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

Refer to NMFS No.:
WCRO-2020-03674

April 29, 2022

Captain Rhinehart
Naval Base Kitsap
120 South Dewey Street, Building 443
Bremerton, Washington 98314-5020

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Electromagnetic Management Ranging System, Bangor Naval Base, Washington.

Dear Captain Rhinehart:

Thank you for your email 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 U.S. Navy's proposed Electromagnetic Management Ranging System.

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

Please contact Lisa Abernathy, consulting biologist at the Oregon Washington Coastal Office (Lisa.Abernathy@noaa.gov; 206-526-4742), 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: Cynthia Kunz
Tiffany Selbig

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

Electromagnetic Management Ranging System, Bangor Naval Base, Washington

NMFS Consultation Number: WCRO-2020-03674

Action Agency: U.S. Department of Defense, Department of the Navy

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely to Jeopardize Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely to Destroy or Adversely Modify Critical Habitat?
Puget Sound DPS Chinook Salmon	T	Yes	No	Yes	No
Puget Sound DPS Steelhead	T	No	No	N/A	N/A
Hood Canal summer-run chum	T	No	No	Yes	No
Puget Sound/Georgia Basin DPS bocaccio rockfish	E	Yes	No	Yes	No
Puget Sound/Georgia Basin DPS yelloweye rockfish	T	Yes	No	N/A	N/A
Humpback whale; Mexico DPS	T	No	No	N/A	N/A
Humpback whale; Central America DPS	E	No	No	N/A	N/A

Fishery Management Plan That Describes EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific groundfish	Yes	Yes
Pacific coast salmon	Yes	Yes
Coastal pelagic species	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service
West Coast Region

Issued By:

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

Date: April 29, 2022

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1. INTRODUCTION

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

1.1 Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), 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 Coast Office in Lacey, Washington.

1.2 Consultation History

The Navy originally requested consultation for the Electromagnetic Management Ranging (EMMR) System project in 2013. At that time NMFS completed a consultation, NWR-2012-9805, however the construction of the project never took place. In the spring of 2020, the Navy reintroduced the idea of project construction to NMFS through a technical assistance request. Since the original consultation in 2013, the critical habitats for two species of rockfish in Puget Sound were listed. The new listing required the project to be reinitiated for consultation. Formal consultation began on August 6, 2021. At that time, the Navy provided NMFS a Biological Assessment (BA) and an email requesting formal consultation and concurrence with its findings, Table 1, including the finding of *may adversely affect* designated EFH for Pacific groundfish, Pacific coast salmon, and coastal pelagic species.

Table 1. The Navy's Determinations

Species	Species Effects	Critical Habitat Effects
Puget Sound DPS Chinook Salmon	May affect, not likely to adversely effect	May affect, not likely to adversely effect
Puget Sound DPS Steelhead	May affect, not likely to adversely effect	No Effect
Hood Canal summer-run chum	May affect, not likely to adversely effect	May affect, not likely to adversely effect
Puget Sound/Georgia Basin DPS bocaccio rockfish	May affect, not likely to adversely effect	May affect, not likely to adversely affect
Puget Sound/Georgia Basin DPS yelloweye rockfish	May affect, not likely to adversely effect	No Effect
Humpback whale	No effect	No Effect

NMFS concurs with the Navy's "No Effect" call for humpback whales and steelhead, and yelloweye rockfish critical habitat. Additionally, we concur that the project is "Not Likely to Adversely Affect" (NLAA) steelhead and Hood Canal summer-run (HCSR) chum. However, we do not concur the impacts are NLAA Chinook, bocaccio and yelloweye rockfish. Likewise, we do not concur that impacts are NLAA for Chinook, HCSR chum and bocaccio critical habitat.

NMFS sent the Navy draft sections of the Proposed Action and the Terms and Conditions for review on December 17, 2021. The Navy returned the draft sections with comments on January 14, 2022. The Navy's comments clarified the most up to date impacts and revisions were made with the information.

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). We considered, under the ESA, whether the proposed action would cause any other activities and determined that it would not. Under the MSA, "Federal action" means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal agency (see 50 CFR 600.910).

To provide the Navy with the capability to measure the electromagnetic signatures of submarines in the northwestern continental United States, the Navy proposes to build and operate an EMMR system in Hood Canal north of Naval Base (NAVBASE) Kitsap Bangor. The proposed action is needed to ensure that submarines meet the electromagnetic signature requirements of Chief of Naval Operations Instruction (OPNAVINST) S8950.2H, which requires continual monitoring of the submarines electromagnetic signature to reduce susceptibility to threats. In the absence of a functioning EMMR system at NAVBASE Kitsap Bangor, submarines in the Pacific Fleet, including those homeported at NAVBASE Kitsap Bangor, have used facilities located at Pearl Harbor, Hawaii, or San Diego, California, in order to fulfill electromagnetic signature requirements. This work-around has resulted in unacceptable operational inefficiencies for submarines homeported or otherwise operating in waters off the northwestern continental U.S. by adding approximately two weeks of transit time to access facilities at Pearl Harbor or San

Diego from NAVBASE Kitsap Bangor. Further, new operational security requirements for ballistic missile submarines prevent submarines homeported at NAVBASE Kitsap Bangor from using the existing facilities at Pearl Harbor or San Diego (U.S. Fleet Forces Operations Order 3300.17). As such, there is no longer a capability on the west coast to measure the electromagnetic signatures of these submarines, as required. The Proposed Action would reestablish the required capability to measure the electromagnetic signatures of submarines homeported at NAVBASE Kitsap Bangor and provide submarines the ability to conduct on-board electromagnetic systems calibrations in accordance with OPNAVINST S8950.2H.

The proposed action would consist of both in-water components, which would occur in the Hood Canal Military Operating Area North, and onshore components, which would occur on NAVBASE Kitsap Bangor lands. These actions covered in this consultation include the following:

Aid-to-Navigation (Figure 1): A sector light as an aid to navigation (ATN) for submarines utilizing the EMMR system would be installed near the shoreline of NAVBASE Kitsap Bangor, on the north side of Amberjack Avenue. The ATN would be located at an elevation of approximately 30 feet above MLLW, and would be approximately 6 feet in height. The ATN construction would require removal of vegetation from approximately 64 square feet (0.001 acre) of primarily disturbed land. Removal of obstructive vegetation in the ATN corridor could require clearing of up to approximately 400 square feet (0.009 acre) of disturbed land. The ATN would be visible to submarines from Hood Canal and the light would only be used when submarines are transiting the range.

Figure 1. Aid to navigation location

Buried Cable Installed by Horizontal Directional Drilling (Figure 2, blue line): The composite cable would be laid in nearshore waters by horizontal directional drilling (HDD) in order to avoid impacts to nearshore habitat, such as eelgrass. From the existing MSF building the composite cable would be directionally drilled to the onshore launch pit. From the onshore launch pit, located adjacent to an existing gravel parking lot, approximately 1,555 linear feet of cable would be installed by HDD. Starting at the onshore HDD launch pit, traveling under Amberjack Avenue and nearshore habitat, to the offshore HDD exit point 60 feet below MLLW. The cable would then be buried to the offshore platform using a jet plow.

