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-2021-00750

April 29, 2022

Todd Tillinger
Chief, Regulatory Branch
U.S. Army Corps of Engineers, Seattle District
4735 East Marginal Way South, Bldg. 1202
Seattle, Washington 98134-2388

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for Watermark Estate Management Services LLC's 4-Year Shoreline Maintenance Project in Medina, Washington (USACE No. NWS-2020-489, HUC: 171100120400 – Lake Washington)

Dear Mr. Tillinger:

Thank you for your letter of April 6, 2021, 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 U.S Army Corps of Engineers' (USACE) authorization of Watermark Estate Management Services LLC's Shoreline Maintenance Project in Lake Washington. This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)[16 U.S.C. 1855(b)] for this action.

The enclosed document contains the biological opinion (opinion) prepared by the NMFS pursuant to section 7 of the ESA on the effects of the proposed action. In this opinion, the NMFS concludes that the proposed action would adversely affect but is not likely to jeopardize the continued existence of Puget Sound (PS) Chinook salmon and PS steelhead. The NMFS also concludes that the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon but is not likely to result in the destruction or adverse modification of that designated critical habitat. This opinion also documents our conclusion that the proposed action may affect, but is not likely to adversely affect southern resident (SR) killer whales and their designated critical habitat.

This opinion includes an incidental take statement (ITS) that describes reasonable and prudent measures (RPMs) the NMFS considers necessary or appropriate to minimize the incidental take associated with this action, and sets forth nondiscretionary terms and conditions that the USACE must comply with to meet those measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of listed species.

Section 3 of this document includes our analysis of the action's likely effects on EFH pursuant to Section 305(b) of the MSA. Based on that analysis, the NMFS concluded that the action would adversely affect designated freshwater EFH for Pacific Coast Salmon. However, as described at Subsection 3.3, the NMFS knows of no reasonable measures that the applicant could take, beyond those already proposed, that would reduce the project's minor effects on the attributes of Pacific Coast salmon EFH. Therefore, the NMFS has made no conservation recommendations pursuant to MSA (§305(b)(4)(A)). We also concluded that the action would not adversely affect EFH for Pacific Coast groundfish and coastal pelagic species. Therefore, consultation under the MSA is not required for EFH for Pacific Coast groundfish and coastal pelagic species.

Section 305(b) (4) (B) of the MSA requires Federal agencies to provide a detailed written response to the NMFS within 30 days after receiving this recommendation. If the response is inconsistent with the EFH conservation recommendations, the USACE must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the effects of the action and recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, the NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we request that in your statutory reply to the EFH portion of this consultation you clearly identify the number of conservation recommendations accepted.

Please contact Donald Hubner in the North Puget Sound Branch of the Oregon/Washington Coastal Office at (206) 526-4359, or by electronic mail at Donald.Hubner@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

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

cc: Colleen Anderson, USACE

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

Watermark Estate Management Services LLC's 4-Year
Shoreline Maintenance Project in Lake Washington, King County, Washington
(USACE Number: NWS-2020-489)

NMFS Consultation Number: WCRO-2021-00750

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?
Chinook salmon (*Oncorhynchus tshawytscha*) Puget Sound (PS)	Threatened	Yes	No	Yes	No
Steelhead (*O. mykiss*) PS	Threatened	Yes	No	N/A	N/A
Killer whales (*Orcinus orca*) Southern resident (SR)	Endangered	No	No	No	No

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

Fishery Management Plan That Describes EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	No
Pacific Coast Groundfish	No	No
Coastal Pelagic Species	No	No

Consultation Conducted By: National Marine Fisheries Service
West Coast Region

Issued By:

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

Date: April 29, 2022

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LIST OF ABBREIVIATIONS

BE – Biological Evaluation
BMP – Best Management Practices
CFR – Code of Federal Regulations
dB – Decibel (common unit of measure for sound intensity)
DIP – Demographically Independent Population
DPS – Distinct Population Segment
DQA – Data Quality Act
EF – Essential Feature
EFH – Essential Fish Habitat
ESA – Endangered Species Act
ESU – Evolutionarily Significant Unit
FR – Federal Register
FMP – Fishery Management Plan
HAPC – Habitat Area of Particular Concern
HDPE – High Density Polyethylene
HUC – Hydrologic Unit Code
HPA – Hydraulic Project Approval
ITS – Incidental Take Statement
JARPA – Joint Aquatic Resources Permit Application
MPG – Major Population Group
MSA – Magnuson-Stevens Fishery Conservation and Management Act
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
PBF – Physical or Biological Feature
PCE – Primary Constituent Element
PFMC – Pacific Fishery Management Council
PS – Puget Sound
PSTRT – Puget Sound Technical Recovery Team
PSSTRT – Puget Sound Steelhead Technical Recovery Team
RL – Received Level
RPA – Reasonable and Prudent Alternative
RPM – Reasonable and Prudent Measure
SAV – Submerged Aquatic Vegetation
SEL – Sound Exposure Level
SL – Source Level
SR – Southern Resident (Killer Whales)
USACE – U.S. Army Corps of Engineers
VSP – Viable Salmonid Population
WCR – West Coast Region (NMFS)
WDFW – Washington State Department of Fish and Wildlife
WDOE – Washington State Department of Ecology

1. INTRODUCTION

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

1.1 Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (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.), as amended, 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 within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the Oregon Washington Coastal Office.

1.2 Consultation History

The periodic shoreline maintenance work identified in the Proposed Federal Action section below was originally stipulated by the Corps in 1995 to offset impacts from permitted shoreline development at the site (USACE 1995). The periodic shoreline work was subsequently reauthorized in 2009 (NWS-2007-230), which was considered in a NMFS biological opinion (NMFS 2009) that was signed March 20, 2009.

On April 6, 2021, the NMFS received a letter from the U.S. Army Corps of Engineers (USACE) requesting informal consultation for the reauthorization of the periodic shoreline maintenance work (USACE 2021a). The request included the applicant's Biological Evaluation (BE; Lally 2021a) and permit drawings (Lally 2020). On May 7, 2021, the NMFS informed the USACE by email that formal consultation was required for the proposed action. The USACE requested formal consultation on May 10, 2021 (USACE 2021b). On September 7, 2021, the USACE asked to modify the consultation request to add the replacement of 3 weirs within an existing artificial stream and pond feature inland from the lake at the same residence (USACE 2021c). The NMFS agreed to the inclusion on September 10, 2021. On October 27, 2021, the USACE sent an email (USACE 2021d) to provide the applicant's Joint Aquatic Resources Permit Application (JARPA) Form (Lally 2021b) and vicinity map and project drawings (Lally 2021c) for the weir replacement component, as well as the Hydraulic Project Approval (HPA) for the Shoreline Maintenance Project (WDFW 2018). The NMFS considers that formal consultation was initiated for this action on October 27, 2021.

On February 25, 2022, the NMFS requested additional information and provided a copy of the draft proposed action description for confirmation and or correction. The USACE provided additional information on February 28 and March 2, 2022 (USACE 2022a & b), and the applicant's agent provided additional information directly to the NMFS and the USACE on March 3 and 23, 2022, and April 5, 2022 (Lally 2022a, b, d).

This opinion is based on the information in the applicant's BE, JARPA, drawings, HPA, and multiple emails from the USACE (USACE 2021b-d; 2022a & b) and the applicant's agent (Lally 2022a & b); recovery plans, status reviews, and critical habitat designations for ESA-listed PS Chinook salmon and PS steelhead; published and unpublished scientific information on the biology and ecology of those species; and relevant scientific and gray literature (see Literature Cited).

1.3 Proposed 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 (see 50 CFR 402.02). Under MSA, federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded or undertaken by a federal agency (50 CFR 600.910).

The USACE proposes to authorize Watermark Estate Management Services LLC's (Watermark) 4-Year continuation of an ongoing shoreline and nearshore sediment and habitat maintenance project at a residential property along the eastern shore of Lake Washington in Medina, Washington (Figure 1). They would also authorize the repair of an artificial stream and pond complex at the same residence (USACE 2021c).

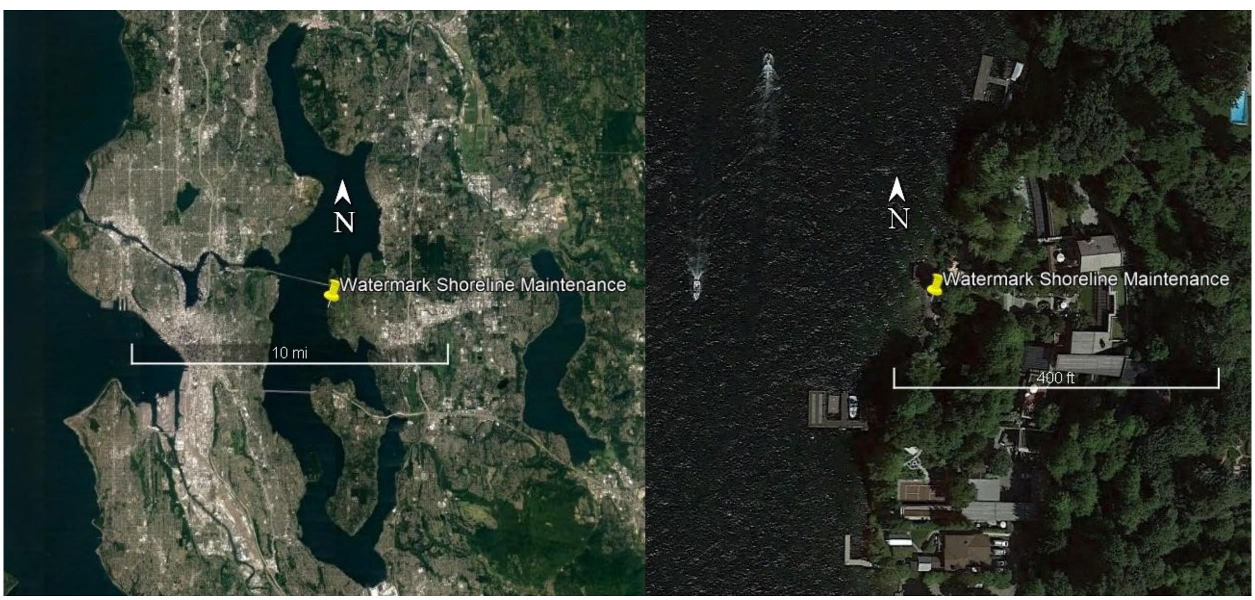

Figure 1. Google Earth photographs of the Watermark project site. The left image shows the project site relative to the City of Seattle and Lake Washington. The right image shows residential property.

In summary, the project would include the continued periodic renourishment of spawning gravel on two man-made nearshore salmon spawning reefs and two small pocket beaches, periodic maintenance of a riparian wave buffer, periodic maintenance dredging of a small boat moorage inlet, and periodic and provisional maintenance of the upwelling system for the spawning reefs (Figure 2). It would also include a stand-alone project to repair an artificial stream and pond feature that is inland from the lake at the same property. That work would primarily consist of the removal of 3 decayed cedar log weirs, the installation of 3 replacement concrete artificial log weirs, and sealing leaks.

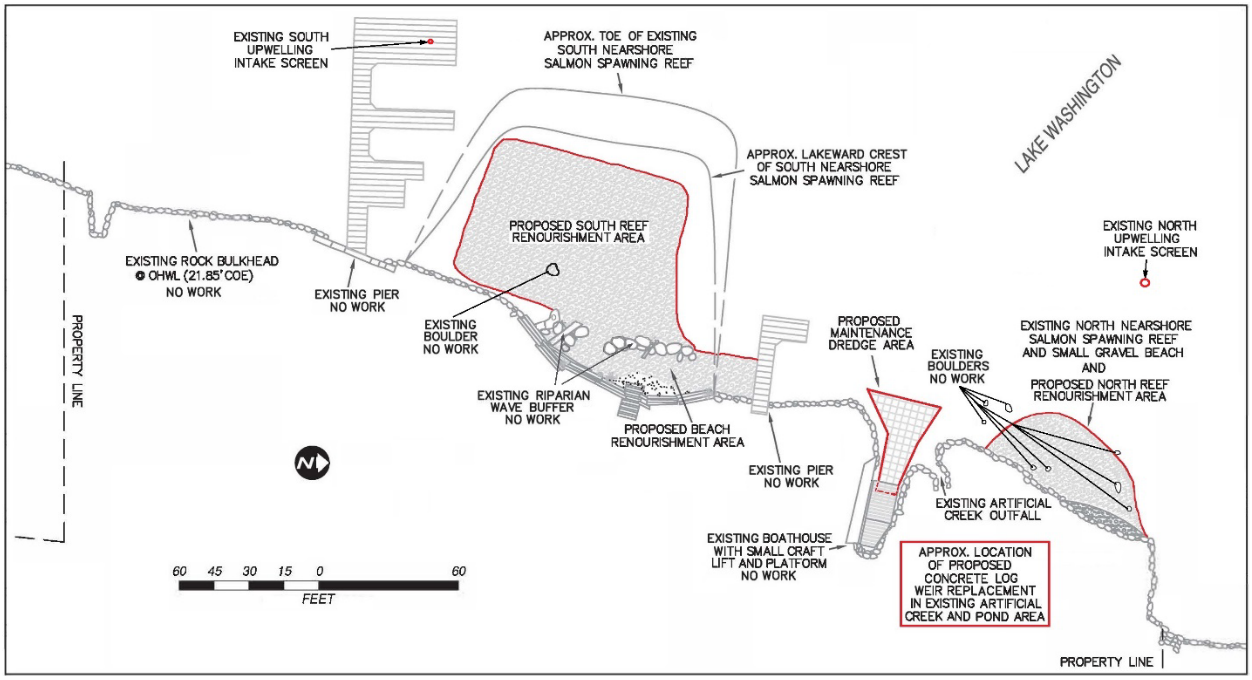

Figure 2. Overhead drawing of the project site. The project component areas are outlined in red (Adapted from Sheet 2 of 6 in Lally 2020 and Sheet 1 of 4 in Lally 2022c). The drawing is rotated 90 degrees right of true north to better fit on the page.

