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

Refer to NMFS No:
WCRO-2022-01368

September 26, 2022

William Abadie
Chief, Regulatory Branch
Department of the Army
U.S. Army Corps of Engineers, Portland District
P.O. Box 2946
Portland, Oregon 97208-2946

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Hyak Tongue Point Mobile Boat Lift Project, near Astoria, Oregon. 6th field HUC 1708000605000, Bear Creek-Frontal Columbia River (NWP-2022-125)

Dear Mr. Abadie:

Thank you for your letter of June 6, 2022, 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 Hyak Tongue Point Mobile Boat lift.

NMFS also reviewed the likely effects of the proposed action on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)) and concluded that the action would adversely affect the EFH of Pacific Coast Salmon, Groundfish and Coastal Pelagic species. Therefore, we have included the results of that review in Section 3 of this document.

NMFS concluded that the proposed action is not likely to jeopardize the continued existence or recovery of or adversely modify the critical habitat of:

1. Chinook salmon (*Oncorhynchus tshawytscha*)
    a. Lower Columbia River Chinook
    b. Upper Willamette River Chinook
    c. Upper Columbia River spring-run Chinook
    d. Snake River spring-run Chinook
    e. Snake River fall-run Chinook
2. Columbia River chum salmon (*Oncorhynchus keta*)
3. Lower Columbia River coho salmon (*Oncorhynchus kisutch*)
4. Snake River sockeye salmon (*Oncorhynchus nerka*)
5. Steelhead (*Oncorhynchus mykiss*)
    a. Lower Columbia River steelhead
    b. Upper Willamette River steelhead
    c. Middle Columbia River steelhead
    d. Upper Columbia River steelhead
    e. Snake River Basin steelhead

NMFS concluded that the proposed action is not likely to adversely affect the following species or their designated critical habitat:

1. North American green sturgeon (*Acipenser medirostris*)
2. Eulachon (*Thaleichthys pacificus*)

Please contact Scott Anderson at Scott.Anderson@noaa.gov, or 306-528-0864 if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Kim W. Kratz. PhD
Assistant Regional Administrator
Oregon Washington Coastal Office

cc: Brad Johnson

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

Hyak Tongue Point Mobile Boat Lift Project (NWP-2022-125)

NMFS Consultation Number: WCRO-2022-01368

Action Agency: U.S. Army Corps of Engineers

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Lower Columbia River Chinook Salmon (*Oncorhynchus tshawytscha*)	T	Yes	No	Yes	No
Upper Willamette River Chinook	T	Yes	No	Yes	No
Upper Columbia River Spring-run Chinook	E	Yes	No	Yes	No
Snake River Spring/Summerrun Chinook	T	Yes	No	Yes	No
Snake River Fall-run Chinook	T	Yes	No	Yes	No
Columbia River Chum Salmon (O. keta)	T	Yes	No	Yes	No
Lower Columbia River coho (*O. kisutch*)	T	Yes	No	Yes	No
Snake River Sockeye (*O. nerka*)	E	Yes	No	Yes	No
Lower Columbia River steelhead (*O. mykiss*)	T	Yes	No	Yes	No
Upper Willamette River steelhead	T	Yes	No	Yes	No
Middle Columbia River steelhead	T	Yes	No	Yes	No
Upper Columbia River steelhead	T	Yes	No	Yes	No
Snake River Basin steelhead	T	Yes	No	Yes	No
Green Sturgeon *Acipenser medirostris*)	T	No	N/A	No	N/A
Eulachon (*Thaleichthys pacificus)*	T	No	N/A	No	N/A

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
Coastal Pelagic Species	Yes	Yes
Groundfish	Yes	Yes

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

Issued By:

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

Date: September 26, 2022

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1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3, below.

1.1. Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), and implementing regulations at 50 CFR part 402.

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

1.2. Consultation History

The proposed action is the Hyak Tongue Point Mobile Boat lift (Boat Lift) overwater structure (OWS) in the Columbia River estuary. The proposed boat lift construction actions affect all salmon and steelhead listed above and their critical habitat.

There was no pre-consultation for this project. NMFS received request for formal Section 7 and EFH consultation along with a memorandum for the service and a biological assessment (BA) on June 6, 2022.

On July 5, 2022, the United States District Court for the Northern District of California issued an order vacating the 2019 regulations adopting changes to 50 CFR part 402 (84 FR 44976, August 27, 2019). This consultation was initiated when the 2019 regulations were still in effect. As reflected in this document, we are now applying the section 7 regulations that governed prior to adoption of the 2019 regulations. For purposes of this consultation, we considered whether the substantive analysis and its conclusions regarding the effects of the proposed actions articulated in the biological opinion and incidental take statement would be any different under the 2019 regulations. We have determined that our analysis and conclusions would not be any different.

1.3. Proposed Federal Action

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

The United States Army Corps of Engineers (USACE) proposes to issue a permit under Section 10 of the Rivers and Harbors Act to the Hyak Tongue Point LLC to construct a mobile boat lift.

Installation of the new mobile lift will require construction of two, 230-foot-long, concrete finger piers, and an upland, "open cell" sheet pile (OCSP) bulkhead to support the mobile lift. The project will also include the removal of 185 linear feet of an existing, southernmost pier at Tongue Point as mitigation for installation of the new in-water/overwater structures

All work conducted below the highest measured tide (HMT) of the Columbia River will occur during the Oregon Department of Fish and Wildlife (ODFW)-preferred in-water work window (IWWW) for the lower Columbia River (November 1 – February 28). The proposed project will require approximately 8 to 10 weeks of in-water work.

All heavy equipment (i.e., crane and excavator) will access the project site via existing roadways, parking areas, previously disturbed upland areas, and floating barges. Staging of construction materials, equipment storage, and fueling will occur within the existing upland parking areas and work pad. No trees or riparian vegetation will be removed.

Finger Pier Construction
The two new finger piers will each be 230-feet long by 12-feet wide, and will consist of cast-in place concrete, supported by steel I-beams (girders) sitting on top of 48, 30-inch diameter steel pilings reinforced with steel cross-bracing. Two 24-inch diameter steel fender pilings will also be placed at the terminus of each pier. Piling installation will be conducted from the shoreline and from a barge using a crane or excavator for placing the steel pilings and support structures. The piles will be installed using a vibratory hammer, and limited use of an impact hammer to seat the piles to their desired depth. The 30-inch piles (60 feet in length) will be seated approximately 45 feet into the substrate, while the 24-inch fender piles will be seated approximately 35 feet into the substrate. Any pilings that cannot be fully embedded with use of a vibratory hammer may require an average of 5 to 15 minutes of impact hammer use, at an average rate of 40 strikes per minute. It is estimated that the average installation rate will be five pilings per day, with up to 200 to 600 strikes per piling (if needed).

The contractor will initiate daily "soft-start" procedures to provide a warning and/or give marine mammals in the vicinity a chance to leave the area prior to use of a vibratory or impact driver at full capacity, thereby minimizing exposure of animals to loud underwater and airborne sounds.

All concrete work will occur above the HMT and will be poured over a pan deck, with tongue and groove falsework under the cantilevered portion of the pier. Any gaps in the falsework seams will be sealed to prevent "green" concrete from entering the water below. The two finger piers will sit level with the existing upland work pad at approximately 15 feet mean lower low water (MLLW). Steel cross bracing between the two sets of pilings for each finger pier will be also be installed.

Motorized Travel Lift

The motorized travel life will consist of an open, steel-framed structure supported at four corners by a set of motorized wheels. The lift will be assembled on the upland work pad, and will simply roll out onto the new finger piers where it can lower motorized cables and straps suspended from the steel framing to lift vessels out of the water, and then carry/roll them back to the upland work pad for repair.

OCSP Bulkhead Construction

An approximately 125-foot long OCSP bulkhead will be installed approximately 6 feet behind the existing HMT/shoreline to provide the needed reinforcement and stability to support the weight of the mobile lift as it travels from the finger piers to the upland work pad. The bulkhead will be comprised of a series of four sheet pile "open cells" that will be backfilled with native soils and gravel, and then compacted and covered with concrete surfacing. The bulkhead construction will be conducted using an excavator and vibratory hammer attachment operating from the upland shoreline. Following installation of the bulkhead, approximately 120 linear of feet of existing riprap located along the immediate shoreline will be removed down to the mudline to maximize water depth for removing vessels. Excavated riprap will be placed in a temporary, upland stockpile location to be either hauled to an upland disposal location or be reused in an upland area on site. The new concrete surface of the bulkhead and existing upland work pad will be graded to capture and treat all stormwater and potential pollutants in accordance with the existing Oregon DEQ 1200-Z permit for Hyak Tongue Point, LLC.

Pier Removal

Construction of the proposed new finger piers will result in approximately 5,520 square feet of new overwater structure. To offset impacts from new overwater structure, approximately 185 linear feet of an existing 30-foot wide, concrete pier located just south of the project site will be removed. The existing 185-foot-long segment of pier is constructed of concrete decking supported on steel H-pilings, with a series of 14-inch diameter wood fender pilings along the sides. Removal of the 185-foot-long segment of pier would result in removal of 5,550 square feet of existing overwater concrete structure, 45 steel H-pilings, and 64 creosote-treated, wood fender piles. The proposed project will ultimately result in a permanent net removal of approximately 1,934 cubic yards of riprap from below the Highest Measured Tide (HMT) of the Columbia River, and 30 square feet of existing overwater structures associated with pier removal.

The concrete decking will be cut into manageable panels, lifted, and hauled to an upland location for disposal or recycling. The existing H piles and wood fender pilings will be dislodged with a vibratory hammer and slowly lifted from the sediment and placed into a contained area for appropriate upland disposal. It is anticipated that the voids left as fender pilings are removed will immediately fill in with native sediments due to vibration. Following demolition, six 16-inch diameter steel pilings will be installed at the new pier terminus. The contractor will implement appropriate sound attenuation methods (i.e., soft start procedures and use of a bubble curtain) as outlined in the Measures to Minimize Impacts (below). No dredging or excavation will be required.

All work conducted below the HMT will occur during the ODFW-preferred IWWW for the lower Columbia River estuary (November 1 – February 28), a period when ESA-listed species are less likely to be present within the vicinity of the project area.

