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-2020-01523

May 11, 2021

William D. Abadie
Chief, Regulatory Branch
U.S. Army Corps of Engineers
Portland Regulatory
333 SW First Avenue
Portland, Oregon 97204-3495

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Port of Longview Maintenance Dredging Project, Longview, Cowlitz County, Washington (17080006). NWP-2000-39-5

Dear Mr. Abadie:

Thank you for your letter of September 3, 2020, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for Port of Longview Maintenance Dredging Project (NWP-2000-39-5). This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

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 (16 U.S.C. 1855(b)) for this action.

In the attached biological opinion, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), Snake River basin (SR) fall-run Chinook salmon, SR spring/summer run Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Upper Willamette River (UWR) Chinook salmon, Columbia River (CR) chum salmon (*O. keta*), LCR coho salmon (*O. kisutch*), SR sockeye salmon (*O. nerka*), LCR steelhead (*O. mykiss*), Middle Columbia River (MCR) steelhead, UCR steelhead, SR steelhead, UWR steelhead, Pacific eulachon (*Thaleichthys pacificus*), green sturgeon (*Acipenser medirostris*) or result in the destruction or adverse modification of designated critical habitats.

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 Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes two conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH. These conservation recommendations are a subset of the ESA take statement's terms and conditions. Section 305(b) (4) (B) of the MSA requires Federal agencies to provide a detailed written response to NMFS within 30 days after receiving these recommendations.

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 request that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

If the response is inconsistent with the EFH conservation recommendations, the Corps must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the effects of the action and the recommendations.

Please contact Scott Hecht (Washington Coast-Lower Columbia Branch Chief), of the Oregon Washington Coastal Area Office in Lacey, Washington, at Scott.Hecht@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: Brad Johnson (Brad.A.Johnson2@usace.army.mil)

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 Longview Maintenance Dredging and Disposal (NWP-2000-39-5)

NMFS Consultation Number: WCRO-2020-01523

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

Affected Species and NMFS' Determinations:

ESA-Listed Species	**ESA Status**	**Is the action likely to adversely affect the species?**	**Is the action likely to adversely affect the critical habitat?**	**Is the action likely to jeopardize the species?**	**Is the action likely to destroy or adversely modify critical habitat?**
Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tschawtscha*)	T	Yes	Yes	No	No
Upper Columbia River (UCR) spring-run Chinook salmon	E	Yes	Yes	No	No
Upper Willamette River (UWR) spring-run Chinook salmon	T	Yes	Yes	No	No
Snake River (SR) spring/summer run Chinook salmon	T	Yes	Yes	No	No
SR fall-run Chinook salmon	T	Yes	Yes	No	No
Columbia River (CR) chum salmon (*O. keta*)	T	Yes	Yes	No	No
LCR coho salmon (*O. kisutch*)	T	Yes	Yes	No	No
SR sockeye salmon (*O. nerka*)	E	Yes	Yes	No	No
LCR steelhead (*O. mykiss*)	T	Yes	Yes	No	No
Middle Columbia River (MCR) steelhead	T	Yes	Yes	No	No
UCR steelhead	T	Yes	Yes	No	No
UWR steelhead	T	Yes	Yes	No	No
SR steelhead	T	Yes	Yes	No	No
Southern DPS of Columbia smelt eulachon (*Thaleichthys pacificus*)	T	Yes	Yes	No	No
Southern DPS of Green sturgeon (*Acipenser medirostris*)	T	Yes	No	No	No

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

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

Issued By:

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

Date: May 11, 2021

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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 the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), 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

This biological opinion is in response to the U.S. Army Corps of Engineers, Portland District's (USACE) request for formal consultation to review the effects of their authorizing the proposed action under Section 404 of the Clean Water Act, on ESA listed species detailed in Table 1.

On June 9, 2020, NMFS received a request for informal consultation.

On September 3, 2020, NMFS received a change in request to formal consultation. Included in this request from the applicant, Port of Longview, and their agent, Anchor QEA, LLC., was a biological evaluation, and supplemental information.

On October 5, 2020, after initial review of the consultation package by NMFS determined it to be complete, and NMFS initiated formal consultation.

Table 1. Listed species and critical habitat affected by the proposed action, species status, and FR notice dates

ESU or DPS Species	Listing Notice	Listing Status	Critical Habitat Listing
Lower Columbia Chinook	6/28/2005 ; 70 FR 37160	Threatened	9/2/2005 ; 70 FR 52630
Lower Columbia Steelhead	1/5/2006 ; 71 FR 834	Threatened	9/2/2005 ; 70 FR 52630
Lower Columbia Coho	6/28/2005 ; 70 FR 37160	Threatened	2/24/2016 ; 81 FR 9252
Columbia River Chum	6/28/2005 ; 70 FR 37160	Threatened	9/2/2005 ; 70 FR 52630
Upper Columbia Chinook	6/28/2005 ; 70 FR 37160	Endangered	9/2/2005 ; 70 FR 52630
Upper Columbia Steelhead	1/5/2006 ; 71 FR 834	Threatened	9/2/2005 ; 70 FR 52630
Middle Columbia Steelhead	1/5/2006 ; 71 FR 834	Threatened	9/2/2005 ; 70 FR 52630
Snake River Sockeye	4/14/2014 ; 79 FR 20802	Endangered	12/28/1993 ; 58 FR 68543
Snake River Spring/Summer Chinook	6/28/2005 ; 70 FR 37160	Threatened	10/25/1999 ; 64 FR 57399
Snake River Fall Chinook	6/28/2005 ; 70 FR 37160	Threatened	10/25/1999 ; 64 FR 57399
Snake River Steelhead	1/5/2006 ; 71 FR 834	Threatened	9/2/2005 ; 70 FR 52630
Upper Willamette River Chinook Salmon	6/28/2005 ; 70 FR 37160	Threatened	9/2/2005 ; 70 FR 52630
Upper Willamette River Steelhead	1/5/2006; 71 FR 834	Threatened	9/2/2005 ; 70 FR 52630
Southern DPS Pacific Eulachon	3/18/10; 75 FR 13012	Threatened	10/20/2011 ; 76FR 65324
Southern DPS Green Sturgeon	4/7/2006 ; 71 FR 17757	Threatened	10/9/2009 ; 74 FR 52300

1.3 Proposed Federal Action

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

The USACE proposes to issue a permit to the Port of Longview (Port), authorizing dredging and ancillary activities (fender pile replacement and riprap repair) at the Port facilities, including Berths 1 through 9, and the boat basin and launch area at Willow Grove Park. The Port Berths are located in the Columbia River at river mile (RM) 66 to 67.5, and at the Willow Grove Park boat launch basin (Willow Grove) at RM 58. Both sites are in Longview, Cowlitz County, Washington (17080006). The Port intends to dispose of the dredged material at any of the USACE's five approved in-water placement locations. Pre-placement surveys will be performed in advance of each placement event to confirm the capacity for dredge placement.

The port is requesting to deepen the authorized dredge prism behind the pier at berth 9, and conduct 10 years of annual maintenance dredging covering all 9 berths, the boat basin, and the boat launch. The annual maximum dredge amount is 40,000 CY, but not to exceed a 10 year total of 300,000 CY. In the event that dredging equipment inadvertently dislodges existing riprap, the Port will restore the affected area using backhoes, excavators and dump trucks.

The new area to be deepened includes areas designated as both shallow- and deepwater habitat areas, where shallow-water habitat is defined as -20 feet Columbia River Datum (CRD) and above (Koellmann, 2021a). The current dredge prism that is approximately 4,000 square feet; which is a 50% reduction from the Port's original proposed dredge prism of 8,000 square feet. The Project will permanently convert a total of 1,107 square feet of shallow-water habitat to deep-water habitat.

The Port proposes to conduct dredging using a crane or excavator-operated clamshell bucket, however, hydraulic dredging (suction dredging) may also be selected by the contractor. Work may be conducted from a barge or from the upland areas.

Table 2. Authorized Depths for Maintenance Dredging at Port of Longview

Authorized Depth -43 +2 feet CRD	Authorized Depth -40 +2 feet CRD	Authorized Depth -6.3 feet CRD
Berths 1, 2, 4, 5, 8 and 9	Berths 1A, 6 and 7	Willow Grove

Fender pile maintenance would include removal and replacement of untreated wood piles at the Port berths on an as needed basis, not to exceed 50 piles in the 10-year duration of the permit[1]. The Port or its contractor will remove piles by placing a choker around the pile and setting it in place at the mudline, then using a vibratory hammer attached to a crane to pull the pile from the sediment and out of the water. The hammer will vibrate for less than 1 minute per pile during removal. Replacement piles will be installed from a barge using a vibratory hammer and will take approximately the same amount of time as removal (<1 minute).

The Port proposes to provide off-site mitigation in the form of shallow-water habitat enhancement at a ratio greater than 3:1 as part of the Project. The Port's mitigation proposal includes donating a minimum of 60 12- to 16-inch average large end diameter, untreated timber pilings to Cowlitz Conservation District (CCD) to enhance shallow-water habitat as part of the Camp Kalama Enhancement Project (hereafter as the Camp Kalama Project) in the lower Kalama River. The pilings will be up to 50 feet long (Koellmann, 2021b). The proposed mitigation plan is provided as Appendix A.

Minimization measures and best management practices proposed by the applicant and described in the biological evaluation submitted by Port of Longview and their consultant, are considered

[1] Only one pile has been replaced due to impacts from dredging events in the last 10 years. However, the potential exists that piles could be damaged during any dredge event and would need to be replaced. Therefore, we evaluate this proposal assuming that an average annual pile replacement scenario be evaluated of 5 piles per year for a total of up to 50 piles being replaced over the 10-year duration of the permit. (Note: more than 5 could be replaced in any given year on an as-needed basis, but the total of 50 replacement piles would not be exceeded) for the period of the permit (Koellmann, D. 2021a).

parts of the proposed action to minimize adverse effects to ESA-listed species and their designated critical habitats. These measures and practices include the following:

- Work will occur within the approved in-water work window (IWWW) of October 1 to December 31. Work would be performed outside of this time frame only with USACE approval and consultation with appropriate agencies (e.g. NMFS, USFWS, WDFW, ODFW)
- Turbidity and other water quality parameters measured during the dredging and in-water placement will meet the Washington State Surface Water Quality Standards and the in-water placement standards for turbidity in Oregon's Department of Environmental Quality 401 Water Quality Certification when placing in the Oregon sites.
- Dredge operators will follow specific operational BMPs including:
    - Eliminate multiple bites while the bucket is on the bottom;
    - No stockpiling of dredged material on the riverbed;
    - No riverbed leveling.
- Enhanced BMPs will be implemented to further control turbidity including:
    - Slowing the velocity (i.e. increase cycle time) of ascending loaded clamshell bucket through the water column;
    - Pausing the dredge bucket near the bottom while descending and near the water line while ascending;
    - Placing filter material over the barge scuppers to clear return water.
- The contractor will be responsible for the preparation of a Spill, Prevention, Control and Countermeasure (SPCC) Plan to be used for the duration of the Project. The SPCC Plan will be submitted to the Project Engineer prior to the commencement of any construction activities.
- Dredge vessel personnel will be trained in hazardous material handling and spill response, and would be equipped with all necessary response tools.
- All fuel hoses, oil or fuel transfer vales, and fittings will be inspected prior to all in-water activity and on a regular basis during operation to check for drips or leak to prevent spills into surface waters.
- Surveys will be conducted pre-placement to confirm the capacity for dredge placement.
- Operations will stop temporarily if injured, sick or dead fish are found in the Project area to determine in additional fish are present and to ensure that operations may continue without further impact. NMFS will be notified, and fish will be handled with care to ensure effective treatment or analysis of cause of death.
- Pile removal BMPs adapted from the U.S. Environmental Protection Agency guidance (USEPA, 2007) and a NMFS Biological Opinion (NMFS, 2008a) will be employed, and include:
    - Wooden fender piles that are damaged during dredge events will be installed with a vibratory hammer and within the same location to the extent practicable.
    - The dredging contractor will inspect fuel hoses, oil or fuel transfer valves, and fittings on a regular basis for drips or leaks in order to prevent spills into the surface water.
    - The contractor will be responsible for the preparation of a Spill Prevention, Control, and Countermeasures Plan to be used for the duration of the Project to safeguard against an unintentional release of fuel, lubricants, or hydraulic fluid from construction equipment.

  - The contractor will initially vibrate the pile to break the friction bond between pile and soil.
  - To help minimize turbidity, the contractor will engage the vibrator to the minimum extent required to initiate vertical pile movement, and will disengage the vibrator once the pile has been mobilized and is moving upward.
  - The piles will be removed in a single, slow, and continuous motion to the best extent possible.
  - Pile cutoff will be used as an alternative where vibratory extraction or pulling is not feasible as described below. In addition, if a pile is broken or breaks during vibratory extraction, the contractor will employ the following methods:
    - A chain will be used if practicable to attempt to entirely remove the broken pile.
    - If the entire pile cannot be removed, the pile will be cut at the mudline.
    - Upon removal from the substrate, the pile will be moved expeditiously from the water to a barge, and then offloaded for disposal or recycling if possible.
- The following additional BMPs specific to repair of existing riprap will be implemented:
  - The extent of riprap replacement will be limited to those areas within the footprint of the existing riprap footprint in the Willow Grove boat basin that are damaged or dislodged during dredging activities.
  - Replacement riprap shall consist of similar type and sizes to current conditions and that contain no fines, soils, or other wastes or contaminants.

We considered whether or not the proposed action would cause any other activities and determined that, because vessel traffic currently uses the berths, boat basin, and launch area, and this proposed work is not intended to increase capacity for additional vessels, no other associated activities would also be caused by the proposed action.

1.4 Action Area

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

The proposed action area includes several discontinuous locations along the Columbia River, including: Port facilities, Willow Grove boat basin, the Willow Grove upland placement site, the set of in-water placement sites, and the Camp Kalama proposed mitigation site (Figures 1 and 2). As described more fully below, in sections 2.5, project-related water quality effects around dredging operations would be the stressor with the greatest range of effects for fish. Those effects are expected to include the waters and substrates of the Columbia River within 300 feet of the dredging areas and placement sites. At the proposed in-water placement sites the waters are fairly shallow (-20 or less) per the requirements of a suitable site as provided by USACE. Based on general proximity to each other, qualities for each in-water site prescribed by USACE, and location within the Columbia River, it is assumed that physical conditions are roughly analogous at each proposed in-water placement site. The Action Area around the proposed placement sites is established as an area approximately 300 feet in each direction at each in-water placement site to account for the extent of a potential turbidity plume and some slight shifts in the exact placement area. The action area is within designated critical habitat for 15 ESA listed fish species and EFH for Pacific salmonids.

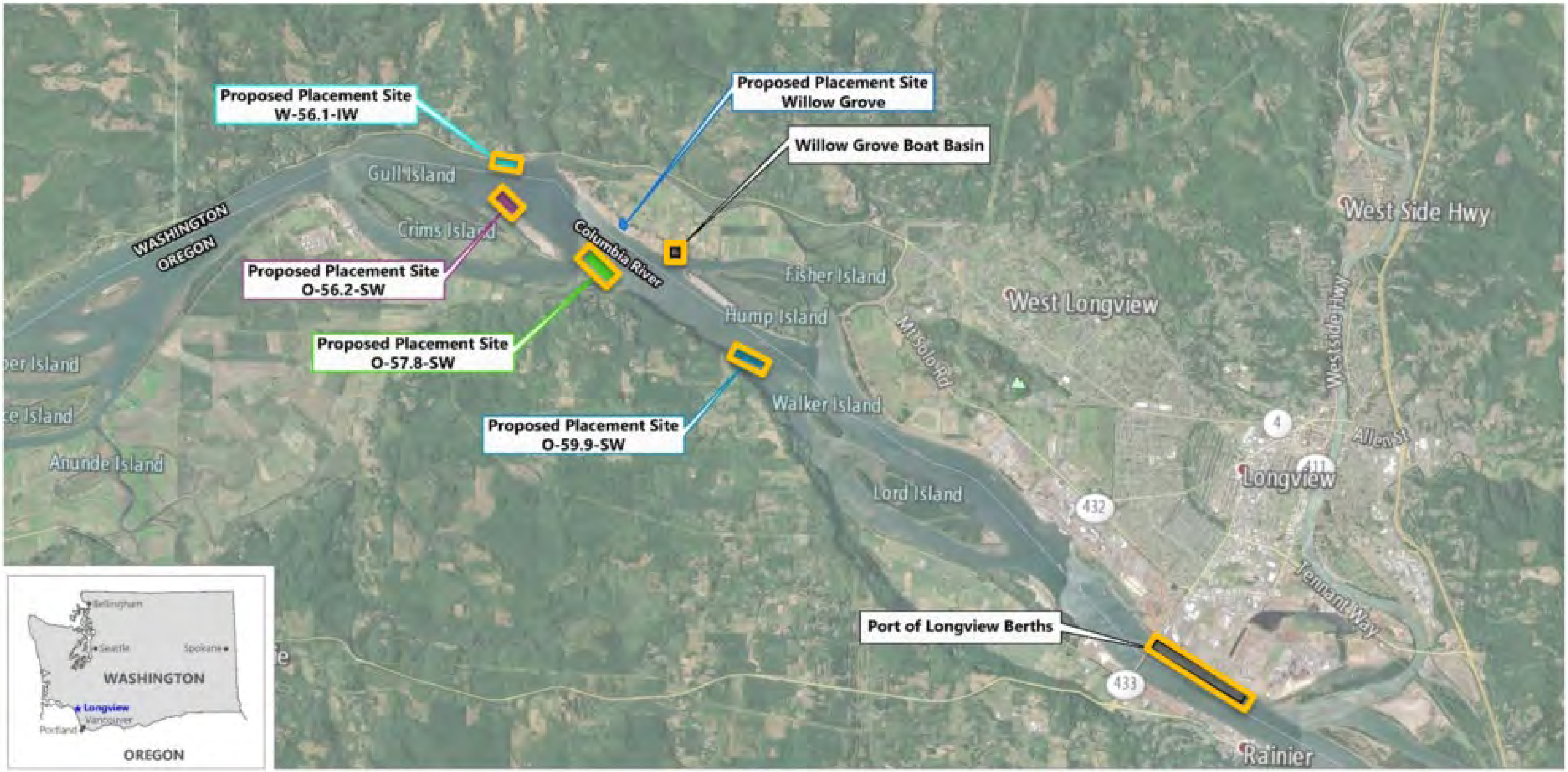

Figure 1. Location of dredging reaches (orange for the 300-ft estimated maximum extent of effects outside of the dredging areas) and the proposed placement sites in the lower Columbia River. Map courtesy of Anchor QE

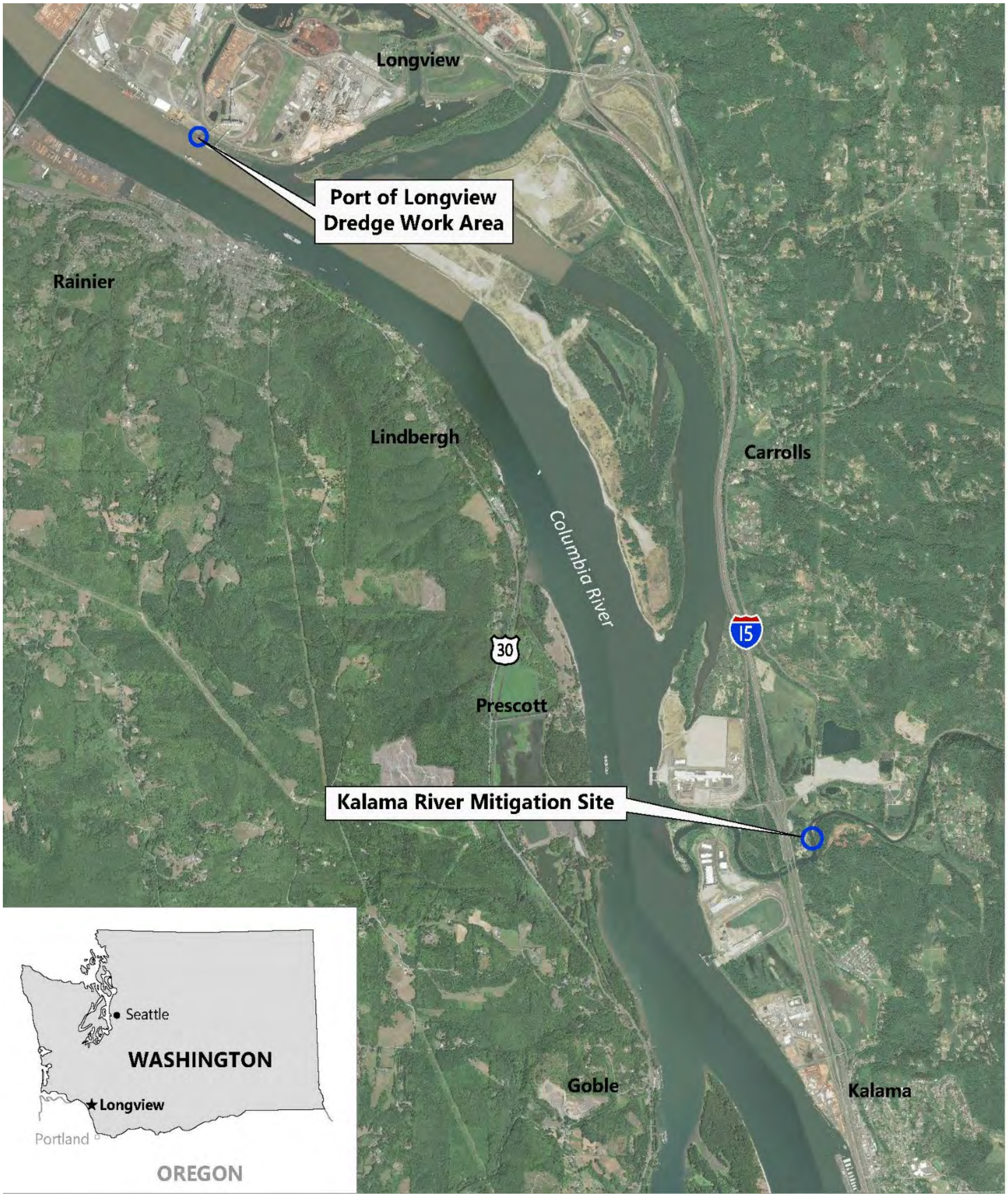

Figure 2. Location of proposed Kalama River Mitigation Site. Map courtesy of Anchor

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 non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1 Analytical Approach

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

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

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

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

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

- Evaluate the range-wide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.

