critical habitat for salmon and steelhead throughout the Puget Sound basin has been degraded by numerous management activities, including hydropower development, loss of mature riparian forests, increased sediment inputs, removal of large wood, 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 in areas of critical habitat. As mentioned above, development of shoreline and estuary areas of Puget Sound is expected to continue to adversely impact the quality of marine habitat for PS salmonids. Projected changes in nearshore and estuary development based on documented rates of developed land cover change in Bartz et al. (2015) show that between 2008 and 2060, an additional 14.7 hectares of development of shoreline areas and 204 hectares of estuary development can be expected.

Chinook salmon critical habitat
The PS recovery domain CHART for PS Chinook salmon (NOAA Fisheries 2005) determined that only a few watersheds with PCEs for Chinook salmon in the Whidbey Basin (Skagit River/Gorge Lake, Cascade River, Upper Sauk River, and the Tye and Beckler rivers) are in good-to-excellent condition with no potential for improvement. Most HUC5 watersheds are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some or a high potential for improvement (Table 8).

Table 8. Puget Sound Recovery Domain: Current and potential quality of HUC5 watersheds identified as supporting historically independent populations of ESA-listed Chinook salmon and Hood Canal summer-run chum salmon (NOAA Fisheries 2005). Watersheds are ranked primarily by "current quality" and secondly by their "potential for restoration."

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC$_5$ Code(s)	Listed Species	Current Quality	Restoration Potential
Strait of Georgia and Whidbey Basin #1711000xxx			
Skagit River/Gorge Lake (504), Cascade (506) & Upper Sauk (601) rivers, Tye & Beckler rivers (901)	CK	3	3
Skykomish River Forks (902)	CK	3	1
Skagit River/Diobsud (505), Illabot (507), & Middle Skagit/Finney Creek (701) creeks; & Sultan River (904)	CK	2	3
Skykomish River/Wallace River (903) & Skykomish River/Woods Creek (905)	CK	2	2
Upper (602) & Lower (603) Suiattle rivers, Lower Sauk (604), & South Fork Stillaguamish (802) rivers	CK	2	1
Samish River (202), Upper North (401), Middle (402), South (403), Lower North (404), Nooksack River; Nooksack River (405), Lower Skagit/Nookachamps Creek (702) & North Fork (801) & Lower (803) Stillaguamish River	CK	1	2
Bellingham (201) & Birch (204) bays & Baker River (508)	CK	1	1
Whidbey Basin and Central/South Basin #1711001xxx			
Lower Snoqualmie River (004), Snohomish (102), Upper White (401) & Carbon (403) rivers	CK	2	2
Middle Fork Snoqualmie (003) & Cedar rivers (201), Lake Sammamish (202), Middle Green River (302) & Lowland Nisqually (503)	CK	2	1
Pilchuck (101), Upper Green (301), Lower White (402), & Upper Puyallup River (404) rivers, & Mashel/Ohop(502)	CK	1	2
Lake Washington (203), Sammamish (204) & Lower Green (303) rivers	CK	1	1
Puyallup River (405)	CK	0	2
Hood Canal #1711001xxx			
Dosewallips River (805)	CK/CM	2	1/2
Kitsap – Kennedy/Goldsborough (900)	CK	2	1
Hamma River (803)	CK/CM	1/2	1/2
Lower West Hood Canal Frontal (802)	CK/CM	0/2	0/1
Skokomish River (701)	CK/CM	1/0	2/1
Duckabush River (804)	CK/CM	1	2
Upper West Hood Canal Frontal (807)	CM	1	2
Big Quilcene River (806)	CK/CM	1	1/2
Deschutes Prairie-1 (601) & Prairie-2 (602)	CK	1	1
West Kitsap (808)	CK/CM	1	1
Kitsap – Prairie-3 (902)	CK	1	1
Port Ludlow/Chimacum Creek (908)	CM	1	1
Kitsap – Puget (901)	CK	0	1
Kitsap – Puget Sound/East Passage (904)	CK	0	0
Strait of Juan de Fuca Olympic #1711002xxx			
Dungeness River (003)	CK/CM	2/1	1/2
Discovery Bay (001) & Sequim Bay (002)	CM	1	2
Elwha River (007)	CK	1	2
Port Angeles Harbor (004)	CK	1	1

As mentioned previously, numerous factors have led to the decline of PS Chinook salmon including overharvest, freshwater and marine habitat loss, hydropower development, and hatchery practices, as mentioned in Section 2.2.1, above. Adjustments can, and have been made in the short term to ameliorate some of the factors for decline. Harvest can be adjusted on yearly or even in-season basis. Since PS Chinook salmon were listed, harvest in state and federal fisheries has been reduced in an effort to increase the number of adults returning to spawning grounds. Likewise, hatchery management can, and has been adjusted relatively quickly when practices are detrimental to listed species. To address needed improvements in hydropower, NMFS has issued biological opinions with reasonable and prudent alternatives to improve fish passage at existing hydropower facilities. Unlike the other factors, however, loss of critical habitat quality is much more difficult to address in the short term. Once human development causes loss of critical habitat quality, that loss tends to persist for decades or longer. The condition of critical habitat will improve only through active restoration or natural recovery following the removal of human infrastructure. As noted throughout this Opinion, future effects of climate change on habitat quality throughout Puget Sound are expected to be negative.

Habitat utilization by Chinook salmon and steelhead in the Puget Sound area has been historically limited by large dams and other manmade barriers in a number of drainages, including the Nooksack, Skagit, White, Nisqually, Skokomish, and Elwha river basins (Appendix B in NMFS (2015a)). In addition to limiting habitat accessibility, dams affect habitat quality through changes in river hydrology, altered temperature profile, reduced downstream gravel recruitment, and the reduced recruitment of large woody debris. Such changes can have significant negative impacts on salmonids (e.g., increased water temperatures resulting in decreased disease resistance) (Spence et al. 1996; McCullough 1999). However, over the past several years modifications have occurred to existing barriers, which have reduced the number of basins with limited anadromous access to historical habitat. The completion of the Elwha and Glines Canyon Dam removals occurred in 2014. The response of fish populations to this action is still being evaluated. It is clear; however, that Chinook salmon and steelhead are accessing much of this newly available habitat. Passage operations have begun on the North Fork Skokomish River to reintroduce steelhead above Cushman Dam, although juvenile collection efficiency is still relatively low, and further improvements are anticipated. Similarly, improvements in the adult fish collection facility at Mud Mountain Dam (White River basin) are near completion, with the expectation that improvements in adult survival will facilitate better utilization of habitat above the dam (NMFS 2014b). The recent removal of the diversion dam on the Middle Fork Nooksack Dam (16 July 2020) and the Pilchuck River Dam (late 2020) will provide access to important headwater salmonid spawning and rearing habitats. Similarly, the proposed modification of Howard Hanson Dam for upstream fish passage and downstream juvenile collection in the longer term (NMFS 2019f) will allow winter steelhead to return to historical habitat (Ford, in press).

2.3 Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

2.3.1 Current Status of Puget Sound

Puget Sound can be generally described as nearshore and deep-water areas. NMFS has identified the several nearshore and deep water physical or biological features essential to conservation for salmonids, and rockfish in Section 2.2.2.

The nearshore is the zone where marine water, fresh water, and terrestrial landscapes interact in a complex mosaic of habitats and processes. The nearshore encompasses the shoreline from the top of the upland bank or bluff on the landward side down to the depth of water that light can penetrate and where plants can photosynthesize (photic zone). The upper extent of the nearshore covers the terrestrial upland that contributes sediment, shade, organic material like leaf litter, and even the insects that fish eat. The lower range of the photic zone depends on water clarity; in Puget Sound, underwater vegetation can be found to depths of 30 to 100 feet below Mean Lower Low Water (MLLW) (Williams and Thom 2001). The nearshore includes a variety of environments: marine shallows, eelgrass meadows, kelp forests, mudflats, beaches, salt marshes, rocky shores, river deltas, estuaries, barrier islands, spits, marine riparian zones, and bluffs. This wide range of habitats supports many species. The nearshore forms the basis for the biologic productivity of the Puget Sound basin. Shoreline modification can cause fragmentation of the landscape that disrupts connectivity and reduces the productivity and biological diversity of Puget Sound watersheds. These impacts leave ecosystems less resilient.

Throughout Puget Sound, the nearshore areas have been modified by human activity, disrupting the physical, biological, and chemical interactions that are vital for creating and sustaining the diverse ecosystems of Puget Sound. There are approximately 503,106 acres of overwater structure in the nearshore of Puget Sound (Schlenger et al. 2011). Currently, 27 percent of Puget Sound's shorelines are armored (Simenstad et al. 2011; Meyer el al. 2010). The shoreline modifications are usually intended for erosion control, flood protection, sediment management, or for commercial, navigational, and recreational uses. Seventy-four percent of shoreline modification in Puget Sound consists of shoreline armoring (Simenstad et al. 2011), which usually refers to bulkheads, seawalls, or groins made of rock, concrete, or wood. Other modifications include jetties and breakwaters designed to dissipate wave energy, and structures such as tide gates, dikes, and marinas, overwater structures, including bridges for railways, roads, causeways, and artificial fill. An analysis conducted in 2011 though the Puget Sound Nearshore Ecosystem Restoration Project (Fresh et al, 2011; Simenstad et al 2011) found that since 1850, of the approximately 2,470 miles of Puget Sound shoreline:

- Shoreline armoring has been installed on 27 percent of Puget Sound shores (Table 9).
- One-third of bluff-backed beaches are armored along half their length. Roads and nearshore fill have each affected about 10 percent of the length of bluff-backed beaches.
- Forty percent of Puget Sound shorelines have some type of structure that impacts habitat quality (shoreline armoring included).

- Overwater structures cover more than 506,103 acres of Puget Sound nearshore habitat
- There has been a 93 percent loss of freshwater tidal and brackish marshes. The Duwamish and Puyallup rivers have lost nearly all of this type of habitat.
- A net decline in shoreline length of 15 percent as the naturally convoluted and complex shorelines were straightened and simplified. This represents a loss of 1,062 km or 660 miles of overall shoreline length.
- Elimination of small coastal embayments has led to a decline of 46 percent in shoreline length in these areas.
- A 27 percent decline in shoreline length in the deltas of the 16 largest rivers and a 56 percent loss of tidal wetlands in the deltas of these rivers.

The distribution and sizes of over water structures (OWS) in the nearshore[14] are detailed further in Schlenger et al. (2011) and (Simenstad et al. 2011).

Table 9. Length of shoreline armored as a percent of total shoreline length (Simenstad et al. 2011) by marine basin (Beechie et al. 2017).

Marine Basin	Armoring (miles)	Shoreline Length (miles)	Percent Armored
Hood Canal	63.9	359.7	17.7%
North Puget Sound	103.3	720.4	14.3%
South Central Puget Sound	397.0	832.6	47.7%
Strait of Juan de Fuca	33.0	210.3	15.7%
Whidbey Basin	68.3	343.4	19.9%
Grand Total	**665.3**	**2466.3**	**27.0%**

Puget Sound nearshore and deep marine waters are fundamental to many life histories of salmon and steelhead and particularly crucial for PS Chinook salmon juvenile (parr, fry, sub-yearling), and sub adult life stages. Juvenile salmon use nearshore habitat extensively during the early marine period (Duffy et al. 2005), a critical time for salmon growth, as larger, faster-growing fish have increased probabilities of surviving to adulthood (Beamish et al. 2004; Duffy and Beauchamp 2011). As mentioned in section 2.2.1 above, the loss of nearshore habitat is considered a factor in the loss of PS Chinook salmon abundance and productivity. Reduction in nearshore habitat quality has reduced survival at multiple life stages. Marine survival rates of PS Chinook salmon in Puget Sound have declined drastically since 1980 (Ruggerone and Goetz 2004, Sharma et al. 2012, Ruff et al. 2017). Smolt-to-adult survival rates for hatchery-reared sub-yearling Chinook salmon within Puget Sound have averaged less than one percent over the past three decades (Kilduff et al. 2014).
There is also evidence that loss of nearshore habitat quality may be eliminating PS Chinook salmon life history strategies that make use of nearshore areas during the early life stages.

[14] The nearshore area includes the area from the deepest part of the photic zone (approximately 10 meters below Mean Lower Low Water [MLLW]) landward to the top of shoreline bluffs, or in estuaries upstream to the head of tidal influence (Clancy et al. 2009).

Campbell et al. (2017) found less than three percent of adults returning to the Green and Puyallup Rivers to exhibit the fry migrant life history concurrent with approximately 95 percent of their estuary habitat having been eliminated. The converse was true from the Skagit and Nooksack estuaries where approximately 50 percent of the estuary remained in a natural state (Beechie et al. 2017) and 36 and 24 percent of the adult population we examined returned from small fry sized fish, respectively.

From 2005 to 2011, in Puget Sound an average of 1.1 miles per year of new shoreline armoring was permitted in and 2.3 miles per year of replacement armoring was permitted (Johannessen et al. 2014). These figures do not include unpermitted structures, which can exceed those constructed with permits. For example, in the Green/Duwamish River Watershed (Water Resources Inventory Area 9), permitted structures comprised only 38 percent of all the armoring physically surveyed in 2012 and 2013 (King County 2014).

Residential parcels make up 57 percent of Puget Sound shorelines and 48 percent of these are armored. In some areas, armoring is even more prevalent: more than 50 percent of the residential parcels are armored in King, Kitsap, Pierce, Snohomish, Mason, and Thurston counties. Overall, 26 percent of residential parcels are in forage fish spawning grounds and 58 percent of those are armored (PSMNGP 2014). In a survey of HPAs issued by WDFW in Puget Sound between January 2005 and December 2010 the data recorded the installation of 6.5 miles of new armor and 14.45 miles of replacement armor. This starkly contrasts with data from that same time period that shows only 0.61 miles of armor were removed (Carman et al 2011). More recent studies have suggested a less dramatic rate of new armoring, but those studies were limited in their geographic scope and types of shoreline modification.[15] The studies have, however, corroborated that the bulk of permitted shoreline armoring activities continue to be repair and replacement. This demonstrates that the lifecycle of structures that includes the repair or replacement of aging armoring and other in- or over-water structures in Puget Sound extends the duration of degraded baseline conditions and retains limits on habitat features and corresponding carrying capacity.

The duration of impairment of habitat condition and function that derive from decades of persistent anthropogenic changes in the amount of and character of estuarine habitat, is made more detrimental due to the compounding nature of these effects, occurring because: (1) regulatory and permitting measures do not avoid all impacts and largely fail to include methods to rectify unavoidable impacts; (2) development pressure continues to impact habitat in the marine and freshwater portion of the range; (3) improvements in human use patterns to minimize resource impacts are slow at best; and (3) few of the 2020 improvement targets identified by the Puget Sound Partnership (PSP)[16] have been reached (Puget Sound Partnership 2018). In more detail, this most recent report points out the following issues:

- Chinook salmon, steelhead and SRKW: ongoing decline.
- Herring stocks: declining

[15] Shoreline Permitting through TACT (Spring 2015) (TACT is an acronym for: Trouble-Shooting, Action Planning, Course Correction, and Tracking and Monitoring).

[16] The PSP Action Agenda is an EPA-approved recovery plan under the National Estuary Program.

- Loss of non-federal forested land cover to developed land cover: continuing. Loss of 1,196 acres of non-federal forested land per year between 2006 and 2011.
- Shoreline armoring: Stable between 2011 and 2014. No recent net increase, restoration actions balance out increase from private shoreline armoring. However, this could be related to poor economic conditions. More years of data are needed to determine trends.
- Accelerated conversion/loss of vegetation cover on ecologically important lands: 0.18 percent loss for 2011-2016. This is even more loss than the cautious 2020 Target: Basin-wide loss of vegetation cover on ecologically important lands under high pressure from development does not exceed 0.15 percent of the total 2011 baseline land area over a 5-year period.
- Marine water quality: Overall, trends have been getting worse with closures of beaches and shellfish harvest in some bays. While there has been some increase between 2011 and 2014 in the amount of shellfish beds open to harvest, about 19 percent are still closed. PCB levels in fish are still high.
- Native Eelgrass (*Z. marina*) abundance seems stable comparing 2011 to 2013 data to baseline from 2000 to 2008. This does not account for losses that occurred prior to 2000.
- Human Sound Behavior Index: No change in average behavior. Thus, an increase in human population is likely to continue to degrade habitat quality. (The Sound Behavior Index tracks 28 human use practices[17] that likely affect habitat and water quality and quantity).
- Over Water Structure (OWS): not assessed by PSP. Current percent of nearshore coverage is 0.63 percent for all of Puget Sound, as detailed below.

The PSP concludes the overall decline in habitat conditions and native species abundance in the Puget Sound has been caused by development and climate change pressures. Over the last 150+ years, 4.5 million people have settled in the Puget Sound region. With the level of infrastructure development associated with this population growth the Puget Sound nearshore has been altered significantly. Major physical changes documented include the simplification of river deltas, the elimination of small coastal bays, the reduction in sediment supplies to the foreshore due to beach armoring, and the loss of tidally influenced wetlands and salt marsh (Fresh et al. 2011).

In addition to beach armoring, other shoreline changes including OWS, marinas, roads, and railroads reduce habitat quality. The amount of these changes varies, and their source varies by region, generally correlating with development, but overall is substantial (Simenstad et al. 2011). The simplification of the largest river deltas has caused a 27 percent decline in shoreline length compared to historical (pre-1890s) conditions. Of 884 historic small embayments, 308 have been eliminated. About 27 percent of PS's shorelines are armored and only 112 of 828 shoreline segments remain in properly functioning condition. The loss of tidal wetlands in the largest deltas averages 26 percent (Fresh et al. 2011). Each of these habitat changes is related to development and overall reduces the quality and quantity of PS Chinook salmon in the Puget Sound nearshore.
Existing shoreline armoring on nearshore and intertidal habitat function has diminished sediment supply, diminished organic material (e.g. woody debris and beach wrack) deposition, diminished

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[17] Human use practices include among others: (a) Number of residents with native vegetation on banks of waterways; (b) number of residents using pump stations for boat wastewater; (c) residents using herbicides and pesticides; and (d) pasture practices for residents with livestock.

overwater (riparian) and nearshore in-water vegetation (SAV), diminished prey availability, diminished aquatic habitat availability, diminished invertebrate colonization, and diminished forage fish populations (see Toft et al. 2007; Shipman et al. 2010; Sobocinski et al. 2010; Morley et al. 2012; Toft et al. 2013; Munsch et al. 2014; Dethier et al. 2016). In some locations shoreline armoring has caused increased beach erosion waterward of the armoring, which, in turn, has created beach lowering, coarsening of substrates, increases in sediment temperature, and reductions in invertebrate density (Fresh et al. 2011; Morley et al. 2012; Dethier et al. 2016).

Shoreline armoring has reduced suitable habitat for forage species (Pacific sand lance and surf smelt) spawning and likely has reduced their abundance and productivity. Bulkheads alter habitat conditions for the duration that they are present and simultaneously diminish or eliminate intertidal habitat for forage species including sand lance, an obligate upper intertidal spawner (Whitman et al. 2014). As stated in Fresh et al. (2011) "we can only surmise how much forage fish spawning habitat we have lost because we lack comprehensive historical data on spawning areas." Considering that these forage fish are an essential food source for salmon, beach armoring has multiple negative effects on salmon including reductions in prey and reductions in access to shallow water rearing habitat and refuge (Davis et al. 2020).

Marine Vessels

Commercial, recreational, military, and public ferry vessel traffic occurs throughout Puget Sound. Vessels range in size from massive commercial shipping container ships to kayaks. Vessels can access Puget Sound through the Strait of San Juan de Fuca, the Strait of Georgia, ports, public and private marinas, naval bases, single-family piers, public boat ramps, and freshwater piers and marinas. Several studies have shown fish to respond physiologically and biologically to increased noise (Mueller 1980; Scholik and Yan 2002; Picciulin et al. 2010). Xie et al. (2008) report that adult migrating salmon avoid vessels by swimming away. Graham and Cooke (2008) studied the effects of three boat noise disturbances (canoe paddling, trolling motor, and combustion engine (9.9 horsepower) on the cardiac physiology of largemouth bass (*Micropterus salmoides*). Exposure to each of the treatments resulted in an increase in cardiac output.

Vessels are subject to existing federal regulations prohibiting approach closer than 200 yards or positioning in the path of the whales within 400 yards (with exemptions for vessels lawfully engaged in commercial or treaty Indian fishing that are actively setting, retrieving, or closely tending fishing gear). State regulations also mandate protections for SRKWs (see RCW 77.15.740, mandating 300 to 400-yard approach limits, 7 knots or less speed within ½ nautical mile of the whales). NMFS and other partners have outreach programs in place to educate vessel operators on how to avoid impacts to whales. The average number of vessels with the whales decreased in 2018, 2019 and 2020 likely due to decreased viewing effort on SRKWs by commercial whale watching vessels, with an average of 10, 9, and 10.5 vessels with the whales at any given time, respectively (Frayne 2021). NMFS initiated scoping in 2019 to evaluate the need to revise existing federal regulations.

Stormwater

Mackenzie et al. 2018 found that stormwater is the most important pathway to Puget Sound for most toxic contaminants, transporting more than half of the Sound's total known toxic load (Ecology & King County 2011). During a robust Puget Sound monitoring study, toxic chemicals were detected more frequently and at higher concentrations during storm events compared with base flow for diverse land covers, pointing to stormwater pollution (Ecology 2011). The Puget Sound basin has over 4,500 unnatural surface water and stormwater outfalls, 2,121 of which discharge directly into the Sound (WDNR 2014).