- All heavy equipment (i.e., crane) will access the project site via existing concrete pad and/or floating barges.

- All new pilings will be installed with a vibratory hammer. In the event that the vibratory hammer cannot fully embed the piles to the necessary depth, the contractor will use an impact hammer to seat the piles. Use of an impact hammer will be limited to daylight hours between 7 a.m. and 7 p.m.

- The contractor will initiate daily "soft-start" procedures to provide a warning and/or give species near piling installation activities a chance to leave the area prior to a vibratory hammer (or impact driver) operating at full capacity, thereby exposing fewer species to loud, underwater and airborne sounds.
    - A soft-start procedure will be used at the beginning of in-water piling removal and installation, or any time piling removal/installation has ceased for more than 30 minutes to provide a warning and/or give species near piling removal and installation activities a chance to leave the area prior to a vibratory hammer or impact driver operating at full capacity, thereby exposing fewer species to loud underwater and airborne sounds.
    - For vibratory hammer operation, the contractor will initiate use for 15 seconds at reduced energy followed by a 30-second waiting period. The procedure shall be repeated two additional times.
    - For impact pile driving (if necessary), the contractor will provide an initial set of strikes from the impact hammer at reduced energy, followed by a 30-second waiting period, then two subsequent sets. (The reduced energy of an individual hammer cannot be quantified given the variations between individual drivers. In addition, the number of strikes will vary at reduced energy given that raising the hammer at less than full power and then releasing it results in the hammer bouncing as it strikes the pile, resulting in multiple strikes).

- During the use of an impact hammer a multi-level bubble curtain will be installed to reduce sound pressure levels. The bubble curtain system shall conform to the following:
    - If water velocity is greater than 1.6 feet per second, surround the piling being driven by a confined bubble curtain (e.g., a bubble ring surrounded by a fabric or non-metallic sleeve) that will distribute air bubbles around 100% of the piling perimeter for the full depth of the water column. Bubblers shall completely surround the pile.
    - Piling shall be completely engulfed in bubbles over the full depth of the water column at all times when an impact pile driver is in use. Bubbles are not required during vibratory pile driving.

- A Pollution Control Plan (PCP) will be prepared by the contractor and carried out commensurate with the scope of the project that includes the following:
    - Best Management Practices to confine, remove, and dispose of construction waste.
    - Procedures to contain and control a spill of any hazardous material.

- All conditions of Oregon Department of Environmental Quality's (ODEQ's) 401 Water Quality Certification will be followed.

- All equipment will be inspected daily for fluid leaks. Any leaks detected will be repaired before operation is resumed. Stationary power equipment (i.e., cranes) operated within 150 feet of the river will be diapered to prevent leaks.

- All old pilings will be removed with a vibratory hammer. During piling removal the following criteria will be implemented to minimize creosote release, sediment disturbance and sediment resuspension:
    - Install a floating surface boom to capture floating surface debris.
    - Consider the best tidal condition for piling removal, try to remove in-the-dry.
    - Keep all equipment (e.g., bucket, cable, vibratory hammer) out of the water, grip piles above the waterline, and complete work during low water and low current conditions.
    - Dislodge piling with a vibratory hammer, when possible; never intentionally break a pile.
    - "Wake" the piling by vibrating to break the friction bond between the piling and sediment.
    - Slowly lift the pile from the sediment and through the water column.
    - Place the pile in a containment basin on a barge deck, pier, or shoreline without attempting to clean or remove any adhering sediment.
    - Fill the holes left by each piling with clean, native sediments immediately upon removal.
    - Dispose of all removed piles, floating surface debris, any sediment spilled on work surfaces, and all containment supplies at a permitted upland disposal site.

- When a pile breaks or is intractable during removal, removal will continue as follows:
    - Every attempt short of excavation will be made to remove each piling, if a pile in uncontaminated sediment is intractable, breaks above the surface, or breaks below the surface, cut the pile or stump off at least 3 feet below the surface of the sediment.

- Mitigation will include removal of approximately 185 linear feet of an existing concrete pier.

"Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02). We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that constructing the boat lift sustains commercial and recreational vessel traffic and moorage. While maintenance dredging will be needed to allow for continued commercial and recreational vehicle usage, it is not considered a consequence of this proposed action for the purposes of this proposed action. This is because the Port, which includes Tongue Point, is applying for a USACE permit authorizing a 10-year dredging program. That project will undergo a separate ESA Section 7 consultation.

1.4. Action Area

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

The action area is bounded by the point in the water column up to 2,800 feet (858 meters) from the pile driver where sound from impact pile driving decreases below 150 decibels (root mean square) (dB_{RMS}). This is the threshold where the behavior of fish is no longer affected by noise. The action area is also bounded by the breakwater where it blocks sound pressure waves and their effects. The approximated action area is shown in Figure 1. Although the action area is a small part of the Columbia River estuary, the water flowing through the action area has background concentrations of pollutants (including metals) that are added to stressors from the proposed action and analyzed in Sections 2.4 and 2.5 take place within this action area. In this way the small action area encompasses all areas of the effects of the proposed action while acknowledging that the water in the action area has accumulated stressors from outside the action area as a baseline condition.

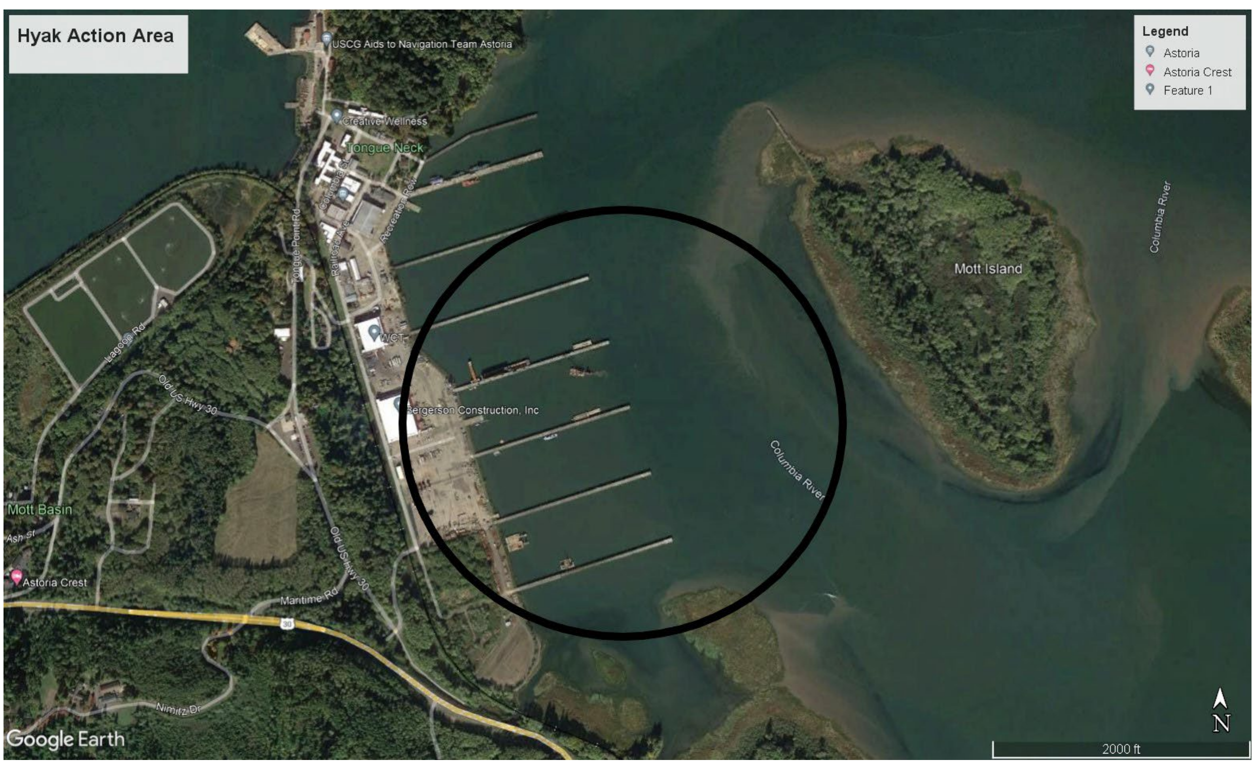

Figure 1. Hyak Tongue Point Mobile Boat Lift Approximate Action Area.

The action area is within designated critical habitat, providing migration and foraging conservation values for all salmon and steelhead listed in Table 1, below. The action area is also EFH for multiple species, including Pacific salmonids, and this is presented more fully in section 3 of this document.

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 for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214, February 11, 2016) The designation(s) of critical habitat for the species considered in this opinion 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.

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.
    - o Effects associated with the present and historical existence of the OWS are considered part of the environmental baseline.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
    - o NMFS based it analysis in part on biological opinions for similar projects, including NW Alloys Dock WCR-2015-00006 and WCR-2015-2157 Aldrich Point Dock Replacement; the NMFS spreadsheet model of pile driving noise and sound pressure levels (SPL); and the other books and technical papers listed in the reference section of this opinion.
    - o Because the proposed action meaningfully extends the life of the structure, future effects associated with the presence of the OWS are considered consequences of the proposed action.
- 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' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that conservation value.

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. Major ecological realignments are already occurring in response to climate change (IPCC WGII, 2022). Long-term trends in warming have continued at global, national and regional scales. Global surface temperatures in the last decade (2010s) were estimated to be 1.09 °C higher than the 1850-1900 baseline period, with larger increases over land ~1.6 °C compared to oceans ~0.88 (IPCC WGI, 2021). The vast majority of this warming has been attributed to anthropogenic releases of greenhouse gases (IPCC WGI, 2021). Globally, 2014-2018 were the 5 warmest years on record both on land and in the ocean (2018 was the 4th warmest) (NOAA NCEI 2022). Events such as the 2013-2016 marine heatwave (Jacox et al. 2018) have been attributed directly to anthropogenic warming in the annual special issue of Bulletin of the American Meteorological Society on extreme events (Herring et al. 2018). Global warming and anthropogenic loss of biodiversity represent profound threats to ecosystem functionality (IPCC WGII 2022). These two factors are often examined in isolation, but likely have interacting effects on ecosystem function.