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

2.2 Range-wide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "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 essential PBFs that help from the conservation value.

One factor affecting the status of ESA-listed species considered in this opinion, and aquatic habitat at large, is climate change. Climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. The largest hydrologic responses are expected to occur in basins with significant snow accumulation, where warming decreases snow pack, 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). 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% 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. 2013).

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).

Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al. 2009). Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB 2007). Reduced flows will make it more difficult for migrating fish to pass physical and thermal obstructions, limiting their access to available habitat (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 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 and 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^{o}C by the end of the century (IPCC 2014). Habitat loss, shifts in species' ranges and 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. Acidification also impacts 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 ESUs (NWFSC 2015). New stressors generated by climate change, or existing stressors with effects that have been amplified by climate change, may also have synergistic impacts on species and ecosystems (Doney et al. 2012). These conditions will possibly intensify the climate change stressors inhibiting recovery of ESA-listed species in the future.

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

2.2.1 Status of Critical Habitat

This section describes the status of designated critical habitat affected by the proposed action by examining the condition and trends of the essential physical and biological features (PBFs) that are essential to the conservation of the listed species throughout the designated areas. These features are essential to the conservation of the ESA-listed species because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging). Table 3, below, summarizes the general status of critical habitat, range-wide, for each species considered in this analysis.

Physical and Biological Features of Salmon and Steelhead Critical Habitat

The NMFS designated critical habitat for three different groups of salmonids that occupy the LCR, on three different dates. For each designation, NMFS used slightly different descriptions of the physical and biological features (PBFs) of critical habitat. In addition, NMFS identified the essential elements of the PBFs using slightly different terminology. This section presents each of the approaches to terminology used for each of the subsequent designations and attributes those to the specific salmonids covered by each designation, but for convenience, in the remainder of the document we will refer to them as PBFs, even though the original designations used different terminologies. Many of the PBFs and their essential elements actually overlap across designations.

The NMFS designated critical habitat for several Snake River salmonids on October 25, 1999 (64 FR 57399), including Snake River Sockeye and separate Spring/Summer, and Fall-run Snake River Chinook salmon ESUs. Snake River steelhead critical habitat was designated in 2005 and is detailed below. The PBFs (originally termed "essential features") of critical habitat for Snake River salmonids are (1) Spawning and juvenile rearing areas; (2) juvenile migration corridors; (3) areas for growth and development to adulthood; and (4) adult migration corridors. The essential elements of the spawning and rearing PBFs are: 1) Spawning gravel; (2) water quality; (3) water quantity; (4) water temperature; (5) food; (6) riparian vegetation; and (7) access. The designation also breaks down the migration corridor for juvenile and adult salmonids as follows: Essential features of the juvenile migration corridors include adequate: (1) Substrate (2) water quality; (3) water quantity; (4) water temperature; (5) water velocity; (6) cover/shelter; (7) food; (8) riparian vegetation; (9) space; and (10) safe passage conditions. The adult migration corridors are the same areas included in juvenile migration corridors. Essential features would include those in the juvenile migration corridors, excluding adequate food.

Subsequently, NMFS designated critical habitat for 10 ESUs and DPSs of Columbia River salmon and steelhead and Snake River steelhead on September 2, 2005 (70 FR 52630), and lower Columbia River coho salmon on February 24, 2016 (81 FR 9252) as shown in Table 2. The PBFs are referred to as Primary Constituent Elements (PCE) in 70 FR 52630 and in 81 FR 9252, and those terms may be used interchangeably in this document. Specific PCEs, and essential features for salmonids designated in 2005, and 2016 include:

1. Freshwater spawning sites with water quantity and quality conditions and substrate that support spawning, incubation, and larval development;

2. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility, water quality and forage that support juvenile development, and natural cover such as shade, submerged and overhanging large wood, logjams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;

3. Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging

large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks that support juvenile and adult mobility and survival;

4. 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; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation;

5. Nearshore marine areas free of obstruction and excessive predation with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and

6. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

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

Physical and Biological Features of Pacific Eulachon Critical Habitat

The NMFS designated critical habitat for the southern DPS of Pacific eulachon on October 11, 2011 (76 FR 65324). Critical habitat includes portions of 16 rivers and streams in California, Oregon, and Washington (USDC 2011). We designated all of these areas as migration and spawning habitat for this species. Specific PBFs, and the essential features associated with the PBFs for Pacific eulachon designated in 2011 include:

1. Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.

2. Freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.

3. Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. Eulachon prey on a wide variety of species including crustaceans such as copepods and euphausiids (Hay and McCarter 2000, WDFW and ODFW 2001), unidentified malacostracans (Smith and Saalfeld 1955), mysids, barnacle larvae, and worm larvae (WDFW and ODFW 2001). These features are essential to conservation because they allow juvenile fish to survive, grow, and reach maturity, and they allow adult fish to survive and return to freshwater systems to spawn.

Table 3. Critical habitat, designation date, federal register citation, and status summary for critical habitat considered in this opinion

Species	Designation Date and FR Citation	Critical Habitat Status Summary
Lower Columbia River Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 47 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some, or high potential for improvement. We rated conservation value of HUC5 watersheds as high for 30 watersheds, medium for 13 watersheds, and low for four watersheds.
Upper Columbia River spring-run Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses four subbasins in Washington containing 15 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some, or high, potential for improvement. We rated conservation value of HUC5 watersheds as high for 10 watersheds, and medium for five watersheds. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Snake River spring/summer-run Chinook salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers, and all tributaries of the Snake and Salmon rivers (except the Clearwater River) presently or historically accessible to this ESU (except reaches above impassable natural falls and Hells Canyon Dam). Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Upper Willamette River Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Oregon containing 56 occupied watersheds, as well as the lower Willamette/Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some, or high, potential for improvement. Watersheds are in good to excellent condition with no potential for improvement only in the upper McKenzie River and its tributaries (NMFS 2005). We rated conservation value of HUC5 watersheds as high for 22 watersheds, medium for 16 watersheds, and low for 18 watersheds.
Snake River fall-run Chinook salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers, and all tributaries of the Snake and Salmon rivers presently or historically accessible to this ESU (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams). Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Columbia River chum salmon	9/02/05 70 FR 52630	Critical habitat encompasses six subbasins in Oregon and Washington containing 19 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 16 watersheds, and medium for three watersheds.

Species	Designation Date and FR Citation	Critical Habitat Status Summary
Lower Columbia River coho salmon	2/24/16 81 FR 9252	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 55 occupied watersheds, as well as the lower Columbia River and estuary rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 34 watersheds, medium for 18 watersheds, and low for three watersheds.
Snake River sockeye salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers; Alturas Lake Creek; Valley Creek; and Stanley, Redfish, Yellow Belly, Pettit and Alturas lakes (including their inlet and outlet creeks). Water quality in all five lakes generally is adequate for juvenile sockeye salmon, although zooplankton numbers vary considerably. Some reaches of the Salmon River and tributaries exhibit temporary elevated water temperatures and sediment loads that could restrict sockeye salmon production and survival (NMFS 2015b). Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Upper Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Washington containing 31 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 20 watersheds, medium for eight watersheds, and low for three watersheds.
Lower Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses nine subbasins in Oregon and Washington containing 41 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 28 watersheds, medium for 11 watersheds, and low for two watersheds.
Upper Willamette River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses seven subbasins in Oregon containing 34 occupied watersheds, as well as the lower Willamette/Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. Watersheds are in good to excellent condition with no potential for improvement only in the upper McKenzie River and its tributaries (NMFS 2005). We rated conservation value of HUC5 watersheds as high for 25 watersheds, medium for 6 watersheds, and low for 3 watersheds.
Middle Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 15 subbasins in Oregon and Washington containing 111 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of occupied HUC5 watersheds as high for 80 watersheds, medium for 24 watersheds, and low for 9 watersheds.
Snake River basin steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 25 subbasins in Oregon, Washington, and Idaho. Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.

Species	Designation Date and FR Citation	Critical Habitat Status Summary
Southern DPS of eulachon	10/20/11 76 FR 65324	Critical habitat for eulachon includes portions of 16 rivers and streams in California, Oregon, and Washington. All of these areas are designated as migration and spawning habitat for this species. In Oregon, we designated 24.2 miles of the lower Umpqua River, 12.4 miles of the lower Sandy River, and 0.2 miles of Tenmile Creek. We also designated the mainstem Columbia River from the mouth to the base of Bonneville Dam, a distance of 143.2 miles. Dams and water diversions are moderate threats to eulachon in the Columbia and Klamath rivers where hydropower generation and flood control are major activities. Degraded water quality is common in some areas occupied by southern DPS eulachon. In the Columbia and Klamath river basins, large-scale impoundment of water has increased winter water temperatures, potentially altering the water temperature during eulachon spawning periods. Numerous chemical contaminants are also present in spawning rivers, but the exact effect these compounds have on spawning and egg development is unknown. Dredging is a low to moderate threat to eulachon in the Columbia River. Dredging during eulachon spawning would be particularly detrimental.

2.2.2 Status of the Species

Table 4, below provides a summary of listing and recovery plan information, status summaries and limiting factors for the species addressed in this opinion. More information can be found in recovery plans and status reviews for these species. Acronyms appearing in the table include DPS (Distinct Population Segment), ESU (Evolutionarily Significant Unit), ICTRT (Interior Columbia Technical Recovery Team), MPG (Multiple Population Grouping), NWFSC (Northwest Fisheries Science Center), and VSP (Viable Salmonid Population).

Table 4. Listing classification and date, recovery plan reference, most recent status review, status summary, and limiting factors for each species considered in this opinion.

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Lower Columbia River Chinook salmon	Threatened 6/28/05	NMFS 2013	NWFSC 2015	This ESU comprises 32 independent populations. Twenty-seven populations are at very high risk, 2 populations are at high risk, one population is at moderate risk, and 2 populations are at very low risk Overall, there was little change since the last status review in the biological status of this ESU, although there are some positive trends. Increases in abundance were noted in about 70% of the fall-run populations and decreases in hatchery contribution were noted for several populations. Relative to baseline VSP levels identified in the recovery plan, there has been an overall improvement in the status of a number of fall-run populations, although most are still far from the recovery plan goals.	• Reduced access to spawning and rearing habitat • Hatchery-related effects • Harvest-related effects on fall Chinook salmon • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Contaminant

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Columbia River spring-run Chinook salmon	Endangered 6/28/05	Upper Columbia Salmon Recovery Board 2007	NWFSC 2015	This ESU comprises four independent populations. Three are at high risk and one is functionally extirpated. Current estimates of natural origin spawner abundance increased relative to the levels observed in the prior review for all three extant populations, and productivities were higher for the Wenatchee and Entiat populations and unchanged for the Methow population. However, abundance and productivity remained well below the viable thresholds called for in the Upper Columbia Recovery Plan for all three populations.	• Effects related to hydropower system in the mainstem Columbia River • Degraded freshwater habitat • Degraded estuarine and nearshore marine habitat • Hatchery-related effects • Persistence of non-native (exotic) fish species • Harvest in Columbia River fisheries
Snake River spring/summer-run Chinook salmon	Threatened 6/28/05	NMFS 2017a	NWFSC 2015	This ESU comprises 28 extant and four extirpated populations. All expect one extant population (Chamberlin Creek) are at high risk. Natural origin abundance has increased over the levels reported in the prior review for most populations in this ESU, although the increases were not substantial enough to change viability ratings. Relatively high ocean survivals in recent years were a major factor in recent abundance patterns. While there have been improvements in abundance and productivity in several populations relative to prior reviews, those changes have not been sufficient to warrant a change in ESU status.	• Degraded freshwater habitat • Effects related to the hydropower system in the mainstem Columbia River, • Altered flows and degraded water quality • Harvest-related effects • Predation

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Willamette River Chinook salmon	Threatened 6/28/05	NMFS 2011	NWFSC 2015	This ESU comprises seven populations. Five populations are at very high risk, one population is at moderate risk (Clackamas River) and one population is at low risk (McKenzie River). Consideration of data collected since the last status review in 2010 indicates the fraction of hatchery origin fish in all populations remains high (even in Clackamas and McKenzie populations). The proportion of natural origin spawners improved in the North and South Santiam basins, but is still well below identified recovery goals. Abundance levels for five of the seven populations remain well below their recovery goals. Of these, the Calapooia River may be functionally extinct and the Molalla River remains critically low. Abundances in the North and South Santiam rivers have risen since the 2010 review, but still range only in the high hundreds of fish. The Clackamas and McKenzie populations have previously been viewed as natural population strongholds, but have both experienced declines in abundance despite having access to much of their historical spawning habitat. Overall, populations appear to be at either moderate or high risk, there has been likely little net change in the VSP score for the ESU since the last review, so the ESU remains at moderate risk.	• Degraded freshwater habitat • Degraded water quality • Increased disease incidence • Altered stream flows • Reduced access to spawning and rearing habitats • Altered food web due to reduced inputs of microdetritus • Predation by native and non-native species, including hatchery fish • Competition related to introduced salmon and steelhead • Altered population traits due to fisheries and bycatch

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River fall-run Chinook salmon	Threatened 6/28/05	NMFS 2017b	NWFSC 2015	This ESU has one extant population. Historically, large populations of fall Chinook salmon spawned in the Snake River upstream of the Hells Canyon Dam complex. The extant population is at moderate risk for both diversity and spatial structure and abundance and productivity. The overall viability rating for this population is 'viable.' Overall, the status of Snake River fall Chinook salmon has clearly improved compared to the time of listing and compared to prior status reviews. The single extant population in the ESU is currently meeting the criteria for a rating of 'viable' developed by the ICTRT, but the ESU as a whole is not meeting the recovery goals described in the recovery plan for the species, which require the single population to be "highly viable with high certainty" and/or will require reintroduction of a viable population above the Hells Canyon Dam complex.	• Degraded floodplain connectivity and function • Harvest-related effects • Loss of access to historical habitat above Hells Canyon and other Snake River dams • Impacts from mainstem Columbia River and Snake River hydropower systems • Hatchery-related effects • Degraded estuarine and nearshore habitat.

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Columbia River chum salmon	Threatened 6/28/05	NMFS 2013	NWFSC 2015	Overall, the status of most chum salmon populations is unchanged from the baseline VSP scores estimated in the recovery plan. A total of 3 of 17 populations are at or near their recovery viability goals, although under the recovery plan scenario these populations have very low recovery goals of 0. The remaining populations generally require a higher level of viability and most require substantial improvements to reach their viability goals. Even with the improvements observed during the last five years, the majority of populations in this ESU remain at a high or very high risk category and considerable progress remains to be made to achieve the recovery goals.	• Degraded estuarine and nearshore marine habitat • Degraded freshwater habitat • Degraded stream flow as a result of hydropower and water supply operations • Reduced water quality • Current or potential predation • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Lower Columbia River coho salmon	Threatened 6/28/05	NMFS 2013	NWFSC 2015	Of the 24 populations that make up this ESU, 21 populations are at very high risk, 1 population is at high risk, and 2 populations are at moderate risk. Recent recovery efforts may have contributed to the observed natural production, but in the absence of longer term data sets it is not possible to parse out these effects. Populations with longer term data sets exhibit stable or slightly positive abundance trends. Some trap and haul programs appear to be operating at or near replacement, although other programs still are far from that threshold and require supplementation with additional hatchery-origin spawners .Initiation of or improvement in the downstream juvenile facilities at Cowlitz Falls, Merwin, and North Fork Dam are likely to further improve the status of the associated upstream populations. While these and other recovery efforts have likely improved the status of a number of coho salmon populations, abundances are still at low levels and the majority of the populations remain at moderate or high risk. For the Lower Columbia River region land development and increasing human population pressures will likely continue to degrade habitat, especially in lowland areas. Although populations in this ESU have generally improved, especially in the 2013/14 and 2014/15 return years, recent poor ocean conditions suggest that population declines might occur in the upcoming return years	• Degraded estuarine and near-shore marine habitat • Fish passage barriers • Degraded freshwater habitat: Hatchery-related effects • Harvest-related effects • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River sockeye salmon	Endangered 6/28/05	NMFS 2015	NWFSC 2015	This single population ESU is at very high risk dues to small population size. There is high risk across all four basic risk measures. Although the captive brood program has been successful in providing substantial numbers of hatchery produced fish for use in supplementation efforts, substantial increases in survival rates across all life history stages must occur to re-establish sustainable natural production In terms of natural production, the Snake River Sockeye ESU remains at extremely high risk although there has been substantial progress on the first phase of the proposed recovery approach – developing a hatchery based program to amplify and conserve the stock to facilitate reintroductions.	• Effects related to the hydropower system in the mainstem Columbia River • Reduced water quality and elevated temperatures in the Salmon River • Water quantity • Predation

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Columbia River steelhead	Threatened 1/5/06	Upper Columbia Salmon Recovery Board 2007	NWFSC 2015	This DPS comprises four independent populations. Three populations are at high risk of extinction while 1 population is at moderate risk. Upper Columbia River steelhead populations have increased relative to the low levels observed in the 1990s, but natural origin abundance and productivity remain well below viability thresholds for three out of the four populations. The status of the Wenatchee River steelhead population continued to improve based on the additional year's information available for the most recent review. The abundance and productivity viability rating for the Wenatchee River exceeds the minimum threshold for 5% extinction risk. However, the overall DPS status remains unchanged from the prior review, remaining at high risk driven by low abundance and productivity relative to viability objectives and diversity concerns.	• Adverse effects related to the mainstem Columbia River hydropower system • Impaired tributary fish passage • Degraded floodplain connectivity and function, channel structure and complexity, riparian areas, large woody debris recruitment, stream flow, and water quality • Hatchery-related effects • Predation and competition • Harvest-related effects

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Lower Columbia River steelhead	Threatened 1/5/06	NMFS 2013	NWFSC 2015	This DPS comprises 23 historical populations, 17 winter-run populations and six summer-run populations. Nine populations are at very high risk, 7 populations are at high risk, 6 populations are at moderate risk, and 1 population is at low risk. The majority of winter-run steelhead populations in this DPS continue to persist at low abundances. Hatchery interactions remain a concern in select basins, but the overall situation is somewhat improved compared to prior reviews. Summer-run steelhead populations were similarly stable, but at low abundance levels. The decline in the Wind River summer-run population is a source of concern, given that this population has been considered one of the healthiest of the summer-runs; however, the most recent abundance estimates suggest that the decline was a single year aberration. Passage programs in the Cowlitz and Lewis basins have the potential to provide considerable improvements in abundance and spatial structure, but have not produced self-sustaining populations to date. Even with modest improvements in the status of several winter-run DIPs, none of the populations appear to be at fully viable status, and similarly none of the MPGs meet the criteria for viability.	• Degraded estuarine and nearshore marine habitat • Degraded freshwater habitat • Reduced access to spawning and rearing habitat • Avian and marine mammal predation • Hatchery-related effects • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Willamette River steelhead	Threatened 1/5/06	NMFS 2011	NWFSC 2015	This DPS has four demographically independent populations. Three populations are at low risk and one population is at moderate risk. Declines in abundance noted in the last status review continued through the period from 2010-2015. While rates of decline appear moderate, the DPS continues to demonstrate the overall low abundance pattern that was of concern during the last status review. The causes of these declines are not well understood, although much accessible habitat is degraded and under continued development pressure. The elimination of winter-run hatchery release in the basin reduces hatchery threats, but non-native summer steelhead hatchery releases are still a concern for species diversity and a source of competition for the DPS. While the collective risk to the persistence of the DPS has not changed significantly in recent years, continued declines and potential negative impacts from climate change may cause increased risk in the near future.	• Degraded freshwater habitat • Degraded water quality • Increased disease incidence • Altered stream flows • Reduced access to spawning and rearing habitats due to impaired passage at dams • Altered food web due to changes in inputs of microdetritus • Predation by native and non-native species, including hatchery fish and pinnipeds • Competition related to introduced salmon and steelhead • Altered population traits due to interbreeding with hatchery origin fish