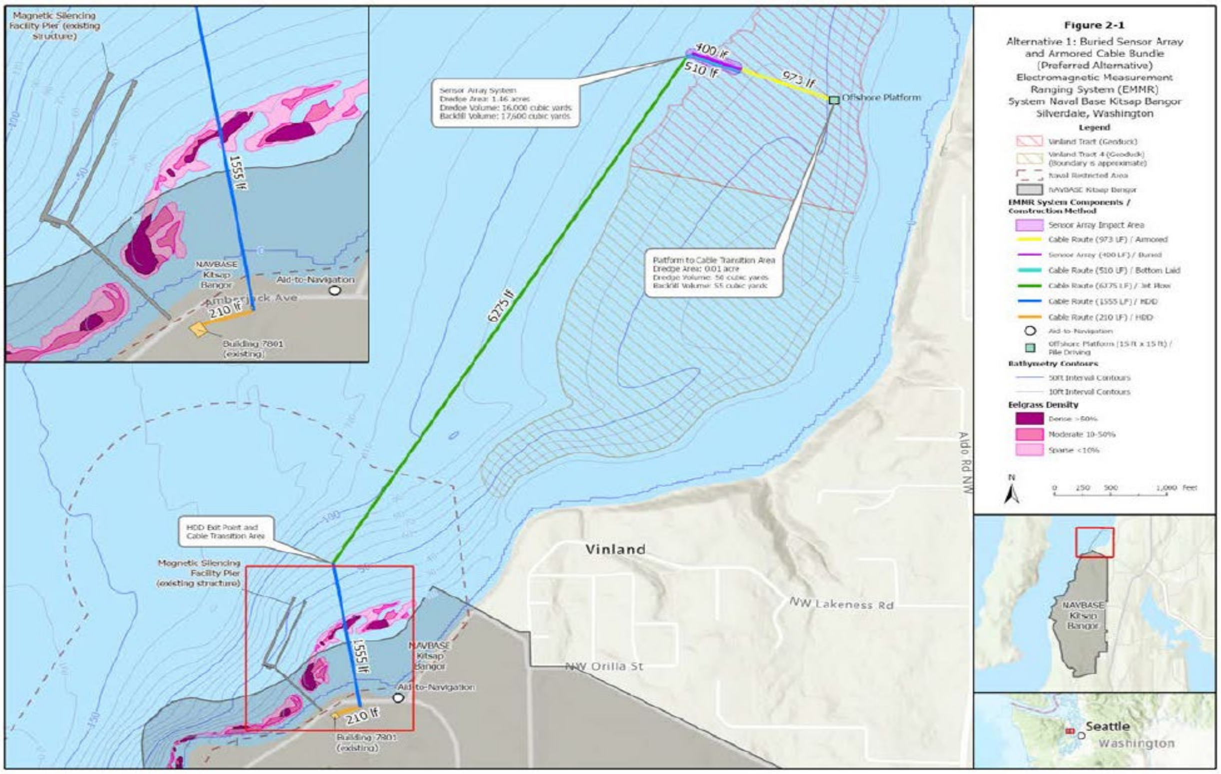

Figure 2. HDD and Trench Route

<u>Buried Cable Installed by Jet Plow (Figure 2, green line):</u> Cable laid and buried with a jet plow would be approximately 4 feet below the mudline, and cable installed by HDD would be more than 6 feet below the mudline. No dredging/backfilling activities are proposed at the HDD exit point. The HDD Exit Point would be positioned at the beginning of the jet-plow area. The transition from HDD to jet plow would take place within the plow footprint.

The total length of cable buried with a jet plow would be approximately 6,275 linear feet. The jet plow would be mounted on a sled and use pressurized seawater from the water pump systems on the cable-laying vessel to loosen the sediments in front of the plow as it is towed along the seabed. The cable-laying vessel would deploy the jet plow with a towline and umbilical cord (a fiber cable for transmitting data to and from the plow) to the appropriate depth on the selected route. Once the plow is placed on the seabed floor, the vessel is moved ahead progressively, increasing tension on the towline until the plow moves ahead. The water-jet system is activated until the desired depth is achieved (i.e., four feet). The vessel speed would be less than 2.3 miles per hour, depending on seabed conditions. The water-jet hydrodynamic forces produce a downward movement to maximize replacement of sediments within the trench as the cable is buried and the plow progresses along the route. The predetermined deployment depth of the jetting and/or plow controls the depth at which the cable is laid.

The disturbance area from the jet plow would be an approximately 1-foot-wide trench. In general, the geometry of the trench could be described as trapezoidal, with the trench width gradually narrowing to the depth of burial. Temporarily suspended sediments are largely contained within the limits of the trench area, with only minor quantities settling out beyond the flanks of the plowed area. The amount of sediment deposition outside of the trenched area typically depends on the sediment grain size, composition, hydraulic-jetting forces, and depth and width of the plow. Suspended sediments could spread up to an estimated 500 feet from jet-plowing, though most sediment (80 to 90 percent) would be expected to settle out within 20 feet of the cable trench corridor within several hours following completion of jet-plowing operations (BPA 2007).

Buried Sensor Array (Figure 2, purple line, and Figure 3): This component includes installation of a linear sensor array system consisting of 8 triaxial magnetometer sensors and 13 electromagnetic triaxial sensors (21 sensors total). The approximately 400-foot-long sensor array would be buried beneath the canal floor/substrate. The sensors would be spaced approximately 20 feet apart. The seafloor would be dredged, and the 21 sensors would be buried such that the top of each sensor would be at a minimum depth of approximately 2 feet below the seafloor.

The center of the sensor array (Sensor Number 11) would be located where the seafloor is at a depth of approximately 70 feet below mean lower low water (MLLW). Depth at the location of the proposed action gradually decreases from west to east from 64 feet below MLLW to 76 feet below MLLW.

Approximately 16,000 cubic yards of material would be dredged for installation of the sensor array. The dredged material would be replaced by 17,600 cubic yards of non-magnetic gravel fill to match the existing seafloor conditions in the top 3 feet. The total area of disturbance to the marine substrate would be approximately 1.46 acres. Displaced soils would be disposed of at a pre-approved in-water dredge disposal site that avoids effects on listed species.

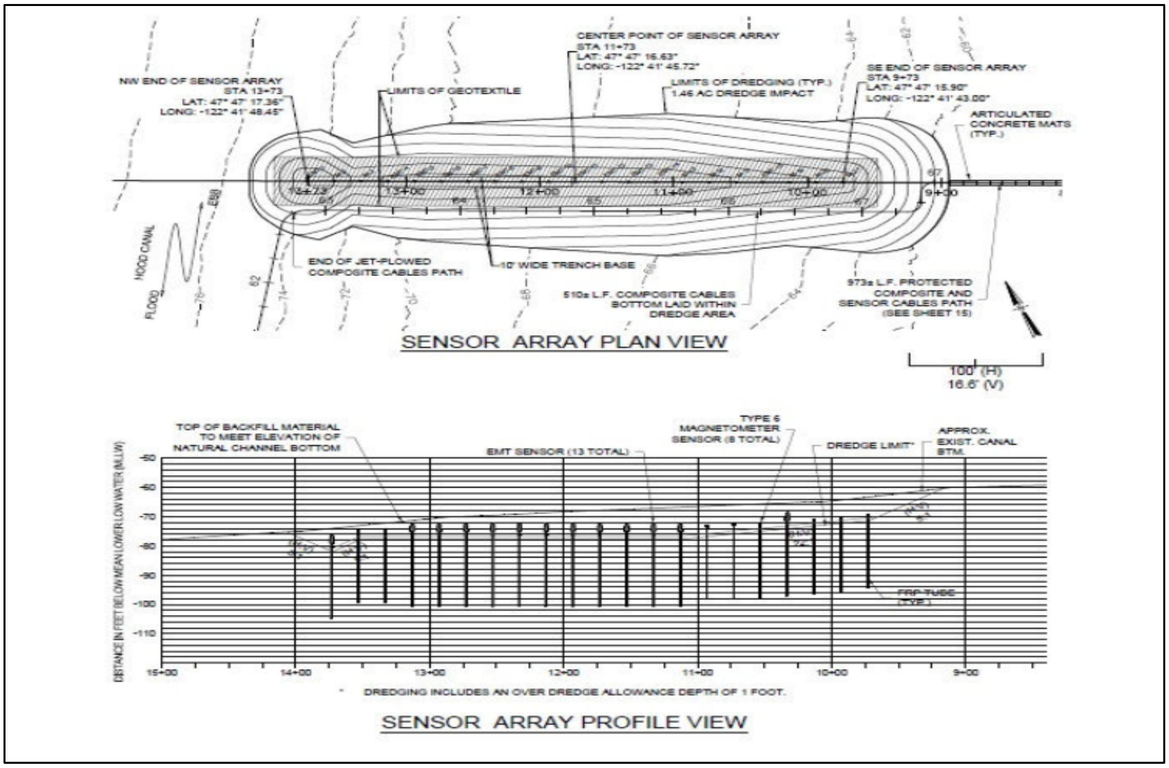

Figure 3. Sensor array

Armored Cable Bundle (Figure 2, yellow line, and Figure 4): Cable from the platform (Figure 5, discussed next) to the sensor array would be laid on the seafloor and protected with concrete armoring. Twenty-one independent cables would run from the offshore platform to the sensor array over a distance of 973 linear feet. Concrete armoring would consist of articulated concrete mat segments, each with a length of 10 feet and average width of approximately 6 feet. Cable armoring would result in a total of approximately 0.13 acre of hard structure from concrete armoring.