With the exception of quarterly inspection and cleaning of upwelling system intake screens, all work would be performed during the July 15 through September 30 in-water work window for the area. All work would be done in compliance with all protective measures, best management practices (BMPs), and provisions identified in the applicant's BE and HPA, including, with the exception of some of the work to maintain the upwelling system, as described below, all in-water work would be conducted within full-depth sediment curtains.

With the exception of the log weir replacement component of this action, work would occur every 2 to 4 years. All major project elements would be conducted from a spud barge with a crane or excavator and an attendant push boat, and the work would typically require a maximum of 5 days of in-water work. The log weir replacement project would be conducted during the first in-water work window following completion of all required permitting. That work would also involve barges, but land-based construction equipment would be landed and operated above the ordinary high water mark (OHWM) in the vicinity of the artificial stream and pond feature, and would require up to 10 weeks of work to complete. Intake screen inspection and cleaning work would be conducted by divers that would enter the water from shore.

Periodic spawning reef and pocket beach renourishment

Every 2 to 4 years, the applicant's contractors would install a maximum of 110 cubic yards (cy) of clean 2-inch minus rounded gravel (spawning gravel) on the pocket beach and the two nearshore reefs. The applicant reports that about 60 cy of gravel is typically installed per maintenance cycle, and that the spawning gravel would be sourced from local quarries. The gravel would be delivered by barge, either stockpiled loose on the deck or in woven super sacks. After installation of a full-depth silt curtain around the area, the gravel would be installed using a barge-mounted crane or excavator with clamshell or open faced bucket (for stockpiled gravel), or by hoisting super sacks over the area to be renourished then opening them. Up to 3 days of work would be required for gravel renourishment.

Periodic maintenance of riparian wave buffer components

The riparian wave buffer consists of boulders, cobbles, and 3 pieces of large woody debris. Although not currently expected due to demonstrated stability, the applicant may repair toe scour after severe storm events, and replace degraded woody debris as needed. As needed to repair toe scour, the applicant's contractor would install up to 2 cy of cobbles (per event) at the bases of the riparian wave buffer's boulders and woody debris. If the existing log components become severely degraded, they would be replaced in kind using natural logs. Cobble would be installed, and logs would be removed and replace using a barge-mounted crane or excavator.

Periodic maintenance dredging of the small boat moorage inlet

Every 2 to 4 years, the applicant's contractors would conduct mechanical dredging of the boat moorage inlet to restore its authorized depth of 14.7 feet below the lake's 20-foot ordinary low water mark, with a 0.5-foot allowable over-dredge. After enclosing the dredge area within a full-depth sediment curtain, the contractor would use a barge-mounted crane or excavator with a clamshell or open faced bucket to carefully remove the clean sands and gravels that have migrated from the adjacent beach and spawning reef area and accumulated in the moorage inlet. The dredged materials would be placed into containers on the barge, and delivered to the contractor's facility for unloading and eventual beneficial use. Occasionally, divers would also use a small (i.e. 4-inch diameter) hand-held hydraulic suction dredge to move up to 5 cy of accumulated sand and gravel out from under the boathouse roof to a location within the dredge footprint where the mechanical dredge can reach it. Up to 2 days would be required for dredging.

Periodic maintenance of the upwelling system

Periodic maintenance of the upwelling system would consist primarily of quarterly inspection and cleaning of upwelling system intake screens, but could also include provisional replacement of damaged pipe sections, and the repair or replacement of the south pump (Figure 3). Depending on the depth of the work area, the work would be accomplished by standard workers and or divers that would operate from shore, a small workboat, or small barge.

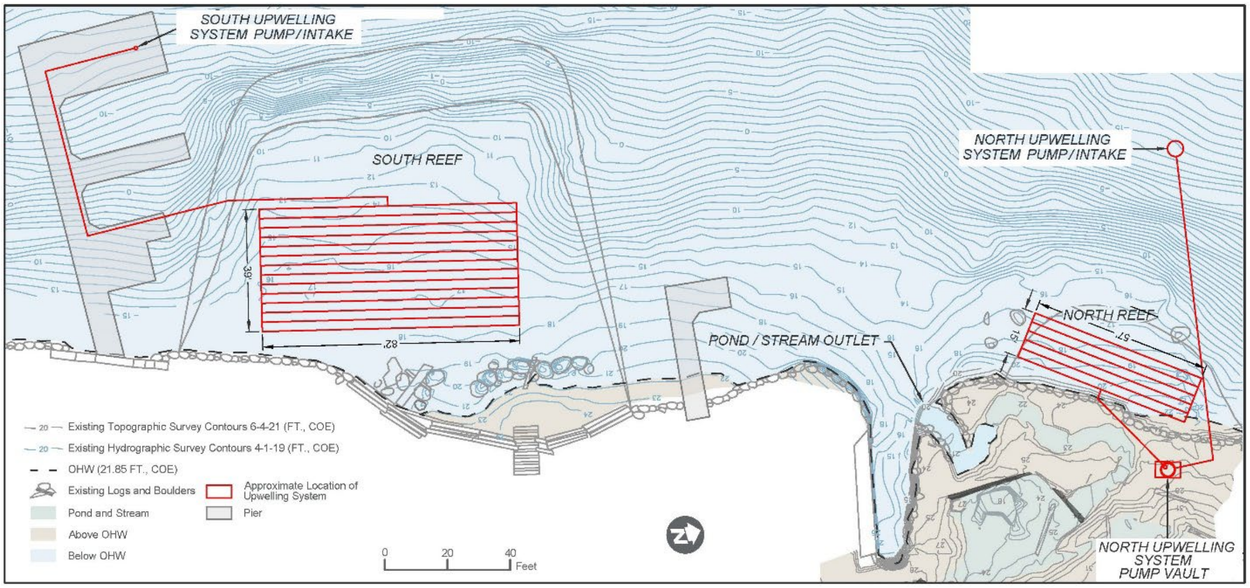

Figure 3. Overhead drawing with the approximate locations of the existing upwelling system intakes, pumps, and pipelines shown in red (Adapted from Page 1 of 4 in Lally 2022c).

On a quarterly basis, scuba divers would inspect and remove impinged algae and debris from the stainless steel screens that enclose the intakes for the two upwelling systems. The screens for both intakes have 3/32-inch diameter holes (30 per square inch). The divers would clean the screens with handheld brushes. Less than one day of work would be required for screen cleaning. This work would be conducted without full-depth sediment curtains, and 3 events would occur outside of the in-water work window.

As-needed, repair or replacement of some of the upwelling system's 2- to 6-inch diameter high density polyethylene (HDPE) plastic pipes may also be required. If needed, the affected pump would be temporarily secured, then turned back on when the work is done. Depending on the depth of the site, that work would consist of standard workers and or divers using shovels and or handheld suction dredges to remove 1 to 3 feet of covering spawning gravel from the damaged pipe section, typically less than 2 cy. The gravel would be deposited about 5 feet to the side of the excavation. They would then install repair sleeves, and or cut out and replace damaged pipe sections then connect the new pipes to the rest of the system using sleeves. The workers and or divers would then reinstall the excavated gravel over the repair site using shovels and or handheld suction dredges. All instance of this work that involves any excavation would be conducted within a full-depth sediment curtain and within the in-water work window. Minor pipe repairs that involve no excavation may occur without full-depth sediment curtains and outside of the in-water work window

Repair or replacement the upwelling system's pumps may be required. The pump for the north system is located on land, above the OHWM, and as such would require no in-water work. The south system's pump is located under the applicant's main pier. To accomplish this work, the pump would be temporarily secured, then working from the pier, divers would use hand tools to disconnect the pump, and then hoist it to the pier deck. A functional pump would be lowered into the water, reconnected to the system in reverse order as the damaged was removed, then turned back on when the work is done. This work would be conducted without full-depth sediment curtains, and may occur outside of the in-water work window.

Log weir replacement

During a single work window, the applicant's contractors would conduct 8 to 10 weeks of work to replace 3 decayed cedar log weirs with concrete artificial log weirs within the existing artificial stream and pond feature at the applicant's residence. (Figure 4).

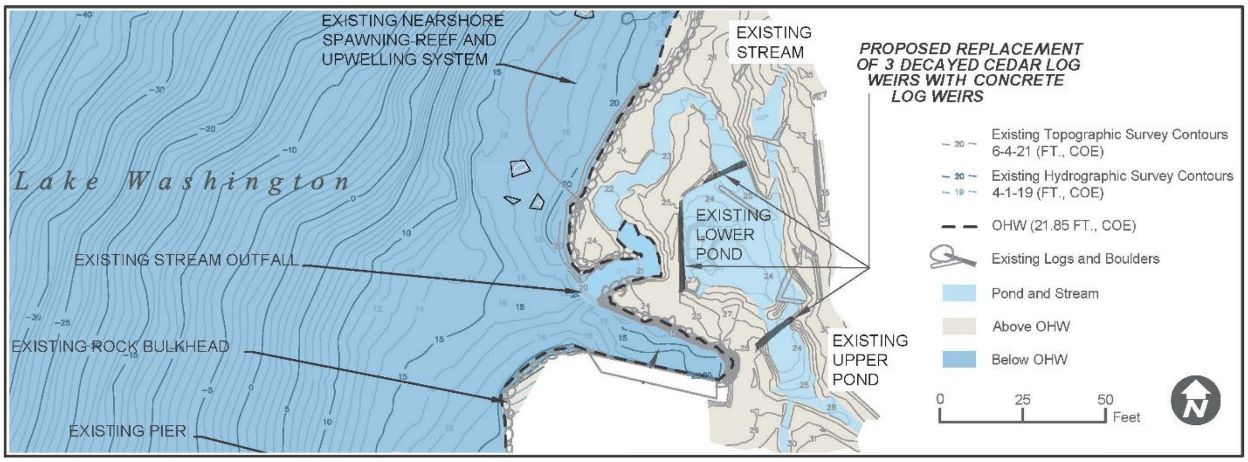

Figure 4. Overhead drawing of the proposed weir replacement locations in the applicant's artificial stream and pond feature (Adapted from Page 2 of 10 in Lally 2021c).

All equipment and materials for the project would be delivered by and staged on a barge that would be moored at the entrance to the boat basin without grounding. With the exception of positioning the barge, and installing a full-depth sediment curtain around it, all work to replace the weirs would occur inland and above the OHWM, and in the dry.

The contractor would install a temporary gangway between the barge and the shore, and erect scaffolding platforms and connecting walkways to provide safe and efficient access to each of the weir replacement locations. The scaffolding will consist of a pipe and clamp system to accommodate the irregular topography of the pond and stream repair site. They would also install temporary erosion and sediment control (TESC) measures around the project area, including a silt fence downslope of and around the upland work area, and a full-depth sediment curtain around the barge (Figure 5).

They would turn off the water flow to the stream and ponds, then drain the stream and pond feature using a small pump. Then, using shovels and wheelbarrows, they would remove accumulated deposits, which would be collected on the barge for transportation to an approved offsite disposal site.

At each weir replacement location, the contractors would saw the deteriorated cedar logs into manageable lengths so they can be taken by wheelbarrow to the barge for offsite disposal. They would use shovels to manually excavate the soils that overlay the pond shell at each weir location to facilitate the temporary installation of concrete log forms in a manner that would allow the new concrete logs to be integrated with the existing pond shell. They would inspect the feature's concrete shell to ensure its integrity.

