



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
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Refer to NMFS No:
WCRO-2020-00988

February 24, 2021

Michelle Walker
Chief, Regulatory Branch
U.S. Army Corps of Engineers – Seattle District
P.O. Box 3755
Seattle, Washington 98124-3755

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the McAmis Lower Columbia River Dredging Project, Clatsop County, Oregon, Wahkiakum, Cowlitz, and Clark Counties, Washington, Columbia River, HUC: (170800060500) (NWS-2019-953)

Dear Ms. Walker:

Thank you for your letter of May 21, 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 the McAmis Lower Columbia River Dredging Project (NWS-2019-953). 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 (MSA)(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 critical habitats.

WCRO-2020-00988



As required by section 7 of the ESA, NMFS is providing an incidental take statement with the biological opinion. The incidental take statement describes reasonable and prudent measures NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The take statement sets forth nondiscretionary terms and conditions, including reporting requirements, that the U.S. Army Corps of Engineers or any applicant must comply with to carry out the reasonable and prudent measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of listed species.

This document also includes the results of our analysis of the action's likely effects on essential fish habitat (EFH) pursuant to section 305(b) of the 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 Bonnie Shorin, of the Oregon Washington Coastal Area Office in Lacey, Washington, at bonnie.shorin@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: Danette Guy

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

McAmis Lower Columbia River Dredging Project (NWS-2019-953)

NMFS Consultation Number: WCRO-2020-00988


Action Agency: U.S. Army Corps of Engineers – Seattle 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 (<i>Oncorhynchus tshawytscha</i>)	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 (<i>O. keta</i>)	T	Yes	Yes	No	No
LCR coho salmon (<i>O. kisutch</i>)	T	Yes	Yes	No	No
SR sockeye salmon (<i>O. nerka</i>)	E	Yes	Yes	No	No
LCR steelhead (<i>O. mykiss</i>)	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 Pacific eulachon (<i>Thaleichthys pacificus</i>)	T	Yes	Yes	No	No
Southern DPS of Green sturgeon (<i>Acipenser medirostris</i>)	T	Yes	Yes	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		
Pacific Coast Groundfish	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: February 24, 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 USC 1531 et seq.), and implementing regulations at 50 CFR 402, as amended.

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

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

1.2 Consultation History

This biological opinion is in response to the U.S. Army Corps of Engineers –Seattle 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. NMFS received the request for consultation on May 21, 2020. Included in this request from the applicant, McAmis, and their agent, Maul Foster and Alongi Inc., was a biological evaluation, and supplemental information. After initial review of the consultation package NMFS determined it to be complete, and initiated formal consultation on June 22, 2020.

Table 1. List of species included in the consultation for the McAmis Lower Columbia River Dredging Project.

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	3/18/10'0 ; 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

“Action” means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). The EFH definition of a 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 authorizing maintenance dredging of sand shoals in four reaches of the lower Columbia River federal navigation channel (FNC) and the temporary storage of the dredged sand at the McAmis upland material storage facility (UMSF). McAmis is requesting a 10-year permit to conduct maintenance dredging of a maximum of 50,000 cubic yards (CY) of sediment per year (500,000 CY total). Dredging would occur for a maximum of 120 days per year for ten years. The proposed dredging will maintain an operation depth of 43 feet (Columbia River Datum), within 5 feet of over-dredge to the FNC. All dredged material will be transported to the McAmis UMSF and stored for future use, as clean upland fill, environmental remediation (capping), restoration projects and commercial use. McAmis proposes to conduct dredging using a closed lip clamshell dredge operated by a derrick crane mounted to a floating barge. Dredged sediments will be placed on a barge and transported to the UMSF.