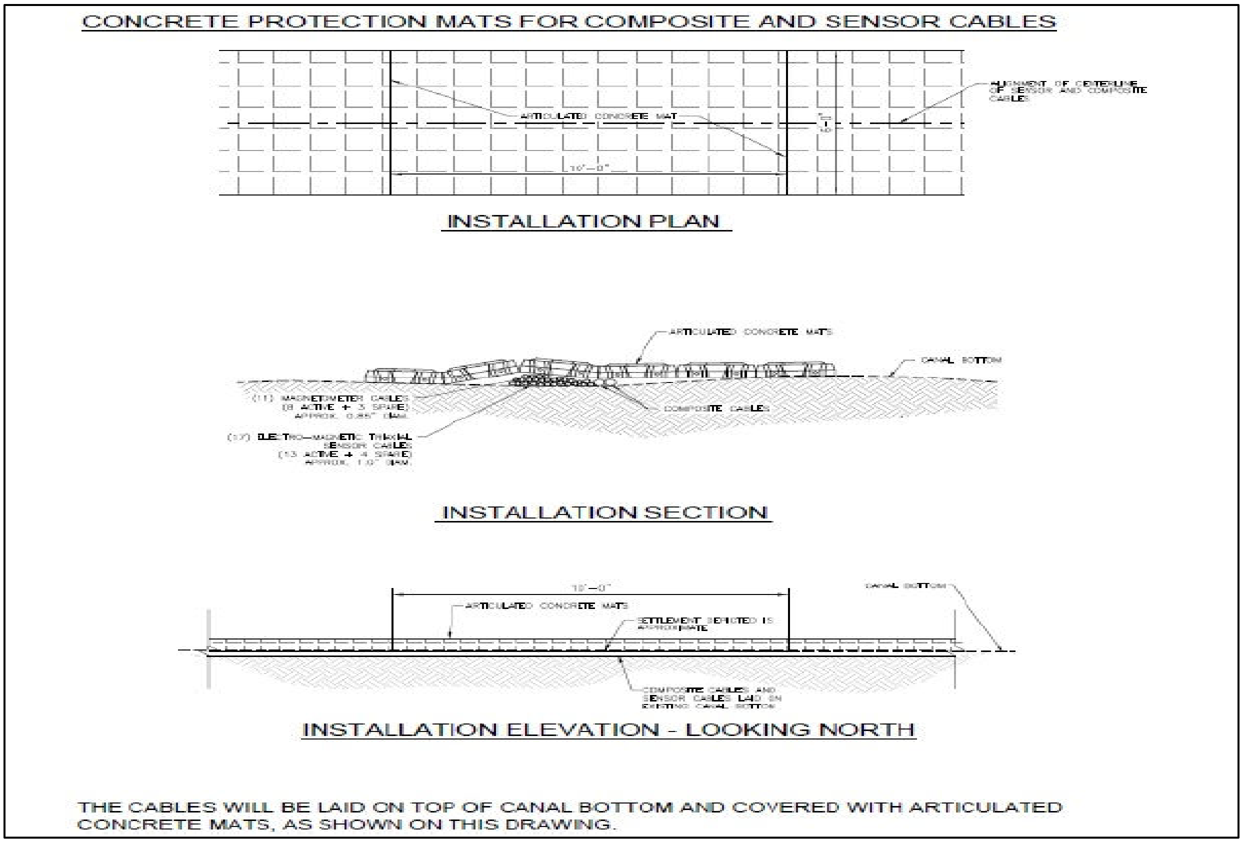

Figure 4. Concrete protection mats for sensor cables

Offshore Platform (Figure 5): The proposed action includes construction of a 15- by 15-foot offshore platform with utilities, requiring installation of five 24-inch square, batter pre-cast concrete piles. The offshore platform would be located approximately 0.20 mile from the shoreline. The five piles would be impact driven. Where the cables meets the offshore platform, the transition area would have a total surface area impact of 423 square feet and require excavation of approximately 50 cubic yards of dredged material. The transition area would be backfilled with non-magnetic gravel to match existing seafloor conditions in the top 3 feet, and would encompass the substrate below the offshore platform and its five supporting piles.

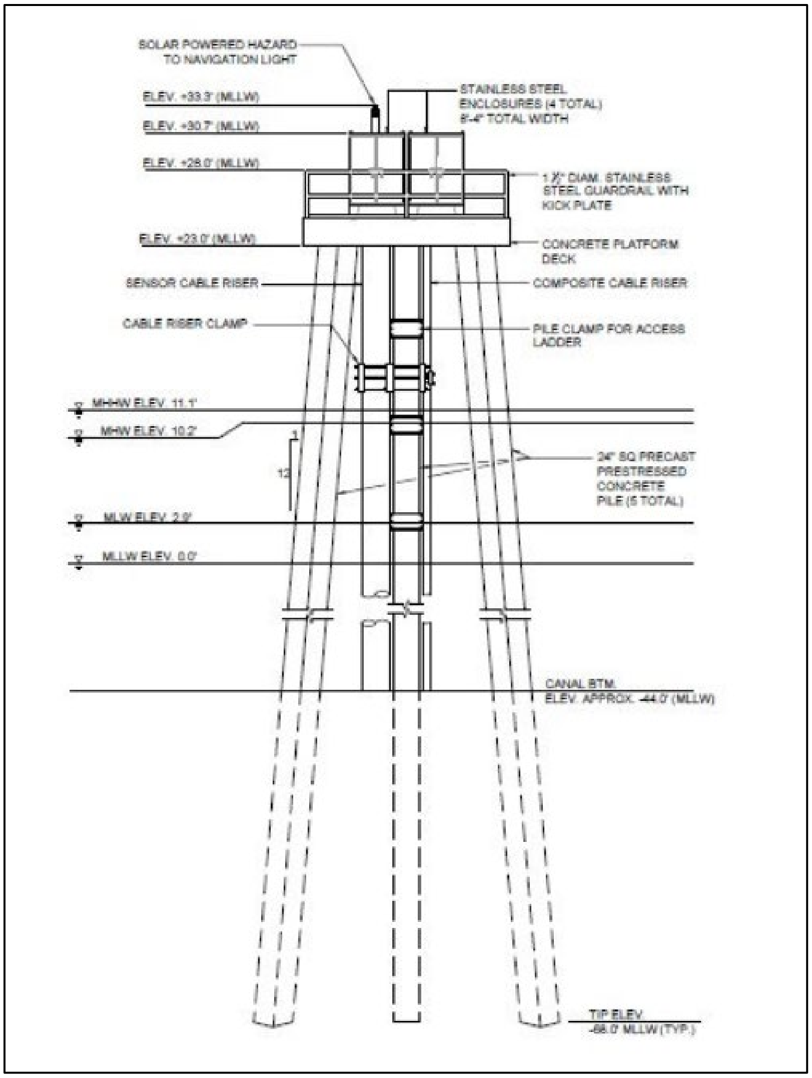

Figure 5. Platform

The Navy would complete in-water construction of the proposed action over 12 months within three years. All in-water construction would occur in the in-water work window (July 16 – January 15) between 2022 and 2026, to reduce impacts to ESA-listed species.