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Middle Columbia River steelhead	Threatened 1/5/06	NMFS 2009b	NWFSC 2015	This DPS comprises 17 extant populations. The DPS does not currently include steelhead that are designated as part of an experimental population above the Pelton Round Butte Hydroelectric Project. Returns to the Yakima River basin and to the Umatilla and Walla Walla Rivers have been higher over the most recent brood cycle, while natural origin returns to the John Day River have decreased. There have been improvements in the viability ratings for some of the component populations, but the DPS is not currently meeting the viability criteria in the MCR steelhead recovery plan. In general, the majority of population level viability ratings remained unchanged from prior reviews for each major population group within the DPS.	• Degraded freshwater habitat • Mainstem Columbia River hydropower-related impacts • Degraded estuarine and nearshore marine habitat • Hatchery-related effects • Harvest-related effects • Effects of predation, competition, and disease
Snake River basin steelhead	Threatened 1/5/06	NMFS 2017a	NWFSC 2015	This DPS comprises 24 populations. Two populations are at high risk, 15 populations are rated as maintained, 3 populations are rated between high risk and maintained, 2 populations are at moderate risk, 1 population is viable, and 1 population is highly viable. Four out of the five MPGs are not meeting the specific objectives in the draft recovery plan based on the updated status information available for this review, and the status of many individual populations remains uncertain A great deal of uncertainty still remains regarding the relative proportion of hatchery fish in natural spawning areas near major hatchery release sites within individual populations.	• Adverse effects related to the mainstem Columbia River hydropower system • Impaired tributary fish passage • Degraded freshwater habitat • Increased water temperature • Harvest-related effects, particularly for B-run steelhead • Predation • Genetic diversity effects from out-of-population hatchery releases

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Southern DPS of green sturgeon	Threatened 4/7/06	NMFS 2018	NMFS 2015c	The Sacramento River contains the only known green sturgeon spawning population in this DPS. The current estimate of spawning adult abundance is between 824-1,872 individuals. Telemetry data and genetic analyses suggest that Southern DPS green sturgeon generally occur from Graves Harbor, Alaska to Monterey Bay, California and, within this range, most frequently occur in coastal waters of Washington, Oregon, and Vancouver Island and near San Francisco and Monterey bays. Within the nearshore marine environment, tagging and fisheries data indicate that Northern and Southern DPS green sturgeon prefer marine waters of less than a depth of 110 meters.	• Reduction of its spawning area to a single known population • Lack of water quantity • Poor water quality • Poaching

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Southern DPS of eulachon	Threatened 3/18/10	NMFS 2017c	Gustafson et al. 2016	The Southern DPS of eulachon includes all naturally-spawned populations that occur in rivers south of the Nass River in British Columbia to the Mad River in California. Sub populations for this species include the Fraser River, Columbia River, British Columbia and the Klamath River. In the early 1990s, there was an abrupt decline in the abundance of eulachon returning to the Columbia River. Despite a brief period of improved returns in 2001-2003, the returns and associated commercial landings eventually declined to the low levels observed in the mid-1990s. Although eulachon abundance in monitored rivers has generally improved, especially in the 2013-2015 return years, recent poor ocean conditions and the likelihood that these conditions will persist into the near future suggest that population declines may be widespread in the upcoming return years	• Changes in ocean conditions due to climate change, particularly in the southern portion of the species' range where ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success. • Climate-induced change to freshwater habitats • Bycatch of eulachon in commercial fisheries • Adverse effects related to dams and water diversions • Water quality, • Shoreline construction • Over harvest • Predation

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 Habitat Conditions in the Action Area

The action area is several different locations along the Columbia River, and is not one continuous reach of the river. The action area is influenced by water quality and prey community impacts associated with all upstream uses, and is considered part of the Columbia River estuary. Fish habitat in the action area has been adversely affected by a variety of in-water and upland human activities, including habitat losses from all causes (urbanization, roads, diking, etc.), flood control, irrigation and hydroelectric dams, pollution, municipal and industrial water use, introduced species, hatchery production (NMFS 2013), and climate change as described in section 2.2 above. Analysis of historical habitat distributions in a Geographical Information System indicated that scrub/shrub and forested wetland types have declined in the estuary since the late 19th and early 20th centuries by 55 and 58%, respectively. Diking, filling, and other changes have reduced the total area of all wetland types combined from approximately 155 to 75 km2 (Bottom et al. 2008).

A portion of the Action Area around the Port includes a highly industrialized corridor of the Columbia River and has characteristics typical of industrial shorelines. Westrock Company is located just upstream of the Port at 300 Fibre Way, near RM 67.5 with a dock on the Old Mouth of the Cowlitz River used to load and offload timber products. The confluence of the Cowlitz and Columbia rivers occurs about 1 mile upstream from the Port near RM 68 and is at the upstream edge of the Action Area. The Cowlitz drainage includes mixed land uses in Longview and Kelso, portions of the I-5 corridor, and large expanses of forested and agricultural lands. On the Oregon side is the shoreline of the community of Rainier, which is similarly developed with uses including the Teevens Log Dock directly across from Port and upstream of the SR 433 Bridge, and the Gypsum Plant immediately just downstream of the SR 433 Bridge. At approximately the same location as the mouth of the Cowlitz entering on the Washington side, development thins out on the Oregon side and the shoreline becomes much more natural, although the river is separated from its floodplain as a result of significant diking. Downstream from the Project site, the Action Area is also heavily industrialized on the Washington side, until approximately the upper end of Lord Island.

Willow Grove Park is a 75-acre public park located between the Columbia River and Willow Grove Road. The boat launch is located within a boat basin that comprises several floating docks and is protected by a pile-supported concrete plank wall breakwater, which is designed to allow for fish passage. Willow Grove Park uplands are characterized by short grass on previously placed dredge sands, and naturally occurring beach sands. n-water placement sites on the Oregon side of the river between RM 59.9 to 56.2 (OR-59.9, OR-57.8, OR 56.2), and one in-water site on the Washington side of the river (WA-56.1). The shorelines on both the Oregon and Washington side of the river between the Port and the proposed in-water placement sites include a mix of residential and agricultural upland land use, shoreline roadways, and undeveloped areas. Habitat elements, including shallow water areas and vegetation, become increasingly more common moving downstream from the Port. Agriculture is the predominant land use on the Washington side in this reach, interspersed among natural areas. Walker Island, Fisher Island, Hump Island, and Crims Island are located between RMs 62 and 56; most of the sites are located in the river between Crims Island and Hump Island. These islands are predominantly wildlife areas, with the exception of Hump island which is used by USACE as a dredged material placement site

The action area is affected by many upriver activities and uses in Columbia River basin watersheds. In general, those conditions have declined in the last 150 years, together influencing conditions in the action area. These multiple watersheds, like the action area, are characterized by loss of connectivity with floodplains and feeding and resting habitat for juvenile salmonids in the form of low-velocity marshland and tidal channel habitats (Bottom et al. 2005). Each of the upland conditions influence habitat characteristics in the action area such as water quality and amount and composition of prey base. Water quality throughout the action area is degraded by urban, industrial, and agricultural practices across the basin that contributes multiple pollutants at levels above natural conditions. Habitat degradation has generally reduced the quality, complexity, and amount of this important rearing and migration habitat for salmon and steelhead. Numerous early life history strategies of CR salmonids have been lost as a result of past management actions that are now considered part of the environmental baseline (Bottom et al. 2005).

The environmental baseline includes the impacts from deep-water dredging to accommodate safe vessel traffic and shallow water dredging to maintain vessel traffic. Therefore, dredging activities occur across numerous areas and microhabitats within the Lower Columbia River including sloughs, secondary channels, and floodplain wetlands. All of these habitat areas provide rearing for ESA-listed fish, and all have been degraded by shore-based development and construction and maintenance of boat moorage facilities. Floodplain and off-channel sloughs have been cut off by dikes and flood control levees, limiting potential refuge areas and forage sites for juvenile salmonids. The dredge sediment disposal in the Lower Columbia River has had adverse effects, including displacement of seasonally-flooded wetlands, regular disruption of shallow water benthic prey communities, and most significantly creation of attractive nesting habitat for avian predators feeding on juvenile salmonids (Evans et al. 2012; Sebring et al. 2013). Survival of salmonids migrating through this reach has declined for both juvenile and adult salmonids resulting in reduced population productivity and abundance.

The hydrology and hydrograph of the Columbia River is significantly altered from historical conditions, shifting natural cues that salmonids rely on for spawning and outmigration behavior. River flow is less dynamic (Sherwood et al. 1990), sediment transport has decreased by as much as 50 percent (Simenstad et al. 1992). Other actions such as the depredation and relocation of large colonial nesting waterbird colonies have reduced the numbers of avian predators that prey upon salmonids in the Columbia River estuary that may improve progress in reaching recovery goals by up to 6 percent (NMFS 2011b). Degraded water quality in the action area results from load of increased fine sediments, elevated water temperatures especially during the winter (Weitkamp 1994), and a host of municipal and industrial discharges, permitted or otherwise (LCREP 2007). These conditions are a result of upstream land uses, all of which influence the LCR and its recovery potential (Fresh et al. 2005).

The baseline also includes the effects of projects that have proceeded subsequent to section 7 consultation. During the last five years, NMFS has engaged in several Section 7 consultations on Federal projects adversely affecting ESA-listed fish and their habitats in and near the action area. These include vicinity (Multnomah County, Oregon; Clark County, Washington) adjacent to or within the action area (WCR-2019-11648, WCR-2018-10138, WCR-2017-7450, WCR-2017-6622, WCR-2016-5516), including the effects of actions addressed in programmatic consultations (the SLOPES IV programmatic consultation; NMFS number WCR-2011-05585). In general, those actions caused temporary, construction-related effects (increased noise and turbidity), and longer term effects like increasing overwater coverage. Current conditions of the baseline hinder the quality of downstream migration and reduce benthic production of forage items.

We note that all actions processed under the SLOPES IV programmatic consultation also include minimization measures to reduce or avoid both short- and long-term effects in the environment. These include requiring grated and translucent materials to allow light penetration, pile caps to prevent piscivorous bird perching, and limits on square footage of new overwater coverage. Actions implemented under SLOPES IV continue to have some effects that can reduce fitness and survival in a small number of individuals, and have contemporaneous minimization measures reduce the level of habitat degradation at large. Overall effects of these SLOPES IV actions do incrementally contribute to the environmental baseline and the effects of existing structures (e.g. increased shading, reduction in prey, increased predation, and possible minor migration delays).

2.3.2 Species in the Action Area

All ESA-listed Columbia basin salmon and steelhead, may rear and/or migrate through the action area, resulting in effects to individuals of species and rearing and migration critical habitat PBFs. Rearing of juvenile salmonids, is likely to occur near the periphery of the dredging sites in shallower waters composed primarily of sand/silt bathos near shorelines. Upstream migration of adult salmonids and downstream migrations of salmonid smolts are likely to occur in the mainstem LCR in proximity to the dredge sites. As mentioned above, survival of migrating fish has been reduced, to the degree that multiple life history strategies have been lost as the habitat has been altered. Similarly, eulachon migrate through the action area both as adults and as larval passive out-migrants. Green sturgeon adults and sub-adults have annual resting and feeding in the Columbia River, including the action area.

Because all of the ESA-listed species considered in this opinion must migrate through the action area, 100% are exposed to the degraded baseline conditions both as juveniles and as adults. Some of the species considered in this consultation rear in the action area, and thus are exposed to the degraded baseline for a significant portion of this sensitive lifestage. Exposure to degraded habitat conditions may negatively affect the condition of individual fishes that will also be exposed to the effects of the proposed action, and may in turn influence the nature and degree of their response. For this reason, we evaluate here the effects of the baseline on listed fish.

Salmonids in the action area will generally exhibit either a stream-maturing or ocean-maturing life history type. A stream-type life history is exemplified by juvenile salmon and steelhead that typically rear in upstream tributary habitats for over a year. Salmonids exhibiting this life history include LCR Chinook salmon (spring runs), LCR steelhead, LCR coho salmon, MCR steelhead, UWR steelhead, UWR Chinook salmon, SR spring/summer Chinook salmon, UCR Chinook salmon, SR steelhead, SR sockeye, and UCR steelhead. These juvenile fish migrate through the action area as smolts, approximately 100 to 200 mm in size, move quickly downstream, and pass by the action area within one to two days (Dawley et al. 1986).

An ocean-type life history is exemplified by juvenile salmon that move out of spawning streams and migrate towards the LCR estuary as sub-yearlings and are actively rearing within the LCR estuary. Fish that exhibit these life histories include LCR Chinook salmon (fall runs), CR chum salmon, and SR fall-run Chinook salmon. These fish are generally smaller in size (less than 100 mm) and more likely to spend days to weeks residing in tidal freshwater habitats characterized by the action area, with peak abundances occurring March through May (Hering et al. 2010; McNatt et al. 2016).

In addition to variations in outmigration timing, juvenile ESA-listed species also have a wide horizontal and vertical distribution in the CR related to size and life history stage. Generally speaking, juvenile salmonids will occupy the action area across the width of the river, and to average depths of up to 35 feet (Carter et al. 2009). Smaller-sized fish use the shallow inshore habitats and larger fish will use the channel margins and main channel. The pattern of use generally shifts between day and night. Juvenile salmon occupy different locations within the CR, and are typically in shallower water during the day, avoiding predation by larger fish that are more likely to be in deeper water. These juveniles will venture into the deeper areas of the river away from the shoreline, towards the navigation channel and along the bathymetric break – or channel margin – and will be closer to the bottom of the channel (Carter et al. 2009). The smaller sub-yearling salmonids will likely congregate along the nearshore areas in shallow water and extend into the channel margins (Bottom et al. 2011). Yet, as Carlson et al. (2001) indicated, there is higher use of the channel margins than previously thought and considering the parameters above, relative juvenile position in the water column suggests higher potential sub-yearling use in areas of 20 to 30 feet deep.

The consequence of systematic habitat loss is a reduction habitat varieties, and corollary loss of species variety that relied on that complex of diverse conditions. According to Rich’s (1920) survey results, salmon present in the estuary during September-December 1916 consisted of a diversity of life history types, including recent migrants from upriver, as well as individuals that had spent a significant period rearing in the estuary (Burke 2005; Bottom et al. 2005).

However, beach-seining surveys since 2002 indicated that proportionally fewer juvenile salmon now utilize the estuary throughout the late summer and fall, and the population curve is now skewed toward the period March through July and peaks sharply in spring or early summer (Bottom et al 2008). Analyzing historical data (Rich 1920), there were at least six Chinook life history types in the Columbia River, including five variants of subyearling life history, prior to extensive development in the basin. These strategies were distinguished by length of time spent in each freshwater environment, time spent in the estuary, and time and size at ocean entrance. Chinook salmon with estuarine rearing life histories are now substantially reduced in importance, leaving three principal life history types in the basin: fry migrants, subyearling migrants that rear in natal streams (including hatchery-reared juveniles) and/or main rivers and yearling migrants (Burke 2005). LCR steelhead has lost 4 historical populations, and LCR Chinook diversity has declined by 8-10 historical populations. In the 2010 status review, the NWFSC determined 28 of the 32 extant populations of LCR Chinook salmon were extirpated or at very high risk of extirpation. Similarly, in 2010 the NWFSC indicated that 21 of 24 historical populations of LC coho were at very high risk of being extirpated, though modest improvements were noted in the 2015 review. CR Chum have 17 historical populations, 14 of which are extirpated or nearly so.

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. 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).

As described in Section 1.3, the Port of Longview proposes to conduct 10 years of routine maintenance dredging that would occur annually between October 31 and January 31. Mechanical dredging with a barge-mounted clamshell bucket would be the predominant method.

Temporary effects of the proposed action are reasonably certain to include: 1) reduction in water quality from high levels of suspended sediment; 2) reduction in available prey from disturbed benthic conditions; and 3) temporary obstruction to safe passage from degraded habitat conditions in the migration corridor, and 4) increased underwater noise while equipment and construction vessels are operating These changes in the environment will affect PBFs of critical habitat, and the species that are present when these effects occur. The Port also proposes mitigation work that is expected to result in long-term positive habitat complexity improvements.

2.4.1 Effects on Critical Habitat

The proposed action will affect designated critical habitat for LCR Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer run Chinook salmon, UWR spring-run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, LCR coho salmon, SR sockeye salmon, LCR steelhead, MCR steelhead, UCR steelhead, SR steelhead, and UWR steelhead, and SDPS eulachon. Given the location of the proposed action and life history expression, all of the species considered in these opinions use this area for migration and/or rearing.

Salmonid Critical Habitat

The action area includes the PBFs for freshwater rearing and migration corridor for all salmonids considered in this opinion. The essential elements of freshwater rearing sites are substrate, water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility include: water quality and forage that support juvenile development, natural cover such as shade, submerged and overhanging large wood, logjams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

The essential features of freshwater migration corridors are freedom of obstruction and excessive predation with water quantity and quality conditions, and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks which support salmonid foraging, mobility, and survival.

These two conservation roles that are served by the action area share many of the same essential features. The essential features in the action area that would be affected by the proposed action include: water quality, substrate, forage, and a migration corridor free of obstruction and predation.

Eulachon Critical Habitat

The action area includes eulachon PBFs for migration corridors, spawning and egg/larval development.

The proposed action will not have any permanent effects to migration corridors within the Columbia River, but will temporarily obstruct or decrease safe passage in a small area immediately around clamshell bucket, during the October 1 to December 31 IWWW due to elevated turbidity, and a risk of entrainment. Additionally, the proposed action will not alter spawning substrate that eulachon rely because adult eulachon do not spawn in this section of the LCR as they typically favor large tributaries (i.e., Sandy River, Washougal River).

Features of habitat found in each species' designated critical habitat are water, prey, and passage. In the action area, water quality is a feature supporting migration for all species considered in this opinion, and rearing for all steelhead, all fall Chinook, LCR coho, SR sockeye, and SDPS green sturgeon. Prey is a feature for all juvenile salmonids. Unobstructed/safe passage features are a migration value for all species with designated critical habitat in the action area.

Water Quality: The proposed action will temporarily degrade water quality (due to turbidity) within the Columbia River each year in which dredging and dredge placement occurs, up to one third of the year based on the October 1 to December 31 authorized dredging work window. Due to the coarseness of the predominant sediments being suspended by the dredge and placement operations (gravels and sands) they are expected to settle out rapidly (within minutes), and in close proximity (several feet) to their source location. The finer sediments (silts and clays) that happen to be suspended by the clamshell dredge will settle out more slowly (within an hour from the time the work ceases) and the longer duration in suspension means the turbidity plume from these materials is more extensive (approximately 300 ft in each direction at each in-water placement site).

Prey availability: Benthic invertebrates provide the primary food source for these fish – dominated by families of midges (Johnson et al. 2011). Loss of forage will occur where frequency and duration of the dredging delays natural recolonization, as dredging operations will disturb benthic habitat and reduce benthic productivity temporarily. Benthic communities are also diminished when smothered by the deposition of the dredged sediments at in-water disposal sites. Because disturbance to the benthos will be small and infrequent, recolonization of the benthic habitat is relatively rapid – within weeks to months (McCabe et al. 1998), and prey availability nearby undisturbed sites will remain unaffected we expect that prey reduction will persist for roughly half of each year in which dredge occurs – three months during the dredge and deposition, and 3 months to recolonize in each location. The limited and localized loss of prey is not likely to reduce available forage for rearing salmonids in sufficient degree to have an impact the ability of the PBF to serve rearing or migration values.

Passage: Three effects of the project influence passage – turbid conditions, operation of dredge equipment, and noise. These effects are described below.

Turbid conditions - Passage conditions outside of the immediate area where the dredge equipment is operating are made less safe by the elevated turbidity (described more fully in water quality effects, above), though the majority of turbidity produced by the clamshell dredge is expected to remain localized in proximity to the active clamshell bucket or suction dredge based on the materials likely to be disturbed. Areas with high levels of suspended sediment may create migration obstruction for salmonids (see salmonid response to turbidity, below in the species effects section), but not for eulachon or green sturgeon.

Operation of equipment/entrainment - Dredging will also temporarily obstruct or decrease safe passage, in a small area immediately around the clamshell bucket or suction dredge, or equipment depositing dredge material, during the October 1 to December 31 IWWW. Entrainment can occur in each of these equipment operations, however the greatest migration risk is when a suction dredge is in use. This reduces safety of passage in the migration corridor for all species.