Conservation measures and best management practices proposed by the applicant and described in the biological evaluation submitted by McAmis and their consultant, considered parts of the

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

- Work will occur within the approved in-water work window (IWWW) of November 1 to February 28. Work would be performed outside of this time frame only with USACE approval and consultation with appropriate agencies (e.g. NMFS, USFWS, WDFW, ODFW)
- McAmis will follow the water quality monitoring requirements of the 401 Water Quality Certifications during all in-water activities.
- McAmis will follow the requirements of the Washington Department of Fish and Wildlife (WDFW) Hydraulic Project Approval (HPA) during all in-water activities.
- McAmis will sequencing and/or phasing work activities to minimize the extent and duration of in-water disturbances.
- McAmis will employ experienced dredge operators.
- Dredge operators will follow specific operational BMPs including:
 - Not dragging the bucket on the bottom;
 - Not stockpiling material underwater;
 - Completing a horizontal dredge pass across the dredge surface before moving to the next deeper pass;
 - Avoiding “glory holing”;
 - Not overfilling the dredge bucket;
 - Lowering and closing the bucket as slowly as possible on the bottom;
 - Pausing before hoisting the bucket off the bottom to allow any excess material to settle prior to raising the bucket through the water column;
 - Hoisting the bucket very slowly;
 - Pausing the bucket at the water surface to minimize the freefall distance of water discharging from the bucket.
 - Slam opening the bucket over the materials barge after material is dumped to dislodge any additional material potentially clinging to the bucket;
 - Ensure that all material has dumped from the bucket onto the materials barge prior to resuming dredging;
 - Removing material from the water with each bucket closure (not dumping partial or full buckets of material into the water).
- McAmis and/or its dredge operators will conduct periodic progress surveys to verify sediment is being dredged to prescribed lines, grades and tolerances.
- McAmis and/or its dredge operators will visually monitor each dredged material load during transit to the sand storage area at the UMSF to verify that dredged material is not incidentally released in transit.
- McAmis will use support vessels during all in-water activities. Support vessels will be equipped with containment booms and sorbent pads to immediately contain and/or absorb debris and sheen.
- Dredging outside the FNC will only commence in authorized areas immediately adjacent, and never above -25 feet Columbia River Datum.

We considered whether or not the proposed action would cause any other activities and determined that 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 dredging will occur in four distinct reaches of the lower Columbia River (Figure 1.) Reach 1 is located between river mile (RM) 14 and 22, near Astoria, Oregon in Clatsop County. Reach 2 is located between RM 32 and 36, adjacent to Welsh Island in Wahkiakum County Washington. Reach 3 is located between RM 66 and 76 near the Lewis and Clark Bridge between Cowlitz County, Washington, and Columbia County, Oregon. Reach 4 is located between RM 100 and 106.5 near the Interstate 5 Bridge between Clark County, Washington and Multnomah County, Oregon. These reaches were identified by USACE during routine soundings used to identify shoaling areas. All the dredged material will be stored at the McAmis UMSF in Longview, Washington in Cowlitz County. The action area is within designated critical habitat for 15 ESA listed fish species and EFH for Pacific salmonids. All reaches include critical habitat for salmonids and eulachon, only reaches 1 and 2 include critical habitat for green sturgeon.



Figure 1. Map depicting the four dredging reaches and the sand storage area within the lower Columbia River. Map courtesy of Maul Foster and Alongi, Inc.

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 rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.

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

2.2 Rangewide Status of the Species and Critical Habitat

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

2.2.1 Status of the 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 of that habitat 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 2, 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 (Sturdevant 1999), cumaceans (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.

Physical and Biological Features of Green Sturgeon Critical Habitat

NMFS designated critical habitat for the southern DPS of Green sturgeon on October 09, 2009 (74 FR 52300). Specific PBFs, and the essential features associated with the PBFs for Green sturgeon designated in 2009 include:

1. Freshwater riverine systems which provide food resources, and water quality including depth and flow for embryo, larval and juvenile growth and development. Adult spawning requires appropriate substrate and sediment quality, in addition to migratory corridors free of obstruction.
2. Estuarine areas which provide food resources, migratory corridors, and appropriate water and sediment quality, flow and depth to support growth of juvenile, sub-adult, and sexually mature green sturgeon.
3. Coastal marine areas with adequate food resources are necessary for sub-adult and sexually mature green sturgeon growth. These areas also provide migratory corridors with appropriate water quality to spawning streams.