<u>Minimization Measures</u>: The Navy proposes to construct the EMMR system in work windows between July 16, and January 15, to reduce impacts to juvenile salmon. In addition, the Navy proposes using HDD methods to bore a conduit from a landward location with an exit hole at approximately 60 feet below MLLW. This construction method would avoid most impacts to eelgrass (Zostera marina) and minimize impacts on attached macroalgae beds that may occur within the vicinity of the proposed cable route. Eelgrass typically grows in areas from 5.9 above to 29 feet below MLLW, with an average depth of 11 feet below MLLW (Mumford 2007).

During drilling operations, the potential loss of drilling muds to the formation[1] would be assessed by monitoring indications, such as reduced volume of mud returns or decreases in drilling fluid pressures. If a loss of drilling mud volume or pressure is detected, drilling may be discontinued or slowed to better assess whether accidental releases of fluids to the surface during HDD drilling may have occurred or could occur. This loss would be an inadvertent release of drilling mud. Visual monitoring of the ground surface and surface waters would be conducted during drilling operations to facilitate quick identification and response to this condition. In the event that a potential loss of drilling mud to the formation were to occur, the driller would take measures to decrease the amount of mud lost to the formation, such as increasing the viscosity of the drilling mud to seal fractures and stabilize the borehole. The Navy would require the drilling contractor to have a Spill Prevention Control and Countermeasure Plan in place before drilling.

Previous eelgrass surveys have not detected eelgrass within the area of the cable burial or HDD exit hole (SAIC 2009 ;Marx et al 2020). The nearest eelgrass bed is approximately 570 feet south of the HDD exit hole. It is likely that a minor amount of sediment would be carried by currents or tidal action to the eelgrass bed, but these would be fine-grained sediments suspended in the water column. As the sediments disperse and settle out, they would become a part of the substrate. Furthermore, to reduce impacts to marine vegetation from construction vessels, barges would not anchor in eelgrass, and propeller wash would be minimized near vegetated areas.

At the HDD exit point the cable would transition to an 1 foot wide by 4 foot deep trench. Cable at the HDD exit point would transition to jet-plow and be laid in the trench, keeping the composite cable at 4 feet below the mudline.

All in-water construction activities occurring between July 16 and January 15 would occur during daylight hours (sunrise to sunset) for the three years of construction. The Navy would conduct marine mammal monitoring during pile-driving activities to ensure that no ESA-listed marine mammals are present within a 384-foot-radius from the offshore platform. Monitoring would begin at least 15 minutes prior to commencement of impact pile-driving, and each qualified observer would be placed at the best vantage point(s) practicable (e.g., on a small boat, the pile-driving barge, on shore, or at any other suitable location) to monitor for marine mammals. Pile-driving activities would begin after it has been determined that no marine mammals are within the disturbance zone. Monitoring would continue throughout all pile-driving operations. Should marine mammals be sighted during pile driving within the disturbance zone (384 feet), the pile driving would be shut down until the animals have voluntarily left the zone or have not been re-sighted within 15 minutes.

It should be recognized that although marine mammals would be protected from Level A harassment by the utilization of marine mammal observers monitoring the near-field injury zones (3.3 feet for pinnipeds and 16 feet for cetaceans), monitoring may not be 100-percent effective at all times in locating marine mammals in the disturbance zone. However, due to the monitors' specialized training and small size of the disturbance zone (384 feet), the Navy expects that visual mitigation would be highly effective.

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[1] Mud loss, also known as lost circulation, can be defined as the loss of drilling mud to the formation during drilling operations. Formation can be defined as the cracks, crevasses, fractures in earth along the pipelines route.

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 NMFS, and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

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 designation(s) of critical habitat for Chinook salmon, HCSRC, and bocaccio uses the term primary constituent element (PCE) or essential features. 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 or essential feature, as appropriate for the specific critical habitat.

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

- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their 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.

For this consultation, NMFS evaluated the proposed action using a Habitat Equivalency Analysis (HEA)[2] and the Puget Sound Nearshore Habitat Values Model (NHVM) that we adapted from Ehinger et al. 2015. We developed an input calculator ("conservation calculator") that serves as a user-friendly interface to simplify model use. Ecological equivalency that forms the basis of HEA is a concept that uses a common currency to express and assign a value to functional habitat loss and gain. Ecological equivalency is traditionally a service-to-service approach where the ecological functions and services for a species or group of species lost from an impacting activity are fully offset by the services gained from a conservation activity. In this case, we use this approach to calculate the "cost" and "benefit" of the proposed action, as well as the impacts of the existing environmental baseline, using the NHVM.

The NHVM includes a debit/credit factor of two applied to new structures to account for the fact that impacts on unimpaired habitat have been found to be more detrimental than future impacts to already impaired habitat at sites with existing structures (Roni et al., 2002). To rephrase, given the current condition of nearshore habitat, impacts from new structures on relatively unimpaired habitat would be, for example, more harmful than impacts resulting from the repair or replacement of existing structures, and the model accounts for this difference.

NMFS developed the NHVM based specifically on the designated critical habitat of listed salmonids in Puget Sound, scientific literature, and our best professional judgement. The model, run by inputting project specific information into the conservation calculator, produces numerical outputs in the form of conservation credits and debits. Credits (+) indicate positive environmental results to nearshore habitat quality, quantity, or function. Debits (-) on the other hand indicate a loss of nearshore habitat quality, quantity, or function. The model can be used to

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[2] A common "habitat currency" to quantify habitat impacts or gains can be calculated using Habitat Equivalency Analysis (HEA) methodology when used with a tool to consistently determine the habitat value of the affected area before and after impact. NMFS selected HEA as a means to identify section 7 project related habitat losses, gains, and quantify appropriate mitigation because of its long use by NOAA in natural resource damage assessment to scale compensatory restoration (Dunford et al. 2004; Thur 2006) and extensive independent literature on the model (Milon and Dodge 2001; Cacela et al. 2005; Strange et al. 2002). In Washington State, NMFS has also expanded the use of HEA to calculate conservation credits available from fish conservation banks (NMFS 2008, NMFS 2015), from which "withdrawals" can be made to address mitigation for adverse impacts to ESA species and their designated CH.

assess credits and debits for nearshore development projects and restoration projects; in the past, we have used this approach in the Structures in Marine Waters Programmatic consultation (NMFS 2016b). More recently, on September 30, 2021, NMFS issued a biological opinion (NMFS 2021) for 11 over-, in- and near-shore projects in the marine shoreline of Puget Sound that used the NHVM to establish a credit/debit target of no-net-loss of critical habitat functions.

The NHVM is also used to assess critical habitat impacts resulting from dredging. The NHVM quantifies the number of and extent to which PCE's are impacted by the proposed dredging. After dredging, the dredged area starts to silt back in and the habitat functions of the migratory corridor gradually increase. The NHVM only assesses the temporal impacts of critical habitat impacts. Short-term effects, like elevated suspended sediments and re-suspended contaminants, are addressed qualitatively in the Effect of the Action in Section 2.5 below.

Use of the NHVM requires an assumption of the amount of time the proposed project, and thus the resulting habitat impacts, would persist. For this consultation and consistent with our application in NMFS 2021, we have applied an assumption that the work at EMMR would persist for 40 years before requiring an additional action to maintain its structural integrity.

As explained above, model outputs for new or expanded projects account for impacts to an undeveloped environment and are calculated at a higher debit rate (2 times greater) than those calculated for replace/repair projects, that assume that some function has already been lost from the existing structure. Appendix 1 has a summary sheet of debits for the proposed project. Following the summary sheets are detailed model output that describe how impacts of the proposed project for 40 years for the platform are determined.

2.2 Rangewide Status of the Species and Critical Habitat

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

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

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

In addition to changes in freshwater conditions, predicted changes for coastal waters in the Pacific Northwest as a result of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Mote et al. 2014). Elevated ocean temperatures already documented for the Pacific Northwest are highly likely to continue during the next century, with sea surface temperature projected to increase by 1.0-3.7°C by the end of the century (IPCC 2014). Habitat loss, shifts in species' ranges and abundances, and altered marine food webs could have substantial consequences to anadromous, coastal, and marine species in the Pacific Northwest (Tillmann and Siemann 2011; Reeder et al. 2013).

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 (Ford, in press).