Operation of equipment/noise– Vibratory pile driving, operation of dredge equipment, and the operation of barges to and from the dredge and disposal sites produces sound waves that fish detect and respond. The noise profile associated with these sources may impair migration values by inhibiting migration behaviors among salmonids. This is detailed more completely in effects to species section, below.

Table 5. Presence of ESA-listed fish species in the Lower Columbia River by life stage, NMFS' Northwest Fisheries Science Center, and NMFS' Protected Resources Division. Work window months depicted by orange highlight.

		=present				= relatively abundant				= peak occurrence			
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Eulachon													
Southern	Adult migr. & holding[1, 2]												
DPS	Adult spawning[2]												
	Egg incubation[3]												
	Larvae emigration												
Green Sturgeon													
Southern DPS	Juvenile rearing												
Salmon: Chinook													
Lower	Adult migr. & holding												
Columbia	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Upper	Adult migr. & holding												
Columbia	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Upper	Adult migr. & holding												
Willamette	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Snake River -	Adult migr. & holding												
Spring/Summer	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Snake River -	Adult migr. & holding												
Fall	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												

		=present	= relatively abundant	= peak occurrence									
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Salmon: Chum													
Columbia River	Adult migration. & holding												
River	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration[4]												
Salmon: Coho													
Lower	Adult migration. & holding												
Columbia	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Salmon: Sockeye													
Snake River	Adult migration. & holding												
	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Steelhead													
Lower	Adult migration. & holding												
	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Middle	Adult migration. & holding												
Columbia	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Upper	Adult migration. & holding												
Columbia	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Upper	Adult migration. & holding												
	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												

		=present				= relatively abundant				= peak occurrence			
Species	**Life Stage**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Snake River	Adult migration. & holding												
	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												

[1] Eulachon Status Review Update, 20 January 2010. Available at: http://www.nwr.noaa.gov/Other-Marine-Species/upload/eulachon-review-update.pdf

[2] Personal communication. Conversation between WDFW (Brad James, Olaf Langness, and Steve West), ODFW (Tom Rien), and NMFS (Rob Markle, Bridgette Lohrman) regarding eulachon presence in the Columbia River. June 23, 2009.

[3] Eulachon egg incubation estimated relative to spawning timing and 20 to 40 day incubation period.

[4] Carter et al. 2009 (Seasonal juvenile salmonid presence and migratory behavior in the lower Columbia River).

2.4.2 Species Effects

Effects of the action on species is based on individual fish exposure to the habitat changes described above, or effects occurring to the fish themselves. In this case, fifteen ESA-listed fish species of the upper and lower Columbia basins occur in the action area and they will be exposed to the habitat effects of the action, as well as direct exposure to the dredging equipment. Adult salmonids will move upstream and through the action area within minutes. Juvenile salmonids, depending on the species and age of the fish, may spend hours to months within the action area. Juvenile salmonid foraging primarily occurs in waters less than 20 feet deep, which is a small proportion of the action area due to historical maintenance dredging of the Port of Longview to depths greater than 30 feet. Deeper waters and greater flows found in the Columbia River flow lane will provide a migration corridor for adults and larger juveniles. Presence overlap with the proposed action by life history stage is provided below in Table 5, which also presents the abundance of each lifestage presence (relative number of individuals likely to be exposed).

The exposure of ESA-listed fish species to habitat changes in the action area (i.e., short-term alterations in water quality from the action, short-term changes in benthic forage), their exposure to potential to entrainment by the dredge equipment, and their exposure to elevated noise will vary by timing and location of activity and when different densities and life history stages of the ESA-listed fish will be present (Table 5). The magnitude of exposure experienced by ESA-listed fish species is directly related to the amount of time the dredge is actively removing material from the benthos, as approximated by days of operation per year. In this case, dredging will occur for up to 14 days per year over a 10-year period.

The numbers of fish exposed and the duration of exposure of adult and juvenile fishes will increase with greater duration and frequency of dredging and pile driving. The greatest exposure for juvenile salmonids to water quality and forage effects will occur during dredging activities in water depths typically less than -20 feet where sub-yearling salmonids (fall Chinook, and LCR chum salmon) tend to rear and forage. Adult salmonids, and smolting stream-type salmonids (spring Chinook salmon, coho salmon, sockeye salmon and steelhead), will have the greatest risk of exposure to short-term water quality alterations during their migration. Smaller, rearing fish will have a greater exposure to dredging activities and its associated stressors.

Salmonid Exposure and Response
Exposure and response are predicated upon presence of individuals contemporaneously with the project or it consequences.

Adult salmonid presence. Though peak migratory periods vary by species, some adult Columbia River salmonids are reasonably certain to be present in the action area during the IWWW, and therefore will be exposed to the effects of the action:

- Adult Chinook salmon presence in the action area is most likely from late spring through the fall.
- Adult coho salmon presence is most likely in late summer through early winter.
- Adult chum salmon primarily occur during the fall.
- Adult sockeye salmon presence will most likely range from late spring to late summer.

- Adult steelhead presence will most likely range from early summer to early fall[2].

Based on the broad run timing of these species, and the proposed work period of October 1 to December 31, exposure is extremely unlikely for adult salmonids with the exception of Columbia River chum and Lower Columbia River coho, for which peak adult migration and holding overlaps with the work window of with the proposed action (Table 5).

Exposure and Response to Turbid Conditions: The proposed action will temporarily degrade water quality (due to turbidity) within the Columbia River each year in which dredging and placement occurs, up to one third of the year, and one time only in the Kalama River while work to install the mitigation is occurring.

Adult salmonids will typically be in the main river channel at depths of 10 to 20 feet below the water surface and off the bottom (Johnson et al. 2005). Areas of increased turbidity are expected to be small because of the equipment used (clamshell), and the substrate characteristics (mostly coarse sands). This suggests that the potential for adult chum and coho (with the exception of Cowlitz River populations, and Kalama River populations) to encounter areas of high suspended sediment is low. Studies show that salmonids are able to detect and distinguish turbidity and other water quality gradients (Bisson and Bilby 1982), and adult salmon have swimming abilities to more easily avoid waters affected by suspended sediment to find refuge and/or passage conditions within unaffected adjacent areas. However, Cowlitz River chum and coho are likely to encounter turbidity plumes as the dredge sites are within their migration pathway to the Cowlitz River, just upstream, and Kalama River chum and coho as they migrate past the area where mitigation is being installed.

Given that adult salmonid migration rates range up to a few miles per hour (Matter and Sandford, 2003), we expect adult ESA-listed chum and coho that do encounter the turbidity associated dredge operations will be moving upstream at such a rate as to limit exposure, probably to a matter of minutes or possibly hours, which reduces the duration of exposure. Even if exposed, larger salmonids are more tolerant of suspended sediment than smaller juveniles (Servizi and Martens 1991, 1992). Thus, to the extent that any adult chum or coho are exposed to turbidity generated by project activities, the primary response is expected to be avoidance behavior. A small number of fish may experience some turbidity when within proximity of the clamshell bucket operation within the main-stem Columbia River where sediments are actively settling out but the brevity of their exposure should result in no significant response. In both cases, we anticipate adult salmonids will pass through the action area without experiencing adverse effects due to the brevity of exposure and therefore should not experience reduced fitness.

Exposure and Response to Entrainment or Bucket Strikes: Although adult coho salmon, and chum salmon will be present in the action area during the proposed action, perhaps in large numbers due to their peak migration timing during the work window, we expect that few adult fish will experience entrainment during the proposed action due to (limiting the potential area of exposure) the limited footprint of dredging operations effects relative to the size of the Columbia River (limiting probability of exposure to individual fish and expected migratory and avoidance behaviors inherent to adult salmon and steelhead (limiting the duration of exposure). The

[2] From passage data at Bonneville Dam 10-year average, http://www.cbr.washington.edu/dart/adult_hrt.html

exception is most likely to be adults returning to the Cowlitz River, who are likely to migrate adjacent to the Port's river frontage to reach their natal stream just upriver.

Exposure to the clamshell dredge are likely to be limited because of the size of the migration corridor in this area. Migrating adult salmon are typically able to widely disperse in the estuary. The spatial extent of action area is less than one percent of the total area of the lower Columbia River, with sufficient space around the dredging for adult fish to safely pass. Adult salmonids are strong swimmers, with strong instinct to reach their natal streams for spawning. They are expected to avoid the clamshell bucket and hydraulic dredge and thus avoid entrainment. These conditions, despite the two months-long overlap with the adult run-timing previously discussed, make it likely that very few adult salmon of any species, will be encounter dredging equipment during dredge operations. Therefore, we anticipate adult salmonids will pass through the action area and respond to equipment with avoidance behavior, completing their migration without experiencing adverse effects of entrainment. As such, we expect no reduced fitness of these individuals.

<u>Exposure and Response to Increased Sound Pressure Levels:</u> The proposed action will temporarily increase sound pressure levels in the action area. Adult Columbia River chum and LCR coho. Pile driving will cause temporary underwater and airborne noise, of which only underwater noise is expected to impact listed fish. Pile installation will be completed with a vibratory pile driver.

Fishes with swimbladders (including salmonids) are sensitive to underwater impulsive sounds (i.e., sounds with a sharp sound pressure peak occurring in a short interval of time). As a pressure wave passes through a fish, the swimbladder is rapidly compressed due to the high pressure, and then rapidly expanded as the "under pressure" component of the wave passes through the fish. The injuries caused by such pressure waves are known as barotraumas. They include the hemorrhage and rupture of internal organs, damage to the auditory system, and death for individuals that are sufficiently close to the source (Abbott et al. 2002; Caltrans 2020). Death can occur instantaneously, within minutes after exposure, or several days later. A multi-agency work group identified criteria to define sound pressure levels in which effects to fish are likely to occur from pile driving activities (Caltrans 2020). Keep in mind these thresholds represent the initial onset of injury, and not the levels at which fish will be severely injured or killed. The most harmful level of effects is where a single strike generates peak noise levels greater than 206 dBpeak1 where direct injury or death of fish can occur. Besides peak levels, sound exposure levels (SEL) (the amount of energy dose the fish receive) can also injure fish. These criteria are either 187 dB_{SEL} 2 for fish larger than 2 grams or 183 dB_{SEL} for fish smaller than 2 grams for cumulative strikes (Caltrans 2020). In addition, any salmonid within a certain distance of the source (i.e. the radius where the root mean square (RMS) sound pressure level will exceed 150 dB_{RMS}) will be exposed to levels that change the fish's behavior or cause physical injury (i.e. harm). The result of exposure could be a temporary threshold shift in hearing due to fatigue of the auditory system, which can increase the risk of predation and reduce foraging or spawning success (Caltrans, 2020). When these effects take place, they are likely to reduce the survival, growth, and reproduction of the affected fish, thereby reducing fitness of exposed individuals.

To analyze the effects from pile driving, we consulted the Washington State Department of Transportation pile driving guidance (WSDOT, 2020) and the California Department of Transportation Compendium for Pile Driving Sound Data (Caltrans, 2020) for information on sound generated when driving pile with a vibratory hammer. The following assumptions were used to estimate the effects of the pile driving component of the proposed action on juvenile and adult salmon and steelhead:

- Sound pressure levels from driving 12- and 14-inch timber piles will approximate sound pressure levels from driving 14 to 16-inch wood piles.
- Piles will not exceed 16-inches in diameter.
- Peak levels are generally 10 to 20 dB higher than RMS levels
- An average annual pile replacement per year is 5 piles (up to 50 total piles replaced)
- Piles will be driven with a vibratory hammer.
- The hammer will vibrate for less than 1 minute per pile during removal, so there would be no more than a few minutes of hammer vibration per pile removed. Installation will take approximately the same amount of time.
- Pile driving will take place on a need basis, and not to exceed one week with pile driving occurring no more than ten hours per day, daily, within that period.
- Adult as well as juvenile salmonids will be present during pile driving.

We estimated that pile driving will emit sound pressure levels of 171 dB_{peak}, and 161 dB_{RMS}. We assume a high likelihood of injury to salmonids from instantaneous pulses of sound above 206 dBp_{eak} (Caltrans, 2020). Vibratory hammering has not been observed to injure or kill fishes or other aquatic organisms. This may be due to the slower rise time (the time taken for the impulse to reach its peak pressure) and the fact that the energy produced is spread out over the time it takes to drive the pile (WSDOT, 2020). Sound energy from a vibratory pile driver is concentrated at a lower frequency than that from an impact pile driver and also differs in intensity, frequency, and total energy content of the pressure wave. The proposed action will increase sound pressure levels during pile driving. However, the use of a vibratory hammer ensures sound pressure will be well below the 206 dB_{peak} threshold. Therefore, the proposed action will not injure or wound fish exposed to pile driving. Thus, we anticipate no reduced fitness of exposed individuals.

Juvenile salmonid presence. Dredging around the port berths in fall through mid-winter overlaps when juvenile salmonids are present but at very low density (Roegner et al. 2012), and at depths ranging from approximately -18' to -45' MLLW. Currently, salmonids expected in the action area will generally exhibit either a stream-maturing or ocean-maturing life history type. Stream type juvenile salmon and steelhead typically rear in upstream tributary habitats for over a year. These include LCR Chinook salmon (spring runs), LCR steelhead, LCR coho salmon, MCR steelhead, UWR steelhead, UWR spring run Chinook salmon, SR spring/summer Chinook salmon, UCR Chinook salmon, SR steelhead, SR sockeye, and UCR steelhead. Juveniles likely to be present are:

- LCR Chinook salmon (rearing occurs for the full duration of the work window, out migration during the month of November, both in “relatively abundant” numbers.

- Upper Columbia Chinook (outmigrants in the month of November in relatively abundant numbers).
- Upper Willamette Chinook (rearing throughout the entire work window in relatively abundant numbers, outmigrants present in the months of November and February).
- Snake River Fall Chinook (rearing and emigration throughout the work window in relatively abundant numbers).
- CR chum (rearing and migration in January and February in relatively abundant numbers).
- LCR coho (rearing in relative abundance for the entire work window).

The level of exposure juvenile salmonids will have to the effects of the action will vary and depend on species and life history stage, along with the location, timing, and depth of the activities. The potential for high numbers of exposed juveniles, and extended duration of exposure, is greatest among those fish that are present as rearing fish throughout the entire work window. These are Snake River Fall Chinook, Upper Willamette Chinook, LCR Chinook, and LCR coho. Rearing CR chum are present in half of the work window. Among those exposed, CR chum salmon, and LCR fall Chinook, and UWR fall Chinook salmon will be most vulnerable due to their age/size when they are present during dredging.

Juvenile ESA-listed species migrate through the action area at different rates and times depending on species and life history. The migration rate and time will influence the duration of exposure for those fish that have a migration path near the areas being dredged. Stream-rearing fish will migrate through the action area as smolts, and these juveniles tend to be 100 to 200 mm in size. At this size and age, individual fish move quickly downstream, and will be through the action area within 1 - 2 days. This limits the duration of exposure to both the operating dredge equipment and the habitat effects of the dredging (turbidity, reduced forage, migration pathway interruption).

Ocean-type juvenile salmon, however, tend to move out of spawning streams and migrate towards the lower Columbia River estuary as subyearlings and are actively rearing within the Lower Columbia River. These include LCR Chinook salmon (fall runs), CR Chum salmon, and SR fall-run Chinook salmon. These fish are smaller in size (less than 100 mm) and more likely to spend days to weeks in the action area foraging (Carter et al. 2009). The potential for their exposure is therefore significantly greater.

Juvenile ESA-listed species have a wide horizontal and vertical distribution related to size and life history stage. Generally speaking, while juvenile salmonids favor areas where water is 20 feet or shallower in depth, they will occupy the full action area, as well as across the width of the river, and to average depths of up to 35 feet (Carter et al. 2009). Smaller-sized fish use the shallow nearshore and shoreline habitats and larger fish will use the channel margins and main channel. The pattern of use generally shifts between day and night. Juvenile salmon occupy different locations within the Columbia River, and are typically in shallower water during the day, and may avoid predation by larger fish that are more likely to be in deeper water. Apparently these younger fish will venture into the deeper areas of the river away from the shoreline, moving towards the FNC and along the bathymetric break – or channel margin – and will be closer to the bottom of the channel. Carlson et al. (2001) notes there is a higher percentage of use along the channel margins than either the shallow nearshore or channel, which indicates potential underestimates for nearshore sub-yearlings. Juvenile salmon position in open water tends to be about 3 meters below the surface (Carter et al. 2009), a minimum of 2 meters off of the bottom in shallow areas, 3 to 10 meters off the bottom on the channel margins, and 5 to 15 meters off the bottom in the main channel (Carlson et al. 2001) with sub-yearlings being closer to the bottom than older 1+ year-old fish (Carter et al. 2009). The smaller sub-yearling salmonids will likely congregate along the nearshore areas in shallow water and extend into the channel margins (Bottom et al. 2011). Yet, as Carlson et al. (2001) indicated, there is higher use of the channel margins than previously thought and considering the parameters above, relative juvenile position in the water column suggests higher potential sub-yearling use in areas of 20 to 30 feet deep than previously considered. Therefore, we anticipate direct overlap with dredging operations and presence of juvenile salmonids. Therefore, we anticipate exposed individuals will experience reduced fitness due to sound.

<u>Exposure and Response to Turbid Conditions</u>: Exposure is likely among all juveniles salmonids considered in this opinion, whether migrating or rearing. The intensity of the exposure is related to how close to the operating equipment the fish are, because suspended sediment is highest nearest the operation, with finer sediments in suspension longer and further from the equipment. The duration of exposure is a maximum of a day or two for migrating juveniles if they engage in no avoidance behavior at all. The duration for rearing juveniles could be much longer because their avoidance abilities are weaker, so could last several days or perhaps a week or more at the outer edges of the plume. Any elevations in turbidity and TSS generated by pile driving will be localized, short-term and similar to the variations that occur naturally. The short duration of the proposed pile driving (a few minutes per pile), generally low level increase in TSS and small affected area renders the effects of the increased TSS on juvenile salmonids not meaningful. Effects of turbidity on adult salmonids, if present, are anticipated to be similarly temporary and minor.

The effects of suspended sediment and turbidity on fish range from beneficial to detrimental. Elevated total suspended solids (TSS) have been reported to enhance cover conditions, reduce piscivorous fish/bird predation rates, and improve survival, although elevated TSS have also been reported to cause physiological stress, reduce growth, and adversely affect survival (Newcombe and Jensen 1996). Fish may experience a reduction in predation from piscivorous fish and birds by occupying turbid waters (Gregory and Levings 1998), but longer term exposure to these conditions can cause physiological stress responses that can increase maintenance energy needs and reduce feeding and growth (Lloyd et al. 1987; Redding et al. 1987; Servizi and Martens 1991).

Newcombe and Jensen (1996) analyzed numerous reports on documented fish responses to suspended sediment in streams and estuaries, and identified a scale of ill effects based on sediment concentration and duration of exposure. The effects of suspended sediment on fish increase in severity with sediment concentration and exposure time and can progressively include behavioral avoidance and/or disorientation, physiological stress (e.g., coughing), gill abrasion, and death—at extremely high concentrations. A severity level of six on the Newcombe and Jensen (1996) scale correlates to moderate physiological stress and is associated with a large increase in the coughing rate and an increase in blood glucose levels (Servizi and Martens 1992), and is considered the break point whereby an adverse effect by NMFS is concluded from exposure. Specifically, level six for juvenile salmonids equates to an increase in suspended sediment concentration of about 1,097 milligrams per liter for 1 to 3 hours exposure time (Newcombe and Jensen 1996). Studies also show that salmonids are able to detect and distinguish turbidity and other water quality gradients (Quinn 1988, Simenstad 1988, Bisson and Bilby 1982), and that larger juvenile salmonids are more tolerant to suspended sediment than smaller juveniles (Servizi and Martens 1991).

Suspended sediment from the dredge and disposal operations is expected to occur, but suspended sediments and associated turbidity is expected to be of short duration. To the extent that salmonids are present in the areas affected with elevated suspended sediment, they are expected to be of sufficient size to enable their avoidance of waters affected by excessive suspended sediments without adverse effects. Thus, exposure of salmon or steelhead to suspended sediment from this project will be for minutes rather than hours and is extremely unlikely to approach the suspended sediment concentrations associated with moderate physiological stress identified in Newcombe and Jensen’s 1996 manuscript (i.e., Level 6).

Juvenile salmonids tend to avoid streams that are chronically turbid, such as glacial streams or those disturbed by human activities, unless the fish traverse these streams along migration routes (Lloyd et al. 1987). Depending on the concentrations of suspended solids and the food supply, juvenile fish will either seek refuge in adjacent areas with less turbidity, or remain in the area, taking advantage of additional cover provided by the turbid water. For this reason, the most likely response is avoidance and displacement from preferred habitats, which could result in increased abundance and competition for resources in adjacent areas. Death or injury to ESA-listed salmonids directly from an increase in turbidity is not likely.