Updated projections of climate change are similar to or greater than previous projections (IPCC WGI, 2021). NMFS is increasingly confident in our projections of changes to freshwater and marine systems because every year brings stronger validation of previous predictions in both physical and biological realms. Retaining and restoring habitat complexity, access to climate refuges (both flow and temperature) and improving growth opportunity in both freshwater and marine environments are strongly advocated in the recent literature (Siegel and Crozier 2020). Climate change is systemic, influencing freshwater, estuarine, and marine conditions. Other systems are also being influenced by changing climatic conditions. Literature reviews on the impacts of climate change on Pacific salmon (Crozier 2015, 2016, 2017, Crozier and Siegel 2018, Siegel and Crozier 2019, 2020) have collected hundreds of papers documenting the major themes relevant for salmon. Here we describe habitat changes relevant to Pacific salmon and steelhead, prior to describing how these changes result in the varied specific mechanisms impacting these species in subsequent sections.

Forests

Climate change will impact forests of the western U.S., which dominate the landscape of many watersheds in the region. Forests are already showing evidence of increased drought severity, forest fire, and insect outbreak (Halofsky et al. 2020). Additionally, climate change will affect tree reproduction, growth, and phenology, which will lead to spatial shifts in vegetation. Halofsky et al. (2018) projected that the largest changes will occur at low- and high-elevation forests, with expansion of low-elevation dry forests and diminishing high-elevation cold forests and subalpine habitats.

Forest fires affect salmon streams by altering sediment load, channel structure, and stream temperature through the removal of canopy. Holden et al. (2018) examined environmental factors contributing to observed increases in the extent of forest fires throughout the western U.S. They found strong correlations between the number of dry-season rainy days and the annual extent of forest fires, as well as a significant decline in the number of dry-season rainy days over the study period (1984-2015). Consequently, predicted decreases in dry-season precipitation, combined with increases in air temperature, will likely contribute to the existing trend toward more extensive and severe forest fires and the continued expansion of fires into higher elevation and wetter forests (Alizedeh 2021).

Agne et al. (2018) reviewed literature on insect outbreaks and other pathogens affecting coastal Douglas-fir forests in the Pacific Northwest and examined how future climate change may influence disturbance ecology. They suggest that Douglas-fir beetle and black stain root disease could become more prevalent with climate change, while other pathogens will be more affected by management practices. Agne et al. (2018) also suggested that due to complex interacting effects of disturbance and disease, climate impacts will differ by region and forest type.

Freshwater Environments

The following is excerpted from Siegel and Crozier (2019), who present a review of recent scientific literature evaluating effects of climate change, describing the projected impacts of climate change on instream flows:

Cooper et al. (2018) examined whether the magnitude of low river flows in the western U.S., which generally occur in September or October, are driven more by summer conditions or the prior winter's precipitation. They found that while low flows were more sensitive to summer evaporative demand than to winter precipitation, interannual variability in winter precipitation was greater. Malek et al. (2018), predicted that summer evapotranspiration is likely to increase in conjunction with declines in snowpack and increased variability in winter precipitation. Their results suggest that low summer flows are likely to become lower, more variable, and less predictable.

The effect of climate change on ground water availability is likely to be uneven. Sridhar et al. (2018) coupled a surface-flow model with a ground-flow model to improve predictions of surface water availability with climate change in the Snake River Basin. Projections using RCP 4.5 and 8.5 emission scenarios suggested an increase in water table heights in downstream areas of the basin and a decrease in upstream areas.

As cited in Siegel and Crozier (2019), Isaak et al. (2018), examined recent trends in stream temperature across the Western U.S. using a large regional dataset. Stream warming trends paralleled changes in air temperature and were pervasive during the low-water warm seasons of 1996-2015 (0.18-0.35°C/decade) and 1976-2015 (0.14-0.27°C/decade). Their results show how continued warming will likely affect the cumulative temperature exposure of migrating sockeye salmon *O. nerka* and the availability of suitable habitat for brown trout *Salmo trutta* and rainbow trout *O. mykiss*. Isaak et al. (2018) concluded that most stream habitats will likely remain suitable for salmonids in the near future, with some becoming too warm. However, in cases where habitat access is currently restricted by dams and other barriers salmon and steelhead will be confined to downstream reaches typically most at risk of rising temperatures unless passage is restored (FitzGerald et al. 2020, Myers et al. 2018).

Streams with intact riparian corridors and that lie in mountainous terrain are likely to be more resilient to changes in air temperature. These areas may provide refuge from climate change for a number of species, including Pacific salmon. Krosby et al. (2018), identified potential stream refugia throughout the Pacific Northwest based on a suite of features thought to reflect the ability of streams to serve as such refuges. Analyzed features include large temperature gradients, high canopy cover, large relative stream width, low exposure to solar radiation, and low levels of human modification. They created an index of refuge potential for all streams in the region, with mountain area streams scoring highest. Flat lowland areas, which commonly contain migration corridors, were generally scored lowest, and thus were prioritized for conservation and restoration. However, forest fires can increase stream temperatures dramatically in short time-spans by removing riparian cover (Koontz et al. 2018), and streams that lose their snowpack with climate change may see the largest increases in stream temperature due to the removal of temperature buffering (Yan et al. 2021). These processes may threaten some habitats that are currently considered refugia.

Marine and Estuarine Environments

Along with warming stream temperatures and concerns about sufficient groundwater to recharge streams, a recent study projects nearly complete loss of existing tidal wetlands along the U.S. West Coast, due to sea level rise (Thorne et al. 2018). California and Oregon showed the greatest threat to tidal wetlands (100%), while 68% of Washington tidal wetlands are expected to be submerged. Coastal development and steep topography prevent horizontal migration of most wetlands, causing the net contraction of this crucial habitat.

Rising ocean temperatures, stratification, ocean acidity, hypoxia, algal toxins, and other oceanographic processes will alter the composition and abundance of a vast array of oceanic species. In particular, there will be dramatic changes in both predators and prey of Pacific salmon, salmon life history traits and relative abundance. Siegel and Crozier (2019) observe that changes in marine temperature are likely to have a number of physiological consequences on fishes themselves. For example, in a study of small planktivorous fish, Gliwicz et al. (2018) found that higher ambient temperatures increased the distance at which fish reacted to prey. Numerous fish species (including many tuna and sharks) demonstrate regional endothermy, which in many cases augments eyesight by warming the retinas. However, Gliwicz et al. (2018) suggest that ambient temperatures can have a similar effect on fish that do not demonstrate this trait. Climate change is likely to reduce the availability of biologically essential omega-3 fatty acids produced by phytoplankton in marine ecosystems. Loss of these lipids may induce cascading trophic effects, with distinct impacts on different species depending on compensatory mechanisms (Gourtay et al. 2018). Reproduction rates of many marine fish species are also likely to be altered with temperature (Veilleux et al. 2018). The ecological consequences of these effects and their interactions add complexity to predictions of climate change impacts in marine ecosystems.

Perhaps the most dramatic change in physical ocean conditions will occur through ocean acidification and deoxygenation. It is unclear how sensitive salmon and steelhead might be to the direct effects of ocean acidification because of their tolerance of a wide pH range in freshwater (although see Ou et al. 2015 and Williams et al. 2019), however, impacts of ocean acidification and hypoxia on sensitive species (e.g., plankton, crabs, rockfish, groundfish) will likely affect salmon indirectly through their interactions as predators and prey. Similarly, increasing frequency and duration of harmful algal blooms may affect salmon directly, depending on the toxin (e.g., saxitoxin vs domoic acid), but will also affect their predators (seabirds and mammals). The full effects of these ecosystem dynamics are not known but will be complex. Within the historical range of climate variability, less suitable conditions for salmonids (e.g., warmer temperatures, lower streamflows) have been associated with detectable declines in many of these listed units, highlighting how sensitive they are to climate drivers (Ford 2022, Lindley et al. 2009, Williams et al. 2016, Ward et al. 2015). In some cases, the combined and potentially additive effects of poorer climate conditions for fish and intense anthropogenic impacts caused the population declines that led to these population groups being listed under the ESA (Crozier et al. 2019).

Climate change effects on salmon and steelhead

In freshwater, year-round increases in stream temperature and changes in flow will affect physiological, behavioral, and demographic processes in salmon, and change the species with which they interact. For example, as stream temperatures increase, many native salmonids face increased competition with more warm-water tolerant invasive species. Changing freshwater temperatures are likely to affect incubation and emergence timing for eggs, and in locations where the greatest warming occurs may affect egg survival, although several factors impact intergravel temperature and oxygen (e.g., groundwater influence) as well as sensitivity of eggs to thermal stress (Crozier et al. 2020). Changes in temperature and flow regimes may alter the amount of habitat and food available for juvenile rearing, and this in turn could lead to a restriction in the distribution of juveniles, further decreasing productivity through density dependence. For migrating adults, predicted changes in freshwater flows and temperatures will likely increase exposure to stressful temperatures for many salmon and steelhead populations, and alter migration travel times and increase thermal stress accumulation for ESUs or DPSs with early-returning (i.e. spring- and summer-run) phenotypes associated with longer freshwater holding times (Crozier et al. 2020, FitzGerald et al. 2020). Rising river temperatures increase the energetic cost of migration and the risk of *en route* or pre-spawning mortality of adults with long freshwater migrations, although populations of some ESA-listed salmon and steelhead may be able to make use of cool-water refuges and run-timing plasticity to reduce thermal exposure (Keefer et al. 2018, Barnett et al. 2020).

Marine survival of salmonids is affected by a complex array of factors including prey abundance, predator interactions, the physical condition of salmon within the marine environment, and carryover effects from the freshwater experience (Holsman et al. 2012, Burke et al. 2013). It is generally accepted that salmon marine survival is size-dependent, and thus larger and faster growing fish are more likely to survive (Gosselin et al. 2021). Furthermore, early arrival timing in the marine environment is generally considered advantageous for populations migrating through the Columbia River. However, the optimal day of arrival varies across years, depending on the seasonal development of productivity in the California Current, which affects prey available to salmon and the risk of predation (Chasco et al. 2021). Siegel and Crozier (2019) point out the concern that for some salmon populations, climate change may drive mismatches between juvenile arrival timing and prey availability in the marine environment. However, phenological diversity can contribute to metapopulation-level resilience by reducing the risk of a complete mismatch. Carr-Harris et al. (2018), explored phenological diversity of marine migration timing in relation to zooplankton prey for sockeye salmon *O. nerka* from the Skeena River of Canada. They found that sockeye migrated over a period of more than 50 days, and populations from higher elevation and further inland streams arrived in the estuary later, with different populations encountering distinct prey fields. Carr-Harris et al. (2018) recommended that managers maintain and augment such life-history diversity.