Table 2. 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

Species	Designation Date and FR Citation	Critical Habitat Status Summary
		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.
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

Species	Designation Date and FR Citation	Critical Habitat Status Summary
		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.
Southern DPS of green sturgeon	10/09/09 74 FR 52300	Critical habitat has been designated in coastal U.S. marine waters within 60 fathoms depth from Monterey Bay, California (including Monterey Bay), north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to its United States boundary; the Sacramento River, lower Feather River, and lower Yuba River in California; the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays in California; tidally influenced areas of the Columbia River estuary from the mouth upstream to river mile 46; and certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor), including, but not limited to, areas upstream to the head of tide in various streams that drain into the bays, as listed in Table 1 in USDC (2009). The CHRT identified several activities that threaten the PBFs in coastal bays and estuaries and necessitate the need for special management considerations or protection. The application of pesticides is likely to adversely affect prey resources and water quality within the bays and estuaries, as well as the growth and reproductive health of Southern DPS green sturgeon through bioaccumulation. Other activities of concern include those that disturb bottom substrates, adversely affect prey resources, or degrade water quality through re-suspension of contaminated sediments. Of particular concern are activities that affect prey resources. Prey resources are affected by: commercial shipping and activities generating point source pollution and non-point source pollution that discharge contaminants and result in bioaccumulation of contaminants in green sturgeon; disposal of dredged materials that bury prey resources; and bottom trawl fisheries that disturb the bottom (but result in beneficial or adverse effects on prey resources for green sturgeon).
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

Species	Designation Date and FR Citation	Critical Habitat Status Summary
		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 3, 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 3. 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	NWFS 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.	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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 except 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.	<ul style="list-style-type: none"> • 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	<p>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.</p>	<ul style="list-style-type: none"> • 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	<p>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.</p>	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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	<p>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</p>	<ul style="list-style-type: none"> • 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
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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 due 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.	<ul style="list-style-type: none"> • 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	<p>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.</p>	<ul style="list-style-type: none"> • 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	<p>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.</p>	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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	<p>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.</p>	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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).

The action area is located within four distinct reaches of the lower Columbia River, and so is influenced by water quality and prey community impacts associated with all upstream uses. 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 dams, pollution, municipal and industrial water use, introduced species, hatchery production (NMFS 2013), and climate change as described in section 2.2 above.

Habitat Conditions in the Action Area

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).

In addition, the environmental baseline includes the impacts from deep-water dredging to maintain the FNC for large commercial vessel traffic and shallow water dredging to maintain marinas for recreational vessels. Therefore, dredging activities occur across numerous areas and microhabitats within the Lower Columbia River including sloughs area, secondary channels, sloughs, and floodplain wetlands. All of these habitat areas provide rearing space 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. 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).

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 outmigrants. 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 will 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.

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).

Effects of the proposed action are reasonably certain to include: 1) annual temporary, localized reduction in water quality; 2) annual temporary, localized reduction in available prey; and 3) annual, temporary, localized obstruction to safe passage. These changes in the environment will affect several PBFs of critical habitat, and the species that are present when these effects occur.

2.5.1 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. 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. The magnitude of effects to PBFs will vary temporally, spatially, and by taxa.

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.

Water Quality and Safe Migration

The proposed action temporarily degrade water quality (due to turbidity) within the Columbia River each year in which dredging occurs, up to one third of the year. Dredging will also temporarily obstruct or decrease safe passage, in a small area immediately around the clamshell bucket, during the November 1 to February 28 IWWW. Passage conditions outside of the immediate area where the dredge equipment is operating will also be made less safe by the elevated turbidity, though the majority of turbidity produced by the clamshell dredge is expected to remain localized in proximity to the active clamshell bucket, based on the materials likely to be disturbed. Due to the coarseness of the predominant sediments being suspended by the dredge 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. Based on the timing of this work, the migration value is diminished for some species, but not others, based on co-occurrence of migration behavior with the anticipated turbid conditions. We evaluate this in more detail below in the section on species effects.