In general, the pollutants in the existing stormwater discharge are diverse. The discharge itself comes from rainfall or snowmelt moving over and through the ground, also referred to here as "runoff." As the runoff travels along its path, it picks up and carries away natural and anthropogenic pollutants (U.S. EPA 2016b). Pollutants in stormwater discharge typically include

- Excess fertilizers, herbicides, insecticides and sediment from landscaping areas.
- Chemicals and salts from de-icing agents applied on sidewalks, driveways, and parking areas.
- Oil, grease, PAHs and other toxic chemicals from roads and parking areas used by motor vehicles.
- Bacteria and nutrients from pet wastes and faulty septic systems.
- Metals (arsenic, copper, chromium, lead, mercury, and nickel) and other pollutants from the pesticide use in landscaping, roof runoff (WDOE 2014), decay of building and other infrastructure, and as airborne particles from street and tire wear.
- Atmospheric deposition from surrounding land uses.
- Erosion of sediment and attached pollutants due to hydromodification.

(Buckler and Granato 1999; Colman et al. 2001; Driscoll et al. 1990; Kayhanian et al. 2003; Van Metre et al. 2005).

Landscape overview

When considered at the landscape scale, the baseline condition of Puget Sound nearshore habitat is degraded, with reduced water quality, reduced forage and prey availability, reduced quality of forage and prey communities, reduced amount of estuarine habitat, reduced quality of nearshore and estuarine habitat, and reduced condition of migration habitat due to structures noise and vessel perturbations. Each of these conditions of the baseline exerts downward pressure on all populations of each listed species considered in the Opinion for the duration of their time in the action area. Loss of production of Chinook salmon from habitat degradation reduces available forage for SRKWs. The baseline currently constrains the carrying capacity of the action area and limits its potential for serving recovery of these species. Overall, the nearshore is impacted in many areas by the degradation from coastal development and pollution. The status of deep-water habitat is impacted by remaining derelict fishing gear and degraded water quality among other factors. The input of pollutants affects water quality, sediment quality, and food resources in the nearshore and deep-water areas of critical habitat.

NMFS's management strategy for conservation and recovery of listed salmonids in the West Coast has long been premised on reducing adverse effects among all of the "4 Hs" namely, Hatcheries, Hydropower, Harvest, and Habitat. Each has had a role in the factors for decline of West Coast salmonids, each has been the subject of section 7 consultations, and each has been found to have continuing negative influence on species' viability. Example dams such as White River Dam, previously operated by Puget Sound Energy, Mud Mountain Dam (NMFS 2014a) operated by the USACE for the purpose of flood control operations, and as needed to facilitate maintenance activities at the downstream White River diversion dam, and Howard Hanson Dam (NMFS 2019c) operated by the USACE for downstream flood damage reduction, have each been found to jeopardize ESA listed fish, and in the case of Mud Mountain and Howard Hanson dams, jeopardy to PS Chinook salmon posed a secondary threat of jeopardy to SRKW.

The outcomes of those jeopardy opinions include the surrender of the White River FERC license. Puget Sound Energy retired the hydro project in 2004. Cascade Water Alliance purchased it from the company in 2009 and intends to complete a habitat conservation plan for its water. Passage improvements at Mud Mountain Dam have already reduced fish mortality, and while a new passage is being designed for Howard Hanson Dam, the USACE is evaluating modifications to its retention and release schedule of water to benefit egg in spawning areas downstream of the dam. In each case, modifications to avoid jeopardizing listed species are being undertaken.

On November 9, 2020, NMFS issued a biological opinion on 39 proposed projects in the nearshore of Puget Sound (WCRO-2020-01361). The 39 individual consultations proposed to construct new overwater or shoreline armoring structures or repair or replace existing in- or overwater or armoring structures, and were consolidated together by NMFS into a single biological opinion based on the locations of the proposed projects and their similar impacts on ESA-listed species and their critical habitat designated under the ESA. In this opinion, we determined the Corps' proposed action, to permit the 39 projects, was likely to jeopardize the continued existence of listed PS Chinook salmon and SRKW. We also concluded the proposed action was likely to adversely modify those species' designated critical habitats. We also determined that the proposed action was not likely to jeopardize listed PS steelhead, PS/Georgia Basin bocaccio rockfish, yelloweye rockfish, or Hood Canal Summer-run chum salmon or adversely modify designated critical habitat for those four species. Our conclusion was based on:

- PS Chinook populations are far from meeting recovery goals and trends in abundance and productivity are mostly negative.
- Nearshore habitat quality is insufficient to support conservation of this ESU. SRKW prey is at a fraction of historical levels. Under the current environmental baseline, nearshore habitat in Puget Sound cannot support the biological requirements of PS Chinook salmon.
- Fewer populations of PS Chinook salmon contributing to SRKW's prey base will reduce the representation of diversity of life histories, resiliency in withstanding stochastic events, and redundancy to ensure there is a margin of safety for the salmon and SRKWs to withstand catastrophic events.
- The condition of the environmental baseline is such that additional impacts on the quality of nearshore habitat is likely to impair the ability of that habitat to support conservation of these species.
- The proposed actions would further reduce the quality of nearshore habitat in Puget Sound.

- The proposed actions would also exacerbate habitat limiting factors identified by the PS Chinook salmon and SRKW recovery plans and are inconsistent with recovery action listed in these plans. Due to demand for future human development cumulative effects on nearshore habitat quality are expected to be mostly negative.

The 2020 jeopardy opinion included an RPA with five elements, including on site habitat improvements; offsite habitat improvements; funding from a habitat restoration sponsor; purchase of credits from a conservation bank in-lieu fee program, or crediting provider; and, project modifications.

The environmental baseline would also include the projected effects of climate change for the time period commensurate with the effects of the proposed actions. Mauger et al (2015) predict that circulation in Puget Sound is projected to be affected by declining summer precipitation, increasing sea surface temperatures, shifting streamflow timing, increasing heavy precipitation, and declining snowpack. While these changes are expected to affect mixing between surface and deep waters within Puget Sound, it is unknown how these changes will affect upwelling. Changes in precipitation and streamflow could shift salinity levels in Puget Sound by altering the balance between freshwater inflows and water entering from the North Pacific Ocean. In many areas of Puget Sound, variations in salinity are also the main control on mixing between surface and deep waters. Reduced mixing, due to increased freshwater input at the surface, can reduce phytoplankton growth, impede the supply of nutrients to surface waters, and limit the delivery of dissolved oxygen to deeper waters. Patterns of natural climate variability (e.g., El Niño/La Niña) can also influence Puget Sound circulation via changes in local surface winds, air temperatures, and precipitation.

All three ESA-listed Puget Sound salmonids were classified as highly vulnerable to climate change in a recent climate vulnerability assessment (Crozier et al. 2019). In estuarine environments, the two greatest concerns associated with climate change are rates of sea-level rise and temperature warming (Wainwright and Weitkamp 2013, Limburg et al. 2016). While the effects of climate change-induced ocean acidification on invertebrate species are well known, the direct exposure effects on salmon remains less certain (Crozier et al. 2019).

The world's oceans are becoming more acidic as increased atmospheric CO_2 is absorbed by water. The North Pacific Ocean is already acidic compared to other oceans, making it particularly susceptible to further increases in acidification (Lemmen et al. 2016). Laboratory and field studies of ocean acidification show it has the greatest effects on invertebrates with calcium-carbonate shells, and relatively little direct influence on finfish; see reviews by Haigh et al. (2015) and Mathis et al. (2015). Consequently, the largest impact of ocean acidification on salmon is likely to be its influence on marine food webs, especially its effects on lower trophic levels, which are largely composed of invertebrates such as pteropods, larval crabs, and krill, which play a significant role in some salmon diets (Haigh et al. 2015, Mathis et al. 2015, Wells et al. 2012). Marine invertebrates fill a critical gap between freshwater prey and larval and juvenile marine fishes, supporting juvenile salmon growth during the important early-ocean residence period (Daly et al. 2009, 2014).

Physiological effects of acidification may also impair olfaction, which could hinder homing ability (Munday et al. 2009), along with other developmental effects (Ou et al. 2015). Although a recent review of ocean acidification studies on fish has called into question many of the behavioral effects of ocean acidification (Clark et al. 2020). Using the criteria of Morrison et al. (2015) for scoring, PS Chinook salmon, HC Chum salmon, and PS steelhead had low-to-moderate sensitivity to ocean acidification (Crozier et al. 2019).

The same document states that "sea level rise is projected to expand the area of some tidal wetlands in Puget Sound but reduce the area of others, as water depths increase and new areas become submerged. For example, the area covered by salt marsh is projected to increase, while tidal freshwater marsh area is projected to decrease. Rising seas will also accelerate the eroding effect of waves and surge, causing unprotected beaches and bluffs to recede more rapidly. The rate of sea level rise in Puget Sound depends both on how much global sea level rises and on regionally-specific factors such as ocean currents, wind patterns, and the distribution of global and regional glacier melt. These factors can result in higher or lower amounts of regional sea level rise (or even short-term periods of decline) relative to global trends, depending on the rate and direction of change in regional factors affecting sea level" (Mauger et al. 2015).

2.3.2 Current Status of Commencement Bay

Industrial development of Commencement Bay began in the late 19th century (Corps et al. 1993) and fragmented estuarine habitats by altering shorelines with vertical or steeply sloping bulkheads and piers (Kerwin 1999). By 1917, several waterways, including the Blair Waterway, had been constructed by dredging and filling mudflats in the Puyallup River delta and Commencement Bay. Side channels, sloughs, and saltwater transition zones historically used by anadromous fish have largely been eliminated. Chemical contamination of sediments within Commencement Bay has compromised the suitability of the remaining habitat (Corps et al. 1993; USFWS & NOAA 1997; Collier et al. 1998). Despite extensive alterations to the natural habitat within Commencement Bay, some species still use the remaining habitat (USFWS & NOAA 1997).

Historically, intertidal mudflats covered an estimated 2,100 acres of Commencement Bay. In 1992, approximately 180 acres remained (Corps et al. 1993). Dredging, diking, and other anthropogenic activity within Commencement Bay are responsible for this change in habitat. Since 1993 several habitat mitigation and restoration sites have been established and approximately 292 additional acres of marine and estuarine habitat within the action area has been restored[18]. The majority of the remaining mudflat habitat is located near the mouth of the Puyallup River, within the Hylebos, Middle, Milwaukee, St. Paul, and Wheeler-Osgood Waterways (Corps et al. 1993; USFWS & NOAA 1997).

The action area within Commencement Bay, has been highly developed and numerous overwater structures and extensive shoreline armoring exist within the vicinity of the project. The natural shoreline has been almost completely replaced by impervious surfaces and nearshore riparian vegetation is absent. The shorelines of Commencement Bay have been highly altered using

[18] Quantity provided by Jennifer Stebbings, Port of Tacoma on January 10, 2022 via a preliminary draft review comment.

riprap, and other materials to provide bank protection. The Port of Tacoma waterways were developed for industrial and commercial operations and the upland areas are heavily industrialized. Blair Waterway comprises seven percent of the total of armored shoreline that covers 71 percent of the length of the Commencement Bay shoreline. Commencement Bay contains dense industrial, commercial, and residential development and is a major shipping route for containerized and bulk cargo, which is consequently subject to high volumes of marine traffic.

Aquatic portions of the project area are composed of intertidal and subtidal habitats. Intertidal habitat along the shorelines of the project area is limited by shoreline armoring and overwater structures. Commencement Bay has been highly modified by industrial development with large areas of fill, dredging, stabilization, and infrastructure (Simenstad 2000). Overwater structures in the form of piers for ship loading are prevalent along the shorelines of the project area. Based on shoreline surveys and aerial photo interpretation of the area, approximately five miles, or 20 percent of the Commencement Bay shoreline, is covered by wide over-water structures (Kerwin 1999). This shading affects the community of the subtidal organisms that serve as fish food or habitat structure in the form of eelgrass and kelp (Nightingale and Simenstad 2001). Piers and other overwater structures can inhibit juvenile salmon migration as physical barriers, shading that causes avoidance, and increased susceptibility to predation (Simenstad et al. 1982).

The depth of sea floor in most of Commencement Bay (30-100 meters; 98-330 feet) and the Blair Waterway (-51 MLLW) is not commonly habitat that salmonids select for feeding or refuge. Some estuarine and marine fish and sub-tidal marine invertebrates inhabit and feed at deeper subtidal elevations within the action area. Additionally, the invertebrates inhabiting the substrate of the Blair Waterway, such as polychaete and nematode worms, do not contribute significantly to the salmonid food chain (Hiss and Boomer 1986). The Blair Waterway has artificial side slopes of 2H:1V throughout most of the waterway.

Baseline conditions include regular disruptions on a daily basis when large shipping vessels transit the channel and displace fish and wildlife due to underwater noise and physical presence. Tacoma Harbor already receives calls from the 14,000 twenty-foot equivalent unit (TEU) capacity Thalassa Axia, which began calling in November 2018. The Thalassa Axia is the largest ship calling at Tacoma Harbor as of December 2019.

2.3.3 Current Status of Blair Waterway

The Blair Waterway, a congressionally authorized federal navigation channel, is a permanent component of the integrated Port system. The Blair Waterway was artificially created and generally has a 2H:1V side slope and piers with varying degrees of slope strengthening (e.g., bulkheads, piles, and riprap) along the length of the channel (28,566 linear feet). The federal navigation channel, infrastructure/facilities, and vessel traffic, within the Blair Waterway are included as part of the environmental baseline considered in this Opinion.

The Blair Waterway was first constructed prior to 1920 by private interests. Over the last 100 years, at least 14 different dredge/cleanup projects have shaped the waterway to its current configuration. It has been at its current length since the mid-1960s. In the last 25 years, there have been several deepening actions, some conducted as part of the Commencement Bay

Nearshore/Tideflats (CB/NT) Superfund cleanup; at least five different cutback actions for widening the waterway; bridge abutment fill removal; slip fills; and pier realignments. During this same 25-year period, there have been numerous pier redevelopments, realignments, expansions, and new construction. The Blair Waterway comprises seven percent of the total armored shoreline within Commencement Bay.

The Blair Waterway has a long history as an integral structure to support marine cargo shipping in the Puget Sound. Since its creation, the Blair Waterway has been actively operated, managed, and maintained as an industrial and commercial navigable waterway. From its initial construction prior to 1920 to 1956, the Blair Waterway (first named Wapato Waterway and then Port Industrial Waterway), was incrementally deepened, widened, and lengthened through actions under the River and Harbors Act of 1935, and the Rivers and Harbors Act of 1954. In 1956, the waterway was approximately 800 feet wide, and -30 feet MLLW, from the mouth to approximately Lincoln Avenue. Following the Rivers and Harbors and Flood Control Act of 1962, the waterway was lengthened to its present configuration (approximately 2.6 miles) and a turning basin was added at the head of the navigation channel. The project was completed in 1969 and the waterway was renamed the Blair Waterway.

In 1983-1984, investigations showed concentrations of arsenic, copper, lead, and zinc in surface water runoff from the area exceeded federal and state marine water quality criteria. In the mid-1990s, the Blair Waterway navigation channel and berth areas were dredged as part of the Sitcum Waterway Remediation Project under the CB/NT Superfund cleanup. The waterway was deepened from -30 feet to approximately -48 feet MLLW from the mouth to approximately 1,000 feet upstream of Lincoln Avenue, and to approximately -45 feet MLLW for the remainder of the waterway, including the turning basin. However, after cleanup, concentrations of metals (arsenic and lead) in soil exceeded MTCA (Model Toxics Control Act) Method A cleanup levels for industrial sites. In addition, arsenic concentrations in stormwater exceeded water quality criteria (surface water runoff at the site discharges to the Blair Waterway). When an environmental covenant exists for a cleanup site, The Washington Department of Ecology (Ecology) reviews site conditions about every five years to ensure the long-term effectiveness of the cleanup action. Ecology inspected the site on April 3, 2019, and investigated current conditions of the cap and the stormwater collection system. Conditions of the cap continues to prevent direct contact with contaminated soil and prevent stormwater from contacting or infiltrating the capped soils.

Sediment within the Blair Waterway have been classified by Ecology as Waters of Concern (Category 2) for hexachlorobenzene and sediment bioassays. A small section of the waterway has also been classified as impaired waters that do not require a TMDL (Category 4b) for sediment bioassays. Soil, groundwater, and nearshore sediment in the uplands around the Blair Waterway are potentially contaminated with residual hazardous materials including total petroleum hydrocarbons, metals, volatile organic compounds (VOCs), semi-volatile organic compounds, and polychlorinated biphenyls (PCBs).

In 1999, the Corps evaluated the Blair Waterway and determined deepening the navigation channel from -48 feet and -45 feet MLLW to -51 feet MLLW in its entirety would eliminate navigation inefficiencies for post-Panamax shipping vessels and would not result in significant environmental impacts. The entire Blair Waterway navigation channel was dredged in 2000 to its current depth of -51 feet MLLW. Two pier realignments and two maintenance dredges have occurred in the Blair Waterway in the last 15 years. First, 600 feet of the Blair Terminal was demolished, the bank cutback to align with the Washington United Terminal (WUT) and 600 feet of new pier was added to the south end of WUT. A small maintenance dredge (approximately 3,300 cubic yards) was performed at WUT in 2009. Next, a maintenance dredge was conducted at Husky Terminal (approximately 42,100 cubic yards) around 2011 to remove high spots from shoaling and sloughed material. Most of Pier 4 at Husky Terminal was demolished and the bank cutback to align with Pier 3 starting in 2014. Part of that action was conducted as an emergency cleanup coordinated by the EPA due to very high levels of Tributyltin found during sediment characterization. Finally, the Corps estimates operation and maintenance dredging occurs within the Blair Waterway approximately every 25 years and removes roughly 30,000 cubic yards of material to maintain navigability of the congressionally authorized channel.

Sediments within the Blair Waterway are predominantly fine-grained, and generally consist of sand and silty sand, as well as organic sediments that enter the action areas from the Puyallup River and Wapato Creek. High turbidity is a major factor within the Blair Waterway, primarily due to propeller wash from vessel activities and turbidity from the Puyallup River, which can enter the waterways during high tides. High levels of turbidity in inner Commencement Bay occur routinely due to the naturally high turbidity of the Puyallup River. In deep-water areas, turbidity is generally lower than surface turbidity.

With the exception of mitigation/restoration sites, the Blair Waterway shoreline is armored along its entire length with riprap, bulkheads (sheetpile or secant walls), or wooden piles. The extent of armoring depends on the location, and ranges from riprap from at least +10 feet above mean lower low water (MLLW) to -2 MLLW, to extensive overwater structures such as piers and docks. In many places armoring goes all the way to the bottom of the water (-51 MLLW) and below to a rock key. A rock key is part of the riprapped slope that extends below the mudline at the bottom of the slope. The proposed action would expand the channel width at various points along the length of the channel and as a result require slope stabilization measures (see Figure 2 in section 1.3.2). Currently, all four locations are stabilized with small to medium sized angular rocks at a 2:1 slope (Figure 7).

The Blair Waterway, in its current congressionally authorized state, lacks high quality nearshore habitat that would provide adequate ecological function necessary to continuously support the ESA-listed species evaluated in this Opinion. The highly developed state and channelized nature of the waterway precludes utilization of the area by most species. The lack of shallow water habitats, suitable substrate, submerged aquatic vegetation, and natural cover and the intense industrial use inhibit species from using these areas as feeding, growth, and reproductive opportunities.