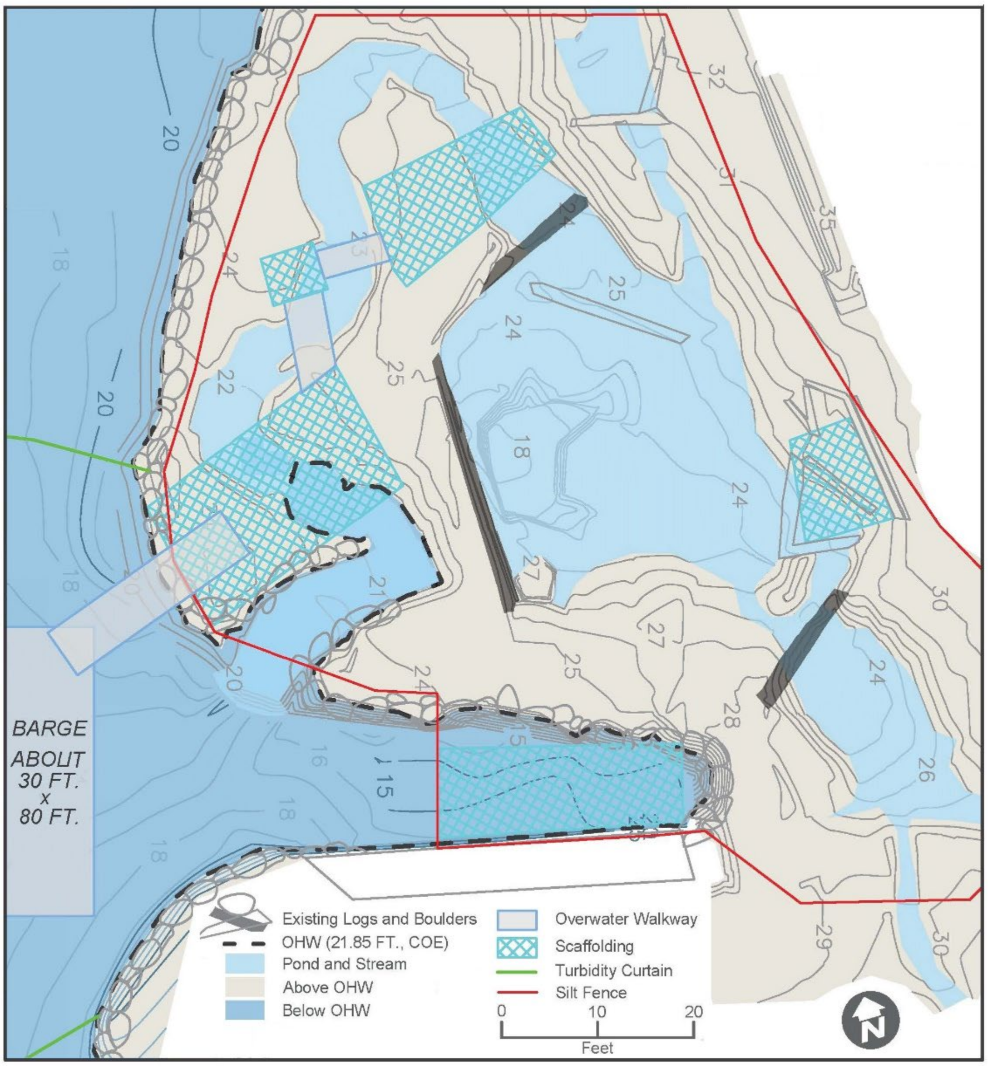

Figure 5. Overhead drawing showing the planned locations for the barge, ramps, scaffolds, and sediment controls to be used during the proposed weir replacement (Adapted from Page 4 of 10 in Lally 2021c).

The contractors would install epoxy-coated rebar dowels into holes drilled into the pond shell, then connect a cylindrical epoxy-coated rebar form over which they would spray shotcrete to create the new log weirs. Dust from the drilling operation will be captured with a HEPA filter. After all components are fully cured, they would use the excavated soils as backfill over the shell to bring the areas at the log weir replacement sites back to their original lines and grades.

Upon completion of the work, they would re-activate the pump system to refill the pond and stream feature. They would then remove all debris and the temporary erosion and sediment control measures, including the silt fence and turbidity curtain, all of which would be placed on the barge from removal from the site.

<u>Other activities that could be caused by the proposed action</u>

The NMFS considered whether or not the proposed action described above would cause any other activities that could affect listed resources. Neither the applicant nor the USACE identified any such activities. The NMFS considered the off-site gravel and cobble suppliers that may be used to produce the spawning gravel and cobbles for this project. The applicant reports that gravels and cobbles for this project would be obtained only from established quarries that are in full compliance with all applicable state and federal regulations. Because those gravel producing operations currently exist and would continue regardless of the specific needs of this project, they have their own utility that is separate from the proposed action, and as such the proposed action could not be considered to be the cause of those operations.

The NMFS also considered whether or not the proposed maintenance dredging of the small boat moorage inlet would facilitate the continued operation of small recreational craft in and adjacent to the inlet. Because the maintenance dredging is required to allow the continued use of the moorage inlet, the action would perpetuate the vessel activity at and adjacent to the inlet for at least 2 to 4 years after the end of this permitted work. The applicant reports that in addition to paddle boards and kayaks, jet-powered personal watercraft and a 26-foot long powerboat may also utilize the inlet (Lally 2022d). Therefore, we included an analysis of the effects of the related vessel operation at the moorage inlet in the effects section of this Opinion.

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 to adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with the NMFS, and section 7(b)(3) requires that, at the conclusion of consultation, the 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 the NMFS to provide an ITS that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

The USACE originally determined that the proposed action is not likely to adversely affect (NLAA) PS Chinook salmon and their designated critical habitat, and PS steelhead, and would have no effect on designated critical habitat for PS steelhead, Southern Resident (SR) killer whales, and designated critical habitat for SR killer whales. The USACE subsequently requested formal consultation without specifically revising their individual effects determinations (USACE

2021b). The NMFS interpreted the request for formal consultation to only revise the USACE's NLAA determinations to likely to adversely affect for PS Chinook salmon, PS steelhead, and designated critical habitat for PS Chinook salmon.

Because the NMFS has concluded that the proposed action is likely to adversely affect PS Chinook salmon, PS steelhead, and designated critical habitat for PS Chinook salmon (Table 1), the NMFS has proceeded with formal consultation. Additionally, because of the trophic relationship between PS Chinook salmon and SR killer whales, the NMFS analyzed the action's potential effects on SR killer whales and their designated critical habitat in the "Not Likely to Adversely Affect" Determinations section (2.12) of this opinion.

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

ESA-listed species and critical habitat likely to be adversely affected (LAA)				
Species	**Status**	**Species**	**Critical Habitat**	**Listed / CH Designated**
Chinook salmon (*Oncorhynchus tshawytscha*) Puget Sound	Threatened	LAA	LAA	06/28/05 (70 FR 37160) / 09/02/05 (70 FR 52630)
steelhead (*O. mykiss*) Puget Sound	Threatened	LAA	N/A	05/11/07 (72 FR 26722) / 02/24/16 (81 FR 9252)
ESA-listed species and critical habitat not likely to be adversely affected (NLAA)				
Species	**Status**	**Species**	**Critical Habitat**	**Listed / CH Designated**
Killer whales (Orcinus orca) Southern resident (SR)	Endangered	NLAA	NLAA	11/18/05 (70 FR 57565) / 11/29/06 (71 FR 69054)

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

2.1 Analytical Approach

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

The designations of critical habitat for PS Chinook salmon and SR killer whales use the term primary constituent element (PCE). The 2016 final rule (81 FR 7414; February 11, 2016) that revised the 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 the specific critical habitats.

The ESA Section 7 implementing regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the final rule revising the definition and adding this term (84 FR 44976, 44977; August 27, 2019), that revision does not change the scope of our analysis, and in this opinion we use the terms "effects" and "consequences" interchangeably.

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

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

2.2 Range-wide Status of the Species and Critical Habitat

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

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

Listed Species

Viable Salmonid Population (VSP) Criteria: For Pacific salmonids, we commonly use four VSP criteria (McElhany et al. 2000) to assess the viability of the populations that constitute the species. These four criteria (spatial structure, diversity, abundance, and productivity) encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment. "Spatial structure" refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. A population's spatial structure depends on habitat quality and spatial configuration, and the dynamics and dispersal characteristics of individuals in the population.

"Diversity" refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation in single genes to complex life history traits.

"Abundance" generally refers to the number of naturally-produced adults that return to their natal spawning grounds.

"Productivity" refers to the number of naturally-spawning adults produced per parent. When progeny replace or exceed the number of parents, a population is stable or increasing. When progeny fail to replace the number of parents, the population is in decline.

For species with multiple populations, we assess the status of the entire species based on the biological status of the constituent populations, using criteria for groups of populations, as described in recovery plans and guidance documents from technical recovery teams. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as metapopulations (McElhany et al. 2000).

The summaries that follow describe the status of the ESA-listed species, and their designated critical habitats, that occur within the geographic area of this proposed action and are considered in this opinion. More detailed information on the status and trends of these listed resources, and their biology and ecology, are in the listing regulations and critical habitat designations published in the Federal Register.

Puget Sound (PS) Chinook Salmon: The PS Chinook salmon evolutionarily significant unit (ESU) was listed as threatened on June 28, 2005 (70 FR 37160). We adopted the recovery plan for this ESU in January 2007. The recovery plan consists of two documents: the Puget Sound salmon recovery plan (SSPS 2007) and the final supplement to the Shared Strategy's Puget Sound salmon recovery plan (NMFS 2006). The recovery plan adopts ESU and population level viability criteria recommended by the Puget Sound Technical Recovery Team (PSTRT) (Ruckelshaus et al. 2002). The PSTRT's biological recovery criteria will be met when all of the following conditions are achieved:

- The viability status of all populations in the ESU is improved from current conditions, and when considered in the aggregate, persistence of the ESU is assured;
- Two to four Chinook salmon populations in each of the five biogeographical regions of the ESU achieve viability, depending on the historical biological characteristics and acceptable risk levels for populations within each region;
- At least one population from each major genetic and life history group historically present within each of the five biogeographical regions is viable;
- Tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations are functioning in a manner that is sufficient to support an ESU-wide recovery scenario; Production of Chinook salmon from tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations occurs in a manner consistent with ESU recovery; and
- Populations that do not meet all the Viable Salmon Population (VSP) parameters are sustained to provide ecological functions and preserve options for ESU recovery.

General Life History: Chinook salmon are anadromous fish that require well-oxygenated water that is typically less than 63º F (17º C), but some tolerance to higher temperatures is documented with acclimation. Adult Chinook salmon spawn in freshwater streams, depositing fertilized eggs in gravel "nests" called redds. The eggs incubate for three to five months before juveniles hatch and emerge from the gravel. Juveniles spend from three months to two years in freshwater before migrating to the ocean to feed and mature. Chinook salmon spend from one to six years in the ocean before returning to their natal freshwater streams where they spawn and then die.

Chinook salmon are divided into two races, stream-types and ocean-types, based on the major juvenile development strategies. Stream-type Chinook salmon tend to rear in freshwater for a year or more before entering marine waters. Conversely, ocean-type juveniles tend to leave their natal streams early during their first year of life, and rear in estuarine waters as they transition into their marine life stage. Both stream- and ocean-type Chinook salmon are present, but ocean-type Chinook salmon predominate in Puget Sound populations.

Chinook salmon are further grouped into "runs" that are based on the timing of adults that return to freshwater. Early- or spring-run chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and finally spawn in the late summer and early autumn. Late- or fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas, and spawn within a few days or weeks. Summer-run fish show intermediate characteristics of spring and fall runs, without the extensive delay in maturation exhibited by spring-run Chinook salmon. In Puget Sound, spring-run Chinook salmon tend to enter their natal rivers as early as March, but do not spawn until mid-August through September. Returning summer- and fall-run fish tend to enter the rivers early-June through early-September, with spawning occurring between early August and late-October.

Yearling stream-type fish tend to leave their natal rivers late winter through spring, and move relatively directly to nearshore marine areas and pocket estuaries. Out-migrating ocean-type fry tend to migrate out of their natal streams beginning in early-March. Those fish rear in the tidal delta estuaries of their natal stream for about two weeks to two months before migrating to marine nearshore areas and pocket estuaries in late May to June. Out-migrating young of the year parr tend to move relatively directly into marine nearshore areas and pocket estuaries after leaving their natal streams between late spring and the end of summer.

Spatial Structure and Diversity: The PS Sound Chinook salmon ESU includes all naturally spawning populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington. The ESU also includes the progeny of numerous artificial propagation programs (NWFSC 2015). The PSTRT identified 22 extant populations, grouped into five major geographic regions, based on consideration of historical distribution, geographic isolation, dispersal rates, genetic data, life history information, population dynamics, and environmental and ecological diversity. The PSTRT distributed the 22 populations among five major biogeographical regions, or major population groups (MPGs), that are based on similarities in hydrographic, biogeographic, and geologic characteristics (Table 2).

Table 2. Extant PS Chinook salmon populations in each biogeographic region (Ruckelshaus et al. 2002, NWFSC 2015).

Biogeographic Region	Population (Watershed)
Strait of Georgia	North Fork Nooksack River
	South Fork Nooksack River
Strait of Juan de Fuca	Elwha River
	Dungeness River
Hood Canal	Skokomish River
	Mid Hood Canal River
Whidbey Basin	Skykomish River
	Snoqualmie River
	North Fork Stillaguamish River
	South Fork Stillaguamish River
	Upper Skagit River
	Lower Skagit River
	Upper Sauk River
	Lower Sauk River
	Suiattle River
	Upper Cascade River
Central/South Puget Sound Basin	Cedar River
	North Lake Washington/ Sammamish River
	Green/Duwamish River
	Puyallup River
	White River
	Nisqually River

Hatchery-origin spawners are present in high fractions in most populations within the ESU, with the Whidbey Basin the only MPG with consistently high fractions of natural-origin spawners. Between 1990 and 2014, the fraction of natural-origin spawners has declined in many of the populations outside of the Skagit watershed (NWFSC 2015).

Abundance and Productivity: Available data on total abundance since 1980 indicate that abundance trends have fluctuated between positive and negative for individual populations, but productivity remains low in most populations, and hatchery-origin spawners are present in high fractions in most populations outside of the Skagit watershed. Available data now show that most populations have declined in abundance over the past 7 to 10 years. Further, escapement levels for all populations remain well below the PSTRT planning ranges for recovery, and most populations are consistently below the spawner-recruit levels identified by the PSTRT as consistent with recovery (NWFSC 2015). The current information on abundance, productivity, spatial structure and diversity suggest that the Whidbey Basin MPG is at relatively low risk of extinction. The other four MPGs are considered to be at high risk of extinction due to low abundance and productivity (NWFSC 2015). The most recent 5-year status review concluded that the ESU should remain listed as threatened (NMFS 2017).