Synchrony between terrestrial and marine environmental conditions (e.g., coastal upwelling, precipitation and river discharge) has increased in spatial scale causing the highest levels of synchrony in the last 250 years (Black et al. 2018). A more synchronized climate combined with simplified habitats and reduced genetic diversity may be leading to more synchrony in the productivity of populations across the range of salmon (Braun et al. 2016). For example, salmon productivity (recruits/spawner) has also become more synchronized across Chinook populations from Oregon to the Yukon (Dorner et al. 2018, Kilduff et al. 2014). In addition, Chinook salmon have become smaller and younger at maturation across their range (Ohlberger 2018). Other Pacific salmon species (Stachura el al. 2014) and Atlantic salmon (Olmos et al. 2020) also have demonstrated synchrony in productivity across a broad latitudinal range.

At the individual scale, climate impacts on salmon in one life stage generally affect body size or timing in the next life stage and negative impacts can accumulate across multiple life stages (Healey 2011; Wainwright and Weitkamp 2013, Gosselin et al. 2021). Changes in winter precipitation will likely affect incubation and/or rearing stages of most populations. Changes in the intensity of cool season precipitation, snow accumulation, and runoff could influence migration cues for fall, winter and spring adult migrants, such as coho and steelhead. Egg survival rates may suffer from more intense flooding that scours or buries redds. Changes in hydrological regime, such as a shift from mostly snow to more rain, could drive changes in life history, potentially threatening diversity within an ESU (Beechie et al. 2006). Changes in summer temperature and flow will affect both juvenile and adult stages in some populations, especially those with yearling life histories and summer migration patterns (Crozier and Zabel 2006; Crozier et al. 2010, Crozier et al. 2019).

At the population level, the ability of organisms to genetically adapt to climate change depends on how much genetic variation currently exists within salmon populations, as well as how selection on multiple traits interact, and whether those traits are linked genetically. While genetic diversity may help populations respond to climate change, the remaining genetic diversity of many populations is highly reduced compared to historic levels. For example, Johnson et al. (2018), compared genetic variation in Chinook salmon from the Columbia River Basin between contemporary and ancient samples. A total of 84 samples determined to be Chinook salmon were collected from vertebrae found in ancient middens and compared to 379 contemporary samples. Results suggest a decline in genetic diversity, as demonstrated by a loss of mitochondrial haplotypes as well as reductions in haplotype and nucleotide diversity. Genetic losses in this comparison appeared larger for Chinook from the mid-Columbia than those from the Snake River Basin. In addition to other stressors, modified habitats and flow regimes may create unnatural selection pressures that reduce the diversity of functional behaviors (Sturrock et al. 2020). Managing to conserve and augment existing genetic diversity may be increasingly important with more extreme environmental change (Anderson et al. 2015), though the low levels of remaining diversity present challenges to this effort (Freshwater 2019). Salmon historically maintained relatively consistent returns across variation in annual weather through the portfolio effect (Schindler et al. 2015), in which different populations are sensitive to different climate drivers. Applying this concept to climate change, Anderson et al (2015) emphasized the additional need for populations with different physiological tolerances. Loss of the portfolio increases volatility in fisheries, as well as ecological systems, as demonstrated for Fraser River and Sacramento River stock complexes (Freshwater et al. 2019, Munsch et al. 2022).

2.2.1 Status of ESA-Listed Fish Species

For Pacific salmon, steelhead, and certain other species, we commonly use the four "viable salmonid population" (VSP) criteria (McElhany et al., 2000) to assess the viability of the populations that, together, constitute the species. These four criteria (spatial structure, diversity, abundance, and productivity) encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment.

"Spatial structure" refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. A population's spatial structure depends on habitat quality and spatial configuration, and the dynamics and dispersal characteristics of individuals in the population.

"Diversity" refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation in single genes to complex life history traits (McElhany et al., 2000).

"Abundance" generally refers to the number of naturally-produced adults (i.e., the progeny of naturally-spawning parents) in the natural environment (e.g., on spawning grounds).

"Productivity," as applied to viability factors, refers to the entire life cycle (i.e., the number of naturally-spawning adults produced per parent). When progeny replace or exceed the number of parents, a population is stable or increasing. When progeny fail to replace the number of parents, the population is declining. McElhany et al. (2000) use the terms "population growth rate" and "productivity" interchangeably when referring to production over the entire life cycle. They also refer to "trend in abundance," which is the manifestation of long-term population growth rate.

For species with multiple populations, once the biological status of a species' populations has been determined, we assess the status of the entire species using criteria for groups of populations, as described in recovery plans and guidance documents from technical recovery teams. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as metapopulations (McElhany et al., 2000).
The summaries that follow describe the status of the ESA-listed species, and their designated critical habitats, that occur within the geographic area of this proposed action and are considered in this opinion. More detailed information on the status and trends of these listed resources, and their biology and ecology, are in the listing regulations and critical habitat designations published in the Federal Register. Additional information (e.g., abundance estimates) that has become available since the latest status reviews and technical support documents also comprises the best scientific and commercial data available and has also been summarized in the following sections.

Table 1, 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), TRT (Technical Recovery Team), and VSP (Viable Salmonid Population).

Table 1. Status of Species Summaries and Limiting Factors

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	NMFS 2016; Ford 2022	This ESU comprises 32 independent populations. Relative to baseline VSP levels identified in the recovery plan (Dornbusch 2013), 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; Spring-run Chinook salmon populations in this ESU are generally unchanged; most of the populations are at a "high" or "very high" risk due to low abundances and the high proportion of hatchery-origin fish spawning naturally. Many of the populations in this ESU remain at "high risk," with low natural-origin abundance levels. Overall, we conclude that the viability of the Lower Columbia River Chinook salmon ESU has increased somewhat since 2016, although the ESU remains at "moderate" risk of extinction	• 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
Upper Columbia River spring-run Chinook salmon	Endangered 6/28/05	Upper Columbia Salmon Recovery Board 2007	NMFS 2016; Ford 2022	This ESU comprises four independent populations. Current estimates of natural-origin spawner abundance decreased substantially relative to the levels observed in the prior review for all three extant populations. Productivities also continued to be very low, and both abundance and productivity remained well below the viable thresholds called for in the Upper Columbia Salmon Recovery Plan for all three populations. Based on the information available for this review, the Upper Columbia River spring-run Chinook salmon ESU remains at high risk, with viability largely unchanged since 2016. .	• 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	NMFS 2016; Ford 2022	This ESU comprises 28 extant and four extirpated populations. There have been improvements in abundance/productivity in several populations relative to the time of listing, but the majority of populations experienced	• Degraded freshwater habitat • Effects related to the hydropower system in the mainstem Columbia River, • Altered flows and degraded water quality • Harvest-related effects

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
				sharp declines in abundance in the recent five-year period Overall, at this time we conclude that the Snake River spring/ summer-run Chinook salmon ESU continues to be at moderate-to-high risk.	• Predation
Upper Willamette River Chinook salmon	Threatened 6/28/05	NMFS 2011	NMFS 2016; Ford 2022	This ESU comprises seven populations. Abundance levels for all but Clackamas River DIP remain well below their recovery goals. Overall, there has likely been a declining trend in the viability of the Upper Willamette River Chinook salmon ESU since the last review. The magnitude of this change is not sufficient to suggest a change in risk category, however, so the Upper Willamette River Chinook salmon ESU remains at "moderate" risk of extinction.	• 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
Snake River fall-run Chinook salmon	Threatened 6/28/05	NMFS 2017b	NMFS 2016; Ford 2022	This ESU has one extant population 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 Complex (NMFS 2017b). The Snake River fall-run Chinook salmon ESU therefore is considered to be at a moderate-to-low risk of extinction.	• 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.
Columbia River chum salmon	Threatened 6/28/05	NMFS 2013	NMFS 2016; Ford 2022	This species has 17 populations divided into 3 MPGs. 3 populations exceed the recovery goals established in the recovery plan (Dornbusch 2013). The remaining populations have unknown abundances. Abundances for these populations are assumed to be at or near zero. The viability of this ESU is relatively unchanged since the	• 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