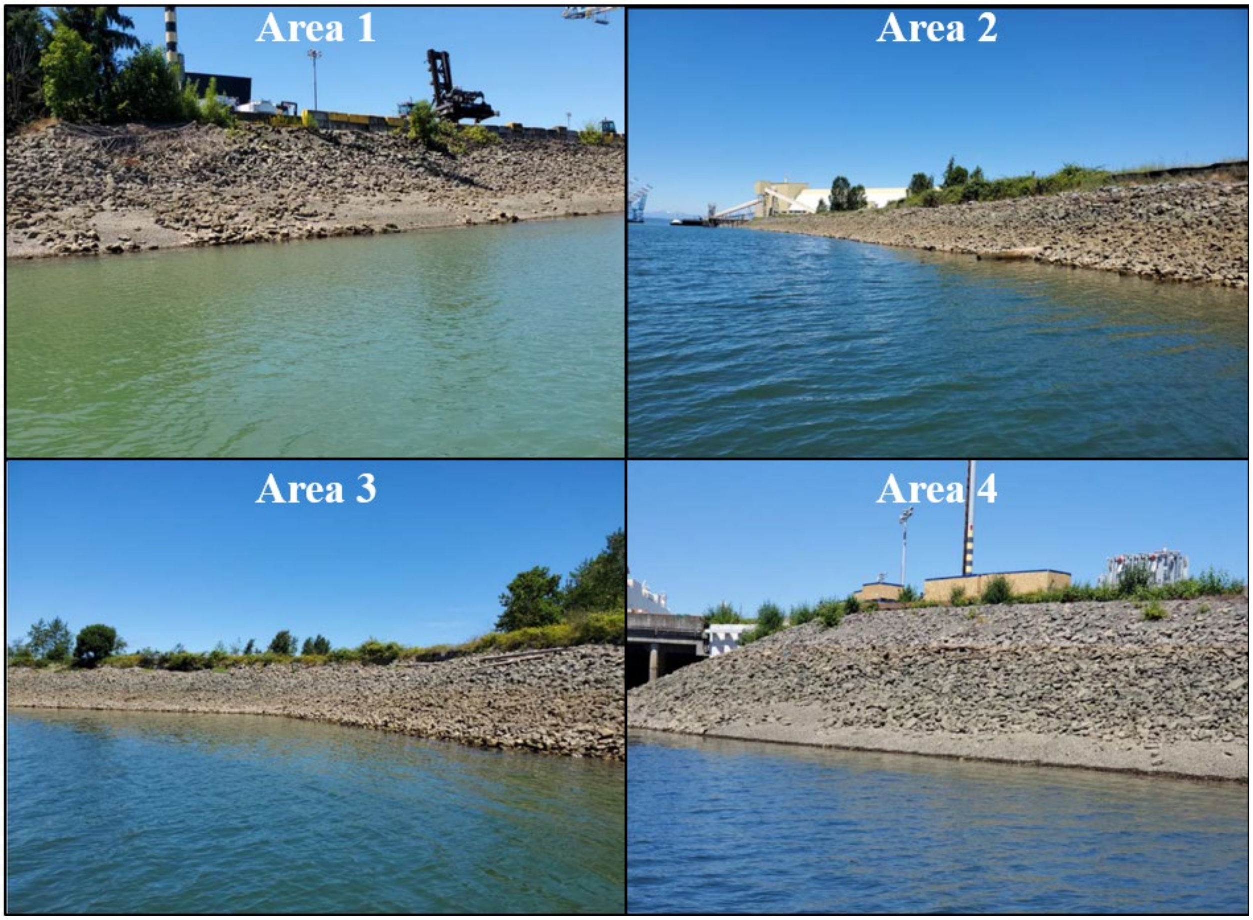

Figure 7. Current habitat conditions of Areas 1- 4 within Blair Waterway proposed added shoreline stabilization as a result of proposed channel widening. Currently, the 2:1 slopes are stabilized by riprap. Areas 1 and 4 are proposed to be stabilized using riprap. Areas 2 and 3 are proposed to be stabilized with secant wall armoring.

2.3.4 Current Status of Saltchuk

The Saltchuk site is located approximately one mile north of Blair Waterway along the shoreline. Within Saltchuk, habitat is degraded due to development of Commencement Bay and previous log storage at the site. Wood waste has accumulated over approximately 100 years and is not known to be chemically treated, and thus not a suspected source of hazardous, toxic, or radioactive waste (HTRW). Three primary locations accounting for approximately 13 percent of the total 64-acre Saltchuk site were observed to contain wood waste during a 1999 dive survey. One large area of wood waste was observed from shore during a low tide event (GeoEngineers 2014a, as cited in GeoEngineers 2015) extending from the lower shore zone to a depth of approximately -30 MLLW. The site contains approximately 53 acres of deep subtidal zone habitat (below -10 MLLW). The majority of the deep subtidal habitat at the site consists of brown and black silt with wood waste over gray clay.

Macroalgae in the lower shore zone is largely composed of sea lettuce (Ulva ssp.) and was observed at approximately the MLLW line. One patch of eelgrass was identified to the southeast of the project area near Hylebos Waterway at depths of approximately -6 feet to -10 MLLW during an August 2014 underwater video survey. Lower shore zone (LSZ) habitat (from +5 to -10 MLLW) is composed of a coarse substrate that transitions to sand and silt near MLLW.

2.3.5 Species in the Action Area

Species considered in this Opinion likely to be present during construction in Commencement Bay, Blair Waterway, or Saltchuk site include PS Chinook salmon, PS steelhead, and PS/GB rockfish (yelloweye and bocaccio).

Regular presence of either PS Chinook salmon or steelhead within Blair Waterway in high numbers is unlikely. However, based on the proximity of Blair Waterway to the Puyallup River, Hylebos Creek, and Wapato Creek, some ESA-listed Chinook salmon or PS steelhead may be present in the area during construction. Specific salmon and steelhead populations likely to be present Commencement Bay during construction include Puyallup River, Carbon River, and White River.

The Puyallup River enters Puget Sound via Commencement Bay west of Blair Waterway. Nine anadromous salmonids have been documented in the Puyallup River basin including winter steelhead, bull trout, coastal cutthroat trout, and spring/fall Chinook, fall chum, coho, sockeye, and odd-year pink salmon (Dames and Moore 1981; NWIFC 2019). Rearing and foraging by juvenile salmonids occurs along the limited shoreline areas that are shallow or retain natural structural diversity. Juvenile salmonids may use the nearshore reaches and Commencement Bay to transition into marine waters. Returning adult salmon typically congregate at the mouth of the Puyallup River prior to upstream migration.

Puyallup, Carbon, and White River salmon and steelhead are also expected to be present in Commencement Bay during construction. Puyallup River (including Carbon River fish) native-origin fall Chinook salmon abundance has been in steady decline since 2000 (Figure 8) and productivity has consistently failed to meet recovery goals since the late 1990's (Figure 9). A similar trend has been documented in the White River spring Chinook salmon population. White River spring Chinook salmon are of significant importance because they are the only remaining spring Chinook salmon stock in the south/central Puget Sound region (Marks et al. 2018). The other concerning trend is the ratio of wild to hatchery spawners in the Puyallup Basin. Since the late 1990's native-origin fall Chinook salmon abundance in the Puyallup River and spring Chinook salmon in the White River have been declining, meaning that populations are highly reliant on hatchery supplementation (Figure 10). PS steelhead abundance and productivity in the Puyallup Basin has slowly been improving since the mid 2000's (Figure 11 and Figure 12). However, abundance remains well below recovery goals; the five-year geometric mean abundance is 136 compared to a recovery goal of 4,500 (Ford, in press).

Adult Chinook salmon would only hold temporarily within the waters of Blair Waterway before migrating to the Puyallup Basin, although, are not likely to be present for an extended period of time. Furthermore, Chinook salmon use of Blair Waterway is up to three times greater near the mouth of the waterway than near the head, where they are found in very low numbers (Duker et al. 1989). Similarly, juvenile Chinook salmon are not expected to spend significant time within the Blair Waterway, but could potentially rear within the nearshore waters of Commencement

Bay. No part of the waterway provides suitable spawning habitat for Chinook salmon, as the waterway is in a marine environment.

Blair Waterway has some suitable habitat for migrating adults and out-migrating juvenile PS steelhead. PS steelhead have been documented in Blair Waterway, Wapato Creek[19] (via the Blair Waterway), Hylebos Creek (via Hylebos Waterway), and Commencement Bay (SalmonScape[20]). Adult and juvenile steelhead most likely use the waterways as holding areas before they enter migration corridors. Outmigration of juveniles typically occurs between approximately the middle of March through the middle of July, and rearing juveniles could be present in Commencement Bay or adjacent waters of Puget Sound at any time of the year, including in Blair Waterway.

Hylebos Creek is a large independent drainage to the Puyallup Basin and flows from its headwaters near Federal Way into Commencement Bay via Hylebos Waterway (Figure 3). The area surrounding Hylebos Creek has been intensely developed and habitat quality is generally poor. Chinook salmon and steelhead have both been observed spawning within Hylebos Creek, although annual abundance is generally low. This suggests that a proportion of the salmon and steelhead exposed to project effects would originate from Hylebos Creek.

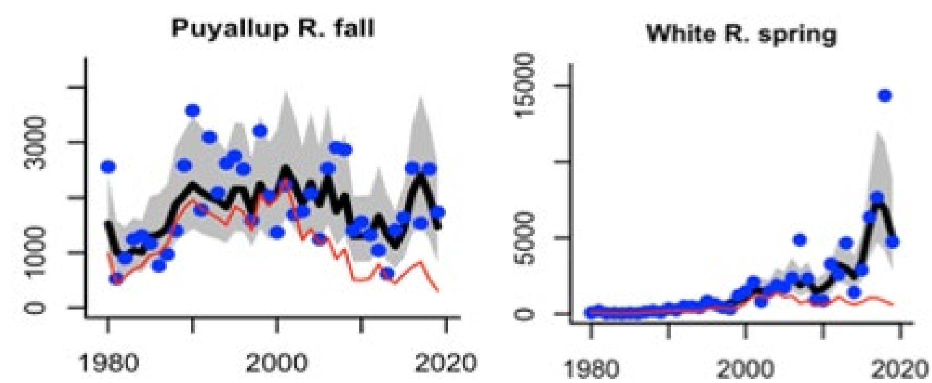

Figure 8. Smoothed trends in estimated total (hatchery and natural origin) (thick black line, with 95% confidence interval in grey) and natural (thin red line) abundance of Puyallup River fall Chinook salmon (left) and White River spring Chinook salmon (Adapted from Ford, in press).

[19] PS steelhead have not been documented in Wapato Creek for at least 20 years.
[20] http://apps.wdfw.wa.gov/salmonscape/map.html

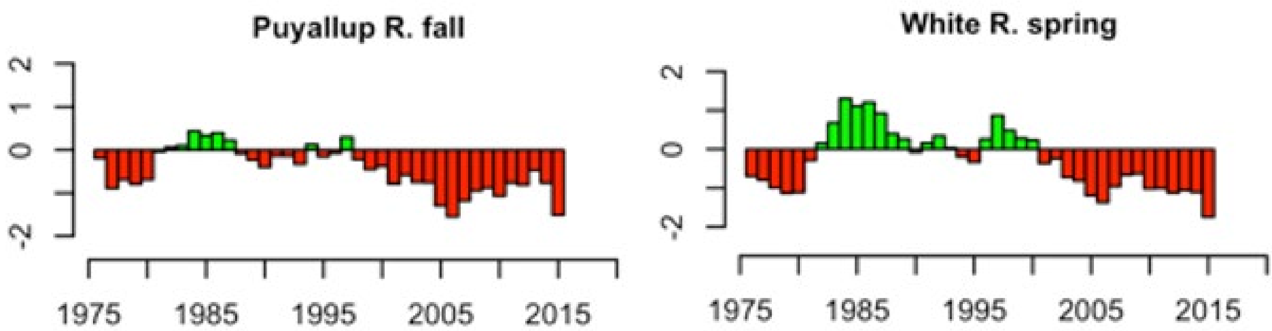

Figure 9. Annual trends in population productivity calculated as the difference of the log of the smoothed natural origin spawning abundance in year *t* and the smoothed natural origin spawning abundance in year *t* – 4 for Puyallup River fall Chinook salmon and White River spring Chinook salmon (Adapted from Ford, in press).

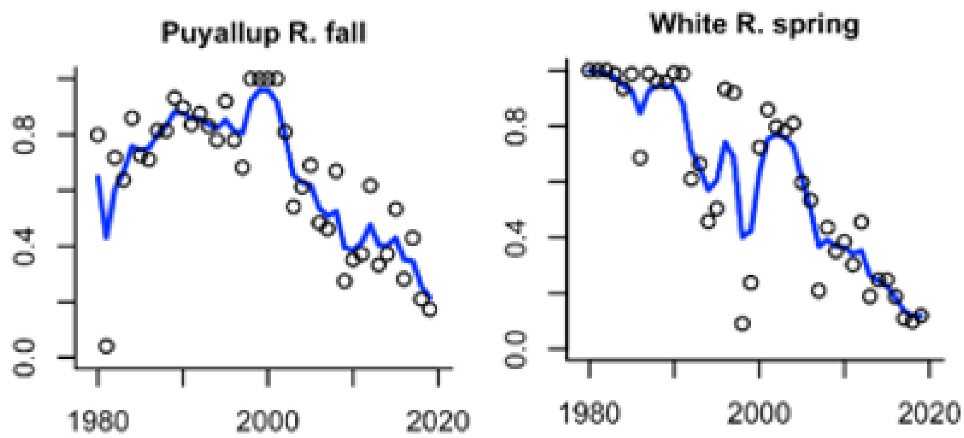

Figure 10. Smoothed trend in estimated fraction of natural-origin spawner abundances (blue line), and annual raw fraction of wild estimates (points) of Puyallup River fall Chinook salmon (left panel) and White River spring Chinook salmon (right panel) (Adapted from Ford, in press).

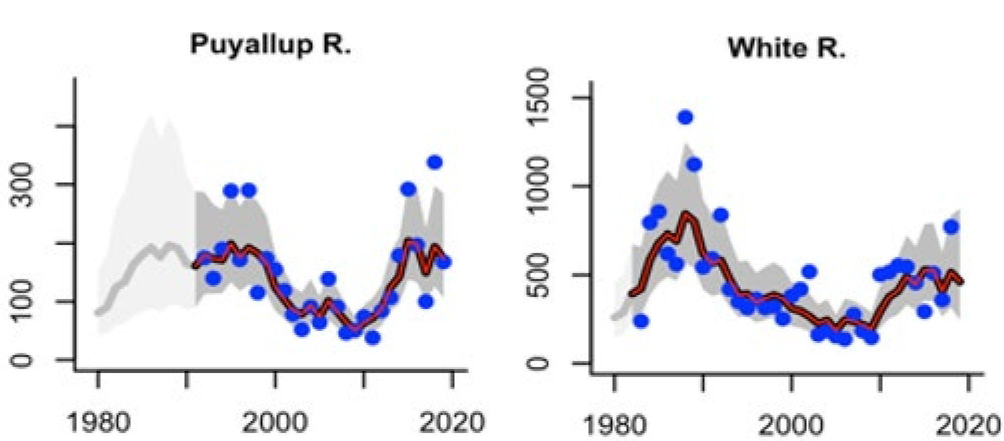

Figure 11. Smoothed trends in estimated total (thick black line, with 95% confidence interval in grey) and natural (thin red line) abundance of Puyallup River (left) and White River steelhead (Adapted from Ford, in press).

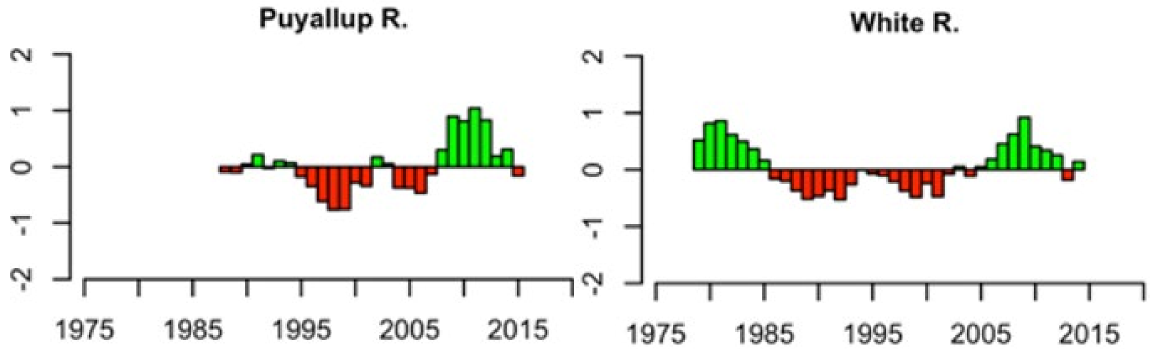

Figure 12. Annual trends in population productivity calculated as the difference of the log of the smoothed natural origin spawning abundance in year *t* and the smoothed natural origin spawning abundance in year *t* – 4 for Puyallup and White River steelhead (Adapted from Ford, in press).

Less information exists regarding the use of Commencement Bay and surrounding areas by PS/GB rockfish. The south Puget Sound Basin is within their historical range, however data is lacking to determine historical presence and abundance within the immediate project area. Adult rockfish are highly mobile and typically utilize deep water areas with large rocks and cover. Larval bocaccio and yelloweye drift for long periods before moving into rockier and deeper habitat once their swimming ability is full developed. Given the overlap of the work window with the second rockfish spawning event and the duration of time larvae drift it is likely that larval rockfish would be in the project area during construction. Larval rockfish have been documented throughout all major basins of Puget Sound (Greene and Godersky 2012).

2.3.6 Distinguishing Baseline from Effects of the Action

As described in more detail in Sections 2.3 and 2.4, the effects of an action are the consequences to listed species or critical habitat that would not occur but for the proposed action and are reasonably certain to occur. The environmental baseline refers to the condition of the listed species or its designated critical habitat in the action area without the consequences caused by the proposed action (50 CFR 402.02).

Relative to this consultation, we must distinguish the impacts from the existing operation and configuration of the congressionally authorized federal navigation channel as the baseline (which is not within the Corps' discretion to alter) compared to the time, place, and manner of the proposed construction to alter the proposed channel, any effects caused by the deepening and widening of the channel, the reduction in intermittent effects caused by marine vessels, and the beneficial use of dredge material placement at Saltchuk, all of which are within the Corps' discretion. The Blair Waterway is congressionally authorized and it is not within the Corps' discretion to modify its current configuration. Therefore, effects associated with the proposed action include those that would not occur but for the proposed action; in this case the deepening and widening of the existing federally authorized waterway, reducing vessel traffic, and placing dredged materials at the Saltchuk site.

With that understanding, the effects of the proposed action are evaluated relative to the current conditions, which include the infrastructure, shipping traffic, and regular maintenance associated with the Blair Waterway. Without the inherent infrastructure and maintenance, the federal channel would fail to operate in its current condition. The ongoing consequences to the environment resulting from the presence and operation of the facilities and structures in the federal navigation channel under the current configuration constitute the environmental baseline. These effects compromise habitat quality for listed species. Under the current environmental baseline, the federal navigation channel within the Blair Waterway would remain a highly developed area incapable of providing quality habitat for listed species.

While maintaining the current configuration of the federal channel is outside of the Corps' discretion, the manner and timing in which that maintenance occurs does fall within Corps' authority. That means the timing and methods used to maintain the proposed width and depth of the Blair Waterway is determined by the Corps and is therefore subject to future ESA Section 7 consultations. Effects of future maintenance dredging and repairs to infrastructure would be evaluated in a future consultation.

2.4 Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action (see 50 CFR 402.02). A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

The proposed action is reasonably certain to cause temporary, intermittent and enduring effects. Temporary effects include: (1) reductions in water quality from increased suspended sediment, turbidity, and contaminants; (2) increased underwater noise resulting from dredging; and (3) entrainment or strike of fish during dredging operations. These effects are likely to occur for the next four years when construction is proposed to be completed within Blair Waterway. Most effects would be expected to be localized and temporary. The proposed action is reasonably certain to cause intermittent effects, including a beneficial reduction in vessel traffic. We also evaluated the effects of an increase in vessel size for impacts to listed species. Specifically, we evaluated the potential for a change in noise, ship strikes, and wake effects on Puget Sound shorelines resulting from the proposed action. NMFS found no information that supported an increase in negative impacts to listed fish or marine mammals. Enduring effects include reductions in available benthic and forage prey resulting from disturbed benthic habitats after channel deepening and widening; however, the deposition of sediments at Saltchuk is likely to increase subtidal and intertidal habitat for juvenile salmon and juvenile bocaccio.

2.4.1 Temporary Effects during Construction

The proposed dredging project would cause direct temporary effects on the fish and habitat that are present during in-water work through exposure to dredging-related elevated noise, bucket strike or entrainment, degraded water quality, and propeller wash. The proposed dredging would also cause indirect effects on fish and habitat through forage contamination and altered benthic habitat. While we classify the following effects as temporary, we expect the effects to persist for the entirety of the annual in-water work window given that dredging work would occur nearly 24 hours a day. The continuous nature of in-water work would ensure that degraded habitat conditions would not abate until the end of the in-water work window each year (August 16 – February 15) or once the project is completed after four years. Finally, certain aspects of species and habitat recovery would not occur until after construction is completed and temporary effects cease (i.e., benthic habitat).

Water Quality

Water quality is likely to be affected during in-water work associated with mechanical dredging, shoreline stabilization, and associated vessel operation within the Blair Waterway and sediment deposition at Saltchuk. Effects to water quality during construction include increased turbidity, decreased DO, and re-suspension of unsuitable materials.

Turbidity and Dissolved Oxygen

Dredging, vessel operation, and material placement would result in increased turbidity and decreased dissolved oxygen due to suspended sediments. Coarser sediments are likely to redeposit close to the dredge location, while finer particles are likely to travel with currents and remain in suspension for longer periods of time. We expect the low current velocity in the Blair Waterway would limit the distance fine particles would travel from dredging site. Resuspension occurs with much greater severity when subsurface debris is encountered. This is due to the dredging bucket not being able to close fully (often because it is obstructed by debris) before removing sediments to the surface. A different type of clamshell bucket (environmental clamshell), which encloses unsuitable sediments is described below.

The dredging BMPs included in the proposed action (see Section 1.3.4) are expected to reduce the amount of suspended sediments to some degree. However, some resuspension of unsuitable material during dredging is unavoidable, even with implementation of BMPs. Propeller wash from vessels may also spread turbidity during construction and transport of dredged materials. Turbidity is expected to extend radially from the path traveled by the vessel but not outside of the action area based on suspended sediment plumes observed from the adjacent Puyallup River.

Suspension of anoxic sediment compounds during in-water work can result in reduced DO in the water column within the mixing zone area as the sediments oxidize. Some dredged material may contain sediment with biological and chemical oxygen demand that could temporarily lower local ambient DO levels during dredging. The upper portion of sediment is classified as loam to silt loam while native sediments are sand to loamy sand. Infaunal and benthic organisms inhabit the upper sediment, thus the likelihood of finding much anaerobic sediment in this stratum of sediment is low. Deeper sediment within the dredge prism is more likely to include anoxic compounds. Based on a review of six studies on the effects of suspended sediment on DO levels, LaSalle (1988) concluded that, when relatively low levels of suspended material are generated and counterbalancing factors such as flushing exist, anticipated DO depletion around in-water work activities would be minimal. High levels of turbidity are also expected to cause reductions in DO within the same affected area.