During the last century, average regional air temperatures in the Pacific Northwest increased by 1-1.4°F as an annual average, and up to 2°F in some seasons (based on average linear increase per decade; Abatzoglou et al. 2014; Kunkel et al. 2013). Recent temperatures in all but two years since 1998 ranked above the 20th century average (Mote et al. 2014). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10°F, with the largest increases predicted to occur in the summer (Mote et al. 2014). In fact, most Washington State models predict average temperatures in Washington State to increase 0.1-0.6°C per decade. Warmer air temperatures will lead to more precipitation falling as rain rather than snow. As the snow pack diminishes, seasonal hydrology will shift to more frequent and severe early large storms, changing stream flow timing and increasing peak river flows, which may limit salmon survival (Mantua et al. 2009). The largest driver of climate-induced decline in salmon and steelhead populations is projected to be the impact of increased winter peak flows, which scour the streambed and destroy salmonid eggs (Mantua et al. 2009).

Decreases in summer precipitation of as much as 30 percent by the end of the century are consistently predicted across climate models (Mote et al. 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB 2007; Mote et al. 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 rise resulted in 3.5-5.3°C increases in Columbia Basin streams and a peak temperature of 26°C in the Willamette (NWFSC 2015). Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al. 2009).

The Northwest Fishery Science Center (NWFSC 2015) reported that climate conditions affecting Puget Sound salmonids were not optimistic, and recent and unfavorable environmental trends are expected to continue (Ford, in press). A positive pattern in the Pacific Decadal Oscillation is anticipated to continue. This and other similar environmental indicators suggest the continuation of warming ocean temperatures; fragmented or degraded freshwater spawning and rearing habitat; reduced snowpack; altered hydrographs producing reduced summer river flows and warmer water; and low marine survival for salmonids in the Salish Sea (NWFSC 2015). Overall, the marine heat wave in 2014-2016 had the most drastic impact on marine ecosystems in 2015, with lingering effects into 2016 and 2017. Conditions had somewhat returned to “normal” in 2018, but another marine heat wave in 2019 again set off a series of marine ecosystem changes across the North Pacific. One reason for lingering effects of ecosystem response is due to biological lags. These lags result from species impacts at larval or juvenile stages, which are typically most sensitive to extreme temperatures or changes in food supply. It is only once these species grow to adult size or recruit into fisheries that the impact of the heat wave is apparent (Ford, in press). Any rebound in VSP parameters for PS Chinook salmon are likely to be constrained under these conditions (NWFSC 2015; Ford, in press).

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

Mauger et al. (2015) reviewed the expected effects of climate change on the Puget Sound marine ecosystem. They identify warmer water temperatures, loss of coastal habitat due to sea level rise, ocean acidification, changes in water quality and freshwater inputs, more frequent algal blooms, and increased erosion from wave action as likely impacts of future climate change.

Recent modeling research has shown variation in the impacts of marine warming on fall-run Chinook salmon distribution depending on stock, resulting in future regional declines or increases in salmon abundance. Shelton et al. (2020) used a Bayesian state-space model to model ocean distribution of fall-run Chinook salmon stocks in the Northwest Pacific, paired with data on sea surface temperature associated with each stock and future ocean climate predictions to predict future distribution of Chinook salmon related to changing sea surface temperature in 2030-2090. In warm years (compared to cool) Klamath, Columbia River (upriver bright run, lower, middle), and Snake River stocks shifted further North, while California Central Valley stock shifted south. Notably, Columbia River and Snake River fall-run Chinook are in the top 10 priority stocks for SRKWs (NMFS and WDFW 2018). Predicted future shifts in distributions due to warming led to future increases in ocean salmon abundance off northern British Columbia and central California, minimal changes off Oregon, Southern British Columbia, and Alaska, and declines in abundance off Washington and northern California (Shelton et al. 2020).

In a broader view, overwhelming data indicate the planet is warming (IPCC 2014), which poses a threat to many species. Climate change has the potential to impact species abundance, geographic distribution, migration patterns, timing of seasonal activities (IPCC 2014), and species viability into the future. Changes in climate and ocean conditions happen on several different time scales and have had a profound influence on distributions and abundances of marine and anadromous fishes.

In marine habitat, scientists are not certain of all the factors impacting salmon and steelhead survival but several ocean-climate events are linked with fluctuations in steelhead health and abundance such as El Niño/La Niña, the Aleutian Low, and coastal upwelling (Pearcy and Mantua 1999). Steelhead, along with Chinook and Coho salmon, have experienced tenfold declines in survival during the marine phase of their lifecycle, and their total abundance remains well below what it was 30 years ago . The marine survival of coastal steelhead, as well as Columbia River Chinook and Coho, do not exhibit the same declining trend as the Salish Sea populations. Specifically, marine survival rates for steelhead in Washington State have declined in the last 25 years with the PS steelhead populations declining to a greater extent than other regions (i.e., Washington Coast and Lower Columbia River). Abundance of PS steelhead populations is at near historic lows (Moore et al. 2010). Climate changes have included increasing water temperatures, increasing acidity, more harmful algae, the loss of forage fish and some marine commercial fishes, changes in marine plants, and increased populations of some marine mammals (i.e. seals and porpoises) (LLTK 2015). Preliminary work conducted as part of the Salish Sea Marine Survival Project reported that approximately 50 percent of the steelhead smolts that reach the Hood Canal Bridge did not survive in the 2017 and 2018 outmigration years. Of the steelhead that did not survive, approximately 80 percent were consumed by predators that display deep diving behavior, such as pinnipeds (Moore and Berejikian 2013). Climate change plays a part in steelhead mortality, but more studies are needed to determine the specific causes of this marine survival decline in Puget Sound.

Evidence suggests that marine survival among salmonids fluctuates in response to 20 to 30-year cycles of climatic conditions and ocean productivity. Naturally occurring climatic patterns, such as the Pacific Decadal Oscillation, El Niño and La Niña events, and North Pacific Gyre Oscillation, can cause changes in ocean productivity that can affect productivity and survival, of salmon (Francis and Hengeveld 1998; Beamish et al. 2004; Hare et al. 1999; Benson and Trites 2002; Dalton et al. 2013, Kilduff et al. 2014), affecting the prey available to SRKWs. (Though relationships may be weakening, see Litzow et al. 2020). Prey species such as salmon are most likely to be affected through changes in food availability and oceanic survival (Benson and Trites 2002), with biological productivity increasing during cooler periods and decreasing during warmer periods (Hare et al. 1999; NMFS 2008). Also, range extensions were documented in many species from southern California to Alaska during unusually warm water associated with "The Blob" in 2014 and 2015 (Bond et al. 2015; Di Lorenzo and Mantua 2016), and past strong El Niño events (Pearcy 2002; Fisher et al. 2015).

The frequency of these extreme climate conditions associated with El Niño events or "blobs" are predicted to increase in the future with climate change (greenhouse forcing) (Di Lorenzo and Mantua 2016) and therefore, it is likely that long-term anthropogenic climate change would interact with inter-annual climate variability. Multiple modeling studies have predicted increases in the frequency of extreme ENSO events and increased ENSO variability due to climate change (Cai et al. 2014, 2015, 2018, Wang et al. 2017). Modeled projections of future marine heat waves similar to the "blob" have predicted decreases in salmon biomass and distribution shifts for salmon, particularly sockeye, in the Northeast Pacific (Cheung and Frölicher 2020). Evidence suggests that early marine survival for juvenile salmon is a critical phase in their survival and development into adults. The correlation between various environmental indices that track ocean conditions and salmon productivity in the Pacific Ocean, both on a broad and a local scale, provides an indication of the role they play in salmon survival in the ocean.