Limiting Factors: Factors limiting recovery for PS Chinook salmon include:

- Degraded floodplain and in-river channel structure
- Degraded estuarine conditions and loss of estuarine habitat
- Riparian area degradation and loss of in-river large woody debris
- Excessive fine-grained sediment in spawning gravel
- Degraded water quality and temperature
- Degraded nearshore conditions
- Impaired passage for migrating fish
- Severely altered flow regime

PS Chinook Salmon within the Action Area: The PS Chinook salmon that are likely to occur in the action area would be fall-run Chinook salmon from the Cedar River population and from the North Lake Washington / Sammamish River population (NWFSC 2015; WDFW 2022a). Both stream- and ocean-type Chinook salmon are present in these populations, with the majority being ocean-types.

The Cedar River population is relatively small, with a total annual abundance fluctuating at close to 1,000 fish (NWFSC 2015; WDFW 2022b). Between 1965 and 2021, the total abundance for PS Chinook salmon in the basin has fluctuated between about 133 and 2,451 individuals, with the average trend being slightly negative. The 2015 status review reported that the 2010 through 2014 5-year geometric mean for natural-origin spawner abundance had shown a positive change since the 2010 status review, with natural-origin spawners accounting for about 82% of the population. WDFW data suggest that natural-origin spawners accounted for about 62% of a combined total return of 963 fish in 2021 (WDFW 2022b).

The North Lake Washington / Sammamish River population is also small, with a total abundance that has fluctuated between about 33 and 2,223 individuals from 1983 through 2021, with the average trend being relatively flat (NWFSC 2015; WDFW 2022b). Natural-origin spawners make up a small proportion of the total population, accounting for about 9% of the 2,186 total return in 2021.

All returning adults and out-migrating juveniles of these two populations, as well as individuals that spawn in the numerous smaller streams across the basin, must pass the action area to complete their life cycles. Adult Chinook salmon pass through Chittenden Locks (aka Ballard Locks) between mid-June through September, with peak migration occurring in mid-August (City of Seattle 2008). Spawning occurs well upstream of the action area between early August and late October. Juvenile Chinook salmon are found in Lake Washington and Lake Sammamish between January and July, primarily in the littoral zone (Tabor et al. 2006). Outmigration through the ship canal and past the action area to the locks occurs between late-May and early-July, with the peak in June (City of Seattle 2008).

Puget Sound (PS) steelhead: The PS steelhead distinct population segment (DPS) was listed as threatened on May 11, 2007 (72 FR 26722). The NMFS adopted the recovery plan for this DPS in December 2019. In 2013, the Puget Sound Steelhead Technical Recovery Team (PSSTRT) identified 32 demographically independent populations (DIPs) within the DPS, based on genetic, environmental, and life history characteristics. Those DIPs are distributed among three geographically-based major population groups (MPGs); Northern Cascades, Central and South Puget Sound; and Hood Canal and Strait de Fuca (Myers et al. 2015) (Table 3).

In 2015, the PSSTRT concluded that the DPS is at “very low” viability; with most of the 32 DIPs and all three MPGs at “low” viability based on widespread diminished abundance, productivity, diversity, and spatial structure when compared with available historical evidence (Hard et al. 2015). Based on the PSSTRT viability criteria, the DPS would be considered viable when all three component MPG are considered viable. A given MPG would be considered viable when: 1) 40 percent or more of its component DIP are viable; 2) mean DIP viability within the MPG exceeds the threshold for viability; and 3) 40 percent or more of the historic life history strategies (i.e., summer runs and winter runs) within the MPG are viable. For a given DIP to be considered viable, its probability of persistence must exceed 85 percent, as calculated by Hard et al. (2015), based on abundance, productivity, diversity, and spatial structure within the DIP.

Table 3. PS steelhead Major Population Groups (MPGs), Demographically Independent Populations (DIPs), and DIP Viability Estimates (Modified from Figure 58 in Hard *et al.* 2015).

Geographic Region (MPG)	Demographically Independent Population (DIP)	Viability
Northern Cascades	Drayton Harbor Tributaries Winter Run	Moderate
	Nooksack River Winter Run	Moderate
	South Fork Nooksack River Summer Run	Moderate
	Samish River/Bellingham Bay Tributaries Winter Run	Moderate
	Skagit River Summer Run and Winter Run	Moderate
	Nookachamps River Winter Run	Moderate
	Baker River Summer Run and Winter Run	Moderate
	Sauk River Summer Run and Winter Run	Moderate
	Stillaguamish River Winter Run	Low
	Deer Creek Summer Run	Moderate
	Canyon Creek Summer Run	Moderate
	Snohomish/Skykomish Rivers Winter Run	Moderate
	Pilchuck River Winter Run	Low
	North Fork Skykomish River Summer Run	Moderate
	Snoqualmie River Winter Run	Moderate
	Tolt River Summer Run	Moderate
Central and South Puget Sound	Cedar River Winter Run	Low
	North Lake Washington and Lake Sammamish Winter Run	Moderate
	Green River Winter Run	Low
	Puyallup River Winter Run	Low
	White River Winter Run	Low
	Nisqually River Winter Run	Low
	South Sound Tributaries Winter Run	Moderate
	East Kitsap Peninsula Tributaries Winter Run	Moderate
Hood Canal and Strait de Fuca	East Hood Canal Winter Run	Low
	South Hood Canal Tributaries Winter Run	Low
	Skokomish River Winter Run	Low
	West Hood Canal Tributaries Winter Run	Moderate
	Sequim/Discovery Bay Tributaries Winter Run	Low
	Dungeness River Summer Run and Winter Run	Moderate
	Strait of Juan de Fuca Tributaries Winter Run	Low
	Elwha River Summer Run and Winter Run	Low

General Life History: PS steelhead exhibit two major life history strategies. Ocean-maturing, or winter-run fish typically enter freshwater from November to April at an advanced stage of maturation, and then spawn from February through June. Stream-maturing, or summer-run fish typically enter freshwater from May to October at an early stage of maturation, migrate to headwater areas, and hold for several months prior to spawning in the following spring. After hatching, juveniles rear in freshwater from one to three years prior to migrating to marine habitats (two years is typical). Smoltification and seaward migration typically occurs from April to mid-May. Smolt lengths vary between watersheds, but typically range from 4.3 to 9.2 inches (109 to 235 mm) (Myers et al. 2015). Juvenile steelhead are generally independent of shallow nearshore areas soon after entering marine water (Bax et al. 1978, Brennan et al. 2004, Schreiner et al. 1977), and are not commonly caught in beach seine surveys. Recent acoustic tagging studies (Moore et al. 2010) have shown that smolts migrate from rivers to the Strait of Juan de

Fuca from one to three weeks. PS steelhead feed in the ocean waters for one to three years (two years is again typical), before returning to their natal streams to spawn. Unlike Chinook salmon, most female steelhead, and some males, return to marine waters following spawning (Myers et al. 2015).

Spatial Structure and Diversity: The PS steelhead DPS includes all naturally spawned anadromous steelhead populations in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive). The DPS also includes six hatchery stocks that are considered no more than moderately diverged from their associated natural-origin counterparts (USDC 2014). PS steelhead are the anadromous form of *O. mykiss* that occur below natural barriers to migration in northwestern Washington State (NWFSC 2015). Non-anadromous ''resident'' *O. mykiss* (a.k.a. rainbow trout) occur within the range of PS steelhead but are not part of the DPS due to marked differences in physical, physiological, ecological, and behavioral characteristics (Hard et al. 2015). As stated above, the DPS consists of 32 DIP that are distributed among three geographically-based MPG. An individual DIP may consist of winter-run only, summer-run only, or a combination of both life history types. Winter-run is the predominant life history type in the DPS (Hard et al. 2015).

Abundance and Productivity: Available data on total abundance since the late 1970s and early 1980s indicate that abundance trends have fluctuated between positive and negative for individual DIP. However, low productivity persists throughout the 32 DIP, with most showing downward trends, and a few showing sharply downward trends (Hard et al. 2015, NWFSC 2015). Since the mid-1980s, trends in natural spawning abundance have also been temporally variable for most DIP but remain predominantly negative, and well below replacement for at least 8 of the DIP (NWFSC 2015). Smoothed abundance trends since 2009 show modest increases for 13 DIP. However, those trends are similar to variability seen across the DPS, where brief periods of increase are followed by decades of decline. Further, several of the upward trends are not statistically different from neutral, and most populations remain small. Nine of the evaluated DIP had geometric mean abundances of fewer than 250 adults, and 12 had fewer than 500 adults (NWFSC 2015). Over the time series examined, the over-all abundance trends, especially for natural spawners, remain predominantly negative or flat across the DPS, and general steelhead abundance across the DPS remains well below the level needed to sustain natural production into the future (NWFSC 2015). The PSSTRT recently concluded that the PS steelhead DPS is currently not viable (Hard et al. 2015). The DPS's current abundance and productivity are considered to be well below the targets needed to achieve delisting and recovery. Growth rates are currently declining at 3 to 10% annually for all but a few DIPs, and the extinction risk for most populations is estimated to be moderate to high. The most recent 5-year status review concluded that the DPS should remain listed as threatened (NMFS 2017).

Limiting Factors: Factors limiting recovery for PS steelhead include:

- The continued destruction and modification of steelhead habitat
- Widespread declines in adult abundance (total run size), despite significant reductions in harvest in recent years

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

<u>PS Steelhead within the Action Area:</u> The PS steelhead populations that occur in the action area consist of winter-runs from the Cedar River and North Lake Washington / Lake Sammamish DIPs (NWFSC 2015; WDFW 2022a). Both DIPs are among the smallest within the DPS. WDFW reports that the total PS steelhead abundance in the Cedar River basin has fluctuated between 0 and 900 individuals between 1984 and 2021, with a strong negative trend. Since 2000, the total annual abundance has remained under 50 fish (WDFW 2022c). NWFSC (2015) suggests that the returns may have been above 1,000 individuals during the 1980s, but agrees with the steep decline to less than 100 fish since 2000. It is unclear what proportion of the returns are natural-origin spawners, if any. A total of only 4 adults are thought to have returned in 2021 (WDFW 2022c).

The Sammamish River population is even smaller. WDFW reports that the total abundance for PS steelhead in the North Lake Washington / Lake Sammamish basin fluctuated between 0 and 916 individuals between 1984 and the last survey in 1999, with a strong negative trend. Abundance never exceeded 45 fish after 1992, and was only 4 in 1999 (WDFW 2022c). NWFSC (2015) disagrees with WDFW in that returns may have been above 1,500 individuals during the mid-1980s, but NWFSC agrees with the steep decline to virtually no steelhead in the basin since 2000.

All returning adults and out-migrating juveniles of these two populations must pass the action area to complete their life cycles. Adult steelhead pass through Chittenden Locks (aka Ballard Locks) and the Lake Washington Ship Canal between January and May, and may remain within Lake Washington through June (City of Seattle 2008). The timing of steelhead spawning in the basin is uncertain, but occurs well upstream of the action area. Juvenile steelhead enter Lake Washington in April, and typically migrate through the ship canal and past the action area to the locks between April and May (City of Seattle 2008).

<u>Critical Habitat</u>

This section describes the status of designated critical habitat that would be affected by the proposed action by examining the condition and trends of physical or biological features (PBFs) that are essential to the conservation of the listed species throughout the designated areas. The PBFs are essential because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging). The proposed project would affect critical habitat for PS Chinook salmon.

The NMFS designated critical habitat for PS Chinook salmon on September 2, 2005 (70 FR 52630). That critical habitat is located in 16 freshwater subbasins and watersheds between the Dungeness/Elwha Watershed and the Nooksack Subbasin, inclusively, as well as in nearshore marine waters of the Puget Sound that are south of the US-Canada border and east of the Elwha River, and out to a depth of 30 meters. Although offshore marine is an area type identified in the final rule, it was not designated as critical habitat for PS Chinook salmon.

The PBFs of salmonid critical habitat include: (1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development; (2) Freshwater rearing sites with: (i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) Water quality and forage supporting juvenile development; and (iii) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks; (3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival; (4) Estuarine areas free of obstruction and excessive predation with: (i) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation; (5) Nearshore marine areas free of obstruction and excessive predation with: (i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and (6) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation. The PBF for PS Chinook salmon CH are listed in Table 4.

Major tributary river basins in the Puget Sound basin include the Nooksack, Samish, Skagit, Sauk, Stillaguamish, Snohomish, Lake Washington, Cedar, Sammamish, Green, Duwamish, Puyallup, White, Carbon, Nisqually, Deschutes, Skokomish, Duckabush, Dosewallips, Big Quilcene, Elwha, and Dungeness rivers and Soos Creek. Critical habitat throughout the Puget Sound basin has been degraded by numerous activities, including hydropower development, loss of mature riparian forests, increased sediment inputs, removal of large wood from the waterways, intense urbanization, agriculture, alteration of floodplain and stream morphology (i.e., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, dredging, armoring of shorelines, marina and port development, road and railroad construction and maintenance, logging, and mining. Changes in habitat quantity, availability, and diversity, and flow, temperature, sediment load and channel instability are common limiting factors of critical habitat throughout the basin.

Table 4. Physical or biological features (PBFs) of designated critical habitat for PS Chinook salmon, and corresponding life history events. Although offshore marine areas were identified in the final rule, none was designated as critical habitat.

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

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

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

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

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

Dams constructed for hydropower generation, irrigation, or flood control have substantially affected PS Chinook salmon populations in a number of river systems. The construction and operation of dams have blocked access to spawning and rearing habitat, changed flow patterns, resulted in elevated temperatures and stranding of juvenile migrants, and degraded downstream spawning and rearing habitat by reducing recruitment of spawning gravel and large wood to downstream areas (SSPS 2007). These actions tend to promote downstream channel incision and simplification (Kondolf 1997), limiting fish habitat. Water withdrawals reduce available fish habitat and alter sediment transport. Hydropower projects often change flow rates, stranding and killing fish, and reducing aquatic invertebrate (food source) productivity (Hunter 1992).