Given the small area of river affected by turbid condition, even when the multiple week duration during relatively high densities of ESA-listed juvenile salmonids we expect only a few ESA-listed fish in the action area are likely to experience the direct of effects caused by suspended sediment (gill abrasion, cough, raised cortisol), however many juveniles are likely to experience avoidance, displacement to adjacent rearing habitat, and increased competition for food and refuge in unaffected habitat areas. A small subset of these fish may experience reduced growth as a result and therefore have reduced fitness.

<u>Exposure and Response to Reduced Benthic Prey</u>: To the degree that some foraging of sub-yearling salmonids in the action area occurs deeper than 25 feet, they are also likely to be exposed to reductions in forage, described above in the effects on Critical Habitat. Sub-yearlings are actively feeding as they move downstream. However, juvenile salmonids in the Columbia River use their vision to detect, acquire and subsequently, feed on small invertebrates (i.e., *Dipterans*, *Psychosidadae*, and *Corophium*; Roegner et al. 2004), so their ability to effectively feed will decline with elevated turbidity. This will likely, and temporarily, reduce growth, lipid stores, and ultimately fitness and survival in the small number of sub-yearling juvenile fish, which are more likely to be rearing within the project site.

We do not expect significantly reduced food availability to juvenile salmonids to occur as a result of dredging, however, because the dredge sites are outside the littoral area and are more than 20 feet deep, slightly deeper than juvenile salmonid's preferred habitat depths. Additionally, despite their occasional presence in waters up to 30 feet deep, juvenile salmonids are likely not rearing in these locations due to a lack of habitat complexity (no large wood or current breaks), and the benthic invertebrates occupying sediment dredge sites will likely be larger than rearing juveniles gape allows for foraging. For these reasons, we expect only a small number of juveniles from each of the species with Columbia River rearing, will be impaired in their forage success and growth, and therefore fitness of some individuals may be reduced as a result of the proposed action.

Exposure and Response to Entrainment or Bucket Strike: Larger, juvenile smolts (>100mm), that are actively migrating within the mainstem Columbia River, like adult salmonids, have swimming abilities which allow for a better avoidance response to dredging disturbance than the younger, rearing fish, and this ability will further reduce but not completely eliminate entrainment and subsequent injury or death of these fish. Based on the likelihood of weeks of exposure among rearing juveniles, rather than 1 -2 days of exposure for migrating juveniles, we focus our analysis on Snake River Fall Chinook, Upper Willamette Chinook, LCR Chinook, and LCR coho (present for the entire work window) and CR chum (present for approximately half of the work window). Based on their relative abundance, multiple individuals of these species are likely to be entrained by dredging equipment due to their smaller size (<100mm), and inferior swimming ability. However, the likelihood of many sub-yearlings occupying the same area in which the clamshell dredge operating, is extremely low, as the clamshell dredge is highly localized to the area in which the bucket is deployed (<1 cubic meter), and the mechanism by which it operates is not documented to have notable entrainment, unlike hydraulic or suction dredging[3]. However, any sub-yearlings that happen to encounter the clamshell bucket during its decent and are within 1 meter above the substrate actively being dredged will be subject to an increased likelihood of entrainment. Any fish located in the immediate area around the clamshell dredge when it makes contact with the substrate will be exposed to significantly elevated turbidity (see below), and a downstream plume of fine sediments is likely to remain for minutes or hours throughout the entire water column of the river bottom to the surface. Both entrainment and elevated turbidity can result in injury or death. When dredging occurs in shallower waters, sub-yearlings are closer to the bottom and are less able to escape entrainment, but in this case dredging is expected to stay below 25 feet in depth. We expect that even though the likelihood of entrainment by clamshell operation is low, given the number of clamshell "passes" during the work window, and the presence of juveniles over the entirety work window (except CR chum which are present only half of the work window), it is very likely that some rearing juveniles will be entrained. This is expected to be a relatively low number of fish, though a few fish will likely be exposed from each of the affected populations. These fish are expected to die as a result.

Exposure and Response to Increased Sound Pressure Levels: Juvenile LCR chinook, Upper Columbia River chinook, Upper Willamette River (UWR) chinook, Snake River fall chinook,

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[3] For example, Wenger et al 2017 explains that the "mortality rate of estuarine fish in Washington immediately after hydraulic entrainment and deposition into the hopper was 38%, but was 60% for pipeline dredges with a cutter head (Armstrong et al.,1982). In the English Channel, only six of the 23 adult fish entrained by a suction trailer dredger were damaged (Lees, Kenny, & Pearson,1992). Furthermore, as fish may avoid areas that are repeatedly dredged (Appleby & Scarratt, 1989), hydraulic entrainment may be more pronounced during capital dredging, when fish densities have not yet been altered by coastal development." (Internal citations omitted).

LCR coho, and LCR steelhead are expected to be present in the action area during pile driving and potentially exposed to increased sound pressure levels, and therefore fitness of some individuals may be reduced as a result of the proposed action.

Eulachon. Eulachon are present at all times of the work window, except for the month of November. Presence occurs both as migrating adults and as larval fish passively outmigrating through the action area. Both life stages are present with relatively high abundance, and peak adult abundance in the month of February. Both adults and juveniles will be exposed to noise, turbid water quality and risk of entrainment. Prey is not a significant feature as larval fish consume their yolk sack while they passively migrate downstream, and do not begin consuming prey until they are lower in the estuary.

The vast majority of eulachon spawning takes place in Washington State tributaries, including the Cowlitz, Elochoman, Kalama, and others. Spawning takes place atop sand and fine gravel substrates to which the eggs adhere and mature, often being transported downstream through this maturation process through sediment transport processes that occur along the riverine corridor. Once eggs are hatched, typically after about 30 days, the larvae disperse throughout the water column and are widely distributed as they drift downstream passively. The proposed work window for this project ends in late December, prior to the peak of eulachon larval outmigration (which occurs from April through June). Dredging could entrain both adults and outmigrant larval eulachon, though outmigration timing significantly reduces the likely abundance of larvae to be present in the action area during the dredging activities. Any entrained eulachon, regardless of lifestage, are expected to be killed by the entrainment.

Adults and juveniles from the 15 ESUs analyzed in this Opinion, use the action area for migration and rearing. We assess the importance of habitat effects in the action area to the ESUs by examining the relevance of those effects to the characteristics of VSPs. The characteristics of VSPs are sufficient abundance, population growth rate (productivity), spatial structure, and diversity. Considering the short residence time of juvenile ESA-listed salmonids in the action area, the number of listed species encountering effects of the action is likely to be low. The effects on the growth and survival of individual salmon is unlikely to affect abundance, productivity, abundance or distribution of the component populations of the ESA-listed salmonids in the action area. Even considering cumulative effects anticipated in the action area, when they are combined with the effects of the action and added to the environmental baseline, the aggregate of impacts to the species will affect too few fish to influence population viability characteristics of the affected species.

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 in the environmental baseline (Section 2.4). We could expect over the 10-year period of the proposed action that some climate effects, described in the baseline, such as warming water temperatures, or increasing variability of volume (low flows, high flows) become more pronounced. These effects could increase food web disruptions, migration success, or other stresses on any or all of the listed species that rely on the action area.

Also in this action area, state or private activities in the vicinity of the project location (e.g., recreational boating, fishing, or other water-based recreation) are expected to increase and be a source of cumulative effects in the action area. Additionally, future state and private activities in upstream areas (particularly intensifying land use, and changes in tree cover) are expected to cause habitat and water quality changes that are expressed as cumulative effects in the action area. Our analysis considers: (1) how future activities in the Columbia River basin are likely to influence habitat conditions in the action area; and (2) cumulative effects caused by specific future activities in the vicinity of the project location.

Approximately six million people live in the Columbia River basin, concentrated largely in urban centers. The effect of that population is expressed as changes to physical habitat and loadings of pollutants contributed to the Columbia River. These changes were caused by residential, commercial, industrial, agricultural, and other land uses for economic development, and are described in the Environmental Baseline (Section 2.3). The collective effects of these activities tend to be expressed most strongly in lower river systems where the impacts of numerous upstream land management actions aggregate to influence natural habitat processes and water quality. As such, these effects accrue within this action area, though most are generated from actions upstream of the action area. As human population grows, the range of effects described here are likely to intensify.

Resource-based industries (*e.g*., agriculture, hydropower facilities, timber harvest, fishing, and metals and gravel mining) caused many long-lasting environmental changes that harmed ESA-listed species and their critical habitats, such as basin-wide loss or degradation of stream channel morphology, spawning substrates, instream roughness and cover, estuarine rearing habitats, wetlands, floodplains, riparian areas, water quality (*e.g.*, temperature, sediment, dissolved oxygen, contaminants), fish passage, and habitat refugia. Those changes reduced the ability of populations of ESA-listed species to sustain themselves in the natural environment by altering or interfering with their behavior in ways that reduce their survival throughout their life cycle. The environmental changes also reduced the quality and function of critical habitat PBFs that are necessary for successful spawning, production of offspring, and migratory access necessary for adult fish to swim upstream to reach spawning areas and for juvenile fish to proceed downstream and reach the ocean. Without those features, the species cannot successfully spawn and produce offspring.

While widespread degradation of aquatic habitat associated with intense natural resource extraction is no longer common, ongoing and future land management actions are likely to continue to have a depressive effect on aquatic habitat quality in the Columbia River basin and within the action area. Additionally, as human population grows, other non-federal uses of the river are likely to increase and intensify, such as recreational boating and fishing, and nonpoint stormwater inputs from upland areas. As a result, recovery of aquatic habitat is likely to be slow in most areas, and contemporaneous cumulative effects from basin-wide activities are likely to have a slightly negative impact on population abundance trends and the quality of critical habitat PBFs into the future.

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 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

Each species considered in this opinion is threatened by extinction risk, with the exception of two (UCR spring Chinook salmon, and Snake River sockeye), which are considered endangered. Each of these species is listed due to a combination of low abundance and productivity, reduced spatial structure, and decreased genetic diversity of their constituent independent populations. Most of the component populations of LCR Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer run Chinook salmon, UWR spring-run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, LCR coho salmon, SR sockeye salmon, LCR steelhead, MCR steelhead, UCR steelhead, SR steelhead, and UWR steelhead, are at a low level of abundance or productivity. Several species have lost multiple historical populations as a result of anthropogenic changes throughout their habitat, and all remaining populations face limiting factors in the habitat they do have, including in the action area. Individuals from almost all of the ESA listed component populations must move through or utilize the action area at some point during their life history. All individual fish from each population and species reaches the action area having experienced reductions in amount and quality of available habitat, including within the action area.

Factoring the current environmental baseline, the fish from the component populations that move through and/or use the action area will encounter habitat conditions degraded by: modified flow regime, reduced water quality from substantial chemical pollution, loss of functioning floodplains and secondary channels, and loss of vegetated riparian areas and associated shoreline cover, and loss of historical estuarine conditions. The significance of the degradation is reflected in the limiting factors including: insufficient access to floodplain and secondary channels, degraded habitat, loss of spawning and rearing space, pollution, juvenile fish stranding, and increased predation, highlighting the importance of protecting current functioning habitat and limiting water quality degradation, minimizing entrainment, and reducing potential predation of ESA-listed fish. The fitness of individual fish that rear or migrate in degraded conditions may already be poor when they reach the action area, which would likely make them more susceptible to detrimental effects when they encounter effects of the proposed action.

Within this context, the proposed action will create, each year for 10 years, a 92-day period with 1) physical disturbance in the water column 2) redistributed material from the bottom, and 3) subsequent reduction of benthic prey in the Columbia River. The modified bathymetry will be maintained for the duration of the 10-year permit. These habitat alterations will cause displacement of a small number of adult and juvenile fish, as they avoid the pile driving operation (elevated underwater noise and turbidity), dredging operation (entrainment and elevated turbidity), plus a period in which fish have reduced prey as the benthic biological productivity is reduced, and then re-establishes, in the vicinity of the dredge prism. These alterations will occur each year of the 10-year permit, during the 92-day work window. Finally, entrainment of a few juvenile salmonids is reasonably certain to occur during each annual operation, which could occur in any of the rearing or migrating ESUs, but is most likely in the rearing ESUs. However, even when we consider the current status of the threatened and endangered fish populations and degraded environmental baseline within the action area, the proposed action's annual decrease in species abundance is likely to be very small, and to be across more than one population, and more than one species. This reduction in abundance itself, even annually for 10 years is not expected to be sufficient to affect distribution, diversity, or productivity of any of the component populations of the ESA-listed species, because the reductions are expected to be among a few juveniles, and, as such, their loss will likely be indistinguishable among that cohort as returning adults.

In the context of the status of designated critical habitat and the specific baseline conditions of PBFs in the action area, the proposed action will not obstruct the passage of migrating salmonids, reduce cover, remove riparian vegetation, alter flows, destabilize the channel or change its characteristics, alter water temperature, or substantially reduce available forage for migrating or rearing salmonids. However, the proposed action will temporarily diminish safe migration corridors, forage, and water qualify PBFs within the action area each year for 10 years. These diminishments do not appreciably further degrade baseline conditions or aggravate limiting factors. As a whole, the critical habitat for migration and rearing is functioning moderately under the current environmental baseline in the action area and the annual disruption of the habitat effectuates a continued constraint on the habitat's restoration of natural function by retaining anthropogenic conditions that limit productivity.

The last element in the integration of effects includes a consideration of the cumulative effects anticipated in the action area. When considering the cumulative effects of non-federal actions, recovery of aquatic habitat from the degraded baseline conditions is likely to be slow in most of the action area, and cumulative effects (from continued or increasing uses of the action area) are likely to have a negative impact on habitat conditions, which in turn may cause slight negative pressure on population abundance trends in the future.

Given that the proposed action will have low-level and periodic effects on the PBFs for migration and rearing for salmonids, even when considered as an addition to the baseline conditions, and together with the cumulative effects the proposed action is not likely to appreciably diminish the value of designated critical habitat for the conservation role of rearing or migration.

In summary, fitness level consequences to exposed individuals are anticipated at low levels. Very few individuals are expected to experience high level fitness consequences. None of the populations are expected to experience reductions in VSP parameters. Therefore, NMFS concludes that the proposed action is not anticipated to reduce appreciably the likelihood of both the survival and recovery of these listed salmonids in the wild.

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 LCR Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer run Chinook salmon, UWR spring-run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, LCR coho salmon, SR sockeye salmon, LCR steelhead, MCR steelhead, UCR steelhead, SR steelhead, UWR steelhead, Southern DPS green sturgeon, or eulachon, or destroy or adversely modify their designated critical habitat.

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). "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 during clamshell dredging,
- Incidental take in the form of harm from increased turbidity, increased noise, and diminished prey availability.

Take by these mechanisms will annually affect juvenile ESA-listed salmon and steelhead, eulachon and green sturgeon via entrainment during dredging, exposure to increased turbidity, exposure to and temporary reductions in forage each year for 10 years, and in one in-water work window in the Kalama River.

Due to the highly variable number of individual fish present at any given time, and difficulties in the ability to observe injury or mortality of fish, which may sink out of site, be consumed by predatory species, or have delayed death outside of the action area, a definitive number of ESA-listed fish that will be killed, injured or otherwise adversely affected cannot be determined. In such circumstances NMFS will use a habitat-based surrogate to account for the amount of take, which is called an "extent" of take. The extent of take is causally related to the harm that occurs, and is an observable measure for monitoring, compliance, and re-initiation purposes.

For this proposed action, the potential for 10 annual occurrences of 1) injury or death from entrainment, and 2) harm from being exposed to elevated turbidity and reductions in forage for juvenile salmonids, is directly related to the amount of time that the dredge is in operation, and the timing of the dredge operation.

Injury or Death from entrainment - Since the potential for ESA listed fish to be entrained, is most directly measured by the amount of time the dredge is actively operating and the timing of the operation, the extent of take identified for the proposed action is related to the number of days of dredging per year within a timeframe that anticipates the lowest presence of vulnerable lifestages of listed fish. Therefore, the extent of take is a maximum of 21 days of dredging, to occur each year, for 10 years between October 1 to December 31.

Harm from turbid conditions – 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 will be present. In this case the downstream extent of the CWA authorized mixing zone is 300 feet downstream from the point of disturbance in the Columbia River, and in the Kalama River.

Harm from diminished prey availability – Reductions in fitness among juveniles are likely when prey availability is decreased and competition increases for prey resources. The extent of take is therefore measured as the volume of river bottom where dredging will remove substrate and the benthic prey communities (40,000 cubic yards/year between the Port berths and Willow Grove basin, and an approximate 4,000 square foot area adjacent to berths 8 and 9).

Injury, death, or harm from sound - Installation of piles is reasonably certain to harm juvenile salmonids sensitive to sound pressure levels created from vibratory hammering, including LCR Chinook salmon, LCR coho salmon, SR fall-run Chinook salmon, and UWR Chinook salmon, which are expected to be present in the action area during pile installation. Death may occur should juvenile salmonids temporarily display behavior putting them at higher risk of predation such as swimming into deeper water where predators occur. We cannot estimate the number of fish likely to be predated because the number of piles to be installed is unknown, and the number of fish present at the time the pile driving occurs is variable. The potential harm to salmonids is related to the duration of vibratory hammer use per day and in total. We measured the extent of take instead by a maximum of <1 hour of pile driving with a vibratory hammer per day for a maximum of 1 day, per year.

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 nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). The USACE shall require any permittee or contractor performing the work described in this document to:

1. Minimize incidental take by minimizing entrainment during dredging;
2. Minimize incidental take from underwater noise during vibratory pile driving;
3. Minimize incidental take by minimizing turbidity; and
4. Ensure completion of an annual monitoring and reporting program to confirm the take exemption for the proposed action is not exceeded, and that the terms and conditions in this incidental take statement are effective in minimizing incidental take.

2.8.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the USACE or the Port of Longview must comply with them in order to implement the RPMs (50 CFR 402.14). The USACE or the Port of Longview 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.

The following terms and conditions implement RPM 1, minimize entrainment during dredging:

a. The applicant Port of Longview, shall ensure that during dredging operations, the clamshell bucket is lowered to the bottom as slowly as possible to allow ESA listed fish the opportunity to escape.

The following terms and conditions implement RPM 2, minimize underwater noise during vibratory pile driving:

a. Use a vibratory hammer to install all piles.
b. Minimize duration of vibratory hammer operation.
c. Carry out pile driving operations as early in the in-water work window as possible.

The following terms and conditions implement RPM 3, minimize turbidity during dredge disposal:

a. The applicant, Port of Longview, shall ensure turbidity remains at background levels downstream (300 ft) during dredging and placement operations by adhering to dredge management protocols including monitoring and compliance reporting of turbidity levels observed during dredging operations.
    i. If turbidity levels are exceeded, install a floating silt curtain around the in-water dredge area to minimize the dispersion of suspended sediment thereby reducing turbidity.
b. USACE and the applicant shall ensure in-water work will be performed in accordance with permit conditions, which set timing restriction for in-water work of October 1 to December 31.

The following terms and conditions implement RPM 4, monitoring and reporting:

a. Action Monitoring. The applicant shall submit a monitoring report to NMFS by March 31 of each year summarizing the following for the previous calendar year:
    i. Hours of dredging for each day dredging occurred;
    ii. The number of days dredging occurred each month;
    iii. The number of days of dredging occurred for the previous calendar year;
    iv. The extent and depth of dredging conducted for the calendar year;
    v. Turbidity levels from monitoring and whether turbidity compliance was met.

a. Monitoring reports shall be submitted to:
    i. projectsreports.wcr@noaa.gov
    ii. Include WCRO-2020-01523 in the subject line.

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 three conservation recommendations are discretionary measures that NMFS believes are consistent with this obligation and therefore should be carried out by the USACE:

1. Regularly require use of floating silt curtains around the in-water dredge area in the Columbia River to minimize the dispersion of suspended sediment thereby reducing turbidity.
2. Narrow the conditions under which maintenance dredging is allowed so that habitat values can more completely recover between dredge occurrences, for example dredging would not be allowed annually, without a showing that sediment accumulation is occurring or has occurred that threatens to impair navigation or berthing.

3. The USACE should consult with NMFS under Section 7(a)(1) to create a mitigation bank to offset impacts associated with the regular exercise of its authority allowing impacts to the nations waters.

Please notify NMFS if the USACE or the applicant carries out this recommendation so that we will be kept informed of actions that are intended to improve the conservation of listed species or their designated critical habitats.

2.10 Species and Critical Habitats Not Likely to be Adversely affected

Green Sturgeon Critical Habitat

The action area includes the PBFs of estuary migratory corridors and prey base for green sturgeon, and the effects of the proposed action on green sturgeon critical habitat are similar to those described above for juvenile salmonids critical habitat PBFs, and we refer back to that section above, to interpret effects on effects of green sturgeon critical habitat. Dredging and disposal of dredge materials are both considered low level threats to the prey base of the southern DPS of green sturgeon critical habitat in coastal bays and estuaries (NMFS 2018).