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
				last review (moderate to high risk), and the improvements in some populations do not warrant a change in risk category, especially given the uncertainty regarding climatic effects in the near future.	• 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	NMFS 2016; Ford 2022	Of the 24 populations that make up this ESUOnly six of the 23 populations for which we have data appear to be above their recovery goals. Overall abundance trends for the Lower Columbia River coho salmon ESU are generally negative. Natural spawner and total abundances have decreased in almost all DIPs, and Coastal and Gorge MPG populations are all at low levels, with significant numbers of hatchery-origin coho salmon on the spawning grounds. Improvements in spatial structure and diversity have been slight, and overshadowed by declines in abundance and productivity. For individual populations, the risk of extinction spans the full range, from “low” to “very high.” Overall, the Lower Columbia River coho salmon ESU remains at “moderate” risk, and viability is largely unchanged since 2016.	• 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
Snake River sockeye salmon	Endangered 6/28/05	NMFS 2015	NMFS 2016; Ford 2022	This single population ESU is at 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. Current climate change modeling supports the “extremely high risk” rating with the potential for extirpation in the near future (Crozier et al. 2020). The viability of the Snake River sockeye salmon ESU therefore has likely declined since the time of the prior review, and the extinction risk category remains “high.”	• 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	NMFS 2016; Ford 2022	This DPS comprises four independent populations. The most recent estimates (five year geometric mean) of total and natural-origin spawner abundance have declined since the last report, largely erasing gains observed over the past two decades for all four populations (Figure 12, Table 6). Recent declines are persistent and large enough to result in small, but negative 15-year trends in abundance for all four populations. The overall Upper Columbia River steelhead DPS viability remains largely unchanged from the prior review, and the DPS is at high risk driven by low abundance and productivity relative to viability objectives and diversity concerns.	• Adverse effects related to the mainstem Columbia River hydropower system • Impaired tributary fish passage • Degraded floodplain connectivity and function, channel structure and complexity, riparian areas, large woody debris recruitment, stream flow, and water quality • Hatchery-related effects • Predation and competition • Harvest-related effects
Lower Columbia River steelhead	Threatened 1/5/06	NMFS 2013	NMFS 2016; Ford 2022	This DPS comprises 23 historical populations, 17 winter-run populations and 6 summer-run populations. 10 are nominally at or above the goals set in the recovery plan (Dornbusch 2013); however, it should be noted that many of these abundance estimates do not distinguish between natural- and hatchery- origin spawners. The majority of winter-run steelhead DIPs in this DPS continue to persist at low abundance levels (hundreds of fish), with the exception of the Clackamas and Sandy River DIPs, which have abundances in the low 1,000s. Although the five-year geometric abundance means are near recovery plan goals for many populations, the recent trends are negative. Overall, the Lower Columbia River steelhead DPS is therefore considered to be at "moderate" risk.,	• 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
Upper Willamette River steelhead	Threatened 1/5/06	NMFS 2011	NMFS 2016; Ford 2022	This DPS has four demographically independent populations. Populations in this DPS have experienced long-term declines in spawner abundance. Although the recent magnitude of these declines is relatively moderate, continued declines would be a cause for concern. In the absence of substantial changes in accessibility to	• 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

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
				high-quality habitat, the DPS will remain at "moderate-to-high" risk. Overall, the Upper Willamette River steelhead DPS is therefore at "moderate-to-high" risk, with a declining viability trend.	• 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
Middle Columbia River steelhead	Threatened 1/5/06	NMFS 2009b	NMFS 2016; Ford 2022	This DPS comprises 17 extant populations. Recent (five-year) returns are declining across all populations, the declines are from relatively high returns in the previous five-to-ten year interval, so the longer-term risk metrics that are meant to buffer against short-period changes in abundance and productivity remain unchanged. The Middle Columbia River steelhead DPS does not currently meet the viability criteria described in the Middle Columbia River steelhead recovery plan.	• 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	NMFS 2016; Ford 2022	This DPS comprises 24 populations. Based on the updated viability information available for this review, all five MPGs are not meeting the specific objectives in the draft recovery plan, and the viability of many individual populations remains uncertain. Of particular note, the updated, population-level abundance estimates have made very clear the recent (last five years) sharp declines that are extremely worrisome, were they to continue.	• 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

2.2.2 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).

For most salmon and steelhead, NMFS' 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.

A summary of the status of critical habitats, considered in this opinion, is provided below.

Table 2. Status of critical habitat

Species	Designation Date and Federal Register 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 PBFs 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 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 PBFs 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.
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 PBFs 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 the lower Snake River and Columbia River has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Snake River fall-run Chinook salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers, and all tributaries of the Snake and Salmon rivers presently or historically accessible to this ESU (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams). Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality the lower Snake River and Columbia River 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 PBFs 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 PBFs 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 the lower Snake River and Columbia River has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
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 PBFs 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 PBFs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. Watersheds are in good to excellent condition with no potential for improvement only in the upper McKenzie River and its tributaries (NMFS 2005). We rated conservation value of HUC5 watersheds as high for 25 watersheds, medium for 6 watersheds, and low for 3 watersheds.
Middle Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 15 subbasins in Oregon and Washington containing 111 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PBFs 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.
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 PBFs 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.
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 the lower Snake River and Columbia River has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.

2.3. Environmental Baseline

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

The presence of the OWS in the baseline affects Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), Upper Willamette River (UWR) Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Snake River (SR) spring/summer-run Chinook salmon, SR fall-run Chinook salmon, Columbia River (CR) chum salmon (*O. keta*), LCR coho salmon (*O. kisutch*), SR sockeye salmon (*O. nerka*), LCR steelhead (*O. mykiss*), UWR steelhead, MCR Steelhead, UCR steelhead, and SR Basin steelhead, that migrate through and forage in the estuary. It also affects their respective critical habitats. The estuary is also EFH for Pacific Coast salmon, coastal pelagic species and groundfish.

2.4.1 ESA-Listed Species in the Action Area

The action area is in the Columbia River estuary which extends from the mouth of the Columbia River to Bonneville Dam. Columbia River estuary habitat is important to the survival of all Columbia Basin salmon and steelhead during rearing and migration because it provides the food-rich environment where they grow and transition to saltwater. Ocean-type fall Chinook and chum salmon spend weeks to months in the estuary and make use of shallow, vegetated habitats such as marshes and tidal swamps. Stream-type coho salmon, spring Chinook salmon, and steelhead spend less time in the estuary and use mostly deeper, main channel estuarine habitats.

2.4.2 Designated Critical Habitat in the Action Area

The action area contains designated critical habitat for all of the ESA-listed species considered in this opinion. More specifically, the action area provides migratory and rearing habitat for these listed species. The current baseline condition of the action area has been impacted by human activities both within and upstream of the action area, and is described in more detail below.

The amount and accessibility of both in-channel and off-channel estuary habitat has been reduced as a result of habitat conversion for agricultural, urban, and industrial uses, hydroregulation and flood control, channelization, and higher bankfull elevations. Overbank flooding that would aid juveniles in accessing off-channel refugia and food resources has been virtually eliminated. Sediment transport processes that structure habitat have been impaired. Up to 77 percent of historical tidal swamps have been eliminated and the surface area of the estuary has decreased by approximately 20 percent. The annual mean river flow through the estuary has declined by about 16 percent and peak spring flows have declined about 44 percent. Irrigation and other water use withdrawals have reduced flows of the Columbia River by 7 percent (NMFS, 2013).

The quality of the habitat available to salmon and steelhead in the estuary has also been compromised. Water temperatures above the upper thermal tolerance range for salmon and steelhead are occurring earlier and more often and are likely to continue to climb as a result of global climate change. A variety of toxic contaminants have been found in water, sediments, and salmon tissue in the estuary at concentrations above the estimated thresholds for health effects in juvenile salmon. These contaminants include polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), DDT and copper. Pesticides, pharmaceuticals, personal care products, and brominated fire retardants appear to pose risks to salmonid development, health, and fitness through endocrine disruption, bioaccumulative toxicity, or other means (NMFS, 2013).

The sediment in the action area has been analyzed for chemicals prior to dredging in 1994, 1998 and 1999. In 1994, sediment samples had low concentrations of 2 or more PAHs, butyltin and metals below screening levels for flow lane disposal. In 1998, one sample core had total DDT detected at 9.69 micrograms per kilograms from the surface to a depth of 4 feet and 7 micrograms per kilogram from a depth of 4 feet to 11 feet. Subsequent bioassays required the dredge sediment to be disposed of at an upland facility. In 1999, one sediment sample detected 0.7 micrograms per liter tributyltin near the Northwest corner of the marina.

The elimination of vegetated wetlands in the estuary have altered the diet of juvenile salmon in the estuary by reducing the supply of insect prey and macrodetrital inputs to the estuarine food web. Increased microdetrital inputs to the estuary from decaying phytoplankton produced in upstream reservoirs and nutrient inputs from urban, industrial, and agricultural development may support of a food web that favors other fish species such as American shad. The presence of native and exotic fish, introduced invertebrates, invasive plant species, and thousands of over-water and instream structures, which alter habitat in their immediate vicinity also alter the salmon food web. Habitat in the estuary supports predation on salmonids by northern pikeminnow, pinnipeds, Caspian terns, and cormorants. Juvenile salmon and steelhead in the estuary are subject to mechanical hazards from dredging activities, ship ballast intake, and beach stranding as a result of ship wakes (NMFS, 2013).

The degraded habitat conditions in the estuary affect the abundance, productivity, spatial structure, and diversity of ESA-listed salmon and steelhead. Estuarine habitat issues limit the viability of Lower Columbia River Chinook, coho, and steelhead and Columbia River chum salmon. Recovery planners estimated baseline anthropogenic mortality in the estuary, excluding mortality attributable to predation, at between 9 and 50 percent, depending on species and population. For most populations, the estimates range from 10 to 32 percent (NMFS, 2013).

We searched for and did not find any future proposed Federal projects in the action area that have undergone ESA consultation but have not been implemented.

2.4. Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR

402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. Effects will include temporary effects associated with construction and long-term effects from presence and removal of structures.

2.5.1 Effects to Designated Critical Habitat

The action area is migration critical habitat for all salmon and steelhead listed in Table 2, and rearing habitat for juveniles for some species (Columbia River Chum, and Fall Chinook salmon). Because salmon and steelhead species have similar estuarine habitat requirements for migration and foraging, the following analysis is applicable to all of the salmon and steelhead critical habitat designations. The essential PBFs of migration corridors and rearing habitat also overlap, and include are, and water quantity and quality, natural cover, side channels, and undercut banks that support foraging, mobility and survival, and for migration habitat an additional PBF is freedom of obstruction and excessive predation (safe passage).

The proposed action will affect several features of designated critical habitat as a result of construction activities. In addition, construction of the boat lift will extend the life of the structure; therefore, future effects associated with the presence of the OWS itself are also considered here. These future effects will hereinafter be referred to as "intrinsic effects" that are associated with the OWS. These intrinsic effects are expected to persist through the design life of this OWS, which is expected to be about 40 years.

The proposed action will result a net decrease of 30 square feet of OWS, and will remove approximately 1,934 cubic yards of rip rap from below the HMT (Highest Measured Tide) of the Columbia River. These actions have beneficial effects on critical habitat (improved substrate and prey conditions) that help offset adverse effects from new OWS. Nevertheless, the proposed action extends the life of the overwater structure (OWS) for decades. Its presence in the estuary is a partial passage obstruction to individual salmon and steelhead adults and smolts migrating along the Oregon shoreline. Although some species are more likely to migrate along the shoreline than others, every species has sufficient life history variance that we can assume that individuals from all 13 ESUs will encounter and be obstructed by the OWS at some time (Kreitman and Fisher, 2013; ODFW, 2008). OWS are a particular impediment to the outmigration of smolts that must swim beneath or around the structure and the boats moored at the structure (Anderson et al., 2005; Kemp et al., 2005), slightly increasing the length of their migration and the energy required to reach the ocean (the migration corridor has obstructions that reduce the conservation role of the habitat).