Juvenile mortality occurs in unscreened or inadequately screened diversions. Water diversion ditches resemble side channels in which juvenile salmonids normally find refuge. When diversion headgates are shut, access back to the main channel is cut off and the channel goes dry. Mortality can also occur with inadequately screened diversions from impingement on the screen, or mutilation in pumps where gaps or oversized screen openings allow juveniles to get into the system. Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in many Puget Sound tributary basins (SSPS 2007).

The nearshore marine habitat has been extensively altered and armored by industrial and residential development near the mouths of many of Puget Sound's tributaries. A railroad runs along large portions of the eastern shoreline of Puget Sound, eliminating natural cover along the shore and natural recruitment of beach sand (SSPS 2007).

Degradation of the near-shore environment has occurred in the southeastern areas of Hood Canal in recent years, resulting in late summer marine oxygen depletion and significant fish kills. Circulation of marine waters is naturally limited, and partially driven by freshwater runoff, which is often low in the late summer. However, human development has increased nutrient loads from failing septic systems along the shoreline, and from use of nitrate and phosphate fertilizers on lawns and farms. Shoreline residential development is widespread and dense in many places. The combination of highways and dense residential development has degraded certain physical and chemical characteristics of the near-shore environment (HCCC 2005; SSPS 2007).

Critical Habitat within the Action Area: Critical habitat has been designated for PS Chinook salmon along the entire length of the Lake Washington Ship Canal, Lake Union, Portage Bay, all of Lake Washington, about 950 yards upstream into in the Sammamish River, and well upstream into the Cedar River watershed. The critical habitat in lake Washington provides the Freshwater Migration PBF for PS Chinook (NOAA 2022; WDFW 2022a).

2.3 Action Area

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

The project site is located along the eastern shore of Lake Washington in Medina, Washington (Figure 1). As described in section 2.5, construction-related forage contamination would be the stressor with the greatest range of effects on fish. Detectable effects would be limited to the waters and substrates within about 300 feet around the project site. However, trophic connectivity between PS Chinook salmon and the SR killer whales that feed on them extends the action area to the marine waters of Puget Sound. The described area overlaps with the geographic ranges of the ESA-listed species and the boundaries of designated critical habitats identified in Table 1. The action area also overlaps with areas that have been designated, under the MSA, as EFH for Pacific Coast salmon, Pacific Coast groundfish, and coastal pelagic species.

2.4 Environmental Baseline

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

Environmental conditions at the project sites and the surrounding area: The project site is located along the eastern shore of Lake Washington in Medina, Washington (Figure 1). Although the action area includes the marine waters of Puget Sound, all detectable effects of the action would be limited to Lake Washington within about 300 feet of the project site (Sections 2.5 &

2.12). Therefore this section focuses on habitat conditions in Lake Washington, and does not discuss Puget Sound habitat conditions.

Lake Washington is a long, narrow, freshwater lake with steeply sloping sides. It is about 22 miles long, north to south, has an average width of 1.5 miles, and covers about 21,500 acres. The lake has an average depth of about 100 feet, and is just over 200 feet deep at its deepest (City of Seattle 2010). The Lake Washington watershed covers about 300,000 acres (472 square miles), and its major influent streams are the Cedar and Sammamish Rivers. The Cedar River enters at the southern end of the lake and contributes about 57 percent of the lake's water. The Sammamish River enters at the north end of the lake, and contributes about 27 percent of the lake's water (King County 2016). Numerous creeks, including Coal, Forbes, Juanita, May, McAleer, Ravenna, and Thornton Creeks also flow directly into Lake Washington.

The geography and ecosystems in and adjacent to the action area have been dramatically altered by human activity since European settlers first arrived in the 1800s. Historically, the Cedar River did not enter the lake, and Lake Washington's waters flowed south to the Duwamish River via the now absent Black River. In the 1880s, dredging and excavation was started to create a navigable passage between Lake Washington and the marine waters of Shilshole Bay. In 1911, engineers rerouted the Cedar River into Lake Washington to create an industrial waterway and to prevent flooding in Renton. In 1916, the Lake Washington Ship Canal was opened, which lowered water levels in the lake by about nine feet, and stopped flows through the Black River.

The majority of the lake's watershed is now highly developed and urban in nature with 63 percent of the area considered fully developed (King County 2016). The City of Seattle boarders most of the west side of the lake. The cities of Bellevue and Kirkland are along the eastern shoreline, with the Cities of Kenmore and Renton on the north and south ends, respectively. Water quality in the lake has been impacted by point and nonpoint pollution sources including past sewage discharges. Ongoing sources include stormwater discharges and subsurface runoff containing pollutants from roadways, failing septic systems, underground petroleum storage tanks, and fertilizers and pesticides from commercial and residential sites. It has also been impacted by upstream forestry and agricultural practices. Cleanup efforts since the 1960s and 1970s, including diversion of wastewater away from the lake, have improved conditions, such that water quality in the lake is generally considered good (City of Seattle 2010).

Urban development has converted most of the original lake shoreline from a mix of thick riparian forests, shrub-scrub, and emergent wetlands to residential gardens and lawns, with only small scattered patches of natural riparian growth remaining (Toft 2001). Additionally, as of the year 2000, over 70 percent of the lake's shoreline had been armored by bulkheads and rip rap, and over 2,700 docks had been installed around the lake (Toft 2001). It is almost certain that those numbers have increased since then.

The armored shorelines around most of Lake Washington, have converted the gently sloping gravel shorelines with very shallow waters that are favored by juvenile salmon, into artificially steep substrates with relatively deep water. Numerous piers and docks create harsh over-water shadows that limit aquatic productivity and hinder shoreline migration of juvenile salmon. Additionally, the artificial shorelines and overwater structures provide habitat conditions that favor fish species that prey on juvenile salmonids, especially the non-native smallmouth bass. Other predators in the lake include the native northern pikeminnow and the non-native largemouth bass (Celedonia et al. 2008a and b; Tabor et al. 2010).

The project site is outside of any areas documented by the Washington State Department of Ecology (WDOE) as having water and or sediment contamination issues (WDOE 2022). The shoreline upland of the lake is vegetated with large trees and shrubs along its entire length (Figure 1). Two artificial sockeye salmon spawning reefs with upwelling systems were constructed along the shoreline at the site in 1995/1996. With the exception of a small pocket beach upslope from the south spawning reef, and emergent gravels along the shoreline at the north spawning reef, the entire shoreline is armored by a rock bulkhead. (Figure 2). The two reefs combined provide about a quarter of an acre of shallow, gently sloping bench with rounded gravels. Periphyton grows on reef gravels, particularly in deeper areas that are below the influence of stronger waves. Otherwise, the spawning reefs are generally free of submerged aquatic vegetation (SAV) during all seasons.

A small pier and a small craft inlet are present between the two spawning reefs. A pocket beach is located upslope of the southern spawning reef. Apart from a small sand area located atop the beach crest, the pocket beach is consists primarily of spawning gravel. The benthic habitat north, south, and offshore of the two reefs consists primarily of steeply sloped fine sediments and silt with large stands of Eurasian watermilfoil.

An artificial pond and stream system were also constructed at the site in 1995/1996. The stream outlet is located near the juncture of the lake shoreline and north side of the boat moorage inlet. Water flow to the reef upwelling systems and to the upland pond and stream complex is provided by two offshore pump intakes (Figure 2). The intakes are enclosed with NMFS-compliant fish screens. The applicant's BE reports that Adult Coho and sockeye salmon have been observed spawning in the stream, and juvenile Coho have been observed rearing in the pond and in the shoreline habitat adjacent to the stream outlet (Lally 2021a).

The past and ongoing anthropogenic impacts described above have reduced the project area's ability to support migrating PS Chinook salmon and PS steelhead. However, the project area continues to provide migratory habitat for adults and juveniles of both species, and the area has been designated as critical habitat for PS Chinook salmon.

<u>Climate Change:</u> Climate change has affected the environmental baseline of aquatic habitats across the region and within the action area. However, the effects of climate change have not been homogeneous across the region, nor are they likely to be in the future. During the last century, average air temperatures in the Pacific Northwest have increased by 1 to 1.4° F (0.6 to 0.8 °C), and up to 2° F (1.1 °C) in some seasons (based on average linear increase per decade; Abatzoglou et al. 2014; Kunkel et al. 2013). Recent temperatures in all but two years since 1998 ranked above the 20th century average (Mote et al. 2013). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10° F (1.7 to 5.6° C), with the largest increases predicted to occur in the summer (Mote et al. 2014).

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

The combined effects of increasing air temperatures and decreasing spring through fall flows are expected to cause increasing stream temperatures; in 2015, this resulted in 3.5-5.3ºC increases in Columbia Basin streams and a peak temperature of 26ºC in the Willamette (NWFSC 2015). Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al. 2009).

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

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

The adaptive ability of these threatened and endangered species is depressed due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. Without these natural sources of resilience, systematic changes in local and regional climatic conditions due to anthropogenic global climate change will likely reduce long-term viability and sustainability of populations in many of these ESUs (NWFSC 2015). New stressors generated by climate change, or existing stressors with effects that have been amplified by climate change, may also have synergistic impacts on species and ecosystems (Doney et al. 2012). These conditions will possibly intensify the climate change stressors inhibiting recovery of ESA-listed species in the future.

2.5 Effects of the Action

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

The USACE proposes to authorize the applicant to continue ongoing shoreline and nearshore sediment and habitat maintenance work over a 4-Year period. They would also authorize the applicant to repair an artificial stream and pond complex at the same site. The shoreline and nearshore maintenance work, would take place every 2 to 4 years, and require about 5 days of in-water work each time. With the exception of quarterly hand cleaning of water in-take screens, the work would be done during the July 15 through September 30 in-water work window for the area. The work to repair the artificial stream and pond complex would require up to 10 weeks of work that would also be done between July 15 and September 30.

The proposed work would cause direct effects on the fish and habitat resources that are present during the in-water work through exposure to work-related noise, water contamination, and propeller wash, and indirect effects from exposure to altered benthic habitat from maintenance dredging of the small boat inlet. The USACE's authorization of the maintenance dredging of the small boat inlet would also have the additional effects of extending the functionality of the inlet by at least 2 to 4 years after the end of this permitted work. Over that time, powerboat operations in the inlet would cause effects on fish and habitat resources through pollutants, elevated noise, and propeller wash.

2.5.1 Effects on Listed Species

Work-related direct effects

Work-related direct effects (i.e. work-related noise, water contamination, and propeller wash) are unlikely to adversely affect PS Chinook salmon and PS steelhead because it is extremely unlikely that individuals of either species would experience meaningful direct effects from any work-related stressors.

The proposed dredging, gravel installation, and related tugboat operations would be the project components that would cause the stressors with the greatest intensity and range for fish at the project site; elevated noise and degraded water quality. Based on numerous similar projects in Lake Washington, detectable effects from elevated noise would be limited to the in-water area within about 72 feet around the work and related tugboat operations, and they would end immediately after the cessation of work. Similarly, detectable water quality impacts work would be limited to the in-water area within about 300 feet around the work and related tugboat operations, and they would be virtually undetectable within a low number of hours after the cessation of work.

Additionally, the planned work window avoids the normal migration season for juvenile PS Chinook salmon. Therefore, with the exception of quarterly intake screen cleaning outside of that window, juvenile Chinook salmon are extremely unlikely to present during the proposed in-water work. If juvenile Chinook salmon are at the site during quarterly screen cleaning, it is most likely that the fish would remain in the very shallow water immediately adjacent to the shoreline, whereas the very brief hand brushing of the intake screens intake screen would occur 20 yards or more away. Therefore, it is extremely unlikely that the juveniles would detect or respond in any meaningful way to that work.

The work window overlaps the normal migration season for returning adult PS Chinook salmon, and slightly overlaps the normal migration seasons for juvenile and adult PS steelhead. However, juvenile steelhead the adults of both species are shoreline independent and likely to remain in deeper offshore waters as they migrate past the site. Additionally, neither species are believed to spawn at the project site, so no adults are expected to be compelled to approach the site, and no juveniles are expected to emigrate from the spawning reefs or from the artificial stream. At most, exposed adult PS Chinook salmon and juvenile and adult PS steelhead that migrate past the site may experience minor behavioral disturbance, in the form of temporary avoidance the area, which would not meaningfully affect their normal behaviors or cause any fitness impacts.

Further, PS steelhead are very rare in the Lake Washington watershed. Fewer than 10 adults from the North Lake Washington and Lake Sammamish population returned to the watershed between 1994 and 1999 when the last WDFW survey was done. Similarly, 50 adults from the Cedar River population have returned to the watershed since 2000, with 10 or less returning since 2007 (WDFW 2022d). Therefore, it is extremely unlikely that any PS steelhead would be present at the project site during any of the covered work events.

Therefore, it is extremely unlikely that PS Chinook salmon and PS steelhead would be exposed to the direct effects of the proposed action. However, over the years-long life of the small boat inlet, juveniles of both species would be exposed to the action's indirect effects when they pass through the project area during their annual out-migration seasons. The PBFs of PS Chinook salmon critical habitat would also be exposed to the action's direct and indirect effects.

<u>Altered benthic habitat</u>

The proposed maintenance dredging of the small boat inlet would maintain altered habitat conditions that are likely to adversely affect juvenile PS Chinook salmon and juvenile PS steelhead.