Clamshell dredging, material placement at Saltchuk, and installation of shoreline stabilization measures are expected to result in short-term increases in turbidity and decreases in DO in a linear plume down current from the activity. The small patch of eelgrass near the mouth of the Hylebos Waterway would be at a small risk of becoming buried under fine sediment during material placement at Saltchuk. However, water quality BMP measures described in the BA and additionally in Section 1.3.3, which limit impacts to eelgrass, would be used (e.g., turbidity curtains). The Corps has proposed to monitor turbidity while dredging to adhere to state water quality requirements outlined in the project's Water Quality Certification and would adjust construction actions based on monitoring results to remain in compliance with Washington State water quality standards.

Re-suspended Contaminants

Any sediments determined to be unsuitable for aquatic disposal would be hauled off-site to an appropriate upland disposal site (see Section 2.3.2 for a discussion on chemicals found in the waterway historically). While this removes potentially toxic sediment from the aquatic environment, some amount of resuspension would occur during the dredging process. Bioaccumulated toxins have appeared in fish tissues collected throughout the Puget Sound region, especially in urban areas (Puget Sound Action Team 2007). Concentrations of PCBs and other bioavailable contaminants in biota may increase during dredging, material placement, and installation of shoreline stabilization structures in the Blair Waterway. We anticipate that the increase in contamination concentrations in biota would be a temporary effect due to low concentration levels, which may persist until the cessation of dredging. However, longer term bioaccumulation of some contaminants in higher trophic species, such as PS Chinook salmon and SRKW are possible without strict adherence to BMPs.

Construction Contaminants

Barges and tugs would be used for dredging and material placement. Minor discharges of hydraulic fluid, oils, or fuels from construction equipment is likely to result from the proposed action. The operation of vessels at each location is likely to cause small incidental discharges caused by drippage from engines, which would introduce very small amounts of fuels, oils, or lubricants into the water. Incidental discharge of oils or fuels, and polycyclic aromatic hydrocarbons (PAHs) may also result from exhaust from these kinds of construction vessels, or from accidental introduction of oils or fuels from equipment in contact with water. Best management practices include inspecting all equipment daily for fluid leaks and each vessel would be equipped with a spill kit at all times and would minimize incidental events (see Section 1.3.4 for a list of BMPs). We expect these PAHs and other contaminants to be introduced into the water column during and immediately following the proposed activity. Because these materials can disperse quickly, they can become quite widespread at very low concentration. The environmental fate of each type of PAH depends on its molecular weight. In surface water, PAHs can volatilize, photolyze, oxidize, biodegrade, bind to suspended particles or sediments, or accumulate in aquatic organisms, with bioconcentration factors often in the 10-10,000 range. PAHs can have persistent negative effects on listed species and their critical habitats and are discussed in more detail in Sections 2.4.4 and 2.4.5. Due to the proposed BMPs, no major discharges of PAHs or other contaminants is expected to occur.

Elevated In-water Noise
Noise is expected as a short-term consequence from construction activities during in-water work to dredge and to stabilize the shoreline within Blair Waterway and placement of materials at Saltchuk. Background noise conditions within the waterway are already higher than other marine areas given the intense industrial use associated with the surrounding area.

Noise generated by clamshell dredges is characterized as continuous, since the elevated sound pressure occurs over several seconds (not milliseconds, as is the case with pulsed noise). It is assumed that clamshell dredging would generate noise levels lower than 125 dB_{RMS}. Several pieces of equipment would be operating and producing underwater noise for up to 24 hours per day during the in-water work window for up to four years. It is assumed only one dredge would be operating at a time, but would be running nearly continuously. One to two tugboats for towing barges would be transiting between the waterway and the open-water disposal site and would increase the amount of noise in an area surrounding each construction site and their transit paths. Tugboats have a dominant frequency range of 100-500Hz with a peak output at 170d_{BRMS}. A survey vessel would slowly transit the area to measure dredging progress. Since the aquatic habitat in the waterway is 200 to 250 meters wide (650 to 820 feet wide), even when the dredge is in the center of the channel, there would be a large area available for avoidance of harassment noise levels. Construction generated sound would be attenuated by the surrounding land limiting the radial extent of the elevated noise. Additionally, given that listed species are only expected to be in the Blair Waterway in very low abundances only a small number of fish would be at risk or exposure.

Elevated noise would also occur during installation of shoreline stabilization structures. Secant walls would be installed using augering methods as opposed to impact or vibratory methods, so as to minimize noise during installation. Drilling (augering) is considered a continuous, non-impulsive noise source (NMFS 2020). Dazey et al. (2012) compared vibratory and auger drilling methods and found no significant difference between the two methods. The Corps found as part of a previous evaluation in the Blair Waterway that noise levels were not expected to exceed 160 dB_{RMS} when driving 12-24 inch concrete piles using vibratory methods (BergerADAM 2012). This suggests that augering would result in less noise than alternative methods and remain well below noise thresholds harmful to fish. Area 2 and 3 are located well within the waterway, which would contain drilling noise to the immediate vicinity of the installation site. Site 2, the area closest to the mouth of the Blair Waterway where marine mammals (especially those listed under the ESA) are more likely to be present than inside the waterway, is about 2,200 meters from the mouth of the waterway. Finally, the current 2H:1V riprap slope would attenuate drilling noise as dredging and slope regrading would occur after secant walls are installed. Placement of riprap at areas 1 and 4 is not expected to generate significant noise. Given the high background noise associated with the waterway, the level of noise expected during augering, the amount of time required for installation, and proposed locations within the waterway we do not expect noise to reach harmful levels or to extend outside of the waterway into Commencement Bay.

Forage and Prey Reduction
Removing bottom substrate in Blair Waterway would simultaneously remove the benthic communities that live within those sediments and reduce prey availability in the footprint of the dredge. Among prey fishes, short-term and intermittent exposure to reduced water quality could

result in minor reductions in forage species via gill damage of forage fishes. Suspended sediment would eventually settle in the area adjacent to the dredge prism, which can disrupt benthic prey species, and if the sediments are contaminated, then sublethal toxicity of benthic prey species could occur. These prey then can become a source of bioaccumulation when exposed to toxins, which can degrade the quality of the prey species for salmonids and SRKW. Prey is expected to be reduced in total abundance and in quality during and following construction, and this diminishment would persist for weeks to months after dredging is completed.

Placement of dredged material at the Saltchuk site would likely kill invertebrates present where the bulk of material lands. Negative effects of disposal events include increased turbidity and burial. While turbidity increases dramatically during deposition events, the effects are expected to be transitory (Roegner et al. 2021) and larger organisms would generally be able to flee the area. Sediments would be a similar type and coarseness as what is already present at the site; generally fine grained and silty sand (see section 2.3.2). Other areas with wood waste or fine material would be covered by native material. Covering the wood waste with native material may initially harm habitat during early consolidation because any infauna and epifauna would be exposed to the pore water forced upwards from the wood waste below. Depending on the nature of the disposal material, and the wood waste being covered, this may be a transient, short-lived effect. The overall depth of the area would be reduced to provide shallow water habitat for juvenile salmonids and rockfish. In a relatively short period, organisms from adjacent non-disturbed areas would reestablish in the placement area.

Entrainment and Strike

In this context, entrainment refers to the uptake of aquatic organisms by dredge equipment. Dredge buckets entrain slow-moving and sessile benthic epifauna along with burrowing infauna that are removed with the sediments as well as algae and aquatic vegetation. There is little evidence of mechanical dredge entrainment of mobile organisms such as fish. In order to be struck by or entrained in a dredge bucket, an organism must be directly under the bucket when it drops. The small size of the bucket, compared against the distribution of the organisms across the available habitat make this situation unlikely. That likelihood would decrease after the first few bucket cycles, because mobile organisms are most likely to move away from the disturbance. Further, dredges move very slowly during dredging operations, with the excavator typically staying in one location for many minutes to several hours, while the bucket is repeatedly lowered and raised within an area limited to the range of the crane arm.

Fish that become captured within a digging bucket (entrainment) or that are struck by the bucket as it descends would likely be killed. However, the documented occurrence of these events for mobile fish species are extremely rare. In the Southeast Region of the US, where closely monitored heavy dredging operations occur regularly in areas inhabited by sturgeon and sea turtles, only two live sturgeon (NMFS 2012) and two live sea turtles (NMFS 2011) are known to have been entrained by clamshell dredging since 1990. However, in recent (2019) dredging in Grays Harbor, Washington, a shark or skate was entrained and killed during hydraulic hopper dredging (USACE 2021b). Hydraulic hopper dredging is different than other dredge methods in that the hopper dredge operates for prolonged periods, generating continuous fields of suction forces around and under the dragheads as they are pulled along the substrate at relatively high speeds (NMFS 2018b). Due to differences in methodology the likelihood of entrainment or strike during mechanical dredging is unlikely; small bucket footprint, operation from a stationary crane position, and slow vertical bucket movements decrease risk of entrainment.

2.4.2 Intermittent Effects

Reduced Vessel Traffic

During consultation, NMFS identified current vessel use associated with the existing operation and configuration of the federal navigation channel as part of the environmental baseline (See Section 2.3). Because the deepening of the channel would allow larger vessels to use the Blair Waterway with fewer overall vessel trips, the proposed action would result in a reduction of vessel traffic throughout the action area. A reduction in vessel traffic would result in positive impacts in the Port, Commencement Bay and the shipping channels of Puget Sound. These positive effects, include a reduction of: (a) water quality impacts from vessel use; (b) reduced noise from vessel operation; (c) reduced scour from vessel operation; and (d) a reduction in risk of marine mammal strikes.

The proposed action is estimated to result in about 27% fewer vessel trips to transport the forecasted cargo in 2030 (Table 3). A similar reduction in vessel trips is predicted for 2035 (28%). Reduction is vessel trips would mean reduced underwater noise throughout the central and northern half of Puget Sound on a daily basis, year-round. Specifically, fewer Post Panamax and Super Post-Panamax vessels would call to the Blair Waterway once channel deepening and widening is completed (Table 3). Ultra Post and New Post Panamax vessel calls would remain the same after the channel deepening and widening action is completed. However, it is unclear how long this beneficial effect would last because human population in the Puget Sound and along the west coast is expected to continue to grow and would likely cause shipping demands to increase. In fact, according to the analysis of vessel traffic completed by the Corps, traffic is expected to increase, regardless of channel depth, by 8% from 2030 to 2035. This suggests that over the 50-year period analyzed here vessel traffic could increase by nearly 75% by 2080 (assuming an annual increase of 8% every 5 years). However, based on the Corps' analysis this level of growth would also occur under current channel conditions. The proposed action would cause fewer vessels to be used despite the increased shipping demands. This is discussed in more detail in the Cumulative Effects section (2.5).

As explained above, because the action will enlarge the existing channel, we expect larger vessels to use the waterway, which will result in a decrease the overall number of vessels. We evaluated whether a shift to larger vessels may cause effects on species or habitat, including the potential for a change in noise, ship strikes, and wake effects on Puget Sound shorelines and concluded it would not. We reviewed Coast Guard guidance and regulations governing the safe passage of these vessels (USCG 2019), along with other available information. We found insufficient data to indicate that the larger vessels would cause an increase in negative impacts to listed fish or marine mammals. Therefore, we conclude that any impacts resulting in noise, vessel strikes on marine mammals, and wave height impacts to shorelines will not change compared with the current baseline conditions.

In summary, the proposed action would widen and deepen the federal navigation channel in the Blair Waterway. The action would allow larger vessels, which are capable of carrying more cargo than smaller vessels, to call at the Port of Tacoma. As a result, vessel trips are expected to decrease, at least through 2035. At the same time, vessel traffic overall is expected to increase as a result of increasing demand for products and commodities in the Pacific Northwest. However, that increase does not result from the proposed action, and is expected to be smaller than it would be without the proposed action.

2.4.3 Enduring Effects

Several enduring effects are expected to result from the proposed action including disruption of benthic and shoreline margin productivity within Blair Waterway and improved nearshore habitat quantity and quality at Saltchuk.

Disrupted Habitat Processes – Channel Deepening
The existing channel depth is -51 feet MLLW (environmental baseline), and the proposed action will deepen the Blair Waterway to a depth of -57 feet MLLW. Substrate composition includes sand and silt intermixed with gravel. The proposed dredging of 6 feet is not expected to alter substrate composition or sizes of those materials. However, areas where sediment is removed by dredging will greatly reduce benthic prey communities. The speed of recovery by benthic communities is affected by several factors, including the intensity of the disturbance, with greater disturbance increasing the time to recovery. Additionally, the ability of a disturbed site to recolonize is affected by whether or not adjacent benthic communities are nearby that can recolonize the affected area, and the composition of the species that recolonize the area may differ from a less frequently perturbed area, as disturbances caused by dredging may lead to a decline in sensitive species, to be subsequently replaced by more tolerant species (Ceia et al. 2013). The available information to describe ecosystem responses to dredging indicates that little recovery occurs during the first seven months after dredging. After that, early successional fauna would begin to dominate over the next six months (Jones and Stokes 1998). During that time, the resulting loss of benthic invertebrates reduces the availability of their larvae, as well as the availability of copepods, daphnids, and larval fish that prey on them, which in turn are prey for juvenile salmon (NMFS 2006a).

Disrupted Habitat Processes – Channel Widening
Other than the temporary loss of benthic invertebrates, the proposed widening of the federal navigation channel is not expected to reduce habitat quality for salmonids or rockfish. This is because the navigation channel is not nearshore habitat and under the current environmental baseline, could not return to nearshore habitat. Increasing the depth of deep-water habitat that might provide marginal migration and foraging areas for salmon and rockfish does not result in a loss of habitat quality.

Disrupted Habitat Processes – Shoreline Stabilization
Approximately 2,500 feet (762 meters), around 8% of the shoreline in the federal navigation channel, would require replacement shoreline stabilization to support channel widening efforts. Areas 1 and 4 would require rock-toe riprap armoring and areas 2 and 3 would require secant wall armoring (Figure 2 and Figure 7). Currently, all four areas are armored with riprap and slopes are approximately 2H:1V (Figure 2 and Figure 7). Installation of replacement riprap at areas 1 and 4 would modify slopes to 1.5H:1V and secant wall installation at areas 2 and 3 would maintain 2:1 slopes waterward of the new secant walls. The impacts of hard armor along shorelines are well documented. Armoring of the nearshore can reduce or eliminate shallow

water habitats via two distinct mechanisms. First, bulkheads cause a higher rate of beach erosion waterward of the armoring because there is higher wave energy, compared to a natural shoreline. This leads to beach lowering, coarsening of substrates, increases in sediment temperature, leading to reductions in primary productivity and invertebrate density within the intertidal and nearshore environment (Bilkovic and Roggero 2008; Fresh et al. 2011; Morley et al. 2012; Dethier et al. 2016). As a result of deepening of the intertidal zone adjacent to the bulkhead, as well as increased wave energy, bulkheads also reduce SAV (Patrick et al. 2014). Reduced SAV can reduce spawning habitat (i.e., eelgrass) for Pacific herring, another forage species of Chinook salmon and juvenile PS/GB bocaccio. Reduced SAV also diminishes habitat for juvenile rockfish, which in their pelagic stage rely on SAV for prey and cover for several months. Under baseline conditions, SAV is very limited within the channel and implementation of the proposed shoreline stabilization is unlikely to further reduce SAV density or abundance from its current state. Additionally, shoreline armoring under the proposed action is unlikely to erode current shorelines in the Blair Waterway because those slopes are already heavily armored under the current Congressional authority.

Second, shoreline armoring located within the intertidal zone (below HAT) prevent upper intertidal zone and natural upper intertidal shoreline processes such as accumulation of beach wrack (Sobocinski et al. 2010; Dethier et al 2016). This is an additional mechanism that reduces primary productivity within the intertidal zone and diminishes invertebrate populations associated with beach wrack (Sobocinski et al. 2010; Morley et al. 2012; Dethier et al. 2016). Reductions in forage from shoreline armoring then affects primary productivity and invertebrate abundance in both the intertidal and nearshore environments. Invertebrates are an important food source for juvenile PS/GB bocaccio and PS Chinook salmon and for forage fish prey species of salmonids. However, in this case these natural tidal processes and primary productivity are already severely diminished given the intense industrial development and use within and surrounding the channel.

Commonly, beach erosion is increased by wave energy adjacent to shoreline armoring structures, which prevents the delivery of upland sediment from reaching the beach and erodes sediment waterward of armoring structures. Finer material like gravel and sand provide important spawning substrate for sand lance and surf smelt. Therefore, a reduction of this substrate type within the intertidal and nearshore zone as a result of armoring would reduce potential spawning habitat availability and fecundity of both species (Rice 2006; Parks et al. 2013), which are both important prey species for ESA-listed salmonids. Thus, the loss of material below armoring, together with the loss of upland sources of material from above the armoring, over time, can affect the migration and growth of juvenile salmonids (primarily PS Chinook salmon) by reducing the amount of available shallow habitat that juveniles rely on for food and cover, and by preventing access to habitat upland of armoring at high tides. Both salmonids and juvenile bocaccio are affected by the loss of prey communities. However, current shoreline habitat in the Blair Waterway is fully developed and would not deliver suitable forage fish spawning habitat if the proposed action were not to occur.

Along with the physical loss of habitat, the impacts of nearshore modification commonly include the loss of functions such as filtration of pollutants, floodwater absorption, shading, sediment sources, and nutrient inputs. Shoreline armoring generally reduces the sediment available for transport by disconnecting the sediment source, e.g. a feeder bluff, from the drift cell, potentially causing loss of beach width and height as transport of material outpaces supply. This can occur at the site of the structure or down the drift cell. Structures in the intertidal zone change the hydrodynamics of the waves washing up on the beach. Hard structures reflect waves without dissipating their energy the way a natural beach would, especially if vegetation is present. This energy can lower the beach, make it steeper, and wash away fine sediments. Dikes and fill reduce estuarine wetlands and other habitat for salmon, forage fish, and eelgrass.

When the physical processes are altered, there is also a shift in the biological communities. The number and types of invertebrates, including shellfish, can change; forage fish lose spawning areas; and juvenile salmon and forage fish lose the feeding grounds that they use as they migrate along the shore (Shipman et al. 2010). Native shellfish and eelgrass have specific substrate requirements and altered geomorphic processes can leave shellfish beds and eelgrass meadows with material that is too coarse or with too much clay exposed. Shoreline armoring can also physically bury forage fish spawning beaches when structures are placed in or too close to the intertidal zone. When shoreline development removes vegetation, the loss of shading and organic material inputs can increase forage fish egg mortality (Penttila 2007). Surf smelt, for example, use about 10 percent of Puget Sound shorelines for spawning and many bulkheads are built in forage fish spawning habitat, threatening their reproductive capacity (Penttila 2007). The effects of nearshore modification cascade through the Puget Sound food web. The consequences can be seen in the population declines of a variety of species that depend on these ecosystems, from shellfish, herring, and salmon to orcas, great blue heron, and eelgrass.

Habitat conditions within the federal navigation channel are poor and provide little utility for salmonids or rockfish. However, the proposed stabilization measures would further degrade habitat relative to current conditions. Specifically, shoreline slopes would become steeper as a result of the action in areas 1 and 4, where slopes would increase to 1.5H:1V from 2H:1V. Increased slopes would result in reduced wave attenuation and increased energy and erosion rates. Wave attenuation would decrease along riprap armored shore and would reduce habitat for benthic invertebrates by increasing scour along the shoreline.

Improved Habitat Quantity and Quality at Saltchuk
Beneficial use of dredged material at Saltchuk is expected restore nearshore intertidal and subtidal habitat substrate conditions. Based on the capacity of Saltchuk, the quantity estimated for nearshore placement is approximately 1.8 million cubic yards from the Blair Waterway, to convert approximately 40.9 acres of deep zone (DZ) habitat to lower shore zone (subtidal and intertidal habitat). At full build-out, the shallow subtidal bench would start at approximately -10 MLLW and slope gradually up to approximately -6 MLLW across the bench. Eelgrass may establish in this area naturally from the nearby eelgrass patch. Increasing eelgrass habitat would increase potential spawning habitat for Pacific herring and create important nursery habitat for other marine species including ESA-listed salmonids and rockfish. Target species to benefit from the material placement include juvenile and adult Chinook salmon, adult and juvenile PS steelhead, and larval and juvenile PS/GB bocaccio as well as other ESA-listed species, like bull trout.

Although a relatively long-term and enduring benefit, the sediment placement at Saltchuk is only proposed during the four years of proposed dredging. For the purposes of this analysis, NMFS assumes that over time the benefits would likely diminish as sediment is transported to other areas via currents and tidal fluctuations. The beneficial effects of placing materials at the Saltchuk site would slowly diminish over time under erosion pressures from vessel traffic and natural wave energy if not maintained to a point that natural processes are self-sustaining[21]. As described in Section 1.3.2, NMFS assumes that a fully developed Saltchuk site plan is reasonably likely to occur in collaboration with NMFS and the non-federal sponsor; however, insofar as the project details are unavailable for analysis, we assume that the deposit of beneficial use sediment will occur at the Saltchuk site, but we do not assume that the site will remain for more than 50 years or develop into a fully restored site without future efforts.