Prey Base and Substrate

The proposed action will temporarily reduce food availability in a limited area near the periphery of the FNC, but available forage from littoral sources in the immediate area outside of the active dredging site will remain plentiful. Benthic invertebrates provide the primary food source for these juvenile salmonids – dominated by families of midges (Johnson *et al.* 2011). The aquatic invertebrates occupy the upper surface of the river bottom with a life cycle of many weeks to months before emerging into the water column. The proposed dredging operation will disturb benthic habitat by removing layers of sediment, and thus reduce benthic productivity. Recolonization of the benthic habitat by invertebrates is generally rapid for some macroinvertebrates – within weeks to months (McCabe *et al.* 1998), but is dependent upon the frequency of the dredging disturbance, the duration of the disruption at the site, and the availability of upstream benthic communities to serve reseeding of the disrupted area. The disruption will occur for the four months of dredging, and areas dredged should begin to recolonize with new benthic communities once dredging has ceased, though the full abundance and complexity of prey communities may not be fully re-established. Recolonization by benthic invertebrates in the Columbia River is expected to occur in approximately one month. More significant loss of forage will occur where the frequency and duration of the dredging delays natural recolonization. The decline in available prey base then, can be anticipated for up to 5 months in each year in which dredging occurs for 10 years.

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 adult migration corridors within the Columbia River, but will temporarily obstruct or decrease safe passage, in a small area immediately around clamshell bucket, during the November 1 to February 28 IWWW due to

elevated turbidity, and a risk of entrainment (eggs/larvae only). Additionally, the proposed action will not alter spawning substrate that eulachon rely because adult eulachon don't spawn in this section of the LCR as they typically favor large tributaries (i.e., Sandy River, Washougal River).

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).

2.5.2 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, fourteen 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 very small proportion of the action area due to historical maintenance dredging of the Columbia River flow lane 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 4, 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), and their exposure to potential to entrainment by the dredge equipment 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 4). 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 120 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. 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.

Table 4. 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 DPS	Adult migr. & holding ^{1,2}												
	Adult spawning ²												
	Egg incubation ³												
	Larvae emigration												
Green Sturgeon													
Southern DPS	Juvenile rearing												
Salmon: Chinook													
Lower Columbia	Adult migr. & holding												
	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Upper Columbia	Adult migr. & holding												
	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Upper Willamette	Adult migr. & holding												
	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Snake River - Spring/Summer	Adult migr. & holding												
	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												
Snake River - Fall	Adult migr. & holding												
	Adult spawning												
	Eggs & pre-emergence												
	Juvenile rearing												
	Juvenile emigration												

Species	Life Stage	=present		= relatively abundant						= peak occurrence				
		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 Columbia	Adult migration. & holding													
	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 Columbia	Adult migration. & holding													
	Adult spawning													
	Eggs & pre-emergence													
	Juvenile rearing													
	Juvenile emigration													
Middle Columbia	Adult migration. & holding													
	Adult spawning													
	Eggs & pre-emergence													
	Juvenile rearing													
	Juvenile emigration													
Upper Columbia	Adult migration. & holding													
	Adult spawning													
	Eggs & pre-emergence													
	Juvenile rearing													
	Juvenile emigration													
Upper Columbia	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).																

Salmonid Exposure and Response

Exposure and response are predicated upon presence of individuals contemporaneously with the project or its 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 fall¹.

Based on the broad run timing of these species, and the proposed work period of November 1 – February 28, 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

Exposure and Response to Dredging Equipment Operation: 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 the habitat effects from 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).

Exposure to the habitat disruptions and the clamshell dredge are likely to be limited because of the size of the migration corridor in this area. The Lower Columbia River to the Bonneville Dam is a large body of water with a human infrastructure posing migratory obstacles largely located along the shoreline margins of the river, and episodes of high water temperatures that can occur during late summer, outside of the proposed work period. Thus, 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 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 exposed to dredging equipment during dredge operations. Even if adult salmon were near dredging equipment, the operation of equipment used for the collection of dredged material has minimal risk to adult salmonids because of their strong swimming ability which allows for avoidance of entrainment by clamshell buckets. Therefore, we anticipate adult salmonids will pass through the action area without experiencing adverse effects of entrainment.