The normal behaviors of juvenile Chinook salmon in the freshwater emigration phase of their life cycle include a strong tendency toward shoreline obligation, which means that they are biologically compelled to follow and stay close to streambanks and shorelines, and likely to pass through and forage within the project area. The normal behaviors of out-migrating juvenile steelhead is much less tied to shoreline habitats. However, over the years-long presence of the inlet, some out-migrating juvenile steelhead are likely to pass through and forage within the project area.

Over the next 4 years, the applicant's contractors would dredge the small boat inlet every 2 to 4 years. They would also install spawning gravels on a small pocket beach and 2 artificial reefs every 2 to 4 years. By design, maintenance dredging maintains areas of artificially deep water areas with steep slopes by removing accumulated sediments. When dredged to design depth, the small boat inlet presents a 15- to 30-foot wide steep sided swath of 5-foot deep water habitat that cuts across a migratory route for the subset of each year's juvenile Chinook salmon cohort that annually migrate past the site, and for the occasional juvenile steelhead that migrate past the site.

The juvenile Chinook salmon that migrate past the project site would be in a life stage that includes a strong preference for very shallow water and gently sloping substrates. Conversely, the predatory fish that feed on juvenile salmon typically occur in deeper water (Celedonia et al. 2008a; Tabor et al. 2010; Willette 2001). The NMFS knows of no specific figures for freshwater, but Willette (2001) found that marine piscivorous predation of juvenile salmon increased fivefold when juvenile salmon were forced to swim away from shallow nearshore habitats. Therefore, swimming across the inlet would increase the risk of predation for juvenile Chinook salmon by forcing them to swim across artificially deepened water. Although not quite shoreline obligated, juvenile steelhead that migrate through the project area would also experience increased the risk of predation in the inlet than they would if the inlet wasn't present.

Therefore, over the 4-year life of this consultation, and beyond until the substrate within the inlet returns to a more natural bathymetry, it is extremely likely that at least some juvenile PS Chinook salmon and juvenile PS steelhead would experience action-related increased risk of predation.

Additionally, foraging in deeper water typically has higher energetic costs for juvenile salmon as compared to foraging in shallow shoreline waters (Heerhartz and Toft 2015). Therefore, some of the juvenile PS Chinook salmon and juvenile PS steelhead that swim across the inlet may also experience reduced fitness due to increased energetic costs.

The dredging would also reduce the abundance of benthic organisms within the inlet, and alter the population structure of the area's benthic community as compared to what would occur in the absence of dredging. Dredging removes benthic infaunal and epifaunal invertebrate organisms (Armstrong et al. 1981). It also removes SAV, which provides important structural environments that form the base of detrital-based food webs that are a source of secondary production by supporting epiphytic plants, animals, and microbial organisms that in turn are grazed upon by other invertebrates and by larval and juvenile fish (NMFS 1997). The removal of benthic invertebrates reduces the availability of their larvae, as well as the availability of copepods, daphnids, and larval fish that prey on them, and in turn are prey for juvenile salmon (NMFS 2006). The loss of SAV also reduces the availability of structural habitat that juvenile salmon use to avoid predators.

The available information to describe ecosystem responses to dredging indicates that little recovery occurs during the first seven months after dredging. After that, early successional fauna would begin to dominate over the next six months (Jones and Stokes 1998). The rate and degree of SAV recovery is uncertain, but could also take more than a year. Therefore, the proposed maintenance dredging would likely maintain reduced availability of benthic organisms and SAV within the inlet. The reduced abundance of benthic organisms in the project area would likely act synergistically with the altered habitat structure to increase energetic costs and further reduce the fitness of some of the juvenile PS Chinook salmon and juvenile PS steelhead that swim across the inlet. Therefore, over the 4-year life of this consultation, and beyond until the benthic community within the inlet fully recovers, it is extremely likely that at least some juvenile PS Chinook salmon and juvenile PS steelhead would experience action-related trophic impacts that would reduce their fitness enough to reduce their likelihood of survival and growth to adulthood.

The annual numbers of juvenile PS Chinook salmon and juvenile PS steelhead that may be exposed to action-related increased risk of predation and or experience action-related reduced fitness due to diminished forage availability are uncertain. However, the best available information about the sizes of the affected populations, combined with the numerous emigration routes taken by juvenile Chinook salmon and steelhead in the lake supports the understanding that the subsets of the annual juvenile Chinook salmon and steelhead cohorts that would annually migrate through the affected area would be small and highly variable.

Similarly, the intensity of the effects any exposed individual would experience is uncertain, and likely to be highly variable. However, the small affected area combined with the complexities of predator/prey dynamics as well as variations in environmental conditions at the site suggest that predatory fish density in the inlet is likely to be low, and the small size and suboptimal habitat conditions of the inlet support the expectation that juvenile Chinook salmon and steelhead would transit the inlet quickly. Therefore, the likelihood that any individual juvenile Chinook salmon or steelhead would be injured or killed due to action-related increased exposure to predators would be very low. Similarly, the small affected area combined with the expectation that juvenile Chinook salmon and steelhead would transit the inlet quickly suggests that the probability that any individual would experience detectably reduced fitness due to action-related diminished forage availability would be low. Therefore, the annual numbers of juvenile PS Chinook salmon juvenile steelhead that would be injured or killed by predation or that experience reduced fitness due to forage diminishment would be too small to cause detectable population-level effects.

The proposed installation of spawning gravels on the south pocket beach and on the 2 artificial reefs at the project site would act to artificially maintain shallow gently sloping gravelly substrate conditions that are favorable to migrating juvenile salmon, and would cause no conditions or effects that are likely to disturb normal behaviors or cause any negative fitness impacts on the juvenile Chinook salmon that migrate past the project site.

<u>Inlet-related pollutants</u>

Inlet-related pollutants are unlikely to adversely affect PS Chinook salmon and PS steelhead because it is extremely unlikely that the concentrations of inlet-related pollutants would be high enough to cause detectable effects in either species through direct exposure to pollutants in the water column or through indirect exposure to pollutants through the trophic web.

The most likely source of inlet-related pollutants would be fuels and lubricants that are discharged from the powerboats that may occasionally utilize the inlet. However, the episodic and short-duration of powerboat operations in the inlet support the understanding that vessel-related discharges of petroleum-based pollutants would be very infrequent and small, and that in-water concentrations would be very low and quickly diluted to undetectable levels.

Further, because the typical boating season is outside of the normal emigration timing for juvenile Chinook salmon and steelhead, and because vessel operations in the inlet would be episodic and short in duration, it is very unlikely that any individuals would be exposed to detectable concentrations of vessel-related pollutants.

The infrequent and low-concentration discharges of inlet-related pollutants is extremely unlikely to cause any detectable reduction in prey availability, or any detectable increase in prey contamination.

Based on the best available information, as described above, it is extremely unlikely that the concentrations of any inlet-related pollutants would be high enough to cause detectable effects in PS Chinook salmon and or PS steelhead through direct or indirect exposures.

Inlet-related noise

Inlet-related noise is likely to adversely affect juvenile PS Chinook salmon and juvenile PS steelhead, but cause minor effects in adults of both species. As described above, juvenile Chinook salmon and steelhead are likely to pass through the project area, but the adults of both species are independent of shallow water nearshore habitats in the lake, and therefore unlikely to be meaningfully exposed to this stressor.

The effects caused by a fish's exposure to noise vary with the hearing characteristics of the fish, the frequency, intensity, and duration of the exposure, and the context under which the exposure occurs. At low levels, effects may include the onset of behavioral disturbances such as acoustic masking (Codarin et al. 2009), startle responses and altered swimming (Neo et al. 2014), abandonment or avoidance of the area of acoustic effect (Mueller 1980; Picciulin et al. 2010; Sebastianutto et al. 2011; Xie et al. 2008), and increased vulnerability to predators (Simpson et al. 2016). At higher intensities and or longer exposure durations, the effects may rise to include temporary hearing damage (a.k.a. temporary threshold shift or TTS, Scholik and Yan 2002) and increased stress (Graham and Cooke 2008). At even higher levels, exposure may lead to physical injury that can range from the onset of permanent hearing damage (a.k.a. permanent threshold shift or PTS) and mortality. The best available information about the auditory capabilities of the fish considered in this opinion suggest that their hearing capabilities are limited to frequencies below 1,500 Hz, with peak sensitivity between about 200 and 300 Hz (Hastings and Popper 2005; Picciulin et al. 2010; Scholik and Yan 2002; Xie et al. 2008).

The NMFS uses two metrics to estimate the onset of injury for fish exposed to high intensity impulsive sounds (Stadler and Woodbury 2009). The metrics are based on exposure to peak sound level and sound exposure level (SEL). Both are expressed in decibels (dB). The metrics are: 1) exposure to 206 dB_{peak}; and 2) exposure to 187 dB SEL_{cum} for fish 2 grams or larger, or 183 dB SEL_{cum} for fish under 2 grams. Further, any received level (RL) below 150 dB_{SEL} is considered "Effective Quiet". The distance from a source where the RL drops to 150 dB_{SEL} is considered the maximum distance from that source where fishes can potentially experience TTS or PTS from the noise, regardless of accumulation of the sound energy (Stadler and Woodbury 2009). When the range to the 150 dB_{SEL} isopleth exceeds the range to the applicable SEL_{CUM} isopleth, the distance to the 150 dB_{SEL} isopleth is typically considered the range at which detectable behavioral effects would begin, with the applicable SEL_{CUM} isopleth identifying the distance within which sound energy accumulation would intensify effects. However, when the range to the 150 dB_{SEL} isopleth is less than the range to the applicable SEL_{CUM} isopleth, only the 150 dB_{SEL} isopleth would apply because no accumulation effects are expected for noise levels below 150 dB_{SEL}. This assessment considers the range to the 150 dB_{SEL} isopleths as the maximum ranges for detectable acoustic effects because this action's inlet -related vessel operations are unlikely to extend long enough to cause effects due to accumulated sound energy.

The discussion in Stadler and Woodbury (2009) indicate that these thresholds likely overestimate the potential effects of exposure to impulsive sounds. Further, Stadler and Woodbury's assessment did not consider non-impulsive sound, which is believed to be less injurious to fish than impulsive sound. Therefore, application of the criteria to non-impulsive sounds is also likely to overestimate the potential effects in fish. However, these criteria represent the best available information. Therefore, to avoid underestimating potential effects, this assessment applies these criteria to the non-impulsive sounds that are expected from inlet-related noise to gain a conservative idea of the potential effects that fish may experience due to exposure to that noise.

Elevated in-water noise at levels capable of causing detectable effects in exposed fish would be caused by episodic vessel operations at the applicant's inlet. The applicant reports that a powerboat may be periodically use the inlet. The applicant reports that jet-powered personal watercraft and a 26-foot long powerboat may utilize the inlet.

The estimated in-water source levels (SL, sound level at 1 meter from the source) used in this assessment are based on numerous sources that describe sound levels for ocean-going ships, tugboats, and recreational vessels (Blackwell and Greene 2006; McKenna et al. 2012; Picciulin et al. 2010; Reine et al. 2014; Richardson et al. 1995). The best available information about the source levels from vessels close in size to those that would operate at the inlet is also described in the acoustic assessment done for a similar project (NMFS 2018). In this assessment, we examined vessel noise from an 85-foot long ferry, tugboats, and a 23-foot long powerboat, and used the noise for the 23-foot long powerboat as the surrogate to estimate potential vessel noise levels at the applicant's inlet. All of the expected peak source levels are below the 206 dB_{peak} threshold for instantaneous injury in fish.

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

Application of the practical spreading loss equation to the expected SEL SLs suggests that noise levels above the 150 dB_{SEL} threshold would extend between about 33 feet (10 m) and 207 feet (63 m) from the 23-foot long powerboat used as a surrogate for this assessment (Table 5).

Table 5. Estimated in-water source levels for vessels similar to those that may operate in the applicant's inlet, and ranges to effects thresholds for fish.

Source	Acoustic Signature	Source Level	Threshold Range
85 foot Tourist Ferry	< 2 kHz Combination	187 dB_{peak}	206 @ N/A
Episodic periods measured in minutes to hours		177 dB_{SEL}	150 @ 63 m
Tugboat	< 2 kHz Combination	185 dB_{peak}	206 @ N/A
Episodic periods measured in minutes to hours		170 dB_{SEL}	150 @ 22 m
23 foot Boat w/ 2 4~ 100 HP Outboard Engines.	< 2 kHz Combination	175 dB_{peak}	206 @ N/A
Episodic brief periods measures in minutes		165 dB_{SEL}	150 @ 10 m

Individual vessel operations close to mooring structures typically consist of brief periods of relatively low-speed movement as boats are driven to the structures and tied up. Their engines are typically shut off within minutes of arrival. The engines of departing vessels are typically started a few minutes before the boats are untied and driven away. Therefore, it is extremely unlikely that vessels would be run at anything close to full speed while near the piers. However, they may briefly use high power settings while maneuvering.

To be protective of fish, this assessment estimates that inlet-related in-water vessel noise levels above the 150 dB_{SEL} threshold could occasionally extend about 33 feet (10 m) in and around the inlet. The vessel noise levels would be non-injurious. However, juvenile Chinook salmon and steelhead that are within the 150 dB_{SEL} isopleth, are likely to experience behavioral disturbances, such as acoustic masking, startle responses, altered swimming patterns, avoidance, and increased risk of predation. Further, the intensity of these effects would increase with increased proximity to the source and or duration of exposure. Response to this exposure would be non-lethal in most cases, but some individuals may experience stress and fitness effects that could reduce their long-term survival, and individuals that are eaten by predators would be killed.