2.4.4 Effect on Critical Habitat

Critical habitat for PS Chinook salmon is designated within the action area and would be impacted by temporary and enduring effects of the proposed action. Critical habitat for PS steelhead, PS/GB bocaccio and PS/GB Yelloweye rockfish has not been designated in the Blair Waterway or at the Saltchuk site. NMFS reviews the proposed actions effect on critical habitat by examining how the PBFs of critical habitat would be altered, the duration of such changes, and the influence of these changes on the potential for the habitat to serve the conservation values for which it was designated.

PBFs of nearshore habitat for PS Chinook salmon include complexity, absence of artificial obstructions, natural cover, adequate water, and high water-quality. The nearshore environment supports various life stages of PS Chinook salmon including growing and sexually maturing adults, migrating spawners, and rearing and growing juveniles.

The proposed action would occur for four years between August 16 and February 15. Dredging, shoreline stabilization, and material placement at Saltchuk would disturb bottom substrates, causing temporary effects to the following PBFs of critical habitat for PS Chinook salmon:

1. Estuarine areas free of obstruction and excessive predation with: water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater;
2. Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and
3. Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Intermittent and enduring effects to PS Chinook salmon critical habitat include reduced vessel traffic and increased nearshore habitat quantity and quality at Saltchuk, respectively. Other than the temporary loss of benthic invertebrates, the proposed widening and deepening of the federal navigation channel is not expected to reduce habitat quality for salmonids. This is because the

[21] Further modeling and analysis during PED may provide additional information to inform this assumption. Moreover, monitoring of the site would provide important data on how the site changes over time and whether sediment remains in place.

navigation channel is not currently nearshore habitat, and under the current environmental baseline, could not return to nearshore habitat. Increasing the depth of deep-water habitat that might provide marginal migration and foraging areas for salmon does not appreciably result in a loss of habitat quality; and widening the channel actually provides more habitat that can be occupied by salmon and rockfish, albeit that habitat is of very limited quality.

Water Quality

Turbidity and Dissolved Oxygen

Dredging would degrade water quality in the Blair Waterway surrounding the area actively being dredged by temporarily elevating suspended sediments and turbidity and decreasing DO. We do not expect water quality degradation to extend past the 3-mile radius that would be affected by dredging, disposal, and construction. Similar water quality degradations are expected at Saltchuk during material placement. Dredging in Blair Waterway and material placement at Saltchuk is not expected to cause measurable changes in water temperature and salinity. Turbidity, suspended sediments, and DO are expected to return to baseline within a matter of days after work ceases. However, given that the dredging equipment is expected to operate continuously throughout the in-water work window (August 16 – February 15) water quality would remain degraded for a significant portion of the year and likely preclude fish access to Blair Waterway and Saltchuk by disrupting passage until construction is completed each year. As such, elevated turbidity and reduced DO would force any fish utilizing the Blair Waterway or Saltchuk restoration site to seek suitable habitat elsewhere. These sites are unlikely to return to baseline conditions until after work ceases in February at the conclusion of each construction year and fish would not be expected to return until baseline conditions return. The Corps would work with the Washington Department of Ecology for certification under Section 401 of the Clean Water Act to ensure the project meets state water quality standards and area of mixing are minimized to less than 300-feet.

Suspended Contaminants

Contaminants held in benthic sediments unsuitable for aquatic disposal would be re-suspended into the water column during dredging activities. This aspect of water quality degradation would temporarily impair the value of critical habitat for growth and maturation of juvenile salmonids during the in-water work window (August 16 – February 15) by exposing them to pollutants with both immediate and latent health effects, and could incrementally impair forage/prey communities that are exposed to the contaminants, delaying the speed that these communities re-establish after being physically disrupted by dredging. This impairment of the water quality PBF is also expected to persist for the duration of annual in-water work due to the continuous operation of dredging and construction equipment. Even though suspended contaminants typically resettle in the benthos after a short period of time (hours to days depending on currents) the continuous operation of dredging and construction equipment would ensure that benthic sediments and any associated contaminants remain suspended until sufficient time has passed following cessation of construction to allow contaminants to redeposit in benthic sediments. This temporary impairment results in adverse effects to water quality PBFs for PS Chinook salmon.

Forage and Prey
Designated critical habitat for PS Chinook salmon would experience temporary declines in forage and prey communities.

Dredging and material placement would disturb sediment, and consequently disrupt the benthic communities that live within those sediments, reducing prey availability in the footprint of the dredging area and adjacent areas where suspended sediment settles out. Among prey fishes, short-term and intermittent exposure to reduced water quality could result in minor reductions in juvenile salmonid prey species via gill damage to forage fishes. Suspended sediment would eventually settle out in the area adjacent to dredged sites, which can smother benthic prey species. Additionally, if the sediments are contaminated, then sublethal toxicity effects of benthic prey species may occur.

Dredging activities cause short-term changes in the characteristics of the benthic in-faunal biota, of which the majority are expected to recover within a few months to two years after dredging is completed. For example, Romberg et al. (2005), studying a subtidal sand cap placed to isolate contaminated sediments in Elliott Bay, identified 139 species of invertebrates five months after placement of the cap. The benthic community reached its peak population and biomass approximately two and one-half years after placement of the cap, while the number of species increased to 200 (Wilson and Romberg 1996).

In this case, because dredging within Blair Waterway is expected to take four years, as is the associated placement of dredged material at Saltchuk, recovery of benthic communities within the impacted areas to baseline conditions is unlikely to begin until after the project is completed. This means that full recovery may not occur until two years after completion of the project. While disruption of the benthic environment in the Blair Waterway would be temporary and recover to baseline in a manner of months to years after the project is completed, the benthic communities would be impaired during that time resulting in adverse effects to the forage and prey PBF of salmon critical habitat.

Conversely, over months to one year, material placement at Saltchuk is expected to improve critical habitat conditions for benthic communities and forage fish, providing a positive impact on the quality of PS Chinook salmon critical habitat at Saltchuk (discussed in more detail in the Effect on Species section below). Overtime, the beneficial use of dredged materials at Saltchuk would increase prey base, increase forage opportunities, create new rearing habitat and cover opportunities, and improve migratory pathways for juveniles and adults. While benefits may be realized within months of material placement, it would take several years with additional restoration to be fully functional. Additional restoration measures, such as establishing aquatic vegetation or supplementing the sediment through time, would be necessary to achieve full restoration potential of the Saltchuk site. Without additional maintenance and restoration measures, we expect the benefits of material placement at Saltchuk to diminish during the 50-year period analyzed in this Opinion as sediment is transported by currents and tidal fluctuations.

Degraded Shoreline Habitat

Bank armoring degrades sediment conditions, forage base, and access to shallow water waterward of the structures. Armoring also prevents access to forage and shallow water habitat upland of the structures during high tides. Shoreline armoring is extensive in urban areas worldwide, but the ecological consequences are poorly documented. A study by Morley et al. (2012) mapped shoreline armoring along the Duwamish River estuary and evaluated differences in temperature, invertebrates, and juvenile salmon diet between armored and unarmored intertidal habitats. Epibenthic invertebrate densities were over tenfold greater on unarmored shorelines and taxa richness double that of armored locations. Over 66 percent of the Duwamish shoreline is armored, similar to much of south and central Puget Sound, the impacts from armoring, and denying access to potential food sources, can effect overall fish health, growth, and survival.

As described above, shoreline armoring typically coarsens sediments waterward of shoreline armoring by concentrating marine energy and washing away finer sediments. Because armoring located within the intertidal zone (below HAT) would typically prevent upper intertidal zone and natural upper intertidal shoreline processes such as deposition and accumulation of beach wrack from occurring a reduction of primary productivity within the intertidal zone and diminish invertebrate populations would be expected (Sobocinski et al. 2010; Morley et al. 2012; Dethier et al. 2016). Reductions in forage may result from armoring effects on primary productivity and invertebrate abundance in the intertidal and nearshore environments. Invertebrates provide an important food source for juvenile PS Chinook salmon and for forage fish prey species of salmonids. Under the degraded and industrialized condition of the Blair Waterway, both physical and biological conditions are unlikely to be severely changed as a result of the proposed action.

The loss of marine shoreline material, over time, can affect the migration areas of juvenile salmonids by reducing the amount of available shallow habitat that juveniles, both by steepening shore areas waterward of armoring, and, particularly during high tides, creating a physical barrier that obstructs water from reaching high shore areas.

While the amount of shoreline habitat providing any value to listed species in the navigation channel is extremely limited, the installation of shoreline armoring would degrade shoreline areas further by slightly increasing channelization and erosion. The riprap may provide some substrate for macroinvertebrates, cover and forage opportunities for juvenile salmonids and rockfish, and the shallower slope reduces predation risk. The proposed 1.5H:1V riprap armoring at areas 1 and 4 would not change habitat conditions substantially from current conditions. In summary, the degraded and industrialized baseline condition of the Blair Waterway is unlikely to change physical and biological conditions as a result of the proposed action, although these actions will continue to prolong recovery of listed populations in the action area.

Summary of Effects to Critical Habitat

Impairment to PS Chinook salmon PBFs would result from temporary adverse effects to water quality, including turbidity, low DO, and re-suspending unsuitable sediments. Within months to one year, material placement at Saltchuk is expected to improve critical habitat conditions for PS Chinook salmon PBF. Over a period of years to a few decades, the beneficial use of dredged materials at Saltchuk would increase prey base, increase forage opportunities, create new rearing habitat and cover opportunities, and improve migratory pathways for juveniles and adults.

2.4.5 Effects on Species

Effects on listed species is a function of (1) the numbers of animals exposed to habitat changes or effects of an action; (2) the duration, intensity, and frequency of exposure to those effects; and (3) the life stage at exposure.

As noted above, the project has temporary, intermittent, and enduring effects. Our exposure and response analysis identifies the multiple life stages of listed species that use the action area, and whether they would encounter these effects, as different life-stages of a species may not be exposed to all effects, and when exposed, can respond in different ways to the same habitat perturbations.

Period of Exposure and Species Presence

Dredging would occur throughout the in-water work window of August 16 through February 15 for up to four years to achieve target depths. The in-water work window co-occurs with the presence of various PS Chinook salmon and PS steelhead life stages in Commencement Bay and its tributaries including the Puyallup River, Hylebos Creek, and Wapato Creek (Table 10).

Table 10. Expected use of the Commencement Bay and Blair Waterway action areas by listed species. Spring Chinook salmon are exclusive of the White River, while fall Chinook salmon and winter steelhead are widely dispersed throughout the greater Puyallup River basin.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
IWWW												
Spring Chinook			Adult Migration									
	Juvenile Migration											
Fall Chinook						Adult Migration						
	Juvenile Migration											
Winter Steelhead	Adult Migration											
			Juvenile Migration									
Rockfish			Juveniles					Juveniles				

Chinook salmon

Two distinct populations of Chinook salmon are present in the Puyallup River Basin: White River spring Chinook and Puyallup River fall Chinook salmon. White River spring Chinook salmon are the only remaining spring stock in the south/central Puget Sound region (Marks et al. 2018, Ruckelshaus et al. 2002, NWFSC 2015, and Ford, in press). Adult spring Chinook salmon migrate through Commencement Bay to the Puyallup River as early as March or April, while adult fall Chinook salmon generally enter the Puyallup River June through early November on their way to spawning habitat (Marks et al. 2018) (Table 10). Adults are expected to occur in the deep, open-water areas around the Blair Waterway and in Commencement Bay during the winter of their upstream spawning migration. Adult fish would typically be oriented to the outflow of the Puyallup River. The work window avoids spring Chinook salmon presence, but does not avoid all exposure in the fall (between August 15 and November).

Juvenile Chinook salmon typically use shallow water marine habitat to rear, grow, and feed. These components were mostly eliminated by the industrial development and use of the estuary. Juvenile salmonid trapping by the Puyallup Tribal Fisheries Department observed juvenile Chinook salmon emigrating from the lower Puyallup River (River Mile 10.6) as early as January and as late as August, although the peak outmigration is typically late May (Marks et al. 2018) (Table 10). Historic beach seine sampling (1980-1995) in the Blair Waterway generally captured juvenile Chinook salmon after mid-February and before mid-August, with a peak around the end of May (Pacific International Engineering 1999). Additionally, data suggests that Chinook salmon fry and sub-yearlings that out-migrate past the Puyallup River before June spend more time in the lower Puyallup River to become acclimated to the salinity, and fish that move into Commencement Bay before reaching 55 mm have a higher mortality than larger juveniles later in the season (Marks et al 2018). The proposed dredging to occur in January and February would have limited overlap with early-migrating juvenile Chinook salmon because many would still be rearing in the lower Puyallup River. The proposed work window would minimize overlap of temporary construction effects with outmigrating and rearing juvenile Chinook salmon in the Blair Waterway and Commencement Bay, but would not avoid all exposure.

<u>*PS Steelhead*</u>
Two distinct populations of steelhead occur in the Puyallup Basin: 1) Puyallup/Carbon winter steelhead and 2) White River winter steelhead (Hard et al. 2015; WDFW 2015). These populations typically enter the river in January and then hold throughout the river until moving to spawning grounds between March and June (NMFS 2005b) (Table 10). However, a few summer-run strays, likely from the Green or Skykomish rivers, are caught annually during August and September in the lower Puyallup (Marks et. al 2014). Mainstem spawning occurs as low as RM 10 in the Puyallup River and RM 3 on the Carbon River (Pierce County 2013). Adults are expected to occur in the deep, open-water areas around the Blair Waterway during the winter of their upstream spawning migration, and would be oriented to the outflow of the Puyallup River.

Juvenile steelhead outmigration in the Puyallup River system generally occurs between April and July (Berger et al. 2011) (Table 10). However, steelhead smolts have been found in low abundances in the marine nearshore, outside of their natal estuary, between May and August (Brennan et al. 2004), which overlaps about 2 weeks with the in-water work window. Juveniles are not anticipated to be in the nearshore zone of the project area in large numbers because the majority of steelhead smolts migrate directly to the open ocean and do not rear extensively in the estuarine or coastal environments (Burgner et al. 1992; Goetz et al. 2015). The proposed work window would minimize overlap of temporary construction effects with the presence in nearshore habitat of juvenile PS steelhead in the action area, but would not avoid all exposure.

Rockfish

Larval rock fish presence peaks twice in the spawning period, once in spring and once in late summer (Table 10). As described in the Species Status section (2.2.1) PS/GB bocaccio frequently utilize nearshore environments during larval and juvenile life stages. Studies have observed rockfish larvae at the Commencement Bay open-water disposal site during the proposed in-water work window (August 16 through February 15), suggesting larvae may be present during dredging and material placement at Saltchuk (Greene and Godersky 2012; NMFS 2015). The in-water work window avoids the earliest and largest density peaks of rockfish in April and August. Observations of rockfish larvae density at the Commencement Bay open water disposal site between April 2011 and February 2012 reached 150 larvae per 1,000 cubic meters in May, 100 larvae per 1,000 cubic meters, and fell to zero in the winter (Greene and Godersky 2012) (Figure 13).

The presence of adult PS/GB bocaccio and yelloweye rockfish in the action area is extremely low. Suitable habitat is extremely limited in the work area for is this life stage as preferred habitat depths and features such as rugosity are lacking. Adult rockfish are not expected to occur in Blair Waterway given that the channel contains shallow sandy-bottom habitat and is not near typical rockfish spawning locations. However, given the ability of this species to move throughout the marine environment, we cannot preclude that they would not occasionally enter in the Blair Waterway. It is likely that adult rockfish would be present in Puget Sound shipping lanes associated with the Port of Tacoma (Figure 1), but it would be unlikely that they would be exposed to project effects due to the depth of habitat they typically occupy.

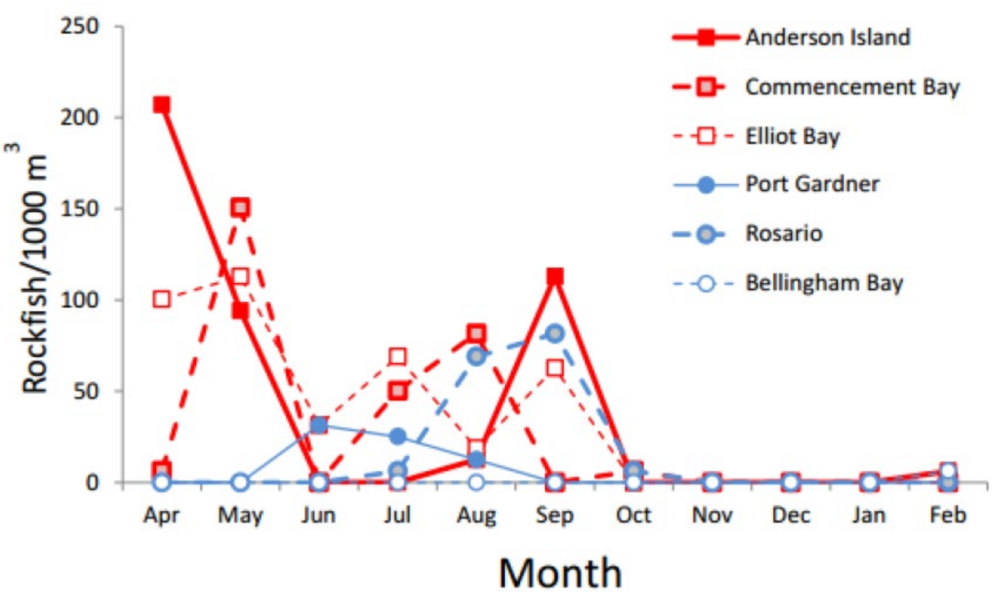

Figure 13. Rockfish density per 1,000 cubic meters at six sediment disposal sites in the Puget Sound from April 2011 through February 2012. (Adapted from Green and Godersky 2012).

Temporary Effects

Response to Degraded Water Quality

The proposed in-water work would temporarily affect water quality through increased turbidity and mobilized unsuitable sediments during dredging and material disposal at Saltchuk. It may also temporarily reduce DO. NMFS estimates that all detectable water quality impacts would be limited to the extent of the project-related turbidity, up to 3-miles radially, and would return to background levels shortly after the end of construction (hours to days).

Turbidity and Dissolved Oxygen

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

Water quality is considered adversely affected by suspended sediments when turbidity is increased by 20 NTU over background conditions for a period of 4 hours or more (Berg and Northcote 1985; Robertson et al. 2007). The effects of turbidity on fish are somewhat species and size dependent. In general, severity typically increases with sediment concentration and duration of exposure, and decreases with the increasing size of the fish. Bjornn and Reiser (1991) report that adult and larger juvenile salmonids appear to be little affected by the high concentrations of suspended sediments that may be mobilized during storm and snowmelt runoff episodes. However, empirical data from numerous studies report the onset of minor physiological stress in juvenile and adult salmon after one hour of continuous exposure to suspended sediment concentration levels between about 1,100 and 3,000 mg/L, or to three hours of exposure to 400 mg/L, and seven hours of exposure to concentration levels as low as 55 mg/L (Newcombe and Jensen 1996). The authors reported that serious non-lethal effects such as major physiological stress and reduced growth were reported after seven hours of continuous exposure to 400 mg/L and 24 hours of continuous exposures to concentration levels as low as about 150 mg/L.

Mechanical dredging in areas containing high levels of fine-grained material is likely to cause suspended sediment plumes that could extend 200 to 500 feet down-current from the point of dredging, and may take hours after work has stopped to return to background levels. LaSalle et. al. (1991) reported suspended sediment concentrations of about 700 mg/L at the surface, and 1,100 mg/L near the bottom, about 300 feet from clamshell dredging in areas containing high levels of fine-grained material. During monitored clamshell dredging of inner Grays Harbor, the suspended sediment concentrations exceeded 500 mg/L in 23 of 600 samples, and seven of those samples were for tests of ambient conditions (COE 2011b). The single highest reported concentration was 3,000 mg/L when the ambient TSS concentration was 700 mg/L. The dredging contractors would be required to monitor and limit turbidity according to the water quality monitoring plan. State water quality standards require that turbidity not exceed 5 NTUs above background when ambient conditions are less than 50 NTUs; and no more than 10 NTUs above background when ambient conditions are above 50 NTUs.

Tugboat propeller wash would also mobilize bottom sediments. The intensity and duration of the resulting turbidity plumes are uncertain, and would depend on a combination of the tugboat's thrust, the water depth under it, and the type of substrate. The higher the thrust and the finer the sediment, the more sediment that is likely to be mobilized. Fine material (silt) remains mobilized longer than coarse material (sand). The shallower the water, the more thrust energy that would reach the substrate. A recent study described the turbidity caused by large tugboats operating in Navy harbors (ESTCP 2016). At about 13 minutes, the plume extended about 550 yards (500 m), where the TSS concentration was about 80 mg/L. The plume persisted for hours and extended far from the event, but the TSS concentration fell to 30 mg/L within 1 hour and to 15 mg/L within 3 hours. At its highest concentration, the plume was below the concentrations required to elicit physiological responses reported by Newcombe and Jensen (1996). The exact extent of turbidly plumes from tugboat operations for this project are unknown, but it is extremely unlikely that would exceed those described above. Based on that information, and on the consultations for similar projects in the region, sediment mobilization from tugboat propeller wash would likely consist of relatively low-concentration plumes that could extend to about 300 feet from the site, and last a low number of hours after the disturbance. However, work-related tugboat turbidity would be indistinguishable from the turbidity caused by the high levels of routine vessel operations in and around the project site. Shipping traffic throughout the action areas routinely disturbs sediments. Any temporary increase in turbidity as a result of the proposed action is not anticipated to measurably exceed levels caused by normal periodic increases due to this industrial traffic or highly turbid water from the Puyallup River within the waterways. The generally slow velocity of water movement within the navigation channel would also greatly minimize the potential negative effects of temporarily increased turbidity.