The presence of the OWS also benefits salmon and steelhead predators (Celedonia et al., 2008). Caspian terns, double crested cormorants, glaucous winged/wester gull hybrids, California gulls and ring-billed gulls that hunt for smolts in the estuary roost and rest on the OWS (Anderson et al., 2007; NMFS, 2013). Salmon and steelhead smolts migrate in spring pulses past colonies with more than 100 breeding pairs of California gulls, ring-billed gulls, glaucous winged western gull hybrids, Caspian terns or Double Crested cormorants on East Sand Island at river mile 5 and Rice Island at river mile 21. Caspian terns disproportionately consume smolts in the estuary within 19 miles of their breeding colony (Lyons et al., 2007) and double-crested cormorants have a foraging range of around 18 miles (Anderson et al., 2007) so the OWS benefits both predators (the migratory pathway less safe for juvenile outmigrants).

The presence of the OWS reduces benthic forage in the estuary. Shade from the OWS reduces primary production. OWS piles take up space where benthic macroinvertebrates could grow (Haas et al., 20 02). The lost benthic forage beneath the OWS as a result of shade and space displaced by piles has a small direct effect on smolts foraging in the action area. Juvenile salmon that search for and fail to find suitable estuarine rearing habitat and sufficient forage experience higher risk of mortality (ISAB, 2015). NMFS (2013) expresses concern that the carrying capacity of the estuary cannot always support the annual number of natural and hatchery fish dependent upon it for growth before they enter the ocean. However, there is insufficient information to determine whether available forage in the estuary limits the existence and recovery of ESA-listed salmon and steelhead (ISAB, 2015) so the reduction in the forage PBF may not reduce conservation values.

The presence of the OWS reduces water quality. Boats that use the boat lift can leak or spill fuel into the water. Boat props create suspended sediment in shallow water (water quality conditions supporting growth and development in rearing and migration habitat is reduced).

The proposed action construction also temporarily affects critical habitat PBFs. Vibratory pile driver noise spreads through the water, degrading water quality and creating a passage obstruction, until it reaches a solid barrier. The November 1 through February 28 work window overlaps the migration of salmon and steelhead smolts through the action area (Morrice et al., 2020), particularly smolts that remain in the estuary through the winter to grow (Bottom et al., 2005; Connor et al., 2005). It also overlaps the upstream migration time of adult fall Chinook salmon, chum salmon and winter steelhead through the estuary. We used the NMFS Pile Driver Calculator to estimate that vibratory pile driving noise is greater than 150 dB_{RMS} threshold that affects fish behavior within 2800 feet of the pile (Buehler et al., 2015). This is a temporary reduction in safe migration value and in rearing values.

Vibratory pile driving and removal of piles also transports sediment around the pile up into the water column further degrading water quality while the pile driver is operating and for a time after the pile driver stops. The November 1 through February 28 work window overlaps the migration of salmon and steelhead smolts through the action area, particularly smolts that remain in the estuary through the winter to grow. It also overlaps the upstream migration time of adult fall Chinook salmon, chum salmon and winter steelhead through the estuary. The concentration of suspended sediment depends on the sediment size distribution around the pile but is generally less than 100 milligrams per liter (Weston Solutions, 2006). Water quality conditions supporting growth and development in rearing and migration habitat is temporarily reduced in the area of suspended sediment.

Impact pile driving to complete installation of the vibratory driven piles also degrades water quality. Like vibratory pile driver noise, impact pile driver sound pressure waves spread through the water until they reach a solid barrier. Up to 3000 driver strikes per day (up to 5 piles per day, up to 600 strikes per pile) will create elevated sound pressure up to ten weeks of the November 1 through February 28 work window. The November 1 through February 28 work window overlaps the migration of salmon and steelhead smolts through the action area, particularly smolts that remain in the estuary through the winter to grow. It also overlaps the upstream migration time of adult fall Chinook salmon, chum salmon and winter steelhead through the estuary. We used the NMFS pile driver noise calculator to estimate that impact pile driving sound pressure is greater than 187 dB_{SEL} threshold that injures or kills fish greater than 2 grams within 113 meters of the pile. These same calculations indicate fish smaller than 2 grams could be injured or killed within 158 meters of the pile during impact pile driving. (This creates a temporary reduction in rearing and migration value.

Construction equipment can spill hazardous fluids into the water, degrading water quality. Hazardous fluids may be spilled during each of the four annual construction phases. If an accidental spill does occur, BMPs require that on site spill kits be used to recover spilled fluids immediately if possible. If spilled fluids are unable to be recovered, chemicals may be in the action area water column for up to several hours while they are physically dispersed. Chemicals that partition to sediments may be present in the action area for decades. The November 1 to February 28 work window overlaps the migration of individual smolts in the action area (Morrice et al., 2020) and the migration of adult fall Chinook, chum, and winter steelhead past the action area (Kreitman and Fisher, 2013). Fuels, lubricants and some fluids used in construction equipment have constituent chemicals that are acutely toxic such as benzene, toluene, ethyl benzene and xylene (BTEX) to fish or contribute to chronic toxicity effects such as polynuclear aromatic hydrocarbon (PAH) (Johnson et al., 2007a; Johnson et al., 2007b; Logan, 2007). However, it is extremely unlikely that contamination of surface water will occur during construction because BMPs to prevent a spill during in water/over water construction will be implemented, and spill response equipment will be onsite and available for immediate use in the event of a spill. Therefore, this potential effect will not be further evaluated.

In summary, the new OWS will result in a long term decrease in 30 square feet of OWS, and removal of 1,934 cubic yards of riprap which together will slightly improve conditions above baseline in the action area. The benefits will be long lasting, and will improve benthic conditions and prey base. However, the at the same time, new OWS sustains permanent (~4 decades) impacts to critical habitat PBFs. To summarize these impacts are:

- a small benefit to predators that consume juvenile salmon and steelhead;
- the loss of a small area of estuary benthic forage beneath the OWS;
- and a small degradation of water quality from boats that use the OWS.

OWS construction creates transient impacts to critical habitat PBFs. These impacts are

- short periods (hours) of degraded water quality from of noise loud enough to alter salmon and steelhead behavior and partially obstruct their migration;
- suspended sediment concentrations up to 100 milligrams per liter; and
- small sound pressure level zones around piles sufficient to injure or kill exposed smolts.

The effects on PBFs of critical habitat, when beneficial and adverse effects are both considered, are negative.

2.5.2 Effects to Salmon and Steelhead

The proposed action is likely adversely affect the following species:

1. Lower Columbia River (LCR) Chinook salmon
2. Willamette River spring Chinook salmon
3. Snake River basin (SR) fall-run Chinook salmon
4. Snake River spring/summer run Chinook salmon
5. Upper Columbia River spring-run Chinook salmon
6. SR steelhead
7. Middle Columbia River (MCR) steelhead
8. Columbia River chum salmon
9. LCR steelhead
10. Willamette River steelhead
11. Upper Columbia River (UCR) steelhead
12. LCR coho salmon
13. SR sockeye salmon

Implementation of the proposed action is likely to adversely affect individuals of ESA-listed species that occur in the action area. More specifically, individual fish will be exposed to noise (vibratory pile driving), SPL (impact pile driving), and increase suspended sediment and chemical contaminants (removal and installation of the causeway) during construction. The construction effects are limited to a period of roughly 10 weeks, and this reduces the numbers of fish that will be exposed. In addition, individual fish will be impacted by the intrinsic effects of the OWS as described in the Section 2.5.1 above, and because these intrinsic effects are co-extensive with the structures (estimated to be 40 years) many fish from multiple cohorts of multiple populations will be exposed over that period of time.

The effects of vibratory and impact pile driving on critical habitat water quality are transient, that is water quality is degraded while the pile driver is operating and returns to normal when the pile driver is off. Therefore, pile driving effects to critical habitat only directly affect individual fish if the fish is sufficiently near the pile driver while it is operating. The November 1 to February 28 work window overlaps the upstream migration of adult fall Chinook, chum and winter steelhead and the downstream migration of smolts from all 13 ESU/DSPs past the action area. The density of smolts in the estuary drops dramatically in September, from 1,000s of fish per 1,000 square meters to 10s of fish per 1,000 square meters (Roegner et al., 2016). Vibratory pile driving creates noise greater than 150 dB_{RMS} (re: 1μPa) within 2,800 feet of the pile (Buehler et al., 2015). The Fisheries Hydroacoustic Working Group (FHWG, 2008) determined that SPLs in excess of 150 dB_{RMS} are likely to cause temporary behavioral changes, including a startle response or other behaviors indicative of stress. Popper et al. (2003) reports that behavioral response of fishes to sounds may include "freezing", increasing the vulnerability of individual fish to predation. Proposed action vibratory pile driving BMP (three sequences of operating the pile driver at reduced energy for 15 seconds and then turning the driver off for 30 seconds whenever the pile driver has been silent for more than 30 minutes) may increase the likelihood that any individual fish that have entered the action area will leave before they are exposed to noise greater than 150 dB_{RMS}. In addition to the relative brevity (10 weeks) of this effect in the environment, the BMPs combined with the blocking of noise by the land around the marina and the low density of fish in the estuary during the work window are likely to minimize the number of individual fish exposed to the effects of vibratory pile driver noise.

The contractor will use up to 600 impact pile strikes to complete installation of each pile. BMPs dictate that the contractor start with three sequences of an initial set of strikes at reduced energy followed by 30 seconds of waiting to encourage fish to leave the action area before the pile is driven. Impact pile driving within a bubble curtain will create sound pressure greater than 187 dB_{SEL} within 158 meters of the pile (Buehler et al., 2015). Adult salmon exposed to 187 dB_{SEL} for one hour may be injured by SPL (Oestman et al., 2009) and smolts exposed to 187 dB_{SEL} for one hour may be killed by SEL. BMPs combined with the low density of fish in the action area are likely to minimize the number of fish exposed to injurious or lethal SPL.