The annual numbers of juvenile PS Chinook salmon and PS steelhead that would be impacted by this stressor, and the intensity of any effects that an exposed individual may experience are unquantifiable with any degree of certainty. However, for the same reasons expressed for Altered Benthic Habitat, the numbers of individuals that would be detectably affected are expected to be very low and highly variable over time. Further, the majority of their typical emigration seasons are well outside of the typical summer boating season when inlet-related boat traffic would be highest. Therefore, the annual numbers of PS Chinook salmon and PS steelhead that may be exposed to inlet-related elevated noise would represent extremely small subsets of their respective cohorts, and the numbers of exposed fish that would be meaningfully affected would be too low to cause detectable population-level effects.

Inlet-related propeller wash

Inlet-related propeller wash is likely to adversely affect juvenile PS Chinook salmon and juvenile PS steelhead, but cause only minor effects in adults of both species.

Spinning boat propellers kill fish and small aquatic organisms (Killgore et al. 2011; VIMS 2011). Spinning propellers also generate fast-moving turbulent water (propeller wash) that can displace and disorient small fish, as well as dislodge benthic aquatic organisms and SAV, particularly in shallow water and or at high power settings (propeller scour).

The juvenile Chinook salmon and steelhead that would be within the project area are likely to remain close to the surface where they may be exposed to spinning propellers and powerful propeller wash near the pier. Additionally, juvenile Chinook salmon tend to stay as close to shore as possible. Conversely, adults of both species would tend to swim offshore and below the surface, and they would be able to swim against most propeller wash they might be exposed to, without experiencing any measurable effect on their fitness or normal behaviors.

Juveniles that are struck or very nearly missed by the spinning propellers of boats in the inlet would be injured or killed by the exposure. At greater distances, the boats' propeller wash may displace and disorient fish. Depending on the direction and strength of the thrust plume, displacement could increase energetic costs, reduce feeding success, and may increase the vulnerability to predators for individuals that tumble stunned and or disoriented in the wash. Although the likelihood of this interaction is very low for any individual fish or individual boat trip, it is very likely that over the years-long life of the inlet, at least some juvenile PS Chinook salmon and juvenile PS steelhead would experience reduced fitness or mortality from exposure to spinning propellers and or propeller wash in the applicant's inlet.

The low power settings that would typically be used by vessels in the inlet, combined with the very low density of SAV and other benthic organisms in the inlet would be due to periodic maintenance dredging, suggests that propeller scour would cause little to no measurable effects on benthic resources at the site. Therefore, it is extremely unlikely that inlet-related propeller scour would cause any detectable effects on the fitness and normal behaviors of juvenile Chinook salmon and juvenile steelhead.

The annual numbers of juvenile PS Chinook salmon and juvenile PS steelhead that would be exposed to propeller wash, and the intensity of any effects that an exposed individual may experience are unquantifiable with any degree of certainty. However, for the same reasons expressed for Altered Benthic Habitat, the annual numbers of individuals that would be detectably affected by this stressor are expected to be very low and highly variable over time. Further, the majority of their typical emigration seasons are well outside of the typical summer boating season when inlet-related boat traffic would be highest. Therefore, the annual numbers of juvenile PS Chinook salmon and juvenile PS steelhead that would be meaningfully affected by inlet-related propeller wash would be too low to cause detectable population-level effects.

2.5.2 Effects on Critical Habitat

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

Puget Sound Chinook Salmon Critical Habitat: The proposed action, including full application of the planned conservation measures and BMPs, is likely to adversely affect designated critical habitat for PS Chinook salmon as described below.

1. Freshwater spawning sites: None in the action area.

2. Freshwater rearing sites: None in the action area.

3. Freshwater migration corridors free of obstruction and excessive predation:
   a. Obstruction and excessive predation – The proposed action would cause minor long-term adverse effects on this attribute. Maintenance of the inlet across a migration corridor combined with inlet-related vessel noise would maintain habitat conditions that prevent normal migration behaviors, and increase the risk of predation for juvenile Chinook salmon that cross the inlet.
   b. Water quantity – The proposed action would cause no effect on this attribute.
   c. Water quality – The proposed action would cause minor short- and long-term adverse effects on this attribute. Maintenance dredging and gravel installation would cause short-term adverse effects on water quality that would persist no more than a low number of hours after work stops. Episodic vessel operations in the inlet would maintain persistent low level inputs of contaminants at the site. Detectable water quality impacts would be limited to the area within 300 feet around the project site. The action would cause no measurable changes in water temperature or salinity.
   d. Natural Cover – The proposed action would cause long-term minor adverse effects on this attribute. Dredging would reduce SAV availability in the inlet for about 5 years (1 year or more after the final dredging covered by this 4-year consultation).

4. Estuarine areas free of obstruction and excessive predation: None in the action area.

5. Nearshore marine areas free of obstruction and excessive predation: None in the action area.

6. Offshore marine areas: None in the action area.

2.6 Cumulative Effects

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

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the discussion of environmental baseline (Section 2.4).

The current conditions of ESA-listed species and designated critical habitat within the action area are described in the Rangewide Status of the Species and Critical Habitat and Environmental Baseline sections above. The non-federal activities in and upstream of the action area that have contributed to those conditions include past and on-going bankside development, vessel activities, and upland urbanization, as well as upstream forest management, agriculture, road construction, water development, subsistence and recreational fishing, and restoration activities. Those actions were, and continue to be, driven by a combination of economic conditions that characterized traditional natural resource-based industries, general resource demands associated with settlement of local and regional population centers, and the efforts of conservation groups dedicated to restoration and use of natural amenities, such as cultural inspiration and recreational experiences.

The NMFS is unaware of any specific future non-federal activities that are reasonably certain to affect the action area. However, the NMFS is reasonably certain that future non-federal actions such as the previously mentioned activities are all likely to continue and increase in the future as the human population continues to grow across the region. Continued habitat loss and degradation of water quality from development and chronic low-level inputs of non-point source pollutants will likely continue into the future. Recreational and commercial use of the waters within the action area are also likely to increase as the human population grows.

The intensity of these influences depends on many social and economic factors, and therefore is difficult to predict. Further, the adoption of more environmentally acceptable practices and standards may gradually reduce some negative environmental impacts over time. Interest in restoration activities has increased as environmental awareness rises among the public. State, tribal, and local governments have developed plans and initiatives to benefit ESA-listed PS Chinook salmon and PS steelhead within many of the watersheds that flow into the action area. However, the implementation of plans, initiatives, and specific restoration projects are often subject to political, legislative, and fiscal challenges that increase the uncertainty of their success.

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in assessing the risk that the proposed action poses to species and critical habitat. 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.

As described in more detail above in Section 2.4, climate change is likely to increasingly affect the abundance and distribution of the ESA-listed species considered in the opinion. It is also likely to increasingly affect the PBF of designated critical habitats. The exact effects of climate change are both uncertain, and unlikely to be spatially homogeneous. However, climate change is reasonably likely to cause reduced instream flows in some systems, and may impact water quality through elevated in-stream water temperatures and reduced dissolved oxygen, as well as by causing more frequent and more intense flooding events.

Climate change may also impact coastal waters through elevated surface water temperature, increased and variable acidity, increasing storm frequency and magnitude, and rising sea levels. The adaptive ability of listed-species is uncertain, but is likely reduced due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation.

The proposed action will cause direct and indirect effects on the ESA-listed species and critical habitats considered in the opinion well into the foreseeable future. However, the action's effects on water quality, substrate, and the biological environment are expected to be of such a small scale that no detectable effects on ESA-listed species or critical habitat through synergistic interactions with the impacts of climate change are expected.

2.7.1 ESA Listed Species

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

PS Chinook salmon

The long-term abundance trend of the PS Chinook salmon ESU is slightly negative. Reduced or eliminated accessibility to historically important habitat, combined with degraded conditions in available habitat due to land use activities appear to be the greatest threats to the recovery of PS Chinook salmon. Commercial and recreational fisheries also continue to impact this species.

The PS Chinook salmon most likely to occur at the project site would be fall-run Chinook salmon from the Cedar River and the North Lake Washington/Sammamish River populations, and part of the South Puget Sound MPG. Both populations are considered at high risk of extinction due to low abundance and productivity.

The project site is located along the eastern shore of Lake Washington in Medina, Washington (Figure 1), which serves primarily as a freshwater migration route to and from marine waters for adult and juvenile PS Chinook salmon from both affected populations. The environmental baseline at and adjacent to the project site has been degraded by the effects of nearby intense bankside development and maritime activities, and by nearby and upstream industry, urbanization, agriculture, forestry, water diversion, and road building and maintenance.

Work-related direct effects are unlikely to adversely affect PS Chinook salmon. However, low numbers of out-migrating juveniles that pass through the project area over the next 5 years or more would be exposed to low levels of diminished forage and other altered habitat conditions, that both individually and collectively, would cause some combination of altered behaviors, reduced fitness, and mortality in some of the exposed individuals. However, the annual numbers of individuals that would be detectably affected by action-related stressors would be extremely low.

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

PS steelhead

The long-term abundance trend of the PS steelhead DPS is negative, especially for natural spawners. Growth rates are currently declining at 3 to 10% annually for all but a few DIPs. The extinction risk for most DIPs is estimated to be moderate to high, and the DPS is currently considered “not viable”. Reduced or eliminated accessibility to historically important habitat, combined with degraded conditions in available habitat due to land use activities appear to be the greatest threats to the recovery of PS steelhead. Fisheries activities also continue to impact this species.

The PS steelhead most likely to occur at the project site would be winter-run fish from the Cedar River and North Lake Washington/Lake Sammamish DIPs. The abundance trends between 1984 and 2016 was strongly negative for both DIPs, and ten or fewer adult natural-spawners are estimated to return to the DIPs annually.

The project site is located along the eastern shore of Lake Washington in Medina, Washington (Figure 1), which serves as a freshwater migration route to and from marine waters for adult and juvenile PS steelhead from both affected DIPs. The environmental baseline at and adjacent to the project site has been degraded by the effects of nearby intense bankside development and maritime activities, and by nearby and upstream industry, urbanization, agriculture, forestry, water diversion, and road building and maintenance.

Work-related direct effects are unlikely to adversely affect PS steelhead. However, low numbers of out-migrating juveniles that pass through the project area over the next 5 years or more would be exposed to diminished forage and other altered habitat conditions, that both individually and collectively, would cause some combination of altered behaviors, reduced fitness, and mortality in some of the exposed individuals. The annual numbers of individuals that would be detectably affected by action-related stressors would be extremely low.

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

2.7.2 Critical Habitat

Critical habitat was designated for PS Chinook salmon to ensure that specific areas with PBFs that are essential to the conservation of that listed species are appropriately managed or protected. The critical habitat for PS Chinook salmon will be affected over time by cumulative effects, some positive – as restoration efforts and regulatory revisions increase habitat protections and restoration, and some negative – as climate change and unregulated or difficult to regulate sources of environmental degradation persist or increase. Overall, to the degree that trends are negative, the effects on the PBFs of critical habitat for PS Chinook salmon are also likely to be negative. In this context we consider how the proposed action's impacts on the attributes of the action area's PBFs would affect the designated critical habitat's ability to support the conservation of PS Chinook salmon as a whole.

Past and ongoing land and water use practices have degraded salmonid critical habitat throughout the Puget Sound basin. Hydropower and water management activities have reduced or eliminated access to significant portions of historic spawning habitat. Timber harvests, agriculture, industry, urbanization, and shoreline development have adversely altered floodplain and stream morphology in many watersheds, diminished the availability and quality of estuarine and nearshore marine habitats, and reduced water quality across the region.

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

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

The PBF for PS Chinook salmon critical habitat at and adjacent to the project site is limited to freshwater migration corridors free of obstruction and excessive predation. The attributes of that

PBF that would be affected by the action are obstruction and excessive predation, water quality, and natural cover. The project site is located along a heavily impacted lake shoreline, and all three of these attributes currently function at reduced levels as compared to undisturbed freshwater migratory corridors. The proposed project would cause a mix of adverse and beneficial effects on critical habitat attributes at the project site. The proposed maintenance dredging would maintain habitat conditions that slightly increase the risk of predation and slightly reduce forage availability and feeding efficiency for juvenile PS Chinook salmon that migrate past at the site. Conversely, the proposed installation of spawning gravels on the south pocket beach and on the 2 artificial reefs at the project site would maintain shallow gently sloping gravelly substrate conditions that are favorable to migrating juvenile salmon.

Based on the best available information, the scale of the proposed action's effects, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small to cause any detectable long-term negative changes in the quality or functionality of the freshwater migration corridors PBF in the action area. Therefore, this critical habitat will maintain its current level of functionality, and retain its current ability for PBFs to become functionally established, to serve the intended conservation role for PS Chinook salmon.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is the NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of PS Chinook salmon and PS steelhead, nor is it likely to destroy or adversely modify designated critical habitat for PS Chinook salmon.

2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "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 incidental take statement (ITS).

2.9.1 Amount or Extent of Take

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

Harm of PS Chinook salmon and PS steelhead from exposure to:

- Altered Benthic Habitat,
- Inlet-related noise, and
- Inlet-related propeller wash.