¹ From passage data at Bonneville Dam 10-year average, http://www.cbr.washington.edu/dart/adult_hrt.html

Exposure and Response to Turbid Conditions: 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 in the FNC 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 salmon 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 (Sedell *et al.* 1990).

Given that adult salmonid migration rates range up to a few miles per hour (Matter and Sandford, 2003), we expect adult ESA-listed salmonids 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, again reducing the likelihood 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 adults 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.

Juvenile salmonid presence. Dredging of the proposed FNC sites from November to February overlaps when juvenile salmonids are present. 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 depending on species and life history. The migration rate 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 sub-yearlings 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 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.

Exposure and Response to Equipment Operation: 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 dredging². 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 Turbid Conditions: 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.

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

² 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; Table S4). 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).

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).

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.

Exposure and Response to Reduced Benthic Prey: 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. 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. Because disturbance to the benthos will be localized 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 fish to not have noticeably diminished growth or fitness. The limited and localized loss of prey is not likely to reduce available forage for rearing salmonids in sufficient degree to have an impact on juvenile fish survival. 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. Also, the community of benthic invertebrates in the deeper (greater than 20 feet), more dynamic areas are more evolved to handle natural disturbance regimes of faster flows and dynamic coarse grain sediment redistribution, and are expected to recolonize within weeks of the completed dredge. 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, growth, or fitness as a result of the proposed action.

Green Sturgeon and Eulachon Exposure and Response

Green Sturgeon. Few, if any, green sturgeon are likely to be present within the action area during the period in which the action is proposed because they are not 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 therefore 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 be able to avoid the clamshell dredge without adverse effects from entrainment. Notwithstanding, 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). Thus, 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).

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 lifestages are present with relatively high abundance, and peak adult abundance in the month of February.

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 February, 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.

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. 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 4-month 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 within the FNC 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 dredging operation (entrainment and elevated turbidity), plus a short-term (*weeks - months*) 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 120-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 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 quality 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.

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, and incidental take in the form of harm from localized increased turbidity 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, and temporary reductions in forage each year for 10 years.

Due to the overall nature of the proposed action, 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 clamshell dredge is in operation, and the timing of the dredge operation. Since the potential for ESA listed fish to be entrained, exposed to elevated turbidity, and experience reduced foraging opportunities 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 up to 120 days of dredging per calendar year for 10 years during the November 1 to February IWWW.

Dredging operations that exceed 120 days or are outside of IWWW will increase the likelihood of more listed individuals being exposed to the effects of the action described above. The number of days of dredging per year, and dredging outside of the IWWW are each a threshold for reinitiating consultation. Exceeding this indicator for extent of take will trigger the reinitiation provisions of this opinion.

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 by minimizing turbidity; and
3. 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 McAmis must comply with them in order to implement the RPMs (50 CFR 402.14). The USACE or McAmis 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 reasonable and prudent measure 1, minimize entrainment during dredging:

1a. The applicant McAmis 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 reasonable and prudent measure 2, minimize turbidity during dredge disposal:

2a. The applicant, McAmis, shall ensure turbidity remains at background levels downstream 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.

2b. 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 November 1 –February 28.

The following terms and conditions implement reasonable and prudent measure 3, monitoring and reporting:

3a. 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.

3b. Monitoring reports shall be submitted to:

- i. projectsreports.wcr@noaa.gov
- ii. Include WCRO-2020-00988 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 Reinitiation of Consultation

This concludes formal consultation for McAmis Lower Columbia 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-STEVENSON 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 dredging will temporarily diminish water quality, disturb benthic habitat and create turbidity 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 diminishment 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 dredging activity will be contained and turbidity minimized by use of the clamshell dredge and monitoring and controlling discharge of return waters at the material collection site. 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.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, approximately 40 acres of designated EFH and HAPC 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)).

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

portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

The 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(1)).

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are USACE. Other interested users could include McAmis, and their agent Maul Fosher and Alongi, Inc. 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.

4.2 Integrity

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

4.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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