Green Sturgeon. Green sturgeon are likely to be present within the action area during the period in which the action is proposed because they are known to use the estuary habitat for rearing except during the summer and early fall months (Moser and Lindley 2007) As cited by these authors, commercial catches of green sturgeon peak in October in the Columbia River estuary, and records from other estuarine fisheries (Willapa Bay and Grays Harbor, Washington) support the idea that sturgeon are only present in these estuaries from June until October. However, comprehensive fishery sampling has not been conducted year-round in the Columbia River estuary, and some overlap with sub-adult green sturgeon presence with the proposed dredge timing is possible. In the event that green sturgeon are present during dredging actions in the action area, they are likely to be larger sub-adults. Further, even those that may be present will easily able to avoid the clamshell dredge without adverse effects from entrainment. Unpublished photographic evidence of sub-adult sturgeon entrainments from dredging operations elsewhere along the West Coast (maintained on file at NMFS) supports the possibility that green sturgeon could become entrained, as do other published and contractual reports (Buell 1992). The potential entrainment of green sturgeon by dredging cannot be discounted. If any individual green sturgeon were entrained, we expect that it would be injured and likely die as result of the entrainment.

Green sturgeon, if present in the main-stem Columbia River, may encounter the turbid conditions and reduced forage opportunities created by the proposed action. Green sturgeon will respond similarly to a loss of forage as described for juvenile salmonids above.

Green sturgeon are typically found in turbid conditions and forage in the benthos by stirring up the sediment to access benthic prey such as burrowing shrimp and are thus relatively tolerant of higher suspended sediment concentrations. As such, in the unlikely event that individual green sturgeon are present to encounter turbidity and elevated total suspended sedimentss related the project, effects on green sturgeon are not expected to harm any individual of this species. This conclusion is supported further by recent results in the closely related Atlantic sturgeon, wherein juveniles were experimentally exposed to 100, 250 or 500 mg/L TSS for three consecutive days and found to exhibit no significant effects on survival or swimming performance even while prevented from seeking cleaner waters in the tests (Wilkens et al. 2015).

2.11 Reinitiation of Consultation

This concludes the ESA section 7 consultation for Port of Longview Dredging Project.

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.

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 USACE and descriptions of EFH for Pacific Coast salmon (PFMC 2014), and Pacific Coast groundfish (PFMC 2005) 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

As part of the information provided in the request for ESA concurrence, the USACE determined that the proposed action may have an adverse effect on EFH designated for Pacific Coast Salmon, specifically the habitat areas of particular concern (HAPC) include, complex channel and floodplain habitats and HAPC of coastal estuaries for Pacific Coast groundfish. The effects of the proposed action on EFH are the same as those described above in the ESA portion of this document and NMFS concurs with the findings in the EFH assessment.

3.2 Adverse Effects on Essential Fish Habitat

The proposed action will temporarily diminish water quality, disturb benthic habitat, create turbidity, and increase underwater noise that will affect forage production and local hydraulic conditions. Overall, the area of disturbance is relatively small in relation to the Columbia River Estuary, partially disconnected/isolated from the main-stem Columbia River, the disturbance will be short-lived, will maintain current conditions, and will not change the functional characteristics of the habitat. These localized and temporary diminishments in EFH will occur in each year of the 10 years of the action.

3.3 Essential Fish Habitat Conservation Recommendations

The effects of the proposed action will be minimized by use of clamshell dredge and monitoring and use of vibratory hammer. To minimize the effects on Pacific Coast salmon EFH, including complex channels and floodplain habitats HPAC the USACE should:

1. Require that the applicant use a floating silt curtain during annual dredging to reduce the likelihood of extensive fine sediments plume

2. In order to ensure maximum habitat recovery between dredge periods, allow maintenance dredging to occur within the 10 year permit only on a showing that sediments have accumulated or are accumulating in a manner that threatens to impede navigation, rather than have a blanket allowance for annual dredging.

3. Use only untreated wood piles.

4. Ensure pile driving is completed in an efficient manner minimizing total days of pile driving.

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.

3.4 Statutory Response Requirement

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

3.5 Supplemental Consultation

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

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

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 USACE and the Port of Longview. Individual copies of this opinion were provided to the USACE. 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.

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.

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, if applicable*] 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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Appendices

Appendix A. Port of Longview Maintenance Dredging Project, Berths 8 and 9 Compensatory Mitigation Plan

6720 South Macadam Avenue, Suite 125
Portland, Oregon 97219
503.670.1108

ANCHOR QEA

Memorandum

March 3, 2021

To: George Fornes, WDFW and Stacey Kilarski-Jacobson, NMFS

From: Derek Koellmann, Anchor QEA

cc: Chris Wills, Port of Longview

Re: Port of Longview Maintenance Dredging Project, Berths 8 and 9 Compensatory Mitigation Plan

Compensatory Mitigation Plan

- **Project Name:** Port of Longview Maintenance Dredging Project
- **Applicant's Name:** Port of Longview
- **Location:**
  - Port of Longview, 10 International Way, Longview, Washington 98632
  - Camp Kalama, 5055 Meeker Drive, Kalama, Washington 98625
- **Date Plan Was Prepared:** February 17, 2021
- **Prepared by:** Derek Koellmann, AICP, and Leah Erickson, MLA, Anchor QEA, LLC

1 Project Description

The Port of Longview (Port) has proposed a 10-year maintenance dredging project (Project) for the ongoing maintenance of berth areas in the Columbia River, approximate river mile (RM) 66 (Figure 1). In addition to routine maintenance dredging, the Port proposes to deepen an area adjacent to berths 8 and 9 to accommodate safe vessel movement. This new dredge work area will become part of the Port's dredge footprint for all future maintenance dredging.

The new dredge work area to be deepened includes areas designated as both shallow- and deep-water habitat areas, where shallow-water habitat is defined as -20 feet Columbia River Datum (CRD) and above (G. Fornes and J. Ashline Personal Communication, November 12, 2020). The Project will permanently convert a total of 1,107 square feet of shallow-water habitat to deep-water habitat. A comparison of the existing and proposed area of deep-and shallow-water habitat is shown Table 1. Additional shallow-water habitat occurs outside the boundaries of the new dredge work area that will not be impacted.

Table 1
Shallow- and Deep-Water Habitat Pre- and Post-construction

Elevations (CRD)	Existing Condition (including side slopes) (sf)	Post-Construction (including side slopes) (sf)	Net Change (sf)
-4 feet to -20 feet CRD	2,245	1,138	-1,107
-20 feet to -43 feet	9,081	10,188	+1,107

Note:
sf: square feet

The Port originally proposed a larger footprint for the new dredge work area, but subsequently reduced the footprint in response to further input from regulatory agencies and vessel operators. The revised total new dredge work area represents the minimum area that can be dredged and also accommodate safe vessel movement. The previous and current dredge footprint are illustrated in Figure 2; cross sections of the revised area are illustrated in Figure 3.

The purpose of this memorandum is to document a proposal to mitigate the conversion of 1,107 square feet of shallow-water habitat resulting from the Port's proposed new dredge work area at an off-site location. This proposal is based on previous conversations with Washington Department of Fish and Wildlife and National Marine Fisheries Service (G. Fornes and J. Ashline Personal Communication, November 12, 2020), and the Cowlitz Conservation District (CCD). This memorandum builds on those discussions to provide additional information to support the Port's permitting process.

Under this proposal, the Port will donate a minimum of sixty 12- to 16-inch average large end diameter, untreated timber pilings to CCD to enhance shallow-water habitat as part of the Camp Kalama Enhancement Project (hereafter as the Camp Kalama Project) in the lower Kalama River. The pilings will be up to 50 feet long. Table 2 demonstrates how the enhancement Project will benefit the same Endangered Species Act-listed salmonids that may potentially be affected by the changes to shallow-water habitat at the Port's new dredge work area. If the number of piles exceeds what is required for the Camp Kalama Project, remaining piles will be retained for future uses as prescribed by CCD.

Table 2
Species and Critical Habitat Presence Comparison

Species	ESU/DPS	ESU/DPS Present at Port of Longview	ESU/DPS Present at Kalama River Project
Chinook salmon (*Oncorhynchus tshawytscha*)	Lower Columbia River ESU	Yes	Yes
	Upper Columbia River Spring Run ESU	Yes	Yes
	Snake River Spring/Summer Run ESU	Yes	Yes
	Snake River Fall-Run ESU	Yes	Yes
	Upper Willamette River ESU	Yes	Yes
Chum salmon (*Oncorhynchus keta*)	Columbia River ESU	Yes	Yes
Coho salmon (*Oncorhynchus kisutch*)	Lower Columbia River ESU	NA	Yes
Sockeye salmon (*Oncorhynchus nerka*)	Snake River ESU	Yes	Yes
Steelhead (*Oncorhynchus mykiss*)	Winter Steelhead DPS	Yes	Yes
	Summer Steelhead DPS	Yes	Yes
Eulachon (*Thaleichthys pacificus*)	Southern DPS	Yes	Yes
Bull trout (*Salvelinus confluentus*)	Lower Columbia River	Yes	Yes

Notes:
DPS: Distinct Population Segment
ESU: Evolutionary Significant Unit

2 Existing and Proposed Mitigation Footprint

The Project includes converting a total of 1,107 square feet of shallow-water habitat to deep water habitat within the new dredge work area within a proposed total new work dredge prism that is approximately 40 by 100 feet in size. The proposed area for deepening is situated within heavily modified aquatic and riparian conditions at an active industrial site managed by the Port. On-site mitigation is not possible or practicable due to these existing site constraints. Therefore, the Port is proposing to provide off-site mitigation in the form of shallow-water habitat enhancement at a ratio of greater than 3:1 as part of the Camp Kalama Project.

The Camp Kalama Project will be implemented by the CCD including project design, permitting, and construction elements of this shallow-water enhancement project in the Kalama River. The CCD is partnering with the upland property owner, Camp Kalama. The Port will donate the untreated timber piles (these piles were removed from Port berths as part of previously permitted maintenance actions) to the Camp Kalama Project for construction of large woody material structures. Table 3 provides a comparison of the impact areas at the Port berths and the enhancement areas at the Camp Kalama Project.

Table 3
Shallow-Water Habitat Comparison in Each Project Area

Site	Shallow-Water Habitat, Existing[1] (sf)	Shallow-water Habitat to be Converted to Deepwater Habitat (sf)	Shallow-Water Habitat Enhancement (sf)	Life Stage Impacts (multiple ESU/DPS)
New Work Dredging Area	2,245	1,107	0	Decreased juvenile rearing, decreased adult migration
Camp Kalama Project	4,000	0	4,000[2]	Increased adult pre-spawn holding, fry colonization, juvenile rearing

Notes:
1. Within limits of project area
2. Minimum area to be enhanced. Final area expected to be higher.

The Camp Kalama Project will construct a channel margin debris jam complex (where the donated piles will be integrated); regrade the streambank to replicate natural conditions; and restore the riparian buffer within the project area. Specific design figures of the Camp Kalama Project provided by CCD can be found in Attachment 1. The Camp Kalama Project area includes approximately 400 linear feet of aquatic habitat restoration in the Kalama River, plus over 1,000 linear feet of associated riparian buffer restoration.

3 Existing Aquatic Resource Conditions

3.1 Port of Longview

The new dredge work area is located in the active working waterfront of the Port of Longview and nearshore conditions are generally degraded from a natural condition due to historic modifications from industrial uses. The nearshore in the vicinity of the new dredge work area is dominated by deep water and the presence of over-water structures associated with industrial operations.

The new dredge work area is surrounded on two sides by pier structures, including a paved, asphalt pier (Berth 8) and an open grated metal pier (Berth 9). Areas waterward of the new dredge work area are maintained at -43 feet CRD for deep draft vessels. Areas landward of the new dredge work area slope steeply between the elevations of -5 to -40 CRD (between 2:1 and 1.5:1 slopes). The aquatic substrate consists of coarse sands typical of the Columbia River and the adjacent Lower Columbia River Federal Navigation Channel.

Vegetation and habitat conditions at the Port of Longview Berths are limited due to existing development built along the Columbia River shoreline. No riparian vegetation occurs at existing Berth 8 due to the existing overwater structures designed for deep water docking. Limited riparian vegetation occurs behind (i.e., landward of) Berth 9. Deciduous shrubs are present in a narrow band adjacent to the apparent ordinary high-water mark of the Columbia River. Woody material is also present; interspersed with boulders that armor the steep shoreline. Above the narrow band of riparian shrubs, vegetation is dominated by grasses. Similar shoreline conditions extend upstream of the new dredge work area.

3.2 Camp Kalama

Camp Kalama is situated on the Kalama River between RM 1.40 and 1.63. Erosion of the riverbank over time has significantly reduced riparian vegetation and threatens the camp's infrastructure. Approximately 400 linear feet of the bank is actively eroding, contributing large quantities of fine sediment into existing spawning, rearing, and side-channel habitat at the Camp Kalama site and downstream (CCD 2020). Sediment in this reach includes gravel and cobble that provides spawning habitat for fall Chinook salmon (LCFRB, 2010).

Riparian function is effectively absent at Camp Kalama. Riparian vegetation is limited and continues being lost to ongoing erosion; additionally, recruitment of large woody material is minimal. Riparian buffer vegetation has been in decline since 2000, and now a single row of riparian plants is present along 400 linear feet (CCD 2020).

4 Avoidance and Minimization of Aquatic Resource Impacts

The Port identified the need to address unsafe deep-draft vessel access at Berth 8 and proposes to expand their maintenance dredge footprint to meet this need. Addressing these safety concerns necessitates that the navigation areas are maintained at a depth of -43 feet CRD and, therefore, deepening of their berths in this area is necessary to accommodate the Project objectives. Conversion of a portion of the new dredge work area from shallow to deep water habitat was identified as the only feasible Project approach. Although avoidance is not possible, the Port identified minimization measures described below to reduce the potential adverse impacts to the shallow-water ecosystem.

The Port initially proposed the new dredge work area with a base dredge prism of approximately 8,000 square feet to provide the most flexibility for vessel pilots. Following consultation with permitting agencies, consultant biologists, and operations staff, the Port reduced the footprint to the minimum size needed to meet their stated Project need. This revision reduced the base dredge prism by approximately 50% or 4,000 square feet. In addition, the original 8,000-square-foot based dredge prism also resulted in side slopes that covered an additional 8,200 square feet. The revised 4,000 square-foot dredge prism will result in side slopes covering an additional 7,300 square feet, therefore further reducing impacts to in-water habitats from the reduced size of the base dredge prism.

Other Project elements that will minimize aquatic resource impacts include the following:

- Deepening of the new dredge work area will only be performed following sediment characterization and receipt of a sediment quality determination from the Portland Sediment Evaluation Team (PSET) to ensure that all dredged sediments are appropriate for open-water disposal (or other disposal method as identified by the PSET).
- Dredging will be completed within the allowable in-water work window established by regulatory agencies.
- Turbidity and other water quality parameters measured during dredging and in-water placement (per the Project's Washington State Department of Ecology-approved water quality monitoring plan) will meet Washington State Surface Water Quality Standards (Washington Administrative Code 173-201A) and the in-water placement standards for turbidity in Oregon's Department of Environmental Quality 401 Water Quality Certification when placing in the Oregon sites.
- Best management practices for dredge operations will be implemented as detailed in Section 2.2 of the Biological Evaluation for the Project (Anchor QEA 2020).

5 Impacted Aquatic Resource Functions

The Project will result in a net decrease in the amount of shallow-water habitat at the Port; however, the benefits to shallow-water habitat quality as a result of implementing the Camp Kalama Project are expected to provide a larger area of enhanced shallow-water habitat for the same salmonid Evolutionary Significant Units (ESUs) impacted by the Project. Furthermore, the new dredge work area will impact the shallow-water habitat that is farthest from the Columbia River shoreline and some shallow-water habitat adjacent to the shoreline will remain. This remaining shallow-water habitat is in closer proximity to existing riparian vegetation and is contiguous with upstream shallow-water habitat.

During construction, there could be temporary impacts such as increased levels of turbidity associated with sediment disturbance from dredging. The potential effects of turbidity are described in more detail in the Project Biological Evaluation (Anchor QEA 2020). Project construction will meet permit requirements for state water quality standards. Construction activities will be limited to the in-water work window to minimize impacts to salmonids that may occur in the Project area.

The Camp Kalama Project does not involve dredging, but may temporarily negatively affect aquatic habitat during construction. However, the project is expected to result in long-term positive habitat improvements post-construction. Construction-related effects will be addressed and evaluated during the permitting process completed by CCD.

The Camp Kalama Project will benefit multiple primary constituent elements and life stages for the ESUs identified in Table 2 through the construction of one or more large woody material structures and restoration of riparian vegetation. These project features will reduce the input of fine sediment to this reach of the Kalama River, which will benefit egg incubation and rearing habitat both within the project reach and in reaches farther downstream.

6 Mitigation Site Rationale

Habitat enhancement elements to be constructed for Camp Kalama Project support the same ESUs that are found in the new dredge work area at the Port (Table 2). The in-kind donation of timber piles to the Camp Kalama Project provides the opportunity to improve shallow-water habitat to a degree that would not be possible at the Port given its site constraints.

The Camp Kalama Project was identified as an appropriate mitigation option for the following reasons.

- The location is near the Port's Project site on the Columbia River.
- The salmonid ESUs impacted at the Port's Project site will be benefitted by the Camp Kalama Project.
- Impacts to degraded shallow-water at the Port's berths will be offset by the greater habitat complexity and overall habitat benefits realized by the Camp Kalama Project.
- The Project will achieve a habitat conversation to enhancement ratio of more than 3:1.

7 Mitigation Work Plan and Description of Aquatic Functions Provided at Mitigation Site

The Camp Kalama Project directly addresses habitat diversity, channel stability, sediment inputs, and declines in riparian function, which are among the limiting factors for the recovery of Coho salmon, fall/spring Chinook salmon, and winter/summer steelhead. The Camp Kalama Project goals and objectives identified by CCD are consistent with key priorities and habitat measures within the Washington Lower Columbia Salmon Recovery and Fish and Wildlife Plan, and align with sub-basin and reach-scale priorities for these species. Although Lower Columbia River ESUs are the primary targets of the shallow-water enhancement efforts in the Kalama River, the Project will improve shallow-water habitat for Chum, Eulachon, out-of-basin stocks that seek cold-water refugia in the Kalama (CCD 2020), and outmigrating juveniles (Carter et al. 2009).

The Port will provide wooden piles to the CCD in support of the developing a large woody material complex structure. If the number of piles exceeds what is required for the Camp Kalama Project, the piles may be used for other projects CCD designates.

CCD proposes the following project objectives as part of the Camp Kalama Project:

- Construct a channel margin debris jam complex.

- Regrade the streambank to replicate natural conditions.
- Restore the riparian buffer within the project area.

8 Site Protection Instrument and Long-Term Management

The CCD will establish the basis for protection of habitat enhancement features for the Camp Kalama Project. The Port will not be involved in site protection nor long-term management.

9 Maintenance Plan

The CCD will be responsible for establishing a maintenance plan for long-term functionality of the shallow-water habitat. The Port will not be involved in development of a maintenance plan for the Camp Kalama Project.

10 Performance Standards

The CCD will establish goals, objectives, and performance standards for the proposed habitat enhancement measures.

11 Monitoring Requirements

The CCD will address monitoring requirements for the proposed habitat enhancement measures.