Elevated suspended sediments affect ESA-listed species in several ways, including: (1) reduction in feeding rates and growth, (2) physical injury, (3) physiological stress, (4) behavioral avoidance, and (5) delayed migration. Laboratory studies have consistently found that the 96-hour median lethal concentration of fine sediments for juvenile salmonids is above 6,000 mg/L (Stober et al. 1981) and 1,097 mg/L for 1 to 3-hour exposure (Newcombe and Jensen 1996). Lethal concentrations and duration of exposure are not likely to occur for several reasons. LaSalle et al. (1991) determined that, within 300 feet of bucket dredging fine silt or clay, the expected concentrations of suspended sediment would be about 700 and 1,100 mg/L at the surface and bottom of the water column, respectively. Studies have shown that salmonids have an ability to detect and distinguish turbidity and other water quality gradients (Quinn 2005; Simenstad 1988), and that larger juvenile salmonids are more tolerant to suspended sediment than smaller juveniles (Servizi and Martens 1991; Newcombe and Jensen 1996).

In addition to this behavioral response, however some exposure to suspended sediments is likely and can elicit an array of responses. Even moderate levels of suspended sediment exposure not associated with gill damage can affect the respiratory ability of salmonids (Waters, 1995) and trigger an acute stress response (Michel et al., 2013). Some sediment-associated stress responses include elevated plasma glucose and plasma cortisol (Redding et al. 1987, Servizi and Martens, 1992), increased cardiac output (Bunt et al., 2004), and changes in hematological parameters (Lake and Hinch, 1999, Michel et al., 2013). Suspended solids are also known to impact fish's feeding ability (e.g. due to impaired spotting of prey), routine activity, and stress levels (Berg and Northcote, 1985, Sweka and Hartman, 2001, De Robertis et al., 2003, Robertson et al., 2007, Awata et al., 2011). Behavioral responses (e.g., alarm reaction and avoidance of the plume) can occur with only six minutes of exposure (Newcombe and Jensen 1996). Physiological effects (e.g., gill flaring and coughing) may occur with 15 minutes of exposure, temporary reduced feeding rates and success with 1 hour of exposure, and moderate levels of stress with 3 hours of exposure (Newcombe and Jensen 1996).

Disposal of sediment at the Saltchuk site would also expose juvenile salmonids and juvenile and larval rockfish to elevated turbidity and associated adverse effects. While we expect juvenile/larval rockfish presence to be low, we cannot rule out the possibility of individuals occupying the site. For periods when larval rockfish and dredge disposal co-occur, determining the extent of effect is dependent upon the frequency of disposal, estimated sediment concentrations, and the relative abundance of ESA-listed rockfish. Furthermore, the concentrations and duration of suspended sediments within the water column depends upon the depth, currents, and composition of the material, and concentrations would injure or kill them or alter their feeding rate. A number of studies have assessed suspended sediment effects on Pacific herring larvae, as well as other marine fish. Larval herring death rates ranged from 82.8 to 99.4%, compared to 23.6% of the control group when they were exposed to suspended sediment levels of 10,000, 5,000, and 500 mg/l for four days (Morgan and Levings 1989). Larval herring had abraded yolk sacs that increased relative to the concentration when exposed for 24 hours to suspended sediment concentrations of up to 8,000 mg/l (Boehlert 1984), and their feeding rates were observed to maximize when concentrations reached 500 mg/l, and decreased at higher concentrations (Boehlert and Morgan 1985). When exposed to 10,000, 5,000, and 500 mg/l for ten days, larval lingcod death rates ranged from 90 to 98%, compared to 18% in a control group (Morgan and Levings 1989). None of the aforementioned studies replicate the short term but very high concentrations of suspended sediment that would result from sediment disposal at Saltchuk.

Given the extreme fragility of larval rockfish, some fish within the water column at Saltchuk would be injured or killed by ruptured capillaries, maceration of highly vascular organs and internal bleeding. As an example of their fragility, larval rockfish were observed to be injured by strong flowing water in laboratory-rearing environments (Canino and Francis 1989). We do not expect juvenile Chinook salmon or steelhead or juvenile rockfish to be nearly as susceptible to the effects from sediment disposal as larval rockfish, due to the swimming abilities of juveniles being more advanced than the larval lifestage. However, we do expect proportional or exposed juveniles to be harmed and or killed as a result of sediment disposal at Saltchuk. Therefore, we find the effects of sediment disposal in the form of elevated turbidity to be adverse.

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

Despite being present during a small portion of the work window, juvenile PS steelhead are not nearshore dependent and are not expected to be in the nearshore in large numbers. Juvenile steelhead (smolts) are between 150 – 250 mm upon entering the marine environment and are considered agile swimmers. Those present are expected to be only briefly in the area where elevated suspended sediment would occur (within a 150- to 300-foot radius to account for the point of compliance for aquatic life turbidity criteria) and to have strong capacity as larger juveniles to avoid areas of high turbidity. In the event that there is a contemporary decrease in DO within sediment plumes, we do not anticipate a significant behavioral response from steelhead to reduced DO because we expect that they would have only brief exposure to the affected area. Therefore, we consider temporary exposure to low DO would not be sufficient to cause any injury or harmful behavioral response to juvenile PS steelhead.

Juvenile PS Chinook salmon are likely to be present during in-water construction activities and likely to be exposed to the temporary construction effects, most notably elevated levels of suspended sediment. Turbidity and TSS levels would return to background levels quickly and be localized to the in-water construction areas (150- to 300-foot radius turbidity mixing zone). Again, decreased DO is expected to be contemporaneous with and in the same footprint of the suspended sediment. While juvenile PS Chinook salmon may encounter these areas, they can detect and avoid areas of high turbidity, and exposure is expected to be brief. Thus, duration and intensity of exposure of juvenile PS Chinook salmon is also unlikely to cause injury or a harmful response. Those that engage in avoidance behaviors or with raised cortisol levels may have decreased predator detection and avoidance increasing the likelihood of predation.

Larval yelloweye and bocaccio rockfish would be present at the project site because they passively drift and distribute with prevailing currents, although we find the likelihood of a large abundance of individuals to be relatively low (see section 2.4.5 – Period of Exposure and Species Presence) (Greene and Godersky 2012). However, larval rockfish, given their limited swimming abilities may be disproportionally exposed to effects from the resulting plume and harmed by the high turbidity and low DO conditions. Because the Blair Waterway lacks deep water, suitable rocky substrate, and preferred aquatic vegetation (kelp and eelgrass), the likelihood of adult and juvenile rockfish presence is low. The turbidity plume and low DO expected resulting from dredging the sandy substrate of Blair Waterway may have sublethal effects such as gill irritation, and would cause juvenile rockfish to flee the area or find refuge in clearer water outside of the dredging footprint. While we expect abundance to be low, larval or juvenile rockfish that are exposed to high turbidity and associated degraded DO are likely to be harmed or killed as a result.

Re-suspended Contaminants

Dredging within Blair Waterway and material disposal at the Saltchuk site would re-suspend toxic contaminants. Saltchuk exists within the Commencement Bay, Nearshore/Tide Flats Superfund site, although there are no HTRW sites that overlap with Saltchuk. The Blair Waterway was historically considered a Superfund site, although it was delisted in 1996. Both sites have the potential to harbor contaminants in stored in sediments. A feasibility-level sediment characterization regarding the potential suitability of up to 2.5 million cubic yards (cy) of dredged material from the Blair Waterway for open-water disposal at the Commencement Bay disposal site or for potential beneficial use was summarized in an advisory memorandum (DMMP 2019). Concentrations of PAHs and PCBs in the sediments within the project area were quite low in the advisory characterization (DMMP 2019). PCBs exceeded the DMMP screening level (SL) in only one location, which was a sideslope area near Washington United Terminal. A screening level of 2,000 µg/kg was used for determining potential for beneficial use of sediment based on a 2014 NMFS proposed total PAH SL[22]. There were no SL exceedances for any individual or summed PAHs in any of the samples. The proposed action would cause chemicals such as PAHs to be re-suspended into the water column. There are two pathways for PAH exposure to listed fish species in the action area, direct uptake through the gills and dietary exposure (Lee and Dobbs 1972; Neff et al. 1976; Karrow et al. 1999; Varanasi et al. 1993; Meador et al. 2006; McCain et al. 1990; Roubal et al. 1977). Fish rapidly uptake PAHs through their gills and food but also efficiently remove them from their body tissues (Lee and Dobbs 1972; Neff et al. 1976). Juvenile Chinook salmon prey, including amphipods and copepods, uptake PAHs from contaminated sediments (Landrum and Scavia 1983; Landrum et al. 1984; Neff 1982). Varanasi et al. (1993) found high levels of PAHs in the stomach contents of juvenile Chinook salmon in the Duwamish estuary. The primary response of exposed salmonids, from both uptake through their gills and dietary exposure, are immunosuppression and reduced growth. Karrow et al. (1999) characterized the immunotoxicity of creosote to rainbow trout (*O. mykiss*) and reported a lowest observable effect concentration for total creosote of 17 µg/l or 611.63 ng/l PAHs. Varanasi et al. (1993) found greater immune dysfunction, reduced growth, and increased mortality compared to control fish. In order to isolate the effects of dietary exposure of PAHs on juvenile Chinook salmon, Meador et al. (2006) fed a mixture of PAHs intended to mimic those found by Varanasi et al. (1993) in the stomach contents of field-collected fish. These fish showed reduced growth compared to the control fish. Of the listed fish exposed to PAHs and other contaminants, all are likely to have some degree of immunosuppression and reduced growth, which, generally, increases the risk of death.

The number of years that detectable amounts of contaminants would be biologically available at the site is uncertain. Similarly, the annual numbers of juvenile PS Chinook salmon and juvenile PS steelhead that may be exposed to construction-related contaminated forage are uncertain and likely to be highly variable, as are the amounts of contaminated prey that individual fish may consume, or the intensity of effects that exposed individuals may experience. We expect that some individual listed fish species would experience sublethal effects from elevated turbidity, low DO, and re-suspended contaminants such as stress and reduced prey consumption, some may respond with avoidance behaviors, and some may be injured. We expect sediment impacts would adversely affect PS Chinook salmon and PS steelhead at multiple life stages, and juvenile and larval PS/GB yelloweye and bocaccio rockfish.

Response to Entrainment and Strike During Dredging

In this context, entrainment refers to the uptake of aquatic organisms by dredge equipment (i.e., the dredge bucket). Dredge buckets entrain slow-moving and sessile benthic epifauna along with burrowing infauna that are removed with the sediments. They also entrain algae and aquatic

[22] The National Marine Fisheries Service (NMFS) proposed a screening level of 2,000 µg/kg total PAH for the protection of fish at the Regional Sediment Evaluation Team annual meeting in November 2014 (DMMP 2019).

vegetation. Fish that become captured within a digging bucket or that are struck by the bucket as it descends would likely be killed. However, the documented occurrence of these events for mobile fish species are extremely rare. In the Southeast Region of the US, where closely monitored heavy dredging operations occur regularly in areas inhabited by sturgeon and sea turtles, only two live sturgeon (NMFS 2012) and two live sea turtles (NMFS 2011) are known to have been taken by clamshell dredging since 1990. However, recently dredging in Grays Harbor, Washington a shark was killed after it was entrained by a hopper dredge (USACE 2021b).

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

Adult PS Chinook salmon and PS steelhead may pass through the area during migration to their natal streams. Adult PS Chinook salmon and adult PS steelhead are strong swimmers that are likely to avoid the noise and activity, which would reduce the likelihood of entrainment or strike. Similarly, juvenile PS Chinook and PS steelhead are unlikely to be entrained or struck by construction equipment for the same reasons and are unlikely to be in the area in appreciable number further reducing the encounter potential. Based on the best available information described above, NMFS considers the risk of entrainment or strike occurring to adult and juvenile PS Chinook salmon PS steelhead to be low. Risk to adult rockfish, yelloweye and bocaccio, is also low because they are unlikely to be present in the dredging areas. Juvenile rockfish are also at low risk of entrainment because they would respond to the initial disturbance and avoid the area. Entrainment and strike risk is higher for larval rockfish given their lack of mobility.

While the risk of entrainment is very low, we cannot rule out the possibility of fish being entrained or struck while dredging is occurring and any individual fish harmed or killed as a result of being entrained or struck by a dredge constitutes an adverse effect.

Response to Reduced Forage and Prey Communities

The effect of dredging activities on macrofauna assemblage recovery depends on the methods used, duration and frequency of dredging, the area and amount of material to be dredged, substrate characteristics, resulting sedimentary profile of the affected seabed, local hydrology, seasonal effects (Barrio Froján et al., 2011, Newell et al., 1998) and biotic interactions (Ólfasson et al., 1994). Areas where sediment is removed by dredging would diminish benthic prey communities. In areas where suspended sediment settles on the bottom, some smothering can occur which also disrupts the benthic communities. The speed of recovery by benthic communities is affected by several factors, including the intensity of the disturbance, with greater disturbance increasing the time to recovery (Dernie et al., 2003). Additionally, the ability of a disturbed site to recolonize is affected by whether or not adjacent benthic communities are nearby that can recolonize the affected area, and the composition of the species that recolonize the area may differ from a less frequently perturbed area, as disturbances caused by dredging may lead to a decline in sensitive species, to be subsequently replaced by more tolerant species (Ceia et al. 2013). Lastly, suspended sediment would eventually settle in the area adjacent to the dredge prism, which can disrupt benthic prey species, and if the sediments are contaminated, then sublethal toxicity of benthic prey species could occur. These prey then can become a source of bioaccumulation, which degrades the quality of the prey.

We expect only the cohorts of PS Chinook salmon and PS steelhead that are present in Blair Waterway and Saltchuk to be exposed to this temporary reduction of prey. Therefore, feeding, growth, development, and fitness of the exposed individuals would be affected during the months of construction activity. We consider the temporary effects of reduced forage on any juvenile PS Chinook salmon and PS steelhead in the action area to be unlikely to cause injury at the population scale.

On the other hand, juvenile PS/GB bocaccio feed on the young of other rockfish, surfperch, and jack mackerel in nearshore areas (Love et al. 1991; Leet et al. 1992). Juveniles also eat all life stages of copepods and euphausiids (MacCall et al. 1999). Because juvenile rockfish are less able to access adjacent areas compared with salmon species, reductions in benthic prey communities, and in SAV from disturbance in work areas would reduce available forage for PS/GB bocaccio in their nearshore settlements, reducing growth and fitness of affected individuals.

Response to Elevated In-water Noise

The effects to fish caused by exposure to noise vary with the hearing characteristics of the fish, the frequency, intensity, and duration of the exposure, and the context under which the exposure occurs. At low levels, effects may include the onset of behavioral disturbances such as acoustic masking (Codarin et al. 2009), startle responses and altered swimming (Neo et al. 2014), abandonment or avoidance of the affected area (Mueller 1980; Picciulin et al. 2010; Sebastianutto et al. 2011; Xie et al. 2008) and increased vulnerability to predators (Simpson et al. 2016). At higher intensities and longer exposure durations, effects may 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 (i.e., 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).

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

The above-discussed criteria specifically address fish exposure to impulsive sound. Stadler and Woodbury (2009) make it clear that the thresholds likely overestimate the potential for impacts on fish from non-impulsive sounds (e.g., vibratory pile driving). Non-impulsive sounds have less potential to cause adverse effects in fish than impulsive sounds. Impulsive sources cause short bursts of sound with very fast rise times and the majority of the energy in the first fractions of a second. Whereas, non-impulsive sources cause noise with slower rise times and sound energy that is spread across an extended period of time; ranging from several seconds to many minutes in duration. Therefore, application of the criteria to non-impulsive sounds is also likely to overestimate the potential effects in fish. However, these criteria represent the best available information. Therefore, to avoid underestimating potential effects, this assessment applies these criteria to provide a conservative measure of the potential effects that fish may have experienced due to exposure to project-related sounds.

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

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

Application of the practical spreading loss equation to the expected SLs suggests that noise levels above the 150 dB_{SEL} threshold could extend to 72 feet (22 m) around tugboats, and about 13 feet (4 m) around dredging work (Table 11). Individual fish that are beyond the 150 dB_{SEL} isopleth for any of these sources would be unaffected by the noise. However, fish within the 150 dB_{SEL} isopleth are likely to experience a range of impacts that would depend on their distance from the source and the duration of their exposure.

Several pieces of equipment would be operating and producing underwater noise for up to 24 hours per day during the in-water work windows, for up to four years. Tugboats have a dominant frequency range of 100-500Hz with a peak output at 170dB_{RMS}. However, their frequent movement is expected to preclude any concern for impacts on fish from accumulated sound energy. Grading the slope to the appropriate channel depth would have in-water noise effects similar for dredging. Although in-water dredging would be source of continuous noise during the project, is extremely unlikely that any fish would remain within 13 feet of that work long enough for accumulated sound energy to have an effect. Further, the full-depth sediment curtain that would surround the project site would act as a fish exclusion device that would be installed more than 13 feet from the dredging area. Additionally, these sound sources are very unlikely to have any additive effects with each other due the differences in the frequencies and other characteristics of their sound. At most, the combination of the various types of equipment noise during any given day would cause fish-detectable in-water noise levels across the entire workday.

Adult salmon and steelhead are unlikely to be affected by noise caused by dredging, installation of shoreline stabilization measures, and material placement at Saltchuk because noise levels would be well below the 150 dB_{RMS} threshold for behavioral effects and essentially the same as the background noise level in the Port. Displacement of adults may occur on a minor scale as the dredge operates in a small area compared to the entire width of the navigation channel and aquatic habitat available. Larval yelloweye rockfish and larval and juvenile PS/GB bocaccio would also be exposed in uncertain numbers. During the in-water work window, all exposed PS Chinook salmon and PS steelhead individuals would be at least two grams, which reduces the likelihood of lethal response. Larval rockfish and younger juvenile PS/GB bocaccio would be less than two grams, making them more vulnerable to die.

Table 11. Estimated in-water source levels for the loudest project-related activities and the associated distances thresholds are expected to attenuate.

Source	Acoustic Signature	Source Level (dBSEL)	Threshold (dBSEL; meters)
Tugboat Propulsion	< 1 kHz Combination	170	150; 22
Dredge Bucket Strike	< 370 Hz Impulsive	167	150; 4

Intermittent Effects

<u>Response to Reduced Vessel Traffic</u>

Vessel traffic is expected to decrease as a result of the proposed action because load capacity per vessel would increase as a result of the increased depth of Blair Waterway. Less vessel traffic translates to a reduction in underwater noise, associated pollution, and disruption of benthic prey. This would likely result in a slight increase in growth rates, carrying capacity, and survival of juvenile and adult listed PS steelhead, PS Chinook salmon, PS/GB yelloweye rockfish, and PS/GB bocaccio. We also evaluated the effects of an increase in vessel size for impacts to listed species. Specifically, we evaluated the potential for a change in noise, ship strikes, and wake effects on Puget Sound shorelines resulting from the proposed action. NMFS found no information that supported an increase or a decrease in negative impacts to listed fish or marine mammals from larger vessels in Puget Sound.

Enduring Effects

<u>Response to channel deepening and widening</u>

The proposed dredging of 6 feet (plus two feet of over-depth) is not expected to alter substrate composition or sizes of those materials. Although areas where sediment is removed by dredging will greatly reduce benthic prey communities in the near-term, the speed of recovery by benthic communities is likely to occur within two years (NMFS 2006a). Other than the temporary loss of benthic invertebrates, the proposed widening and deepening of the federal navigation channel is not expected to reduce habitat quality for salmonids or rockfish. This is because the navigation channel is not nearshore habitat and, under the current environmental baseline, could not return to nearshore habitat. Increasing the depth of deep-water habitat that might provide marginal migration and foraging areas for salmon and rockfish does not result in a loss of habitat quality as we expect benthic organisms to recolonize within two years.

<u>Response to Modified Shoreline</u>

The shoreline of the Blair Waterway, in its current state, is highly industrialized and lacks high quality nearshore habitat and does not provide the ecological function necessary to sustain the ESA-listed species evaluated in this Opinion. The lack of shallow water habitats, suitable substrate, submerged aquatic vegetation, and natural cover and the intense industrial use precludes ESA-listed rockfish and salmonids species from using most of these areas as feeding, growth, and reproductive opportunities. Due to current Congressional authorization, the Corps is required to maintain the current condition and functionality of the channel, meaning the current depth, width, and quantity of shoreline armoring would be maintained in its current state without implementation of the proposed action (see section 2.3.3). We do not expect adverse effects to occur as a result of the proposed shoreline stabilization measures because conditions would not appreciably change from current conditions. However, the proposed shoreline armoring at all four locations would prolong the recovery of the species considered in this Opinion as conditions would remain degraded as a result.

<u>Response to Improved Nearshore Conditions at Saltchuk</u>

The proposed action would add approximately 1.8 million cubic yards of dredged materials at the 64-acre Saltchuk site, increasing productive intertidal and subtidal habitat (Figure 1). Over the long term, improved habitat conditions at Saltchuk are expected to increase feeding and rearing opportunities for juvenile salmonids including PS Chinook salmon, PS steelhead, and bull trout. These benefits may take many years to be fully realized, but would be expected to benefit juveniles in the nearshore, likely increasing abundance, survival, and growth rates as long as the dredged material remains on site and suitable habitat remains. Habitat complexity would likely slowly develop, providing important cover and refugia from piscivorous fish and avian predators. Commencement Bay carrying capacity would also slightly increase as a result of the improved nearshore habitat. Juvenile PS Chinook salmon are most likely to benefit from the proposed improvements to the nearshore given their reliance on nearshore habitats during their marine growth and rearing life stage. These positive effects would likely attenuate over time, as placement of material and the site would not result in a permanent improvement in habitat without maintenance and additional restoration actions under consideration by the Corps (COE 2021a).