Pile driving and removal will also result in elevated concentrations of suspended sediment. Any individual fish near the pile-substrate interface will be exposed to up to 100 milligrams per liter of suspended sediment during and for a short time following vibratory pile driving. Wilber and Clarke (2001) report that adults exposed to 10-100 milligrams per liter of suspended sediment for less than 2 hours will result in behavioral effects such as reduced visual acuity and altered swimming either toward or away from suspended sediment and that juvenile fish exposed to 10 to 100 milligrams per liter for 8 hours would experience sublethal physiological effects such as reduced feeding and behavioral effects such as alarm followed by relocation. They note that these effects are somewhat offset by the ability of smolts to hide from predators in the turbidity associated with suspended sediment. Again, BMPs and the low density of fish in the estuary during the work window are likely to minimize the number of individual fish exposed to suspended sediment from vibratory pile driving.

Salmon and steelhead smolts that migrate in shallow water along the shoreline and swim beneath the OWS may be exposed to construction stressors including noise, suspended sediment and sound pressure from pile driving, resulting in behavioral changes, injuries or death. As described in the previous section, construction of the boat lift sustains permanent (decades) impacts to critical habitat PBFs and, as result, will negatively impact individual fish. Individual fish may: (1) expend more energy to reach the ocean due to the longer migration lengths; (2) experience greater predation pressures; (3) have few foraging opportunities; suitable estuarine rearing habitat and sufficient forage experience higher risk of mortality. While a very large number of fish from each of the populations of the listed species will be exposed to the presence of these structures in their migration and rearing area, the detrimental effects are reasonably expected to occur among a subset of the exposed fish. It is impossible however, for NMFS to estimate the number of fish that will experience reduced growth, or the decrease in survival.

2.6 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to 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. It is clear however that climate change presents an array of specific threats that can act synergistically with other threats, dramatically increasing the impacts of each. In particular, the loss of population spatial structures, as well as habitat heterogeneity and connectivity, removes the means by which salmon have historically persisted through frequent disturbances and climate extremes. Recent analyses in terrestrial environments found a correlation between habitat loss and climate stress and it is possible that, due to past adaptation or recent stressors, adaptive capacity may already be at its lowest levels precisely where salmon need it most (Crozier et al., 2019) , as warming temperatures, decreasing salinity, increasing acidity, rising sea level, and shifting food webs intensify over the period of years that this project will exist within the action area.

As with all projects in the estuary, the quality of the water that flows through the action area is affected by many city, county and private activities that are regulated by the states. For example, multiple upstream stormwater and wastewater sources deliver chemicals to the Columbia River that are be carried through the action area. Two chemicals of concern are copper and zinc because the proposed action uses treated wood. We've accounted for these cumulative effects by referencing the copper and zinc concentrations reported upstream, adjusted those concentrations to account for tidal mixing and added them to the concentrations expected to be leached from the wood.

We searched for other relevant activities that may affect ESA species in the action area and found none. It is very likely however that upland uses will intensify over the next 75 years as human population growth continues in all areas adjacent to the Columbia River, increasing water withdrawals, storm and waste water inputs, and recreational and commercial boating, each of which incrementally adds to degrading habitat conditions necessary for viability and recovery in the action area.

2.5. 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.

With the exception of UCR spring-run Chinook salmon and SR sockeye salmon, which are already considered endangered, each species of salmon and steelhead considered in this opinion is at risk of becoming endangered in the foreseeable future. These species are EA-listed due to a combination of low abundance and productivity, reduced spatial structure, and decreased genetic (and in some cases, life history) diversity. Recent adult returns have been substantially below averages for many populations/MPGs. We expect that abundance could further decrease and extinction risk increase for many ESUs and DPSs due to factors associated with climate change.

The status of all designated critical habitats considered in this opinion varies across the geographic extent of the designation, with habitat conditions being excellent in wilderness and roadless areas to severely degraded habitat conditions in areas subject to intense human activities such as agricultural and urban development. There are a number of common limiting factors, including altered flow regimes, reduced access to off-channel rearing habitat in the lower Columbia River, impaired water quality and reduced habitat complexity.

The current baseline condition of the action area has been impacted by human activities both within and upstream of the action area. Under the environmental baseline, the fish from the component populations of each ESU and DPS that move through and use the action area will encounter habitat conditions degraded by a modified flow regime; reduced water quality (chemical contamination and elevated summer and fall temperatures); loss of functioning floodplains; and loss of vegetated riparian areas and associated shoreline cover; and high predation rates.

We translate the effects of the proposed action on individuals into their effects on the abundance, productivity, spatial structure and diversity (APSSD) parameters that summarize the survival and recovery of each species. In the Columbia River estuary action area, there are 13 species of salmon and steelhead that are exposed to the effects of the action. Salmon and steelhead smolts that migrate in shallow water along the shoreline and swim beneath the OWS may be exposed to construction stressors including noise, suspended sediment and sound pressure from pile driving, injuries or death. As described in the previous section, construction of the new finger piers and associated piles will incur permanent (decades) impacts to critical habitat PBFs and, as result, will negatively impact individual fish. Individual fish may: (1) expend more energy to reach the ocean due to the longer migration lengths; (2) experience greater predation pressures; (3) have few foraging opportunities; suitable estuarine rearing habitat and sufficient forage experience higher risk of mortality.

Most of the individuals in the 13 species are not going to be affected by the construction activities because the vast majority of adults and smolts migrate past the action area outside of the proposed in water work window. Indeed, this is the intent of in water work windows, to dramatically reduce exposure to proposed action stressors. However, to be conservative, we’ve assumed that some individuals from each ESU population will migrate past the project during the proposed work window and be exposed to construction-related impacts. Furthermore, because the OWS will be present year-round, we have assumed individual fish will be exposed to intrinsic effects associated with the OWS.

The very presence of the OWS provides a benefit to predators of juvenile salmon and steelhead because they can use it to roost, rest or hide, and ambush. The proposed action extends this predator benefit into the future. However, we note that the presence of predators in the action area is not caused by OWS; even if the OWS was removed, these predators would presumably find substitute structures and continue to hunt salmon and steelhead. Therefore, the OWS benefit to predators is relatively small, and does not appreciably alter the impact of the predation as a limiting factor to ESU survival and recovery. The OWS displaces a small area of benthic forage that salmon and steelhead use to grow while they are in the estuary. This displaced forage may affect a few individual fish but because of its small size, it does not affect forage as a limiting factor to recovery of ESUs, which is primarily driven by lost estuarine tidal wetlands and competition for forage with hatchery fish.

We expect few, if any, smolts to be killed by impact pile driving because the density of smolts in the estuary is very low during the IWWW and the proposed action includes best management practices shown to keep fish away from the area around the pile where sound pressure forces are lethal. Similarly, noise and suspended sediment from vibratory pile driving may affect the behavior of individual fish and may even cause them to swim into an area where they may more likely be killed by a predator. The number of individuals whose behavior may be altered or who may be harmed or killed as a result of implementation of the proposed action is expected to be too small to translate into a reduction in future population abundance or the growth rate of the population. For example, if one individual smolt from any population is killed by impact pile driving sound pressure forces, the reduction in future abundance would be much less than 0.02 adults because the smolt to adult return ratio for salmon and steelhead is greater than (and for subyearlings much greater than) 50. Given the relatively short duration of the construction, implementation of BMPs to reduce impacts, and because the structure encompasses a very small proportion of the Lower Columbia River, implementation of the proposed action will affect far too few individual smolts to change future adult abundance or productivity.

Construction activities and extending the life of the OWS will not affect spatial structure because no populations originate in the action area and all populations must move through the estuary to reach the ocean. Similarly, construction activities and extending the life of the OWS will not affect diversity which is overwhelmingly driven by hatchery programs. Therefore, even though the proposed action may alter the behavior of or harm or even kill individuals from any of the 13 ESUs/DPSs, it will not change the survival or the recovery trajectory of any ESU/DPS.

When we consider the current status of the threatened and endangered salmon and steelhead ESU/DSPs and degraded environmental baseline within the action area, the proposed action itself is not expected to affect abundance, distribution, diversity, or productivity of any of the component populations of the ESA-listed species. The effects of the action will be too minor to have a measurable impact on the affected populations. Because the proposed action will not reduce the abundance, productivity, spatial structure, or diversity the affected populations, the action, when combined with a degraded environmental baseline and additional pressure from cumulative effects, will not appreciably reduce the survival or recovery any of the listed species considered in this opinion.

The action area is designated critical habitat for all 13 species of salmon and steelhead. Under the current environmental baseline, migration and rearing is functioning moderately. Proposed construction activities will add low-level, temporary effects on the migration and rearing PBFs. Extending the life of the OWS will add low-level effects on the migration and rearing PBFs in the long-term. The addition of these temporary and long-term effects to baseline and cumulative effects is not likely to appreciably diminish the value of designated critical habitat for the conservation of salmon and steelhead species.

2.6. 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, any effects of interrelated and interdependent activities and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of LCR Chinook salmon, UWR Chinook salmon, UCR spring-run Chinook salmon, SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, CR chum salmon, LCR coho salmon, SR sockeye salmon, LCR steelhead, UWR steelhead, MCR steelhead, UCR steelhead, SR Basin steelhead, or destroy or adversely modify their designated critical habitat.

2.7. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Harass" is further defined by interim guidance as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur because the proposed construction and pile driving will take place when individual salmon and steelhead enter the action area.

Incidental take caused by the adverse effects of the proposed action will occur among individuals of the species identified above in the form of:

- injury or death from exposure to impact pile driver noise and sound pressure waves, and from predators that rely on the in-water structures;
- harm from exposure to suspended sediment (water quality reduction), and vibratory pile driving noise, and small reductions in prey availability.

A definitive number of ESA listed fish that will be killed, injured, or harmed cannot be estimated or measured because of the highly variable presence of species over time, and the inability to observe all injured or dead specimens. Instead, NMFS will use habitat–based surrogates that are causally related to harm to account for the take, which are called the "extent" of take.