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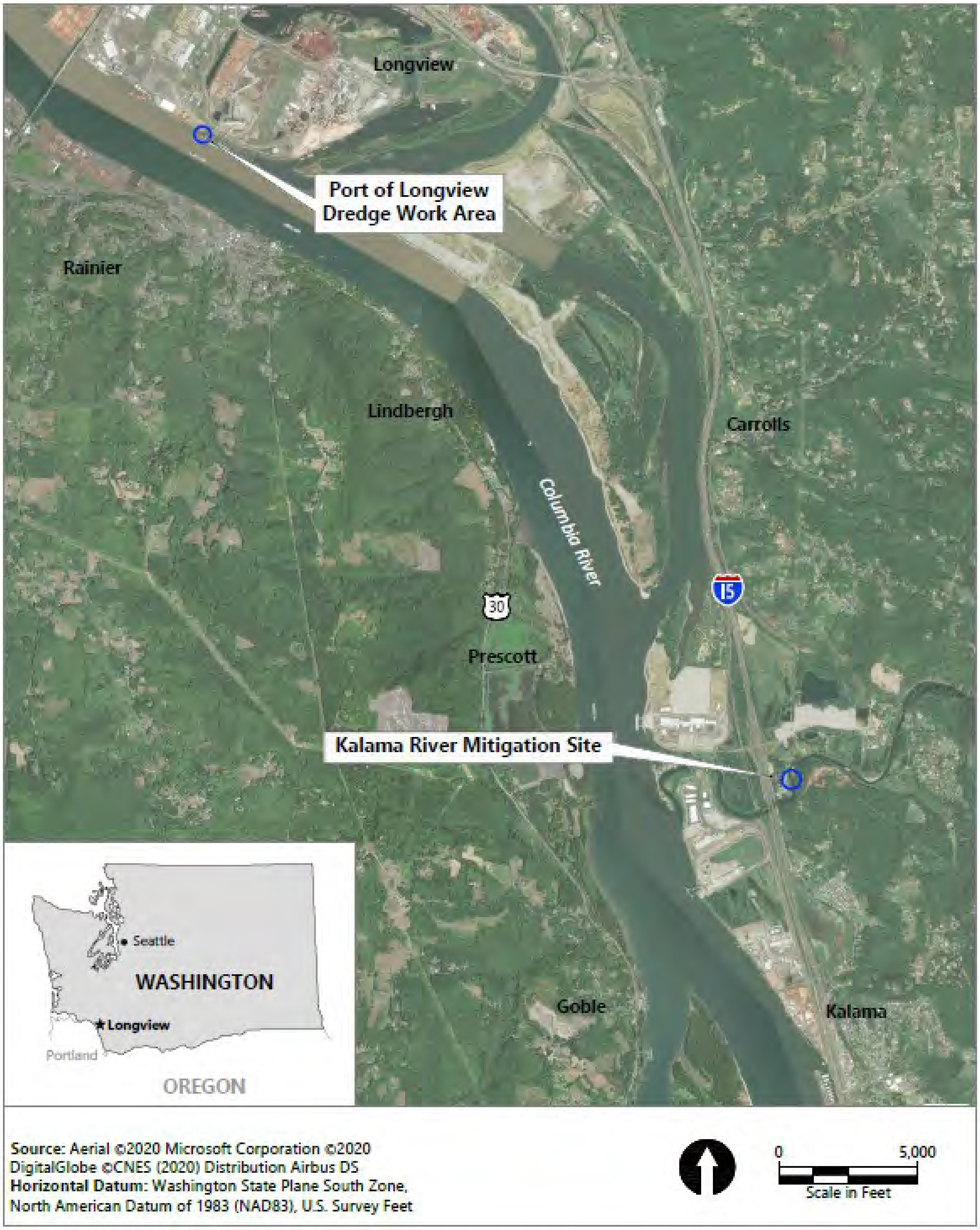
Figures



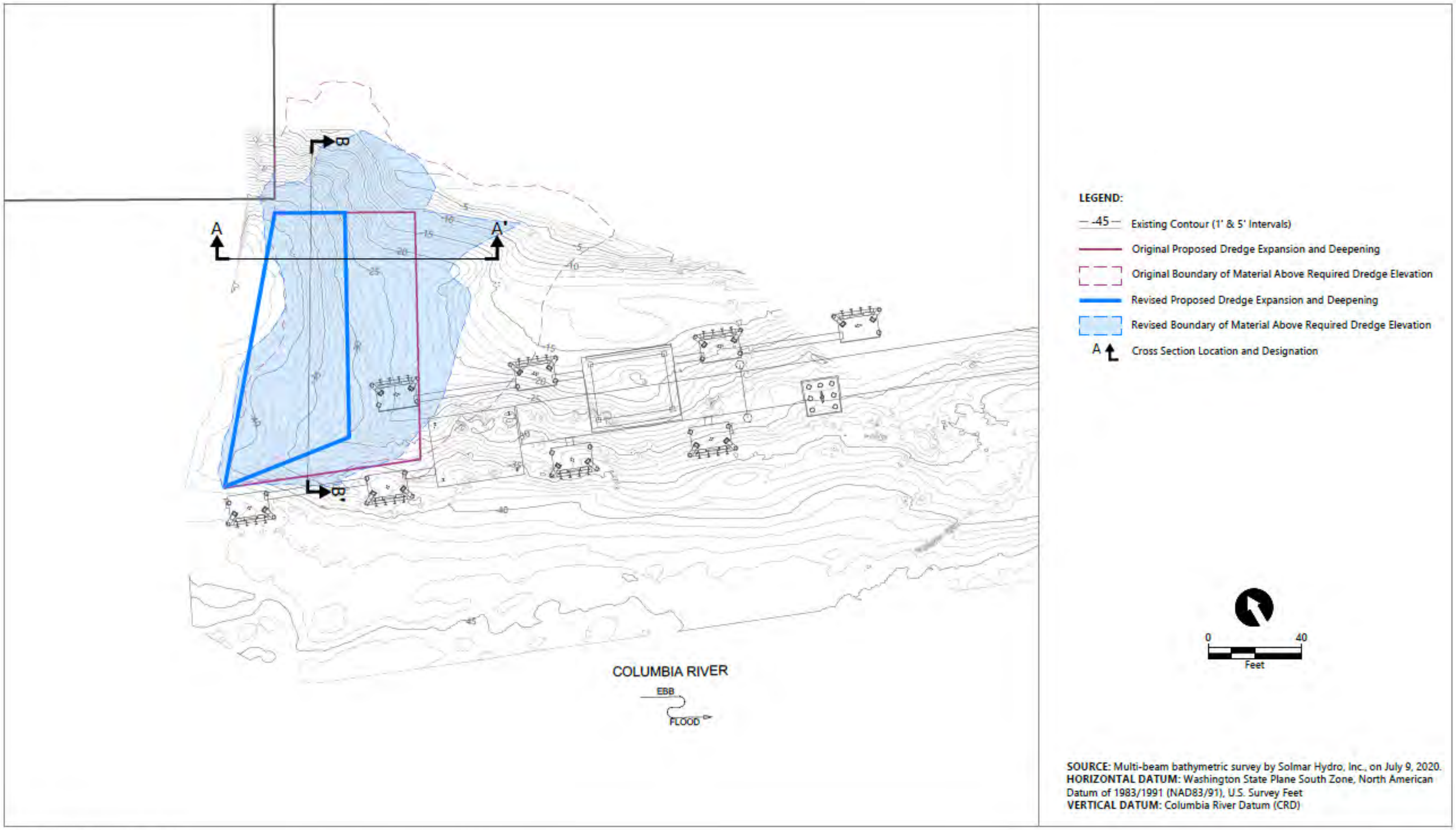
Source: Aerial ©2020 Microsoft Corporation ©2020 DigitalGlobe ©CNES (2020) Distribution Airbus DS
Horizontal Datum: Washington State Plane South Zone, North American Datum of 1983 (NAD83), U.S. Survey Feet

Publish Date: 2021/02/16 8:36 AM | User: hmerrick
Filepath: K:\Projects\0159-KPFF Consulting Engineers\Port of Longview Maintenance Dredging\Mitigation Memo\0159-RP-000 (Vmap).dwg Figure 1

ANCHOR QEA

Figure 1
Vicinity Map: Port of Longview and Proposed Mitigation Site

Mitigation Memo
Port of Longview Maintenance Dredging Project



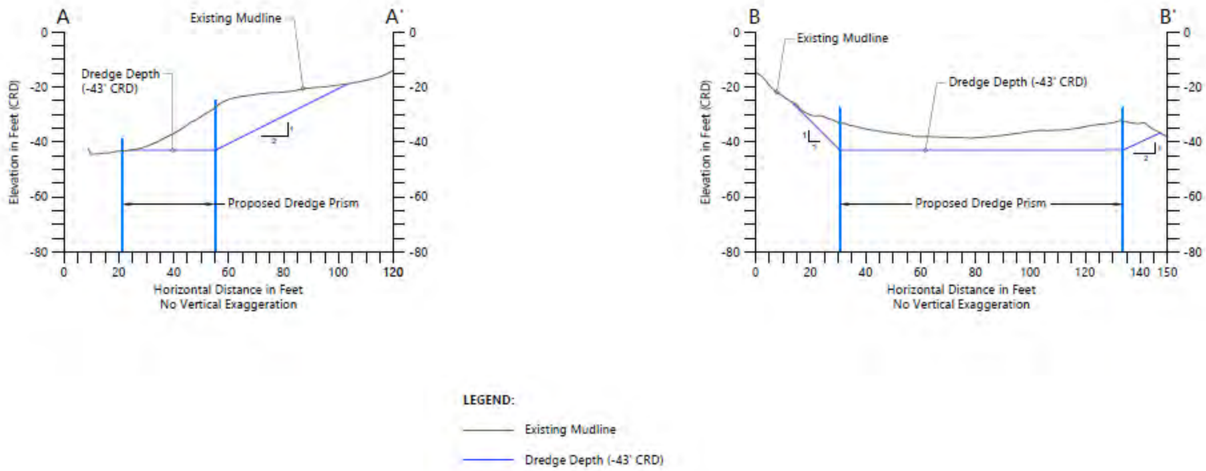
SOURCE: Multi-beam bathymetric survey by Solmar Hydro, Inc., on July 9, 2020.
HORIZONTAL DATUM: Washington State Plane South Zone, North American Datum of 1983/1991 (NAD83/91), U.S. Survey Feet
VERTICAL DATUM: Columbia River Datum (CRD)

Publish Date: 2021/02/16 8:36 AM | User: hmerrick
Filepath: K:\Projects\0159-KPFF Consulting Engineers\Port of Longview Maintenance Dredging\Mitigation Memo\0159-RP-003 (Plan_Sections).dwg Figure 2

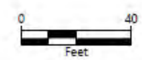
ANCHOR QEA

Figure 2
Original and Revised Dredge Prism: New Dredge Work Area

Mitigation Memo
Port of Longview Maintenance Dredging Project



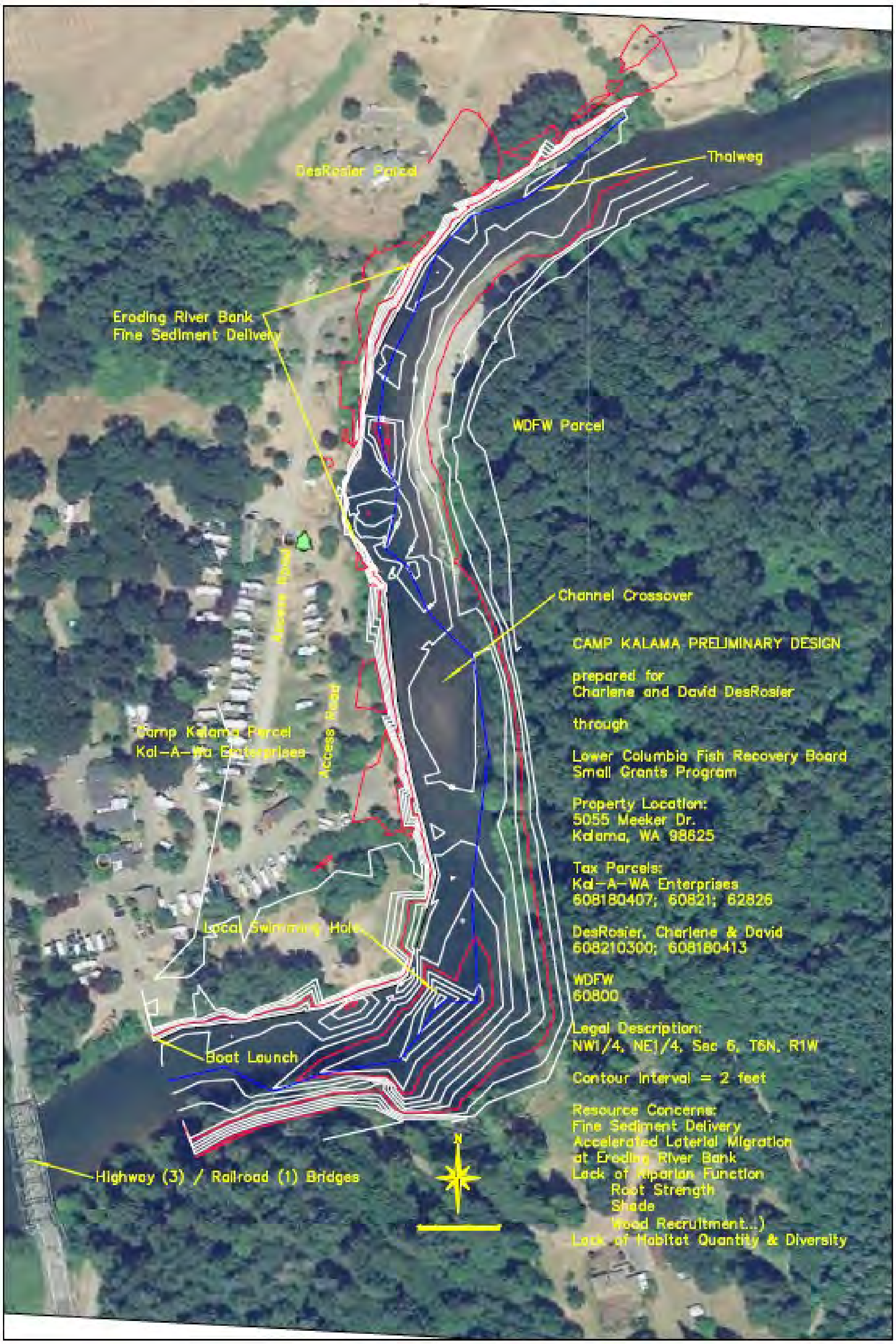
SOURCE: Multi-beam bathymetric survey by Solmar Hydro, Inc., on July 9, 2020.
HORIZONTAL DATUM: Washington State Plane South Zone, North American Datum of 1983/1991 (NAD83/91), U.S. Survey Feet
VERTICAL DATUM: Columbia River Datum (CRD)



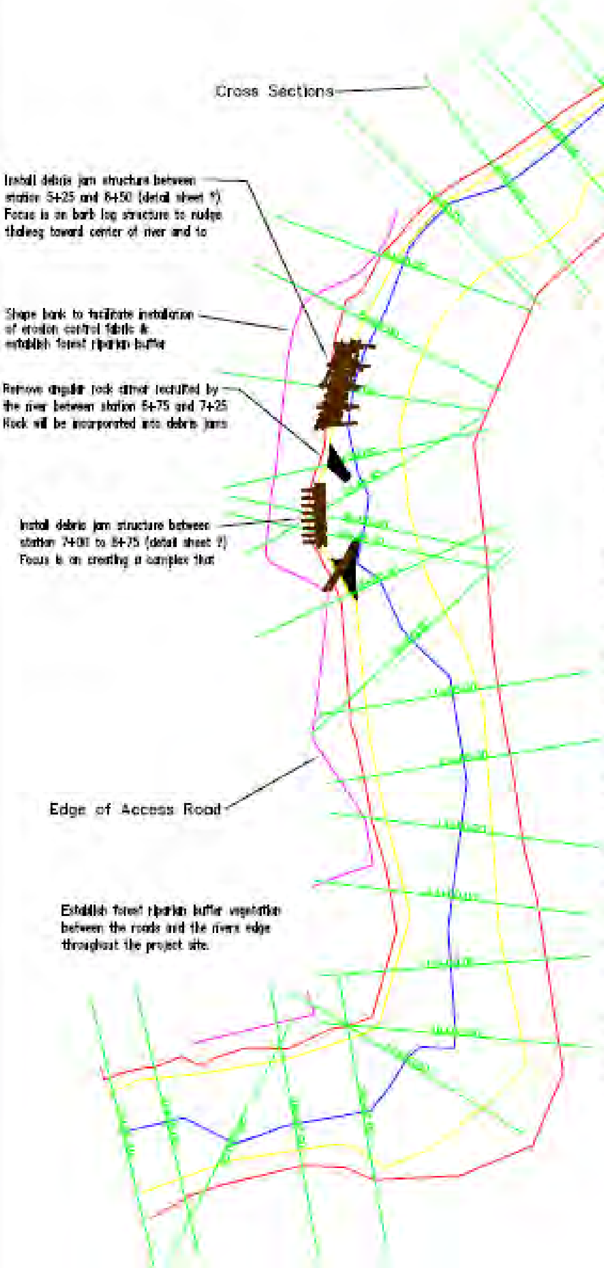
ANCHOR QEA

Figure 3
Cross Sections: New Dredge Work Area, Revised Footprint
Mitigation Memo
Port of Longview Maintenance Dredging Project

Attachment 1
Camp Kalama Project Design Figures



Cowlitz Conservation District 2125 8th Avenue Longview, WA 98632 360-425-1880	DATE: SCALE: CHECKED BY: DRAFTED BY: DESIGNED BY:	EXISTING CONDITION	Sheet 1 of 1



Project Goal:
Implement a minimalist river restoration project to stablize a section of river bank in order to reduce delivery of fine sediment to the reach, create channel margin habitat, and to restore riparian vegetation for long term stewardship of the site.

Restoration Needs Include:
Floodplain function and channel migration processes
Riparian conditions & functions
Stream channel habitat structure & bank stability
Water quality

Primary fisheries limiting factors include:
Key habitat quantity
Habitat diversity
Sediment
Channel stability
Predation

Objectives:

Install wood-based structure along a reach of streambank experiencing accelerated erosion to restore migration processes, to allow for establishment of property riparian conditions and functions, to create stream channel habitat and structure, to improve water quality by reducing sediment delivery, to improve channel / streambank stability.

Restore riparian function to continue to ensure river restoration over the long-term.

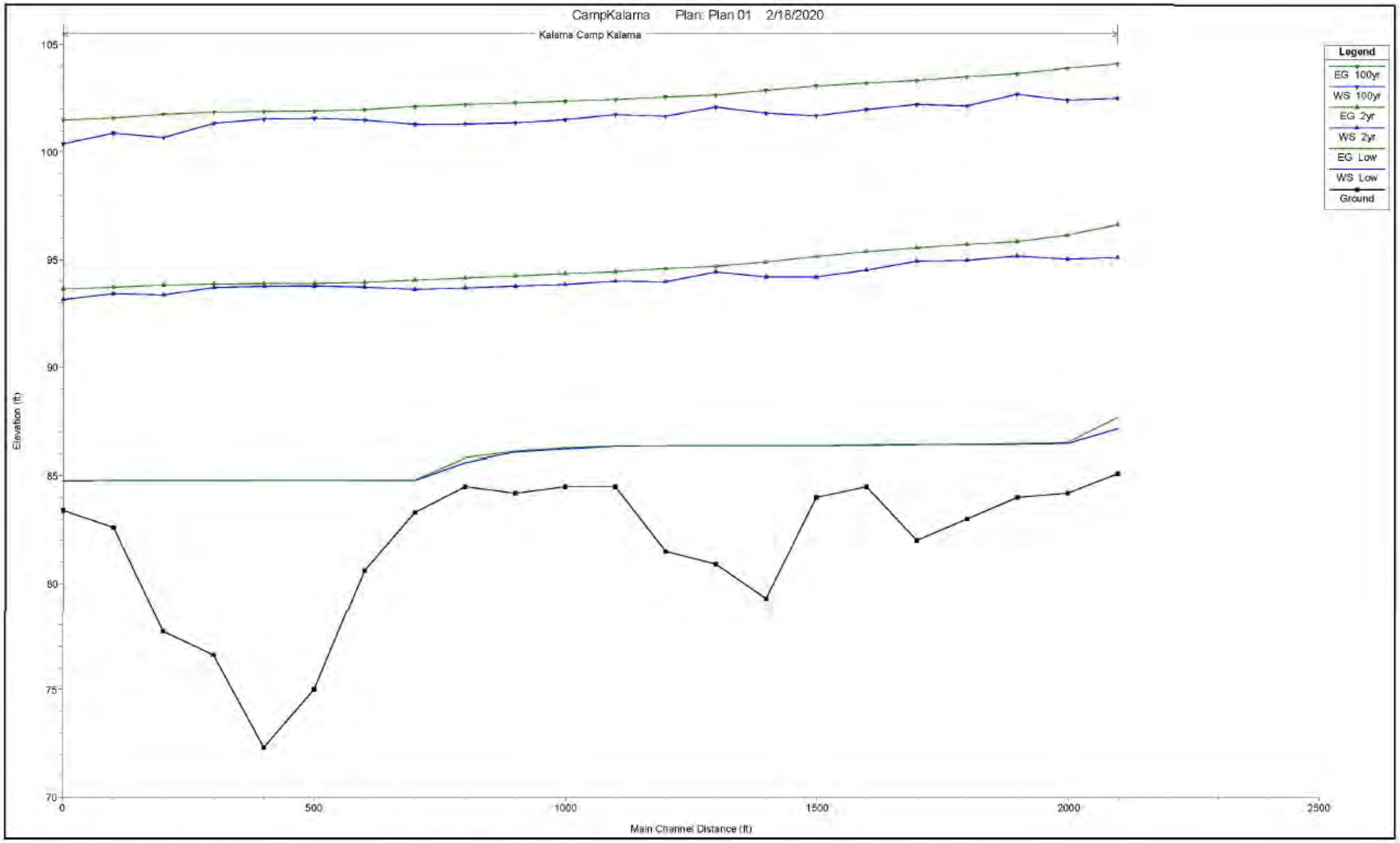
GENERAL CONSTRUCTION NOTES
Project will be constructed in accordance with project design sheets and all applicable local, state, and federal regulations.

Cowlitz Conservation District will provide on site guidance to ensure that goals and objectives and structure stability needs are achieved.