Summary of Effects to Species

Based on the low but not insignificant probability that juvenile and adult PS Chinook salmon and PS steelhead and larval and juvenile PS/GB bocaccio and PS/GB yelloweye rockfish may be present during temporary and localized effects of construction, this project may affect and is likely to adversely affect individuals via degraded water quality (high turbidity, low DO, suspended contaminants), equipment entrainment and strike, reduced forage and prey communities, and elevated in-water noise, but it will not measurable affect populations. Conversely, over the long-term the project may benefit these species through reduced vessel traffic, and improved nearshore habitat at Saltchuk. NMFS did not find literature supporting positive or negative effects to listed species in Puget Sound as a result of large vessel size. The proposed widening and deepening of the federal navigation channel is not expected to reduce habitat quality for salmonids or rockfish.

Effects to Population Viability

We assess the importance of habitat effects in the action area to the species by examining the relevance of those effects to the characteristics of VSP. The characteristics of VSPs are sufficient abundance, population growth rate (productivity), spatial structure, and diversity. While these characteristics are described as unique components of population dynamics, each characteristic exerts significant influence on the others. For example, declining abundance can reduce spatial structure of a population; and when habitats are less varied, then diversity among the population declines. We expect a temporary negative effect from the proposed action on the survival of juvenile PS Chinook salmon, juvenile steelhead, and larval and juvenile PS/GB rockfish. We expect populations from the Puyallup River basin to be present in the action area and impacted by the proposed action.

Abundance: As discussed in Section 2.3.2, the Blair Waterway and its associated facilities have degraded and industrialized the estuarine and marine nearshore environment. Effects to individual fishes from the proposed action would not appreciably increase the effects of the two Chinook salmon populations that use the action area. While we cannot quantify these long-term structure-related effects, we believe them to be limited and proportional to the size of affected habitat. Because PS juvenile steelhead do not commonly reside in the estuarine or marine nearshore habitat, we do not expect the proposed project to notably affect the abundance of PS steelhead. We do expect larval and juvenile rockfish abundance to be incrementally affected each year of construction given their limited swimming ability and general fragility to disturbance. PS/GB bocaccio are likely to be affected at a larger magnitude compared to yelloweye rockfish given their greater reliance on nearshore area during juvenile/larval life stages.

Productivity: Productivity is likely to be negatively impacted over the short-term, but increase over the long-term once construction is complete due to a slight increase in nearshore habitat area and quality at Saltchuk. The resulting slight increase in nearshore habitat area and quality is

expected to slightly increase PS Chinook salmon and PS/GB rockfish productivity and carrying capacity by creating more feeding/foraging opportunities as well as natural cover. A slight increase in nearshore habitat is not likely to improve steelhead productivity because of their limited use of the nearshore environment.
Spatial Structure: We expect the proposed project to marginally affect the spatial structure of the PS Chinook salmon ESU, and PS/GB bocaccio DPS as the majority of impacts would be isolated to the Blair Waterway and Saltchuk site. The addition of beneficial material at the Saltchuk site will improve spatial structure for juvenile Chinook salmon and bocaccio by increasing access to productive habitat and refugia from predators.

Diversity: Salmon have complex life histories and changes in the estuarine environment would have a greater effect on specific life history traits that make prolonged use of this habitat. This would likely result in a slight, proportional to the limited habitat alteration, decline in PS Chinook salmon diversity by differentially affecting specific populations that encounter the developed area in greater frequency during their early estuarine life history. We do not expect the proposed project to affect the diversity of PS steelhead, PS/GB bocaccio, or PS/GB yelloweye rockfish.

2.5 Cumulative Effects

"Cumulative effects" are those effects of future State or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation (50 CFR 402.02 and 402.17(a)). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline vs. cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described earlier in the discussion of environmental baseline (Section 2.3).

Future actions in the nearshore and along the shoreline of Puget Sound are reasonably certain to include port and ferry terminal expansions, residential and commercial development, shoreline modifications, road and railroad construction and maintenance, and agricultural development. Some of these developments will occur without a federal nexus, however, activities that occur waterward of the OHWM (freshwater) or HTL (marine water) require a Corps permit and therefore involve federal activities. Such activities may include additional berth deepening and widening within federal navigation waterways and modifications at Saltchuk.

The repair, replacement, construction and removal of shoreline armoring that may not require federal authorization will continue. However, based on current trends, there could continue to be a net reduction in the total amount of shoreline armoring in Puget Sound (PSP 2018). Changes in tributary watersheds that are reasonably certain to affect the action area include reductions in water quality, water quantity, and sediment transport. Future actions in the tributary watersheds whose effects are reasonably certain to extend into the action area include operation of hydropower facilities, flow regulations, timber harvest, land conversions, disconnection of floodplain by maintaining flood-protection levees, effects of transportation infrastructure, and growth-related commercial and residential development.

All future non-federal actions in the nearshore as well as in tributary watersheds will cause long-lasting environmental changes and will continue to harm ESA-listed species and their critical habitats. Especially relevant effects include the loss or degradation of nearshore habitats, pocket estuaries, estuarine rearing habitats, wetlands, floodplains, riparian areas, and water quality. We consider human population growth to be the main driver for most of the future negative effects on salmon and steelhead and their habitat.

As mentioned above, human populations are expected to increase within the Puget Sound region, and if population growth trends remain relatively consistent with recent trends, we can anticipate future growth at approximately 1.5 percent per year.[23] The human population in the PS region increased from about 1.29 million people in 1950 to about 3.84 million in 2014, and is expected to reach nearly 5 million by 2040 (Puget Sound Regional Council 2020). As of the date of this Opinion, the human population in the Puget Sound Region is 4.2 million, slightly exceeding projections. Thus, future private and public development actions are reasonably certain to continue in and around PS. As the human population continues to grow, demand for agricultural, commercial, and residential development and supporting public infrastructure is also reasonably certain to grow. We believe the majority of environmental effects related to future growth will be linked to these activities, in particular land clearing, associated land-use changes (i.e., from forest to impervious, lawn or pasture), increased impervious surface, and related contributions of contaminants to area waters. Land use changes and development of the built environment that are detrimental to salmonid habitats are reasonably certain to continue under existing regulations. Though the existing regulations minimize future potential adverse effects on salmon habitat, as currently constructed and implemented, they still allow systemic, incremental, additive degradation to occur.

In June 2005, the Shared Strategy presented its recovery plan for PS Chinook salmon and the Hood Canal Coordinating Council presented its recovery plan for Hood Canal summer-run chum salmon to NMFS who adopted and expanded the recovery plans to meet its obligations under the ESA. Together, the joint plans comprise the 2007 PS Chinook and Hood Canal Summer-run Chum Recovery Plan (Shared Strategy 2007; NMFS 2006). Many tribes, not-for-profit organizations and local, state and federal agencies are implementing recovery actions identified in these recovery plans.

The cumulative effects associated with continued development in the action area are reasonably certain to have ongoing adverse effects on all the listed species populations addressed in this Opinion. Only improved, low-impact development actions together with increased numbers of restoration actions, watershed planning, and recovery plan implementation would be able to address growth related impacts into the future. To the extent that non-federal recovery actions are implemented and offset ongoing development actions, adverse cumulative effects may be minimized, but will probably not be completely avoided.

[23] https://www.psrc.org/whats-happening/blog/region-adding-188-people-day

2.6 Integration and Synthesis

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

The species considered in this Opinion have been listed under the ESA, 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. Each species would 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. The action area provides critical habitat for nearshore marine life histories of PS Chinook salmon, although at a degraded state.

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

2.6.1 PS Chinook Salmon

PS Chinook salmon are currently listed as threatened with generally negative recent trends in status. Widespread negative trends in natural-origin spawner abundance across the ESU have been observed since 1980. 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 shows that most populations have declined in abundance over the last evaluation period (NWFSC 2015; Ford, in press)). Most populations are consistently below the spawner-recruit levels identified by the recovery plan for this ESU.

The environmental baseline within the project area has been degraded by the effects of shoreline development and vessel activities. The baseline has also been degraded by nearby industry, urbanization, agriculture, forestry, water diversion, and road building and maintenance. The environmental baseline includes the current congressionally authorized federal navigation channel in the Blair Waterway. Absent a change in the authorization, the federal navigation channel and Blair Waterway cannot return to a condition that would provide high-quality habitat for salmon.

The timing of the proposed construction and dredging overlaps with adult PS Chinook salmon holding and upstream migration through Commencement Bay. The timing avoids the peak migration of juvenile Chinook salmon downstream from the Puyallup River toward Commencement Bay. However, over the next several decades, low numbers of out-migrating juveniles that pass through Commencement Bay would be exposed to low levels of contaminated forage and other altered habitat conditions, that both individually and collectively, would cause some combination of altered behaviors, reduced fitness, and mortality. The annual numbers of individuals that would be detectably affected by action-related stressors would be extremely low.

As described in Section 2.2, the Puyallup Basin supports several populations critical for recovery of the PS Chinook ESU. PS Chinook salmon were recently evaluated by Ford (in press) to be at moderate risk of extinction. Impacts to Puyallup Basin populations may disproportionately affect recovery efforts and VSP characteristics of the PS Chinook salmon ESU. Early returning White River spring Chinook salmon and Puyallup and Carbon River fall Chinook salmon are the populations that would be impacted by the temporary, intermittent, and enduring effects of the proposed action. White River spring Chinook salmon are the most genetically distinct population of Chinook salmon in the central and south Puget Sound and are the last existing early returning spring Chinook salmon population in the southern Puget Sound basin (NMFS 2007). Currently, White River spring Chinook salmon escapement is well below historical averages and failing to meet recovery goals outlined in the 2007 recovery plan (geometric mean of 4,500) (NMFS 2007). While adult escapement has been high in recent years (see Section 2.3.4 Figure 4), productivity and natural origin abundance has been negative and in perpetual decline, respectively (see Section 2.3.4, Figures 5 and 6). Given the importance of White River spring Chinook salmon relative to the diversity of the PS Chinook salmon ESU even small impacts at the population level from the proposed action could impair recovery of the ESU. The restoration measures included in the proposed action at that Saltchuk site is likely to benefit White River spring Chinook salmon over the long-term, although it remains to be seen at what scale benefits would affect abundance, productivity, or carrying capacity.

Based on the best available information, the scale of the direct and indirect negative effects of the proposed action, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause detectable effects on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity) for the affected PS Chinook salmon populations. Despite the slight increase in beneficial habitat improvements at Saltchuk, the degraded baseline of habitat conditions at the Port of Tacoma largely negates improvements to population viability. In addition, since its construction, the Blair Waterway has not provided important rearing habitat for PS Chinook salmon juveniles and the widening and deepening of the channel is unlikely to worsen habitat conditions in any appreciable measure once completed. Furthermore, the in-water work window avoids peak migration periods for both juvenile and adult Chinook salmon further minimizing effects. The proposed action would not appreciably reduce the likelihood of survival and recovery of this listed species because:

- the effect of the dredging proposed to widen and deepen the federal navigation channel are temporary and likely to affect only a few cohorts of the Puyallup Basin populations of PS Chinook salmon;
- the widening and deepening of the federal navigation channel would not cause any meaningful reduction in habitat quality for PS Chinook salmon; and
- the effect at the Saltchuk site would improve the habitat quality for a minimum of several years.

2.6.2 PS Steelhead

The long-term abundance trend of the PS steelhead DPS is negative, especially for native-origin spawners. The extinction risk for most DPSs is estimated to be moderate to high, and the DPS is currently considered "not viable." Reduced or eliminated accessibility to historically important habitat, combined with degraded conditions in available habitat due to land use activities appear to be the greatest threats to the recovery of PS steelhead. Fisheries activities also continue to impact this species.

The PS steelhead populations most likely to occur in the project area would be winter-run fish from the Puyallup/Carbon River and White River DPSs. Adults are expected to occur in the deep, open-water areas adjacent to the Blair Waterway during the winter of their upstream spawning migration, and juveniles may occur in the shallow nearshore zone during typical outmigration periods in the spring and early summer. Adult fish would typically be oriented to the outflow of the Puyallup River. Historical information suggests that PS steelhead utilized Wapato Creek (drains into Blair Waterway) for rearing and spawning, but recent information suggest current use is low or non-existent.

As described in Section 2.2, the Puyallup Basin supports several populations critical for recovery of the PS steelhead DPS. PS steelhead were recently evaluated by Ford (in press) to at moderate risk of extinction. Impacts to these populations may disproportionately affect recovery efforts and VSP characteristics of the PS steelhead DPS. The Puyallup, Carbon, and White River winter steelhead populations are an integral component to the core MPG of the southern Puget Sound ESU (NMFS 2019). The Green, Puyallup, and Nisqually River basins contain important diverse stream habitats to support core populations. Current abundance of Puyallup/Carbon River and White River winter steelhead remain well below recovery goals and significant recovery efforts would be needed to attain recovery of these populations. Specific measures include reconnecting side channels, wetlands, and floodplains, removing bank armoring and reducing confinement throughout the Puyallup River basin. The proposed action does little to promote steelhead recovery in the Puyallup Basin but also does not result in effects likely to significantly reduce population viability.

The environmental baseline within the project area has been degraded by the effects of shoreline development and vessel activities. The baseline has also been degraded by nearby industry, urbanization, agriculture, forestry, water diversion, and road building and maintenance. Absent a change in the authorization, the federal navigation channel and Blair Waterway cannot return to a condition that would provide high-quality habitat for steelhead.

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

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

2.6.3 Rockfish

PS/GB bocaccio are listed as endangered and abundance of this species likely remains low. PS/GB yelloweye rockfish are listed as threatened but likely persist at abundance levels somewhat higher than bocaccio. In Puget Sound, catches of PS/GB yelloweye rockfish have declined as a proportion of the overall rockfish catch (see Figure 2 and Figure 3, from Drake et al. 2010). Lack of specific information on rockfish abundance in Puget Sound makes it difficult to generate accurate abundance estimates and productivity trends for these two DPSs. Available data suggest that total rockfish declined at a rate of 3.1 to 3.8 percent per year from 1977 to 2014 or a 69 to 76 percent total decline over that period (Tonnes et al. 2016). The two listed DPSs declined over-proportionally compared to the total rockfish assemblage.

Juvenile yelloweye rockfish are not typically found in nearshore habitat and adults are found solely in deep water areas of Puget Sound. Juvenile and larval bocaccio and larval yelloweye rockfish are found in nearshore areas and would likely be exposed to the short-term effects of the proposed construction. However, the proposed actions would only result in short-term impacts to a few cohorts of rockfish over the course of the proposed construction. Given the low overall level of impact, the proposed action would not have any meaningful effect on the numbers, reproduction, or distribution of yelloweye or bocaccio rockfish. Simply stated, the proposed action would affect far too few individuals to have any meaningfully effect on the two rockfish DPSs. Restoration efforts at Saltchuk may improve productivity and abundance of juvenile rockfish; although the scale at which those benefits may occur is unclear as limited data exists to evaluate the long-term benefit of material placement within nearshore environments.

2.6.4 Critical Habitat

At the designation scale, the quality of PS Chinook salmon critical habitat is generally poor with only a small amount of freshwater and nearshore habitat remaining in good condition. Most critical habitat for these species is degraded but nonetheless maintains a high importance for conservation of the species, based largely on its restoration potential. Loss of freshwater and nearshore critical habitat quality is a limiting factor for this species. Development of shoreline and estuary areas of Puget Sound is expected to continue to adversely impact the quality of critical habitat PBFs for PS Chinook salmon.

Modification of nearshore habitat in Puget Sound has resulted in a substantial decrease in critical habitat quality for PS Chinook salmon. As noted in Section 2.3, shoreline development is the primary cause of this decline in habitat quality. Development includes shoreline armoring, filling of estuaries and tidal wetlands, and construction of overwater structures. Currently, 27-30 percent of Puget Sound's shorelines are armored (Meyer el al. 2010; Simenstad et al. 2011).

Given the rate of expected population growth in the Puget Sound area, cumulative effects are expected to result in mostly negative impacts on critical habitat quality. While habitat restoration and advances in best management practices for activities that affect critical habitat could lead to some improvement of PBFs, adverse impacts created by the intense demand for future development is likely to outpace any improvements. Current state and local regulations do not prevent much of the development that degrades the quality of nearshore critical habitats. There is no indication these regulations are reasonably certain to change in the foreseeable future Once human development causes loss of critical habitat quality, that loss tends to persist for decades or longer. The condition of critical habitat will improve only through active restoration or natural recovery following the removal of human infrastructure. As noted throughout this Opinion, future effects of climate change on habitat quality throughout Puget Sound are expected to be negative.

In summary, the status of critical habitat for PS Chinook salmon is poor, particularly in the Blair Waterway. Under the current environmental baseline, the federal navigation channel and Blair Waterway do not provide quality critical habitat for PS Chinook salmon. The presence of the federally authorized navigation channel, ensures that recovery of this habitat is not reasonably certain to occur. The proposed action would result in some temporary loss of habitat quality, but these effects are all expected to be temporary. These temporary effects are not nearly substantial enough to meaningfully impact the conservation value of critical habitat at the designation scale. Moreover, the proposed action would result in a slight increase in quality and quantity of habitat at Saltchuk, but is unlikely to provide a measurable increase in abundance or productivity at the population scale.

2.7 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of PS Chinook salmon, PS steelhead, or PS/GB bocaccio or yelloweye rockfish or adversely modify designated critical habitat for PS Chinook salmon.

2.8 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). "Harass" is further defined by interim guidance as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "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 ITS.

2.8.1 Amount or Extent of Take

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

- Incidental take in the form of injury or death due to entrainment or strike during clamshell dredging;
- Incidental take in the form of noise during dredging and installation of shoreline armoring;
- Incidental take in the form of permanent habitat alterations, from sediment deposition at Saltchuk;
- Incidental take in the form of harm from diminished water quality (turbidity, suspended contaminants, etc.); and
- Incidental take in the form of contaminated forage and diminished prey availability.

The distribution and abundance of fish that occur within an action area are affected by habitat quality, competition, predation, and the interaction of processes that influence genetic, population, and environmental characteristics. These biotic and environmental processes interact in ways that may be random or directional and may operate across far broader temporal and spatial scales than are affected by the proposed action. Thus, the distribution and abundance of fish within the action area cannot be attributed entirely to habitat conditions, nor can NMFS precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by the proposed action.

Therefore, we cannot predict with meaningful accuracy the number of PS Chinook salmon, PS steelhead, or PS/GB rockfish 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 casual link established between the activity and the likely extent and duration of changes in habitat conditions to describe the extent of take as a numerical level of habitat disturbance. The most appropriate surrogates for take are action-related parameters that are directly related to the magnitude of the expected take.

For this proposed action, the potential for occurrences of 1) injury or death from entrainment or strike, elevated noise, and alteration of habitat and 2) harm from being exposed to elevated turbidity and reductions in forage for juvenile salmonids, is directly related to the amount of dredged material and the timing of the dredge operation.

Injury or death from entrainment or strike by dredge equipment – Since the potential for PS Chinook salmon (juvenile), PS steelhead (juvenile), PS/Georgia Basin DPSs of yelloweye rockfish and bocaccio (larvae and juvenile) to be entrained is most directly determined by the amount of sediment dredged and the timing of the operation, the extent of take identified for the proposed action is related to the amount of dredged material within a timeframe that anticipates the lowest presence of vulnerable life stages of listed fish. Therefore, the extent of take is a maximum of 3.0 million cy of sediment dredged within Blair Waterway to occur between the August 16 – February 15 work windows for four years. Exceeding this indicator for extent of take would trigger the reinitiation provisions of this Opinion.

Injury or death from elevated noise – PS Chinook salmon (juvenile), PS steelhead (juvenile), PS/Georgia Basin DPSs of yelloweye rockfish and bocaccio (larvae and juvenile) will be exposed to construction-related noise resulting from dredging equipment and construction vessels. Disruption of normal feeding and migration, and injury and death can occur from this exposure. The most appropriate and measurable surrogate for take associated with elevated noise is time spent dredging and operating construction vehicles in the August 16 and February 15, annual work windows for four years. Exceeding this indicator for extent of take would trigger the reinitiation provisions of this Opinion.

Harm from altered habitat – Juvenile PS Chinook salmon and PS/GB bocaccio will be exposed to altered habitat conditions at Saltchuk from the deposit of sediment from the Blair Waterway. During the deposition of 1.8 million cy of beneficial use sediment, juvenile Chinook salmon and juvenile and larval bocaccio will be exposed the placement of sediment over existing subtidal habitat. Since the potential for ESA listed fish to be displaced or smothered is most directly determined by the amount of sediment deposited at the Saltchuk site and the timing of the operation, the extent of take identified for the proposed action is related to the amount of deposited material within a timeframe that anticipates the lowest presence of vulnerable life stages of listed fish. Therefore, the extent of take is a maximum of 1.85 million cy of sediment deposited at Saltchuk to occur between the August 16 – February 15 work windows for four years. Exceeding this indicator for extent of take would trigger the reinitiation provisions of thisOpinion.