For this proposed action, the extent of take from impact pile driving is directly related to the number of impact blows needed to install the 5 piles per year over 4 years (i.e., 100 strikes per year); the extent of take is up to 400 impact blows.

The extent of take from vibratory driving and forage reduction, and suspended sediment from pile driving is directly related the number of piles, and a radius around the piles. The extent of take is 5 piles, and an area up to 150-foot radius from each pile, where the suspended sediment concentration is expected to return to background levels. This same radius is where we expect brief changes in benthic prey communities.

These are measurable and verifiable metrics by which the action agency or other observers can determine if the extent of take has been exceeded.

2.9.2 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.

2.9.3 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 and the applicant shall

1. Minimize incidental take from pile driving.
2. Monitor to ensure the extent of take from pile driving and suspended sediment are not exceeded.

2.9.4 Terms and Conditions

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

1. The following term and condition implements RPM 1:
    a. Ensure that the contractor does all impact pile driving during the ODFW recommended IWWW for the Columbia River estuary below Tongue Point, November 1 to February 28.

2. The following term and condition implements RPM 2:
    a. Prepare and provide NMFS with a plan before construction begins describing how impacts of the incidental take on listed species in the action area would be monitored and documented and a report within 90 days of the completion of construction documenting incidental take monitoring results. Provide the report to: projectreports.wcr@noaa.go. Include the WCR tracking number for this consultation (WCRO-2022-01368) in the regarding line when the report is submitted.

2.8. 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).

2.9.Reinitiation of Consultation

This concludes formal consultation for the Hyak Tongue Point Mobile Boat Lift

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

2.10. "Not Likely to Adversely Affect" Determinations

The proposed action is summarized is described in Section 1.3 of this opinion. The proposed action may affect the Southern DPS of Eulachon (*Thaleichthys pacificus*), Southern DPS of green sturgeon (*Acipenser medirostris*), and their designated critical habitats. Impacts to these species and their designated critical habitats are described in Sections 2.11.1 and 2.11.2, respectively.

2.11.1 Eulachon and their critical habitat

Eulachon Critical Habitat - The essential PBFs of eulachon estuarine migration critical habitat are freedom of obstruction, habitat with water flow, quality and temperature conditions supporting larval and adult mobility, and abundant prey items supporting larval feeding after their yolk sac is depleted. The proposed action stressors on these PBFs are: the partial migration obstruction, reduced larval prey items and degraded water quality from the extended presence of the OWS; the degraded water quality and migration obstruction from vibratory pile driving noise and suspended sediment, partially obstructed passage from vibratory pile driving noise; the degraded water quality from impact pile driving sound pressure waves; and the degraded water quality from hazardous materials accidentally spilled during construction.

Extending the life of the overwater structure sustains an insignificant obstruction to eulachon migration because adult eulachon are not shoreline dependent and can easily swim around or through the marina and larval eulachon are carried downstream by bedload or currents. The effect of OWS shade on the larval eulachon food web is insignificant because the OWS shades far too small of a fraction of the estuary to reduce the phytoplankton or copepods, copepod eggs, mysids, barnacle larvae, and worm larvae prey (76 FR 65323) of eulachon larvae. Fuel leaked from boats using the marina has an insignificant effect on eulachon critical habitat water quality because small spills are physically dispersed quickly by tides and currents and rare large spills are contained and recovered by Federal and State agencies (EPA, 2017). The proposed action construction stressors of vibratory pile driving noise and suspended sediment and impact pile driving sound pressure are a discountable effect to eulachon critical habitat water quality because these are transient effects that are only present during the in water work window before adult eulachon return to the action area in January and larval eulachon begin to reach the action area in March (NMFS, 2017). Fuels and hazardous fluids spilled from construction equipment are an insignificant effect to eulachon critical habitat water quality because proposed action BMPs to prevent (and rapidly clean up) spills render the likelihood of a spill insignificant.

The proposed action is not likely to directly adversely affect eulachon because all of the direct effects to eulachon are transmitted to them through effects to critical habitat PBFs which are shown above to be discountable or insignificant.

2.11.2 Green Sturgeon and their critical habitat

Southern green sturgeon spawn and rear for up to three years in the Sacramento River in California but during the late summer and early fall, subadult and adult green sturgeon aggregate in estuaries along the Pacific coast including the action area. Their presence in the action area overlaps the start of the proposed action in water work window. The PBFs in estuarine areas include: a migratory pathway necessary for the safe and timely passage within estuarine habitats; abundant food items for sub adult and adult life stages; and water quality necessary for normal behavior, growth, and viability of sub adults and adults.

The proposed action’s stressors on critical habitat PBFs are: partial obstruction of the migration corridor, reduced food and degraded water quality from the extended presence of the OWS; degradation of water quality and partially obstructed passage from vibratory pile driving noise and suspended sediment; degraded water quality from impact pile driving sound pressure waves; and degraded water quality from hazardous materials accidentally spilled during construction.

Extending the life of the overwater structure is not likely to obstruct green sturgeon migration because sub adults and adults are large fish that can easily swim around or through the marina without increased risk of predation. The effect of OWS on critical habitat food is insignificant because the OWS piles displace such a small amount of the estuary benthic surface where green sturgeon forage. Fuel leaked from boats in the marina has an insignificant effect on green sturgeon critical habitat water quality because small spills are physically dispersed quickly by tides and currents and rare large spills are rapidly contained and recovered by Federal or State agencies (EPA, 2017). Construction stressors such as vibratory pile driving noise and suspended sediment and impact pile driving sound pressure are an insignificant effect to green sturgeon critical habitat water quality because most of the work window is after green sturgeon have returned to the ocean and sub adult and adult green sturgeon in the estuary are large fish unaffected by noise or sound pressure waves. Fuels and hazardous fluids spilled from construction equipment are insignificant to green sturgeon critical habitat water quality because BMPs to prevent (and rapidly clean up) spills rendering the likelihood of a spill insignificant.

Green sturgeon will not be exposed to construction effects based on the timing of the proposed action. The proposed action is not likely to directly adversely affect green sturgeon because all of the effects to green sturgeon are transmitted through effects to critical habitat PBFs which are show above to be insignificant, therefore response to these insignificant effects is expected to produce insignificant responses.

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

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

This analysis is based, in part, on the EFH assessment provided by the USACE and descriptions of EFH for Pacific Coast groundfish (Pacific Fishery Management Council [PFMC] 2005), coastal pelagic species (CPS) (PFMC 1998), and Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The proposed action adversely affects salmon EFH and the salmon EFH estuary habitat of particular concern (HAPC) as identified in PFMC (2014), groundfish EFH and the groundfish EFH estuary HAPC as described in PFMC (2005) and coastal pelagic species EFH as described in PFMC (1998).

3.2. Adverse Effects on Essential Fish Habitat

The project elements that could potentially impact groundfish, pelagic, and salmon species' EFH and HAPCs are pile removal and installation, and general construction activities.

1. Vibratory pile removal and pile driving could result in temporary increases in noise and turbidity.

2. Impact driving/proofing may result in elevated sound levels for not more than 30 total minutes per day (in approximately five-minute intermittent intervals) for approximately 20 days over the 4 year Project. Potentially injurious sound pressure levels in water would be limited to areas within 22 meters.

3. There are slight reductions in prey communities in areas affected by sound and turbidity.

3.3.Essential Fish Habitat Conservation Recommendations

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

1. The applicant or its contractor will comply with applicable State water quality standards and implement corrective measures if temporary water quality standards are exceeded.

2. Piles will be installed to the extent possible with a vibratory hammer. Impact driving/proofing will be limited to the final 5 feet of embedment for any pile.

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

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the 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 the measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

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

3.5. Supplemental Consultation

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

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the USACE. Other interested users could include the Port of Astoria. Individual copies of this opinion were provided to the USACE. The document will be available 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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6. APPENDIX-CALCULATIONS

We estimated the concentration of copper and zinc in the water column beneath the OWS from the background copper and zinc in the estuary and the copper and zinc that leach from the reconstructed section of the OWS as follows:

We populated the Wood Preserver Institute General Risk Assessment Model (Brooks, 2011) cells E7 and E9 with the above OHW and below OHW dimensions shown in *Table 1*.

We populated cells E28 and E29 with the 210 foot (6,400 centimeter) length and 28 foot (853 centimeter) width of OWS that will be replaced each year. We estimated the average depth of the water column beneath the OWS in cell E30 to be 10 feet (304 centimeters).

We estimate that copper and zinc enter the Columbia River at upstream urban areas such that the average background concentrations of copper and zinc in the Columbia River at River Mile 54 are 1.2 micrograms per liter and 4.8 micrograms per liter, respectively (Morace, 2006). We scaled these concentrations to the ratio of the maximum concentration of salt in the action area (10 ppt, cell E39) to the concentration of salt at the Columbia River mouth (20 ppt) to account for tidal mixing with clean ocean water (Chadwick et al., 2004). This results in average action area background concentrations of 0.6 micrograms copper per liter in cell E40 and 2.4 micrograms zinc per liter in cell E43 respectively. We used the 2 year, 24 hour storm event for Astoria from NMFS (2015) to estimate rainfall volume. Parameter values are summarized below.

Parameter	**Value**	**Reference**
Treated wood area above OHW	11,430,790 cm^2	Biological Assessment
Treated wood area below OHW	1,742,675 cm^2	Biological Assessment
Maximum tidal current speed	77 cm/sec	https://tidesandcurrents.noaa.gov/noaatidepredictions.html ?id=9440083&legacy=1
Steady state current speed	0 cm/sec	https://tidesandcurrents.noaa.gov/noaatidepredictions.html ?id=9440083&legacy=1
Background dissolved copper concentration	0.6 ug/L	(Chadwick et al., 2004; Morace, 2006)
Background dissolved zinc concentration	2.4 ug/L	(Chadwick et al., 2004; Morace, 2006)
Average annual rainfall	124.5 cm/year	2014_03-14_SLOPES V Transportation_NWR-2013-10411
Copper Arch H2O block efficiency	68%	Biological Assessment
Zinc Arch H2O block efficiency	85%	Biological Assessment
Width of Structure	6,400 cm	Biological Assessment
Length of structure	853 cm	Biological Assessment
Water depth	304 cm	Biological Assessment