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

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

Climatic conditions affect salmonid abundance, productivity, spatial structure, and diversity through direct and indirect impacts at all life stages (e.g., ISAB 2007, Lindley et al. 2007, Crozier et al. 2008; Moyle et al. 2013, Wainwright and Weitkamp 2013). Studies examining the effects of long-term climate change to salmon populations have identified a number of common mechanisms by which climate variation is likely to influence salmon sustainability. These include direct effects of temperature such as mortality from heat stress, changes in growth and development rates, and disease resistance. Changes in the flow regime (especially flooding and low flow events) also affect survival and behavior. Expected behavioral responses include shifts in seasonal timing of important life history events, such as the adult migration, spawn timing, fry emergence timing, and the juvenile migration. Indirect effects on salmon mortality, growth rates and movement behavior are also expected to follow from changes in the freshwater habitat structure and the invertebrate and vertebrate community, which governs food supply and predation risk (ISAB 2007, Crozier et al. 2008).

In the marine ecosystem, salmon may be affected by warmer water temperatures, increased stratification of the water column, intensity and timing changes of coastal upwelling, loss of coastal habitat due to sea level rise, ocean acidification, and changes in water quality and freshwater inputs (ISAB 2007, Mauger et al. 2015). Salmon marine migration patterns could be affected by climate-induced contraction of thermally suitable habitat. Abdul-Aziz et al. (2011) modeled changes in summer thermal ranges in the open ocean for Pacific salmon under multiple IPCC warming scenarios. For chum, pink, coho, sockeye and steelhead, they predicted contractions in suitable marine habitat of 30 to 50 percent by the 2080s, with an even larger contraction (86 to 88 percent) for Chinook salmon under the medium and high emissions scenarios. Northward range shifts are a climate response expected in many marine species, including salmon (Cheung et al. 2015). However, salmon populations are strongly differentiated in the northward extent of their ocean migration, and hence would likely respond individualistically to widespread changes in sea surface temperature.

2.2.1 Status of the Critical Habitat

This section describes the status of designated critical habitat affected by the proposed action by examining the condition and trends of the essential physical and biological features of that habitat throughout the designated areas. These features are essential to the conservation of the ESA-listed species because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging).

Salmonids

For salmon, NMFS's critical habitat analytical review teams (CHARTs) ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code in terms of the conservation value they provide to each ESA-listed species that they support (NOAA Fisheries 2005). The conservation rankings were high, medium, or low. To determine the conservation value of each watershed to species viability, the CHARTs evaluated the quantity and quality of habitat features, the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area. Even if a location had poor habitat quality, it could be ranked with a high conservation value if it were essential due to factors such as limited availability, a unique contribution of the population it served, or serving another important role. No critical habitat in marine areas has been designated for PS steelhead, and so the action area does not include critical habitat for this Distinct Population Segment (DPS).

In designating critical habitat (CH) for PS Chinook and HCSR chum salmon in estuarine and nearshore marine areas, NMFS determined that the area from extreme high water extending out to the maximum depth of the photic zone (no greater than 30 meters relative to MLLW) contain essential features that require special protection. For nearshore marine areas, NMFS designated the area inundated by extreme high tide because it encompasses habitat areas typically inundated and regularly occupied during the spring and summer when juvenile salmon are migrating in the nearshore zone and relying heavily on forage, cover, and refuge qualities provided by these occupied habitats.

Rockfish

NMFS designated critical habitat for Puget Sound/Georgia Basin (PS/GB) bocaccio rockfish on November 13, 2014 (79 FR 68042). Critical habitat is not designated in areas outside of United States jurisdiction; therefore, although waters in Canada are part of the DPSs' ranges for the species, critical habitat was not designated in that area. The U.S. portion of the Puget Sound/Georgia Basin that is occupied by PS/GB bocaccio can be divided into five areas, or Basins, based on the distribution of each species, geographic conditions, and habitat features. These five interconnected Basins are: (1) The San Juan/Strait of Juan de Fuca Basin, (2) Main Basin, (3) Whidbey Basin, (4) South Puget Sound, and (5) Hood Canal.

Based on the natural history of PS/GB bocaccio and their habitat needs, NMFS identified two physical or biological features, essential for their conservation: (1) Deepwater sites (>30 meters) that support growth, survival, reproduction, and feeding opportunities; and (2) Nearshore juvenile rearing sites with sand, rock and/or cobbles to support forage and refuge. Habitat threats include degradation of rocky habitat, loss of eelgrass and kelp, introduction of non-native species that modify habitat, and degradation of water quality.

Nearshore critical habitat for PS/GB bocaccio at juvenile life stages is defined as areas that are contiguous with the shoreline from the line of extreme high water out to a depth no greater than 98 feet (30 m) relative to mean lower low water. The PBFs of nearshore critical habitat include settlement habitats with sand, rock, and/or cobble substrates that also support kelp. Important site attributes include: (1) Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; and (2) Water quality and sufficient levels of dissolved oxygen (DO) to support growth, survival, reproduction, and feeding opportunities.

All physical and biological features (or primary constituent elements) of estuarine, and nearshore marine critical habitat for the affected salmonid species and bocaccio critical habitat have been degraded throughout the Puget Sound region. The causes for these losses of critical habitat value include human development, including diking, filling of wetlands and bays, channelization, nearshore and floodplain development. The continued growth contributes to the anthropogenic modification of the Puget Sound shorelines and is the major factor in the cumulative degradation and loss of nearshore and estuarine habitat. The development of shorelines includes bank hardening and the introduction of obstructions in the nearshore, each a source of structure and shade, which can interfere with juvenile salmonid migration, diminish aquatic food supply, and is a potential source of water pollution from boating uses (Shipman et al. 2010; Morley et al. 2012; Fresh et al. 2011).

The degradation of multiple aspects of PS Chinook, HCSR chum salmon and bocaccio rockfish critical habitat indicates that the conservation potential of the critical habitat is not being reached, even in areas where the conservation value of habitat is ranked high.

Table 2 provides a summary of critical habitat information for the species addressed in this opinion. More information can be found in the Federal Register notices available at NMFS's West Coast Region website (http://www.westcoast.fisheries.noaa.gov/).

Table 2. Current Status of Designated Critical Habitat

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Puget Sound Chinook salmon	9/02/05 70 FR 52630	Critical habitat for Puget Sound Chinook salmon includes 1,683 miles of streams, 41 square mile of lakes, and 2,182 miles of nearshore marine habitat in Puget Sounds. The Puget Sound Chinook salmon ESU has 61 freshwater and 19 marine areas within its range. Of the freshwater watersheds, 41 are rated high conservation value, 12 low conservation value, and eight received a medium rating. Of the marine areas, all 19 are ranked with high conservation value.
Hood Canal summer-run chum	9/02/05 70 FR 52630	Critical habitat for Hood Canal summer-run chum includes 79 miles and 377 miles of nearshore marine habitat in HC. Primary constituent elements relevant for this consultation include: 1) Estuarine areas free of obstruction with water quality and aquatic vegetation to support juvenile transition and rearing; 2) Nearshore marine areas free of obstruction with water quality conditions, forage, submerged and overhanging large wood, and aquatic vegetation to support growth and maturation; 3) Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.
Puget Sound/Georgia Basin DPS of bocaccio	11/13/2014 79 FR68042	Critical habitat for bocaccio includes 590.4 square miles of nearshore habitat and 414.1 square miles of deepwater habitat. Critical habitat is not designated in areas outside of United States jurisdiction; therefore, although waters in Canada are part of the DPSs' ranges for all three species, critical habitat was not designated in that area. Based on the natural history of bocaccio and their habitat needs, NMFS identified two physical or biological features, essential for their conservation: 1) Deepwater sites (>30 meters) that support growth, survival, reproduction, and feeding opportunities; 2) Nearshore juvenile rearing sites with sand, rock and/or cobbles to support forage and refuge. Habitat threats include degradation of rocky habitat, loss of eelgrass and kelp, introduction of non-native species that modify habitat, and degradation of water quality as specific threats to rockfish habitat in the Georgia Basin.

2.2.2 Status of the Species

Table 3, below provides a summary of listing and recovery plan information, status summaries and limiting factors for the species addressed in this opinion. More information can be found in recovery plans and status reviews for these species. Acronyms appearing in the table include DPS (Distinct Population Segment), ESU (Evolutionarily Significant Unit), MPG (Major Population Group), NWFSC (Northwest Fisheries Science Center), TRT (Technical Recovery Team), PS (Puget Sound), PS/GB (Puget Sound/Georgia Basin).