Harm from degraded water quality – PS Chinook salmon (juvenile), PS steelhead (juvenile), PS/Georgia Basin DPSs of yelloweye rockfish and bocaccio (larvae and juvenile) would be exposed to degraded water quality. Habitat modified temporarily by suspended solid and contaminants would injure fish by impairing normal patterns of behavior including rearing and migrating in the action area and causing potential health effects. Because injury to individuals can occur when exposed to high levels of suspended sediment, or as a result of avoiding areas affected with high levels of sediment, the extent of take is measured as the anticipated area where suspended sediment would be present. The levels of suspended contaminants are expected to be proportional to the amount of injury that the proposed action is likely to cause through physiological stress from elevated suspended sediments and contaminants throughout the duration of the projects' in water activities. Therefore, the maximum extent of take is defined by the relative increase in turbidity to baseline conditions within the annual work windows for four years. Specifically, turbidity levels shall not exceed 5 NTUs more than background levels when background turbidity is 50 NTUs or less, or there shall not be more than a 10 percent increase turbidity when the background turbidity is more than 50 NTUs. These increases would be limited to a 300 foot area of mixing within the 3-mile radius described in the action area. Exceeding this indicator for extent of take would trigger the reinitiation provisions of this Opinion.

Harm from diminished prey availability – Individual PS Chinook salmon (juvenile), PS steelhead (juvenile), PS/Georgia Basin DPSs of yelloweye rockfish and bocaccio (larvae and juvenile) would be affected by a temporary reduction in prey availability during construction activities. Reductions in fitness among juveniles are likely when prey availability is decreased, and competition increases for prey resources. Therefore, the extent of take is a maximum of 3.0 million cy of sediment dredged within Blair Waterway to occur between the August 16 – February 15 annual work window for four years. Exceeding this indicator for extent of take would trigger the reinitiation provisions of this Opinion.

Exceedance of any of the exposure limits described above would constitute an exceedance of authorized take that may trigger the need to reinitiate consultation. In addition, because the analysis included in this Opinion evaluates project effects for 50 years, the amount or extent of take described above is determined based on that length of time. We cannot reasonably predict the amount or extent of take that would occur after 50 years given the uncertainty of how baseline conditions may change as a result of extraneous factors such as climate change or population growth.

Although these take surrogates could be construed as partially coextensive with the proposed action, they still function as effective reinitiation triggers.

2.8.2 Effect of the Take

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

2.8.3 Reasonable and Prudent Measures

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

1. The Corps shall minimize incidental take of listed species resulting from entrainment and strike.

2. The Corps shall minimize incidental take of listed species resulting from elevated noise.

3. The Corps shall minimize incidental take of listed species resulting from suspended sediment and re-suspended contaminants during dredging, shoreline stabilization, and material placement.

4. The Corps shall develop a monitoring and reporting plan to ensure that the RPM's are implemented as required and take exemption for the proposed action is not exceeded, and that the terms and conditions are effective in minimizing incidental take.

5. The Corps shall develop a plan to enhance restoration efforts implemented at the Saltchuk site and improve nearshore habitat conditions for listed species. Additionally, the Corps and non-federal sponsor shall engage NMFS in finalization of construction and beneficial material use designs to ensure take of listed species is minimized.

2.8.4 Terms and Conditions

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

1. The following terms and conditions implement RPM 1 (minimize entrainment and strike during dredging):
    a. The Corps shall ensure that dredging equipment is lowered to the bottom slowly to allow ESA listed fish the opportunity to escape.
    b. The Corps shall develop a Dredging Monitoring Plan for NMFS review which monitors and analyzes the first dredge clamshell dredged materials in each new area of activity or in the same area of activity after 6 hours of inactivity for any fish. The Dredging Monitoring Plan shall be available for NMFS review a minimum of 60 days prior to dredging activities. The Dredging Monitoring Plan shall include:
        i. Methods of observation, such as videography or physical observers;
        ii. Identification and size of any fish categorized as either entrained or impacted and alive or dead;
        iii. The date and approximate time of the dredge entrainment;
        iv. An annual report of findings shall be provided to NMFS within 2 months after the work window closes.

2. The following terms and conditions implement RPM 2 (elevated noise):
    a. Adhere to in-water work window August 16 – February 15 for the four years of construction.
    b. The Corps shall develop an Underwater Noise Monitoring Plan to monitor underwater noise levels while dredging at the mouth of the Blair Waterway .

The plan shall be available for NMFS review a minimum of 60 days prior to construction. The Underwater Noise Monitoring Plan shall include:

   i. Methods of observation, such as hydrophones
   ii. A list of activities monitored, including underwater clamshell operation, vessel operations, and sediment deposits at Saltchuk;
   iii. An annual report of findings shall be provided to NMFS within 4 months after the work window closes.

3. The following terms and conditions implement RPM 3 (minimize turbidity and suspended sediments during dredge operation):
   a. Comply with Washington State water quality standards by conducting water quality monitoring during dredging activities. Per state permit, turbidity levels shall not exceed 5 nephelometric turbidity units (NTUs) more than background turbidity when the background turbidity is 50 NTUs or less, or there shall not be more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTUs as measured from a distance of 300 feet.
      i. If turbidity levels in the Blair Waterway exceed the standards as described in the Water Quality certification for this project, adhere to exceedance protocol in the Water Quality Monitoring Plan (WQMP), including notification and coordination with Ecology if additional BMPs are necessary to address turbidity.
      ii. If turbidity levels during material placement at Saltchuk exceed the standards as described in the Water Quality certification for this project, adhere to exceedance protocol in the WQMP, including notification and coordination with Ecology if additional BMPs are necessary to address turbidity. This may include use of a floating silt curtain as appropriate.
   b. Dredge in a manner that minimizes spillage of excess sediments from the bucket and minimizes the potential entrainment of fish. This includes, but is not limited to:
      i. Avoiding the practice of washing unsuitable material off the barge and back into the water. This can be accomplished by the use of hay bale and/or filter fabric.
   c. Ensure dredging contractor utilizes a current, accurate Global Positioning System (GPS) dredge positioning to control the horizontal and vertical extent of the dredge to ensure dredging does not occur outside the limits of the dredge prism.
   d. Ensure that an emergency cleanup plan is in place in the event the barge, truck, or railcar has an incident where unsuitable material is spilled. This plan will be on-board the vehicle at all times.

4. The following terms and conditions implement RPM 4 (monitoring and reporting):
   a. The Corps shall develop an Underwater Observation Monitoring Plan associated with dredging in Blair Waterway and material placement at Saltchuk.

b. The Corps shall provide NMFS with an Underwater Observation Monitoring Plan for review a minimum of 60 days prior to the initiation of construction activities. The Underwater Observation Monitoring Plan shall include:
    i. Methods and schedule to monitor ESA-listed fish presence immediately preceding dredging activities within the Blair Waterway;
    ii. Methods to monitor the abundance and diversity of ESA-listed fish utilizing Saltchuk prior to initiation of construction activities during the first year;
    iii. Methods and schedule to monitor the abundance and diversity of fish utilizing Saltchuk immediately preceding the deposition of sediments at Saltchuk during the construction period if "ramping" (e.g., thin-layer placement or excavator-assisted placement) is not used;

c. Submit annual monitoring reports within 4 months after the work window closes in each of the four years of construction, summarizing the following for the previous calendar year:
    i. Hours of dredging completed per day;
    ii. The number of days of dredging per month and for the entire year;
    iii. The total daily and cumulative sediment removal totals;
    iv. Total sediment disposed at each location (Open water site, Saltchuk, upland);
    v. Turbidity levels from monitoring and whether state turbidity compliance was met;
    vi. Results from dredging monitoring
    vii. Results from noise monitoring;
    viii. Results from underwater observation associated with dredging in Blair Waterway and material placement at Saltchuk.
    ix. Monitoring reports shall be submitted to: projectreports.wcr@noaa.gov, include **WCRO-2020-00645** in the subject line.

d. The USACE shall monitor and report the abundance and diversity of ESA-listed fish utilizing Saltchuk in years 3, 5, and 10 following complete construction.

e. The USACE shall monitor and report natural recruitment of eelgrass and SAV at Saltchuk in years 3, 5, and 10 following complete construction to determine if the beneficial use of dredged material is as beneficial as presumed in this Opinion.

5. The following terms and conditions implement RPM 5 (Restoration planning and design finalization):
    a. Develop a Restoration Plan to enhance actions taken at the Saltchuk Restoration Site that includes measures to improve nearshore habitat PBFs for PS Chinook salmon and PS/GB bocaccio. The Restoration Plan shall:
        i. Collaboratively engage with NMFS, state, federal, and tribal agencies in finalizing project designs;
        ii. Provide NMFS with finalized project designs within a minimum of 60 days prior to commencing construction.

Submit Reports. All reports shall contain the WCRO Tracking number and be sent by electronic copy to NOAA's reporting system email address at: projectreports.wcr@noaa.gov.

2.9 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). The following two conservation recommendations are discretionary measures that NMFS believes are consistent with this obligation and therefore should be carried out by the Corps.

Recommended conservation measures include:

1. Monitor water quality for PCBs, PBDEs, and PAHs at the mouth of the Blair Waterway prior to and during construction to expand understanding of long-term exposure risks to ESA-listed salmonids and SRKW critical habitat and increase recovery potential for ESA-listed salmonids and rockfish by reducing the exposure of toxins.

2.10 Reinitiation of Consultation

This concludes formal consultation for the Corps.

As 50 CFR 402.16 states, reinitiation of consultation is required and shall be requested by the federal agency or by the Service where discretionary federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this Opinion, (3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

2.11 "Not Likely to Adversely Affect" Determinations

Southern Resident Killer Whales
The Corps determined that the proposed action was not likely to adversely affect SRKW or adversely modify their critical habitat. NMFS concurs with the Corps' determination.

Between the three pods that comprise this DPS, identified as J, K, and L, some members of the DPS may be present in the Puget Sound at any time of the year based on observational data recorded since 1976. More generally, data shows that all three pods are in Puget Sound June through September, which means that all are likely present in Puget Sound during the designated work window. The whales' seasonal movements are only somewhat predictable and exhibit large inter-annual variability in arrival time and days spent in inland waters. In recent years, late arrivals and fewer days spent in inland waters has been common.

While SRKW are sighted in Commencement Bay, they are not known to enter the Port of Tacoma or nearby areas and typically avoid the high-traffic area around Tacoma Harbor. Vessel speed is the greatest predictor of noise levels received by killer whales. Dredges and associated work vessels will be either stationary or traveling slowly for the purpose of surveying the bottom surface, maneuvering the dredge and barge, or transiting the barge to disposal sites. Slow vessel speeds should minimize emitted sound. Based on the short distance of sound attenuation from the dredges and associated work vessels and that very few killer whales would be present, effects of underwater noise from dredging will be short duration, low intensity, minimal, and therefore insignificant. The number and spread of vessels are not expected to result in blocking movements of the whales in their travel corridors. Therefore, it is unlikely that any small transitory disturbance from vessels that might occur would have more than a very minor effect on passage in designated critical habitat. Lastly, given that the proposed action is expected to result in a 27% reduction in vessel activity throughout Puget Sound, and we did not find any information to indicate the larger vessels would result in an increase in ship strikes on SRKW or other marine mammals in the action area, effects from these activities on passage in SRKWs or their critical habitat is likely to be wholly beneficial.

Concentrations of PCBs and other bioavailable contaminants in biota may increase during dredging. The rate of resuspension is estimated at 3% of material with an increased bioavailability for approximately two to three years (AECOM 2012; Patmont et al. 2018). This minor fraction would have a negligible effect to killer whale prey and an undetectable contribution to the whales themselves. Analysis on continued use of the DMMP disposal sites concluded that effects of transport and disposal of dredged material containing biomagnifying substances to killer whales are discountable. A summary of the rationale provided is that the DMMP uses rigorous testing procedures to quantify effects and disposal sites are showing generally similar or lower concentrations of contaminants compared to nearby locations.

The impairment of prey (PS Chinook salmon) from the temporary construction effects of the proposed action is extremely small, due to the application of the work window to avoid peak presence of this species at the juvenile life stage and the other reasons discussed above. Given the total quantity of prey available to SRKWs throughout their range, this short-term reduction in prey that results from the temporary construction effects is extremely small. Because the annual reduction is so small, there is also a low probability that any of the Chinook salmon killed from implementation of the proposed action would be intercepted by the killer whales across their vast range in the absence of the proposed action. Therefore, the NMFS anticipates that any short-term reduction of Chinook salmon during construction would have little effect on Southern Resident killer whales. While water quality will be briefly reduced by turbid conditions and brief chemical contamination with the removal of the creosote pilings, these diminishments will ameliorate shortly after work ceases, and the features will re-establish their baseline level of function. NMFS did not identify enduring effects on SRKW from the proposed action. SRKW prey species, Chinook salmon, will be adversely affected by the proposed action as described above, but the numbers of individual fish affected, and the degree of these effects are unlikely to alter population level abundance of juvenile fish in a manner that will diminish prey availability of returning adult Chinook salmon. All effects on SRKW PBFs are insignificant.

Humpback Whale
The Corps made no determination of effects to humpback whales as a result of the proposed action.

Humpback whales are occasionally sighted in south Puget Sound, but they have never been documented in the Blair Waterway. Humpback whales if present in the vicinity of the project, would not be expected to venture into Commencement Bay. Humpback whales will not be exposed to the short-term water quality effects because they are unlikely to reach the areas where individuals would be found. The chance of a humpback whale being exposed to any effect caused by the dredging or construction in Commencement Bay is discountable. Any impact resulting from reduced vessel traffic would be wholly beneficial to humpback whales. Based on this analysis, NMFS determined that the proposed action is discountable, and not likely to adversely affect listed humpback whales.

Green Sturgeon
The Corps determined that the proposed action was not likely to adversely affect green sturgeon or adversely modify their critical habitat. NMFS concurs with the Corps' determination.

Effects of the action on green sturgeon are unlikely; if green sturgeon are present in the action area of Puget Sound, they rely on deep bottom areas for feeding and rearing, indicating that the effects of the action are unlikely. The only known spawning areas for green sturgeon are in the Rogue, Klamath, Trinity, Sacramento, and Eel rivers in southern Oregon and Northern California. Therefore, their presence in the project area is considered unlikely and therefore any effects of the action is insignificant.

Eulachon
The Corps determined that the proposed action was not likely to adversely affect eulachon. NMFS concurs with the Corps' determination.

Eulachon are endemic to the eastern Pacific Ocean and range from northern California to southwest Alaska and into the southeastern Bering Sea. The southern DPS of Pacific Eulachon includes populations spawning in rivers south of the Nass River in British Columbia to the Mad River in California. Eulachon primarily spawn in the Columbia River system in Washington State. Eulachon runs are typically found in systems with snow pack or glacier-fed freshets, or extensive spring freshets (Hay and McCarter 2000). Eulachon leave saltwater to spawn in their natal streams in late winter through early summer and typically spawn in the lower reaches of larger rivers fed by snowmelt, glacial runoff, or extensive spring freshets (Gustafson 2010). Spawning begins as early as December and January in the Columbia River system, peaks in February, and can continue through May. Larval outmigration occurs 30 to 40 days after spawning. After hatching, larvae are carried downstream and are widely dispersed by estuarine and ocean currents. Eulachon movements in the ocean are poorly understood. Eulachon are far less common in south Puget Sound drainages and are not considered to be established in the Puget Sound rivers (NMFS 2010). Eulachon may rarely enter the Puget Sound in large schools, but this has seldom been documented; the last such documented large school of Eulachon in the Puget Sound was in 1983 (NMFS 2010). Based on the low likelihood of Eulachon existing in Commencement Bay and Puget Sound we find the effects of the action on species to be unlikely, and therefore insignificant.

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

Section 305(b) of the MSA directs federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)]

This analysis is based, in part, on the EFH assessment provided by the Corps and descriptions of EFH for Pacific Coast groundfish (Pacific Fishery Management Council [PFMC] 2005), coastal pelagic species (CPS) (PFMC 1998), and Pacific Coast salmon (PFMC 2014) 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 entire action area fully overlaps with identified EFH for Pacific Coast salmon, Pacific Coast groundfish, and coastal pelagic species. Designated EFH for groundfish and coastal pelagic species encompasses all waters along the coasts of Washington, Oregon, and California that are seaward from the mean high water line, including upriver extent of saltwater intrusion in river mouths to the boundary of the U.S economic zone, approximately 230 (370.4 km) offshore (PFMC 1998 a,b). Designated EFH for salmonids species within marine water extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone offshore of Washington, Oregon, and California, north of Point Conception to the Canadian border (PFMC 1999). Groundfish, coastal pelagic, and salmonid fish species that could have designated EFH in the action area are listed in tables 12, 13, and 14.

Additionally, Puget Sound is a Habitat Area of Particular Concern (HAPC), based on importance of the ecological function provided by the habitat. The environmental effects of the proposed project may adversely affect EFH for Pacific groundfish, coastal pelagic species, and Pacific coast salmon in the HAPC for these species.

Table 12. EFH Pacific coast groundfish species likely occupying the action area.

Common Name	Scientific Name	Common Name	Scientific Name
Arrowtooth flounder	*Atheresthes stomias*	Pacific Ocean perch	*Sebastes alutus*
Big skate	*Raja binoculata*	Pacific sanddab	*Ctlharichthys sordidus*
Black rockfish	*Sebastes melanops*	Petrale sole	*Eopsetta jordani*
Bocaccio	*Sebastes Paucispinis*	Quillback rockfish	*Sebastes maliger*
Brown rockfish	*Sebastes auriculatus*	Ratfish	*Hydrolagus colliei*
Butter sole	*Isopsetta isolepis*	Redbanded rockfish	*Sebastes proriger*
Cabezon	*Scorpaenichthys marmoratus*	Rex sole	*Glyptocephalus zachirus*
California Skate	*Raja inomata*	Rock sole	*Lepidopsetta bilineata*
Canary rockfish	*Sebastes pinniger*	Rosethorn rockfish	*Sebastes helvomaculatus*
China rockfish	*Sebastes nebulosus*	Rosy rockfish	*Sebastes rosaceus*
Copper rockfish	*Sebastes caurinus*	Rougheye rockfish	*Sebastes aleutianus*
Curlfin sole	*Pleuronichthys decurrens*	Sablefish	*Anoplopoma fimbria*
Darkblotch rockfish	*Sebastes crameri*	Sand sole	*Psettichthys melanistictus*
Dover sole	*Microstomus pacificus*	Sharpchin rockfish	*Sebastes zacentrus*
English sole	*Parophrys vetulus*	Shorts pine thornyhead	*Sebastolobus alascanus*
Flathead sole	*Hippoglossoides elassodon*	Spiny dogfish	*Squalus acanthias*
Greenstriped rockfish	*Sebastes elongatus*	Splitnose rockfish	*Sebastes diploproa*
Hake	*Merluccuys productus*	Starry flounder	*Platichthys stellatus*
Kelp greenling	*Hexagrammos decagrammus*	Tiger rockfish	*Sebastes nigrocinctus*
Lingcod	*Ophiodon elongatus*	Vermilion rockfish	*Sebastes miniatus*
Longnose skate	*Raja rhina*	Yelloweye rockfish	*Sebastes ruberrimus*
Pacific cod	*Gadus macrocephalus*	Yellowtail rockfish	*Sebastes llavidus*

Table 13. EFH coastal pelagic species likely occupying the action area.

Common Name	Scientific Name
Market Squid	*Latigo opalescens*
Norther Anchovy	*Engraulis mordax*
Jack Mackerel	*Trachurus symmetricus*
Pacific Mackerel	*Scomber japonicas*
Pacific Sardine	*Sardinops sagax*

Table 14. EFH Pacific salmon species occupying the action area.

Common Name	Scientific Name
Chinook Salmon	*Oncorhynchus tshawytscha*
Coho Salmon	*Oncorhynchus kisutch*
Pink Salmon	*Oncorhynchus gorbuscha*

3.2 Adverse Effects on Essential Fish Habitat

The proposed action will temporarily diminish water quality, disturb benthic habitat and bottom sediments, and re-suspend contaminated sediments contemporaneously with pulses of turbidity.

While the action increases the overall depth of the Blair Waterway by 6 feet it does not change the functional characteristics of the habitat conditions within the waterway. The disturbance is expected to short lived and benefit species at the Saltchuk disposal site over the long-term.

3.3 Essential Fish Habitat Conservation Recommendations

NMFS determined that the following conservation recommendations are necessary to avoid, minimize, mitigate, or otherwise offset the impact of the proposed action on EFH:

1. Require vessel operators to operate at the lowest safe maneuvering speeds and power settings when maneuvering in waters close to the shoreline;
2. Allow no overflow from the barge or hopper;
3. When using a mechanical dredge increase cycle time and reduce bucket deployment;
4. Always use equipment that generates the least amount of sedimentation, siltation, and turbidity;
5. When using a clamshell bucket, dredge in complete passes;
6. Sample and monitor noise levels in real-time during dredging activities. If noise levels surpass accepted thresholds for aquatic organisms implement alternative methodology to reduce noise;
7. Incentivize development of peer-reviewed studies that identify how noise generated from dredging impacts aquatic organisms and EFH; and
8. Restore eelgrass and nearshore habitat along the Northwest shoreline and throughout Commencement Bay nearshore areas.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2, above, for Pacific coast salmon, Pacific coast groundfish, and coastal pelagic species.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the Corps 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 the 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 Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations (50 CFR 600.920(l)).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this Opinion are the Corps. Individual copies of this Opinion were provided to the Corps. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by 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, if applicable, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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