The NMFS cannot predict with meaningful accuracy the number of PS Chinook salmon and PS steelhead that are reasonably certain to be injured or killed annually by exposure to any of these stressors. The distribution and abundance of the fish that occur within an action area are affected by habitat quality, competition, predation, and the interaction of processes that influence genetic, population, and environmental characteristics. These biotic and environmental processes interact in ways that may be random or directional, and may operate across far broader temporal and spatial scales than are affected by the proposed action. Thus, the distribution and abundance of fish within the action area cannot be attributed entirely to habitat conditions, nor can the NMFS precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by the proposed action. Additionally, the NMFS knows of no device or practicable technique that would yield reliable counts of individuals that may experience these impacts. In such circumstances, the NMFS uses the causal link established between the activity and the likely extent and duration of changes in habitat conditions to describe the extent of take as a numerical level of habitat disturbance. The most appropriate surrogates for take are action-related parameters that are directly related to the magnitude of the expected take.

The timing of in-water work is applicable for this action because, with the exception of hand brushing of two water intake covers, the proposed in-water work window avoids the expected presence of juvenile PS Chinook salmon in the project area. Therefore, working outside of the proposed work window would increase the potential that PS Chinook salmon would be exposed to work-related stressors that they otherwise would not be exposed to.

The areal footprint and depth of the small boat inlet are the best available surrogates for the extent of take of juvenile PS Chinook salmon and juvenile PS steelhead from exposure to inlet-related altered benthic habitat, noise, and propeller wash. The areal footprint is appropriate for altered benthic because the area where increased risk of predation and reduced feeding effciaincy would both increase as the size thredged area increase, and any increase in the artifical illumination would increase nightime phototaxis.

The areal footprint and depth are also appropriate for inlet-related noise, and propeller wash because the number and sizes of boats that can moor there would increase as the size and depth of the mooring inlet increases. As boat sizes and or numbers increase, the potential for, and the intensity of exposure to the related noise and propeller wash would also increase for juvenile PS Chinook salmon and juvenile PS steelhead.

In summary, the extent of PS Chinook salmon and PS steelhead take for this action is defined as:

- In-water work to be completed between July 15 and September 30 for all project components except quarterly inspection and cleaning of upwelling system intake screens; and
- The post-work size and depth the small boat moorage inlet as described in the proposed action section of this biological opinion.

Exceedance of any of the exposure limits described above would constitute an exceedance of authorized take that would trigger the need to reinitiate consultation.

Although these take surrogates could be construed as partially coextensive with the proposed action, they nevertheless function as effective reinitiation triggers. If any of these take surrogates exceed the proposal, it could still meaningfully trigger reinitiation because the USACE has authority to conduct compliance inspections and to take actions to address non-compliance, including post-construction (33 CFR 326.4).

2.9.2 Effect of the Take

In the biological opinion, the 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 measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

The USACE shall require the applicant to:

1. Ensure the implementation of monitoring and reporting to confirm that the take exemption for the proposed action is 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 terms and conditions implement reasonable and prudent measure 1:

   a. The USACE shall require the applicant to develop and implement plans to collect and report details about the take of listed fish. That plan shall:
      i. Require the applicant and or their contractor to maintain and submit records to verify that all take indicators are monitored and reported. Minimally, the records should include:
         1. Documentation of the timing of in-water work to ensure that all work except hand brushing of two water intake covers is accomplished between July 15 and September 30; and
         2. Documentation of the size and depth of the small boat moorage inlet dredging area to confirm that dredging complies with the characteristics described in this opinion.
      ii. Require the applicant to establish procedures for the submission of the construction records and other materials to the appropriate USACE office, and to submit an electronic post-construction report to the NMFS within six months of project completion. Send the report to: projectreports.wcr@noaa.gov. Be sure to include Attn: WCRO-2021-00750 in the subject line.

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, "conservation recommendations" are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

The proposed project includes design features that reduce its impacts on aquatic resources. It also includes a comprehensive set of BMPs to minimize construction-related effects. The NMFS knows of no other reasonable measures that the applicant could include to further reduce the project's effects on PS Chinook salmon, PS steelhead, and the attributes of designated critical habitat for PS Chinook salmon. Therefore, the NMFS makes no conservation recommendations pursuant to Section 7(a)(1) of the ESA.

2.11 Reinitiation of Consultation

This concludes formal consultation for the U.S. Army Corps of Engineers' authorization of the Watermark Estate Management Services LLC's 4-Year Shoreline Maintenance Project in Lake Washington, Medina, Washington.

Under 50 CFR 402.16(a): "Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action."

2.12 "Not Likely to Adversely Affect" Determinations

This assessment was prepared pursuant to section 7(a)(2) of the ESA, implementing regulations at 50 CFR 402 and agency guidance for preparation of letters of concurrence.

As described in Section 1.2 and below, the NMFS has concluded that the proposed action is not likely to adversely affect southern resident (SR) killer whales and their designated critical habitat. Detailed information about the biology, habitat, and conservation status and trends of SR killer whales can be found in the listing regulations and critical habitat designations published in the Federal Register, as well as in the recovery plans and other sources at: https://www.fisheries.noaa.gov/species-directory/threatened-endangered, and are incorporated here by reference.

The applicable standard to find that a proposed action is not likely to adversely affect listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. The effects analysis in this section relies heavily on the descriptions of the proposed action and project site conditions discussed in Sections 1.3 and 2.4, and on the effects analyses presented in Section 2.5.

2.12.1 Effects on Listed Species

The proposed action will have no direct effects on SR killer whales or their critical habitat because all construction and its impacts would take place in freshwater, and SR killer whales and their designated critical habitat are limited to marine waters.

However, the project may indirectly affect SR killer whales through the trophic web by affecting the quantity and quality of prey available to SR killer whales. We therefore analyze that potential here but conclude that the effects on SR killer whales will be insignificant for at least two reasons.

First, as described in Section 2.5, the action would annually affect an extremely low number of juvenile Chinook salmon. The project's detectable effects on fish would be limited to an area no more than 300 feet around the project site, where small subsets of each year's juvenile PS Chinook salmon cohorts from the Cedar River and North Lake Washington populations could be briefly exposed to project-related impacts during the final portion their freshwater migration lifestage, and only very small subsets of the individuals that pass through the area are likely to be detectably affected by the exposure.

The exact Chinook salmon smolt to adult ratios are not known. However, even under natural conditions, individual juvenile Chinook salmon have a very low probability of surviving to adulthood (Bradford 1995). We note that human-caused habitat degradation and other factors such as hatcheries and harvest exacerbate natural causes of low survival such as natural variability in stream and ocean conditions, predator-prey interactions, and natural climate variability (Adams 1980, Quinones et al., 2014). However, based on the best available information, the annual numbers of project-affected juveniles would be too low to influence any VSP parameters for either population, or to cause any detectable reduction in adult Chinook salmon availability to SR killer whales in marine waters.

Second, as described in Sections 1.3, 2.2, and 2.5, the only PS Chinook populations that would be affected by the project would be the two Lake Washington populations that migrate through the Lake Washington ship canal, and both populations are small. Adult returns in 2019 for the Cedar River and North Lake Washington populations were 963 and 2,186 individuals, respectively (WDFW 2022b). Consequently, the two populations, combined, make up a very small portion of the adult Chinook that are available to SR killer whales in marine waters. Therefore, based on the best available information, the proposed action is not likely to adversely affect SR killer whales.

2.12.2 Effects on Critical Habitat

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

SR killer whale Critical Habitat: Designated critical habitat for SR killer whales includes marine waters of the Puget Sound that are at least 20 feet deep. The expected effects on SR killer whale critical habitat from completion of the proposed action, including full application of the conservation measures and BMP, would be limited to the impacts on the PBFs as described below.

1. Water quality to support growth and development
   The proposed action would cause no detectable effects on marine water quality.
2. Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth
   The proposed action would cause long-term undetectable effects on prey availability and quality. Action-related impacts would annually injure or kill extremely low numbers of individual juvenile Chinook salmon (primary prey), during the final portion their freshwater migration lifestage. However, the numbers of affected juvenile Chinook salmon would be too small to cause detectable effects on the numbers of available adult Chinook salmon in marine waters. Therefore, it would cause no detectable reduction in prey availability and quality.

3. Passage conditions to allow for migration, resting, and foraging
   The proposed action would cause no detectable effects on passage conditions.

For the reasons expressed immediately above, the NMFS has concluded that the proposed action is not likely to adversely affect ESA-listed SR killer whales and their designated critical habitat.

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

Section 305(b) of the MSA directs Federal agencies to consult with the 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 the 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 the descriptions of EFH contained in the fishery management plan for Pacific Coast salmon developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce (PFMC 2014).

3.1 Essential Fish Habitat Affected By the Project

The project site is located along the eastern shore of Lake Washington in Medina, Washington (Figure 1). The waters and substrate of Lake Washington are designated as freshwater EFH for various life-history stages of Pacific Coast Salmon, which within the Lake Washington watershed include Chinook and coho salmon. Due to trophic links between PS Chinook salmon and SR killer whales, the project's action area also overlaps with marine waters that have been designated, under the MSA, as EFH for Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species. However, the action would cause no detectable effects on any components of marine EFH. Therefore, the action's effects on EFH would be limited to impacts on freshwater EFH for Pacific Coast Salmon, and it would not adversely affect marine EFH for Pacific Coast Salmon, or EFH for Pacific Coast groundfish and coastal pelagic species.

Freshwater EFH for Pacific salmon is identified and described in Appendix A to the Pacific Coast salmon fishery management plan, and consists of four major components: (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and holding habitat.

Those components of freshwater EFH for Pacific Coast Salmon depend on habitat conditions for spawning, rearing, and migration that include: (1) water quality (e.g., dissolved oxygen, nutrients, temperature, etc.); (2) water quantity, depth, and velocity; (3) riparian-stream-marine energy exchanges; (4) channel gradient and stability; (5) prey availability; (6) cover and habitat complexity (e.g., large woody debris, pools, aquatic and terrestrial vegetation, etc.); (7) space; (8) habitat connectivity from headwaters to the ocean (e.g., dispersal corridors); (9) groundwater-stream interactions; and (10) substrate composition.

As part of Pacific Coast Salmon EFH, five Habitat Areas of Particular Concern (HAPCs) have been defined: 1) complex channels and floodplain habitats; 2) thermal refugia; 3) spawning habitat; 4) estuaries; and 5) marine and estuarine submerged aquatic vegetation. The project area provides no known HAPC habitat features. Although the project site includes two artificial spawning reefs for sockeye salmon, no use of those reefs is documented or expected for Chinook or coho salmon, which both typically spawn in rivers and streams.

3.2 Adverse Effects on Essential Fish Habitat

The ESA portion of this document (Sections 1 and 2) describes the proposed action and its adverse effects on ESA-listed species and critical habitat, and is relevant to the effects on EFH for Pacific Coast Salmon. Based on the analysis of effects presented in Section 2.5 the proposed action will cause minor short- and long-term adverse effects on EFH for Pacific Coast Salmon as summarized below.

1. Water quality: The proposed action would cause minor short- and long-term adverse effects on this attribute. Maintenance dredging and gravel installation would cause adverse effects on water quality that would persist no more than a low number of hours after work stops. For 2 to 4 years after the end of this project, episodic powerboat operations in the inlet would maintain persistent low level inputs of contaminants at the site. Detectable water quality impacts would be limited to the area within 300 feet around the project site. The action would cause no measurable changes in water temperature or salinity.

2. Water quantity, depth, and velocity: The proposed action would cause minor long-term adverse effects on this attribute. Maintenance dredging would maintain artificially deepened water within the small boat moorage inlet that would persist for many years after the end of the project. No changes in water quantity or velocity are expected.

3. Riparian-stream-marine energy exchanges: No changes expected.

4. Channel gradient and stability: No changes expected.

5. Prey availability: The proposed action would cause minor long-term adverse effects on this attribute. Maintenance dredging and gravel installation would respectively remove and cover benthic organisms and SAV within the footprints of the small boat inlet and the two spawning reefs, which would reduce prey availability within their respective footprints for a year or more following the end of each work event. Detectable effects would be limited to the area within about 300 feet around the project site.

6. Cover and habitat complexity: The proposed action would cause minor adverse effects on this attribute. Maintenance dredging and gravel installation would respectively remove and cover SAV within the footprints of the small boat inlet and the two spawning reefs, which would reduce SAV availability within their respective footprints for a year or more following the end of each work event. Dredging would also maintain simplified aquatic habitat that would consist mainly of steeply sloped banks dropping to a flat bottom with little to no SAV and woody debris. Conversely, maintenance of the pocket beach and spawning reefs would maintain two shoreline areas that provide very shallow and gently sloping gravel substrate, which is favored by migrating juvenile salmon.

7. Water quantity: No changes expected.

8. Space: No changes expected.

9. Habitat connectivity from headwaters to the ocean: No changes expected.

10. Groundwater-stream interactions: No changes expected.

11. Connectivity with terrestrial ecosystems: No changes expected.

12. Substrate composition: No changes expected.

3.3 Essential Fish Habitat Conservation Recommendations

The proposed project includes design features that reduce its impacts on the quantity and quality of Pacific Coast salmon EFH. It also includes a comprehensive set of BMPs to minimize construction-related effects. The NMFS knows of no other reasonable measures that the applicant could include to further reduce the project's effects on the attributes of Pacific Coast salmon EFH described above. Therefore, the NMFS makes no conservation recommendations pursuant to MSA (§305(b)(4)(A)).

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the USACE must provide a detailed written response to the 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 the NMFS' EFH Conservation Recommendations unless the 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 the 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, the 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 the 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 the NMFS' EFH Conservation Recommendations [50 CFR 600.920(l)].

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is the USACE. Other interested users could include the applicant, WDFW, the governments and citizens of King County and the City of Medina, and Native American tribes. Individual copies of this opinion were provided to the USACE. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by the 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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