Table 3. Listing classification and date, recovery plan reference, most recent status review, status summary, and limiting factors for each species considered in this opinion.

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Puget Sound Chinook salmon	Threatened 6/28/05 (70 FR 37159)	Shared Strategy for Puget Sound 2007 NMFS 2006	NWFSC 2015	This ESU comprises 22 populations distributed over five geographic areas. Most populations within the ESU have declined in abundance over the past 7 to 10 years, with widespread negative trends in natural-origin spawner abundance, and hatchery-origin spawners present in high fractions in most populations outside of the Skagit watershed. Escapement levels for all populations remain well below the TRT planning ranges for recovery, and most populations are consistently below the spawner-recruit levels identified by the TRT as consistent with recovery.	• Degraded floodplain and in-river channel structure • Degraded estuarine conditions and loss of estuarine habitat • Degraded riparian areas 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
Puget Sound/ Georgia Basin DPS of Bocaccio	Endangered 04/28/10	NMFS 2017	NMFS 2016	Though Bocaccio were never a predominant segment of the multi-species rockfish population within the Puget Sound/Georgia Basin, their present-day abundance is likely a fraction of their pre-contemporary fishery abundance. Most bocaccio within the DPS may have been historically spatially limited to several basins within the DPS. They were apparently historically most abundant in the Central and South Sound with no documented occurrences in the San Juan Basin until 2008. The apparent reduction of populations of bocaccio in the Main Basin and South Sound represents a further reduction in the historically spatially limited distribution of bocaccio and adds significant risk to the viability of the DPS.	• Over harvest • Water pollution • Climate-induced changes to rockfish habitat • Small population dynamics
Puget Sound/ Georgia Basin DPS of yelloweye Rockfish	Threatened 04/28/10	NMFS 2017	NMFS 2016	Yelloweye rockfish within the PS/GB are likely the most abundant within the San Juan Basin of the DPS. Yelloweye rockfish spatial structure and connectivity is threatened by the apparent reduction of fish within each of the basins of the DPS. This reduction is probably most acute within the basins of PS proper. The severe reduction of fish in these basins may eventually result in a contraction of the DPS' range.	• Over harvest • Water pollution • Climate-induced changes to rockfish habitat • Small population dynamics

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 action area in on the northeast side of Hood Canal, approximately 4 miles north of Bangor. The action area covers the area which would be affected by construction impacts. The HDD portion of the project area is in the designated Department of Defense (DoD) restricted and danger zone (yellow dotted line in figure 6). The action area is defined by two activities, the 300-foot turbidity zone around jet plowing line (as defined by WAC173-201A-210) and the temporary increase in noise and sound pressure resulting from the pile driving activities (Figure 6).

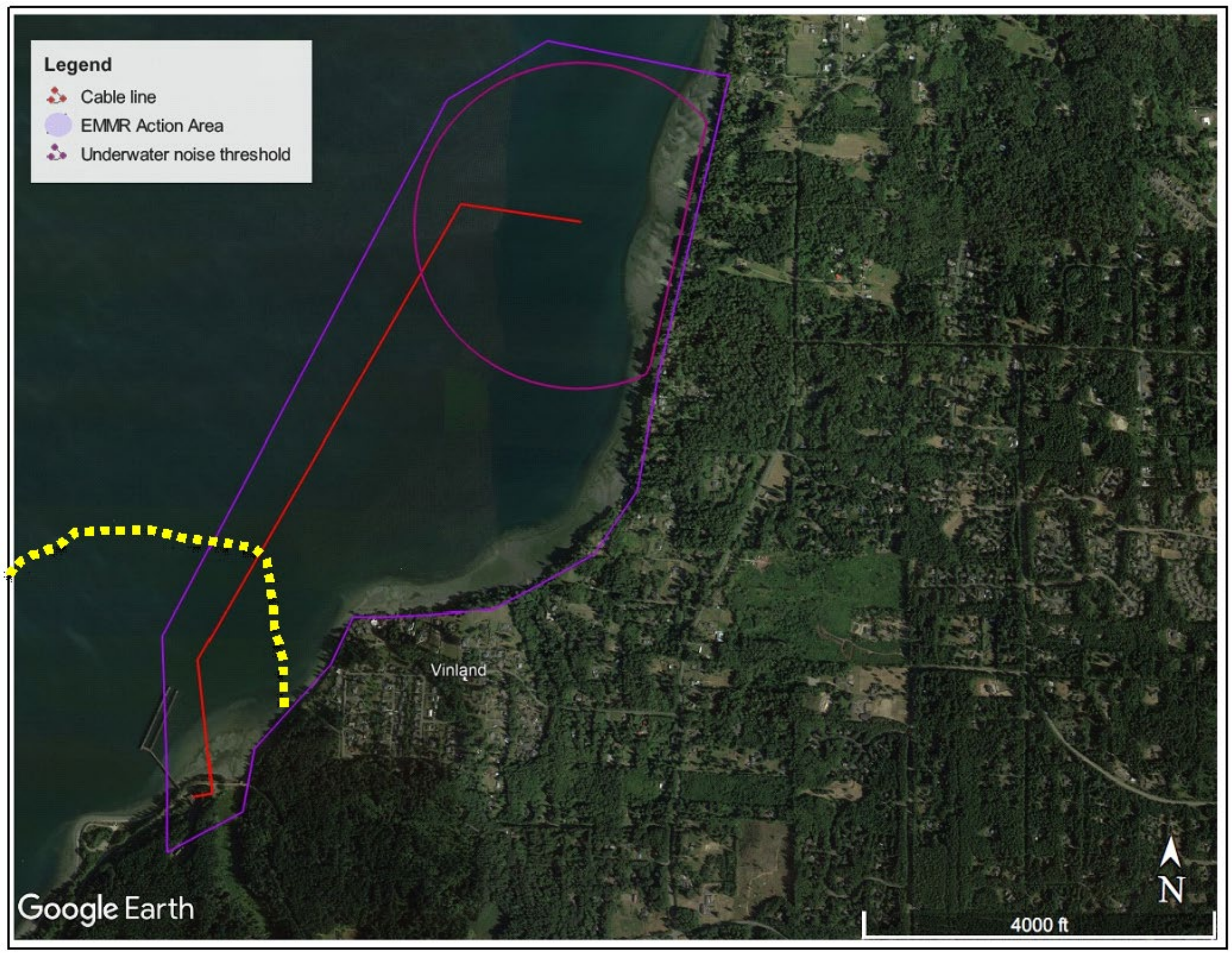

Figure 6. Action area: The red line represents the cable line, the pink circle represents the underwater noise threshold, the yellow dotted line that trails off the page is the end of the Navy Exclusion Zone, and the dark purple line is the Action Area for this Opinion.

Underwater noise levels would extend the farthest from the impact driving of five 24-inch concrete piles. Impact pile driving noise, which has a much smaller area of coverage than vibratory pile driving, is estimated to attenuate to below the marine mammal behavioral disturbance threshold at a max underwater distance of 117 meters from the source (the piles). The fish behavioral threshold lies at 541 meters (pink circle in Figure 6) from the source (Appendix 2). This increase in detectable sound pressure/noise represents an alteration of the physical properties of water quality. The water becomes less desirable due to the pressure. The behavioral threshold for fish

The action area includes designated critical habitat for PS Chinook, HCSR chum, and PSGB bocaccio. Because the action area includes a small portion of designated DoD restricted and danger zone, habitat within this specific zone is excluded from critical habitat designation, even though the area is accessible to listed species.

Effects to habitat features include temporary diminishment of benthic communities, water quality (turbidity), and noise from pile driving. Timing, duration, and intensity of the effects on DoD exempted areas would be the same as for the critical habitat effects (we assume effects are consistent across designated and non-designated areas).

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).

Many of the factors affecting listed species and critical habitat generally are also present as degrading habitat factors in the baseline of the action area (See section 2.3). For example, water quality is affected by upland sources of pollution. Baseline conditions that are specific to the action area, especially for HCSR chum, include background levels of noise from significant levels of commercial vessel traffic, as well as degraded nearshore habitat due to bank armoring and large in-water navy structures.