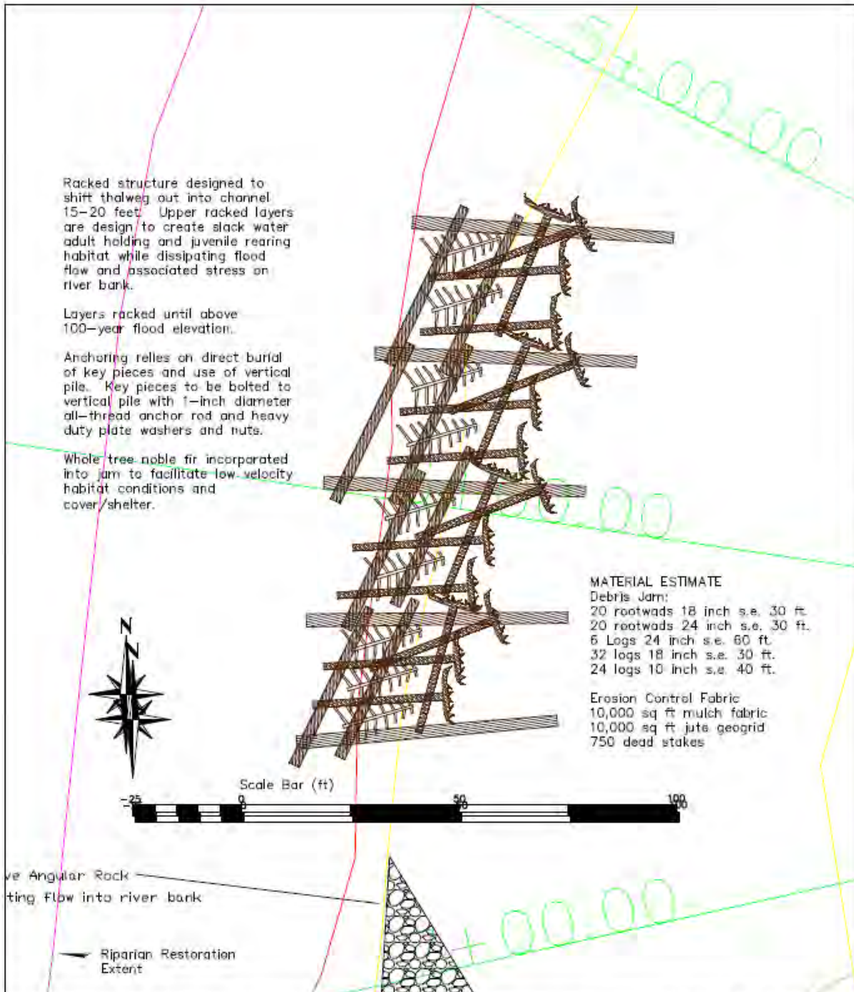
Conservation District will procure LWM needed to construct the project and have it delivered and decked on site.

Construction Contractor will be secured to construct the wood-based structure and erosion control aspects of the design. Construction activities will be coordinated with management of the Camp Ground to avoid unnecessary conflicts.

Cowlitz Conservation District 2125 8th Avenue Longview, WA 98632 360-425-1880	DATE : SCALE : per drawing CHECKED BY: DRAFTED BY: dbh DESIGNED BY: ag & dbh	Camp Kalama Plan View	Sheet 2 of 1



Cowlitz Conservation District 2125 8th Avenue Longview, WA 98632 360-425-1880	DATE: 6/6/2019 SCALE: per drawing CHECKED BY: DRAFTED BY: dbh	REVISIONS	DATE	BY	PREPARED FOR: Camp Kalama (David and Chalene DesRosier) LCFRB Small Grants Program	Existing Condition Longitudinal Profile & Water Surface Elevation	SHEET 3 OF 6



Racked structure designed to shift thalweg out into channel 15–20 feet. Upper racked layers are design to create slack water adult holding and juvenile rearing habitat while dissipating flood flow and associated stress on river bank.

Layers racked until above 100–year flood elevation.

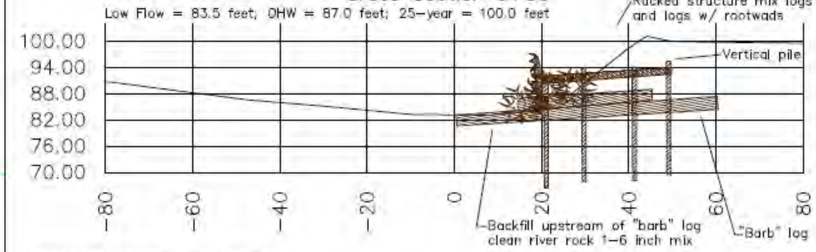
Anchoring relies on direct burial of key pieces and use of vertical pile. Key pieces to be bolted to vertical pile with 1–inch diameter all–thread anchor rod and heavy duty plate washers and nuts.

Whole tree noble fir incorporated into jam to facilitate low velocity habitat conditions and cover/shelter.

MATERIAL ESTIMATE
Debris Jam:
20 rootwads 18 inch s.e. 30 ft.
20 rootwads 24 inch s.e. 30 ft.
6 Logs 24 inch s.e. 60 ft.
32 logs 18 inch s.e. 30 ft.
24 logs 10 inch s.e. 40 ft.

Erosion Control Fabric
10,000 sq ft mulch fabric
10,000 sq ft jute geogrid
750 dead stakes

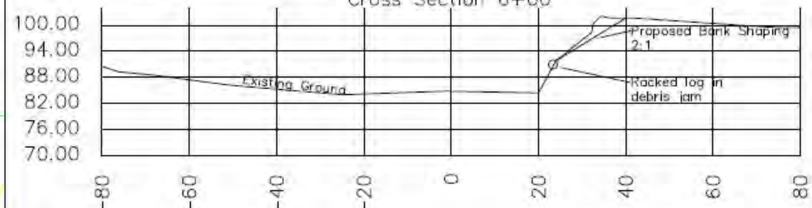
Cross Section 5+50



DEBRIS JAM CONSTRUCTION NOTES

1) 60–foot "barb" log extends into channel 25–30 feet (dependent on stability analysis of as–built structure).
2) Import clean river rock and backfill upstream of "barb" log. Target poorly mixed with round rock 1 – 6 inches
3) Racked structure with rootwads exposed in active channel and logs buried within the river bank.
4) Incorporate whole tree noble fir amongst racked rootwads within active channel to facilitate 0–velocity habitat conditions within debris jam.
5) Drive vertical pile to refusal. Test pile along bank slowed at about 20 feet of embedded depth. Pull test indicated minimum resistance of 16,000 lbs pull at 20 feet and 25,000 lbs at 22'+. Target depth 20 feet used in stability calcs.

Cross Section 6+00

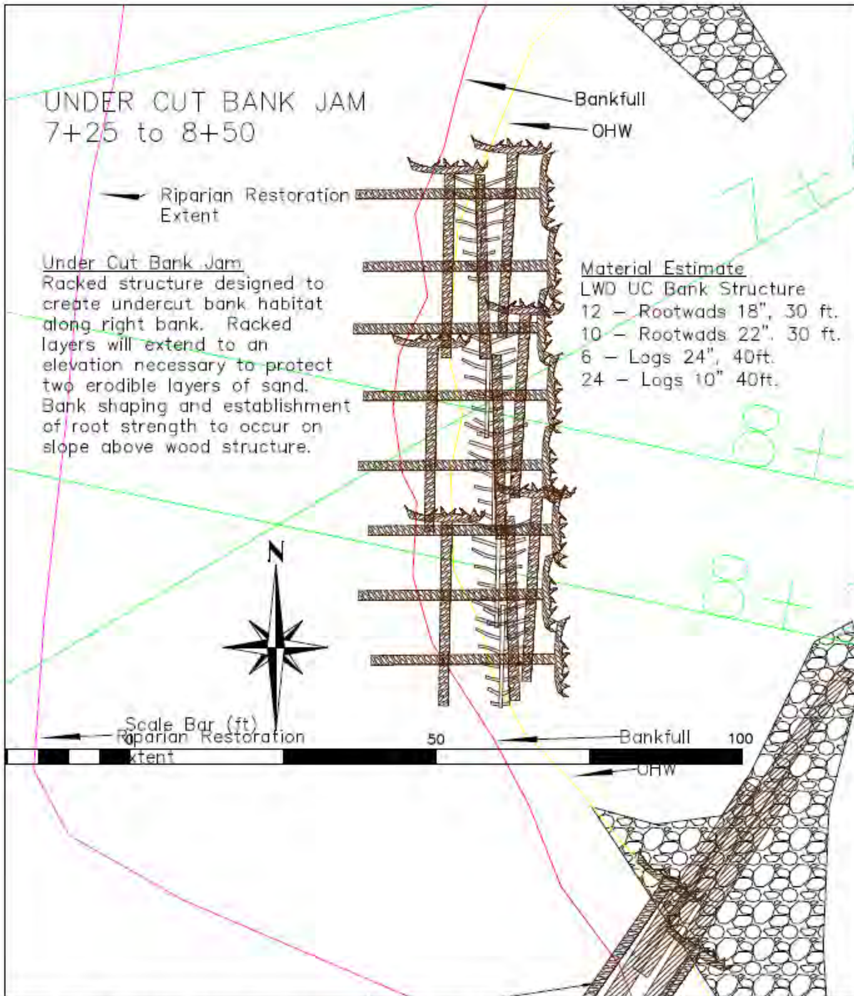


BANK SHAPING / EROSION CONTROL CONSTRUCTION NOTES

1) Begin bank shaping to facilitate using racked log as anchor for proposed geotextile (below lower sand layer)
2) Pull slope at approximate 2:1 slope or flatter blending into debris jams and functioning river bank upstream and downstream. Utilize spoils as backfill on simple wood complexes (detail sheet 5)
3) Excavate cup trench at top of slope about 1 foot landward from hinge. Cup trench will be minimum of 1 foot wide and 1 foot deep.
4) Seed shaped bank with an erosion control seed mix at a rate of 25 pounds per acre.
5) Install mulch fabric over seed anchoring fabric with manufacturer supplied staples.
6) Instal jute geogrid (Dekowe 700 or equivalent. Geogrid to be attached to racked debris jam log by wrapping fabric around a 2 x 4 and spiking the 2x4 to the log. Lay fabric on slope with upstream end draped into cup trench. Use dead stakes to leverage fabric tight and anchor by driving dead stake into soil.
7) Anchor fabric along slope by driving dead stakes into slope on a 3–foot spacing. Fabric will be further anchored under separate contract by installing livestake consisting of 2–5 foot willow and red osier dogwood cutting on an approximate 1.5 foot spacing. Shorter length livestakes low on the slope, longer livestakes higher on the slope.

DEAD STAKES: Dead stakes will consist of a 2–foot long 2x4 that has been ripped diagonally (each 2x4 creates 2 dead stakes)

		REVISIONS	DATE	BY	PREPARED FOR:		SHEET
Cowlitz Conservation District 2125 8th Avenue Longview, WA 98632 360-425-1880	DATE: 6/6/2019 SCALE: per drawing CHECKED BY: DRAFTED BY: dbh				Camp Kalama (David and Chalene DesRosier) LCFRB Small Grants Program	Debris Jam Detail Sheet Racked Structure with "Barb" Logs	4 OF 1

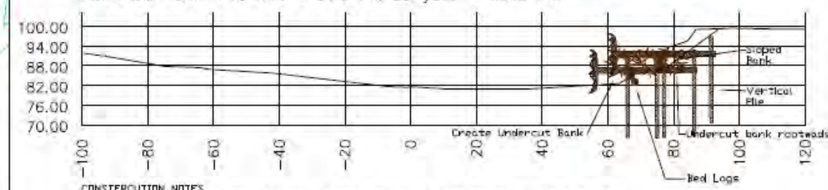


Under Cut Bank Jam
Racked structure designed to create undercut bank habitat along right bank. Racked layers will extend to an elevation necessary to protect two erodible layers of sand. Bank shaping and establishment of root strength to occur on slope above wood structure.

Material Estimate
LWD UC Bank Structure
12 – Rootwads 18", 30 ft.
10 – Rootwads 22". 30 ft.
6 – Logs 24", 40ft.
24 – Logs 10" 40ft.

Debris Jam: Undercut Bank
Cross Section 8+00

Low Flow =83.5 ft.; OHW = 87.0 ft; 25-year = 100.0 ft.



CONSTERCUTION NOTES
1) Structures to be constructed with on site guidance from Cowlitz Conservation District.

2) Excavate tie for bedlogs to support undercut bank logs with rootwads. Anchor in place with vertical pile.

3) Place rootwads to create undercut bank (10-15 ft undercut). Undercut bank rootwads to protect river bank to about OHW.

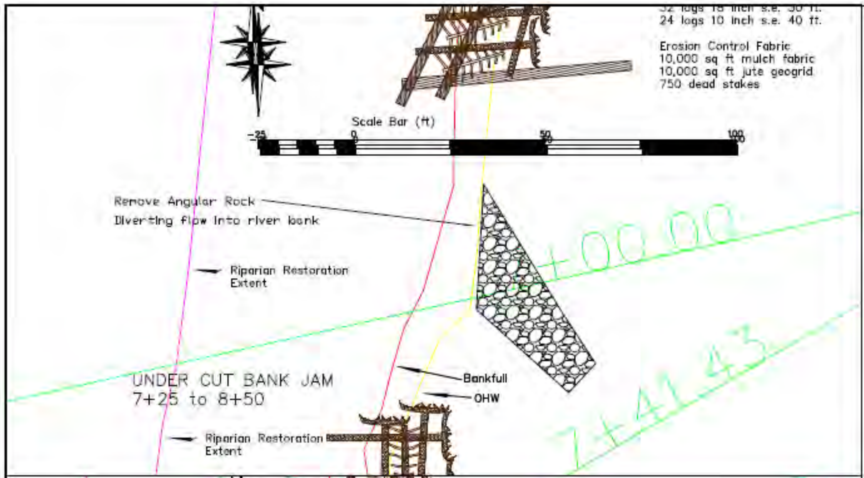
4) Place racking material to slow velocity within debris jam during flows about average annual peak up. Racking material will consist of whole tree noble fir trees to break velocity and to provide holding cover and structure. Continue racking logs with rootwads and logs until structure achieves sufficient elevation to protect the two layers of alluvial sand which is highly erodible.

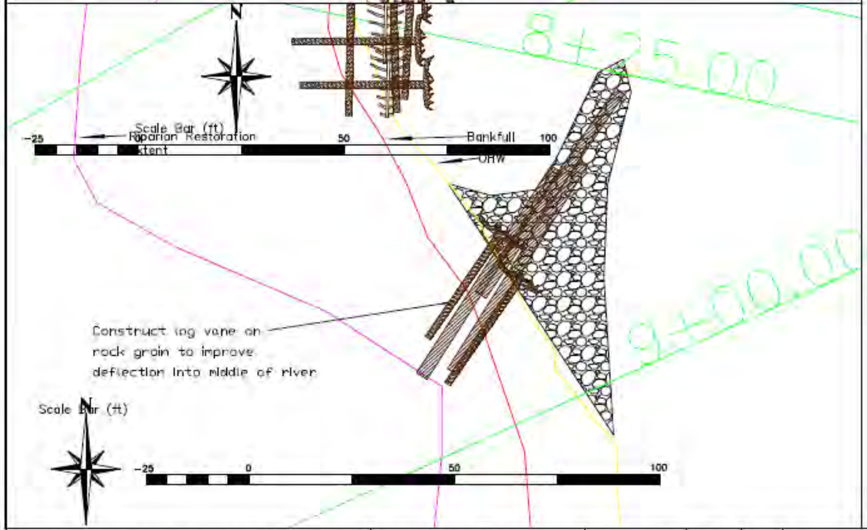
5) Structure anchors will consist of direct burial of key pieces and use of vertical pile. Target embeddedment of vertical pile is 20 feet. Key pieces will be anchored to vertical pile through use of 1-inch diameter all thread anchor bolts and corresponding heavy duty plate washers and nuts. Drive vertical pile to refusal. Test pile along bank slowed at about 20 feet of embedded depth. Pull test indicated minimum resistance of 16,000 lbs pull at 20 feet and 25,000 lbs at 22'+. Target depth 20 feet used in stability calcs.

BANK SHAPING / EROSION CONTROL CONSTRUCTION NOTES
1) Begin bank shaping to facilitate using racked log as anchor for proposed geotextile (below lower sand layer)
2) Pull slope at approximate 2:1 slope or flatter blending into debris jams and functioning river bank upstream and downstream. Utilize spoils as backfill on simple wood complexes (detail sheet 5)
3) Excavate cup trench at top of slope about 1 foot landward from hinge. Cup trench will be minimum of 1 foot wide and 1 foot deep.
4) Seed shaped bank with an erosion control seed mix at a rate of 25 pounds per acre
5) Install mulch fabric over seed anchoring fabric with manufacturer supplied staples
6) Instal jute geogrid (Dekowe 700 or equivalent. Geogrid to be attached to racked debris jam log by wrapping fabric around a 2 x 4 and spiking the 2x4 to the log. Lay fabric on slope with upstream end draped into cup trench. Use dead stakes to leverage fabric tight and anchor by driving dead stake into soil.
7) Anchor fabric along slope by driving dead stakes into slope on a 3–foot spacing. Fabric will be further anchored under separate contract by installing livestake consisting of 2–5 foot willow and red osier dogwood cutting on an approximate 1.5 foot spacing. Shorter length livestakes low on the slope, longer livestakes higher on the slope.

DEAD STAKES: Dead stakes will consist of a 2–foot long 2x4 that has been ripped diagonally (each 2x4 creates 2 dead stakes)

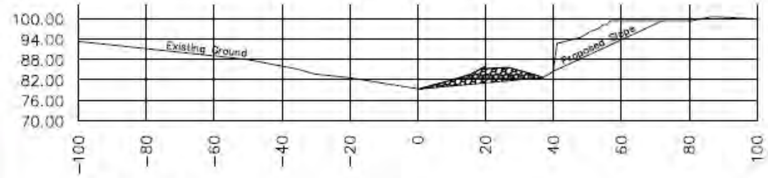
Cowlitz Conservation District 2125 8th Avenue Longview, WA 98632 360-425-1880	DATE : 6/6/2019 SCALE : per drawing CHECKED BY: DRAFTED BY: dbh	REVISIONS	DATE	BY	PREPARED FOR: Camp Kalama (David and Chalene DesRosier) LCFRB Small Grants Program	Debris Jam Detail Sheet Racked Structure Creating UnderBut Bank	SHEET 5 OF 1





Remove Angular Rock & Shape Bank

Cross Section 7+00



CONSTRUCTION NOTES

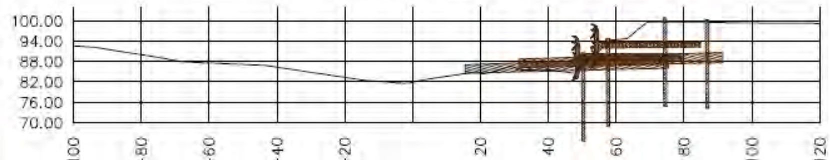
1) Remove angular rock forming dike directing water toward river bank. Material meets the specifications for WSDOT light loose rip rap. Spoils will be used as ballast back fill on debris jam structure and to ensure protection of erodible sand layer(s) as allowed by regulatory agencies. Approximately 90 yards of material to be removed from river channel.

2) Bank to be shaped to an approximate 2:1 slope. Spoils range from sand to silty clay loam. Spoils will be disposed of in an area designated by the owners of Camp Kalama.

3) Bank will be treated for erosion control and planted as specified on detail sheet 4 "Debris Jam Barb Logs"

Vane Structure on Rock Groin

Cross Section 8+50



CONSTRUCTION NOTES

1) Place "vane" or "barb" log on angular rock groin embedded as deep as possible in the rock. Extend log as far as stability calculations will allow. Use up to 2 additional logs to extend vane/barb by bolting logs together with 1-inch diameter all thread anchor bolts in four locations. Backfill vane/barb log with clean river rock upstream of log.

2) Place rootwads to protect disturb soil from log burial from washing from trench. Rootwads should interact with summer low flows up to ordinary high water. If allowed: protect face of trenched area with angular rock removed from groin depicted in cross section 7+00 above.

3) Ensure vertical pile interact with all log and log with rootwads in structure to address velocity force acting on structure. Target pile embeddedment is 20 feet. Anchor key pieces to pile using 1-inch diameter all-thread anchor bolts.

4) Blend river bank in with bank shaping efforts and protect soil from further erosion through use of geotextile fabric and planting as described on detail sheet 4 "Debris Jam Barb Logs".

Cowlitz Conservation District 2125 8th Avenue Longview, WA 98632 360-425-1880	DATE: 6/6/2019 SCALE: per drawing CHECKED BY: DRAFTED BY: dbh	REVISIONS / DATE / BY	PREPARED FOR: Camp Kalama (David and Chalene DesRosier) LCFRB Small Grants Program	Angular Rock Removal & Vane/Barb Log installation Detail Sheet	SHEET 6 OF 1	