Hood Canal is a large fjord that is separated from Puget Sound by the Kitsap Peninsula. Hood Canal averages 3.8-miles wide and 500-feet deep, with a maximum width 10.2 miles and maximum depth of 600 feet (Johnson et al. 2001). The canal stretches 63 miles from its mouth at Admiralty Inlet to the tip of Lynch Cove at Belfair. At the southern extent of Hood Canal, where the Skokomish River enters the Hood Canal, a 90-degree bend to the east occurs (The Great Bend).

Four watersheds, or Water Resource Inventory Areas (WRIA), drain into Hood Canal: Kennedy-Goldbsorough (WRIA 14); Kitsap Basin (WRIA 15); Hood Canal Basin (WRIA 16); and Quilcene Basin (WRIA 17) (Figure 7). Hood Canal has several major tributaries including the Skokomish, Big Quilcene, Dosewallips, Duckabush, Dewatto, Hamma, and Union rivers.

Within northern Hood Canal, nearshore development is limited with few industrial waterfront sites other than NAVBASE Kitsap Bangor. Quilcene has a marina in north Hood Canal. The community of Bridgehaven has nearly 30 private docks and a small marina dock. A few residential docks and small piers occur at Seabeck, approximately 10 miles south of the action area and attracts recreational boaters. Pleasant Harbor, north of Seabeck, represents a larger amount of OWS and significantly more vessel traffic when compared to Seabeck. The Hood Canal Bridge is located approximately 6 miles north of the action area.

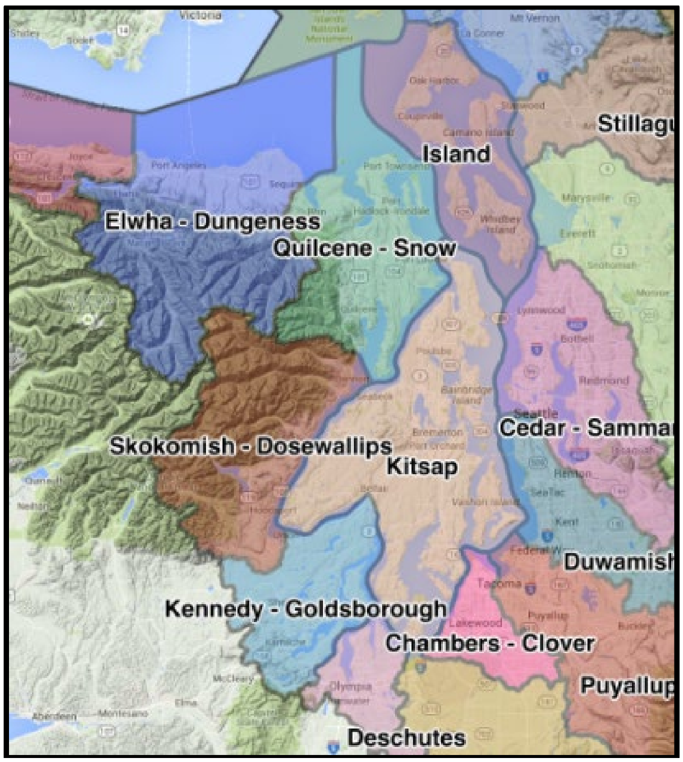

Figure 7. Water Resource Inventory Areas adjacent to the action area.

The immediate shores of Hood Canal in the action area lack wetland habitats. The western shore consists of gravel and driftwood and is undeveloped. Low shrubs and 80-foot conifer trees occupy the riparian zone and extend upwards into the steeps banks of Hood Canal. Unlike the western shore, the eastern shore is more developed due to the presence of NAVBASE Kitsap Bangor. NAVBASE Kitsap Bangor is a large industrial/military complex with more than 3.6 acres of over-water and in-water structures, approximately 4.20 miles of shoreline. These structures can support multiple nuclear submarines at once and support vessels of different sizes.

Hood Canal has several sources of artificial light including commercial and residential shoreline development and overwater structures. For example, many homes and docks have lights. Alderbrook Inn has lighting on their T-dock (near Union) and Hoodsport Public Dock does as well. The communities of Bridgehaven and Port Gamble in north HC, and Hoodsport in south HC, are examples of shoreline communities that produce artificial nighttime lighting. Shellfish harvest often happens at night during the winter. While episodic, they set up lighting on the beach during harvest.

The NAVBASE Kitsap Bangor waterfront also produces artificial light. The overwater and onshore structures currently comprising the NAVBASE Kitsap Bangor waterfront produce lighting through the upper, lower, and deep shore zones with deck mounted lights. These lighting systems are commercial grade, but vary in size, output, orientation, and elevation off the water. This artificial lighting in the upper shore, and extending through the deep shore zones, is continuous in nature, occurring every night with limited—or no—interruptions. Such lighting is known to create a behavioral response in juvenile fish that can impair both migration and survival. Tabor et al (2017) determined that out-migrating juvenile salmonids exposed to artificial nighttime light experience a form of nocturnal phototaxic behavior, moving toward and staying in areas of artificial light. This abnormal behavior can increase the risk of predation especially among juvenile salmonids. Multiple OWS at the Navy's waterfront represent an additional increase in predation risk and decrease in migratory efficiency for salmonids.

Recreational boating activities, including fishing are common in the Canal. The local fishery includes sport and tribal fishing. The abundance of boats on the water is seasonal and varies with the length of the sport fishing season set by the Washington Department of Fish and Wildlife (WDFW). There are several fisheries in Hood Canal and ample aquaculture activities, commercial and non-commercial. The aquaculture activities include on-bottom oyster culture and hand harvesting. Aquaculture activities result in increased nutrient sequestering, invertebrate colonization and periodic events of increased turbidity associated with harvest. There are oyster beds on the upper and lower shore zones throughout the Bangor waterfront which are managed by hand. No shellfish farming is allowed within 20 feet of eelgrass beds (with the exception of long lines and flip bags). The hands-only method is the lowest impact method available and avoids significant increases in turbidity and other potential effects associated with heavy machinery such as dredges. Any increases in turbidity or alterations to the benthic community in the shellfish beds are short in duration and isolated to the immediate area where farmers walked and collected oysters. In addition, extensive, non-aquaculture commercial (state & tribal) fisheries exist in Hood Canal for sea cucumber, urchins, and geoduck.

Frequent vessel traffic from the mix of users produces sound energy throughout Hood Canal and the action area. Documented behavioral and physiological responses to disturbance from boat noise divert time and energy from other fitness-enhancing activities such as feeding, avoiding predators, and defending territory. All of these likely disturb salmonids, causing them to at least temporarily leave an area, and experience sublethal physiological stress all of which increases the likelihood of injury and being predated on.

Circulation patterns within Hood Canal are complex due to the configuration of the basin and the tidal regime. Tides in Hood Canal are mixed semidiurnal with one flood and one ebb tidal event characterized by a small to moderate range (one to six feet) and a second flood and second ebb with a larger range (eight to 16 feet) during a 24.8-hour tide cycle. As a result, higher high, lower high, higher low, and lower low water levels occur within each tide day (URS Consultants, Inc. 1994; Morris et al. 2008). Larger tidal ranges promote higher velocity currents and increased flushing of the basin, whereas small to moderate tidal ranges are associated with weaker currents and comparatively smaller volumes of seawater exchanged between Hood Canal and Puget Sound.

Because the tides are mixed semidiurnal, Hood Canal is subject to one major flushing event per tide day, when approximately three percent of the total canal volume is exchanged over a six-hour period. Due to the wide range of tidal heights, the actual seawater exchange volume for Hood Canal ranges from one percent during a minor tide to four percent during a major tide. Northern Hood Canal has 20 parameters listed on the WDOE's 303(d) List of Threatened and Endangered Waters (WDOE 2014) within WRIA 15. Low DO, high fecal coliform, and high levels of heavy metals and chemicals characterize water quality in Hood Canal.

Storm waves are the principal mechanism driving longshore sediment transport within Hood Canal shoreline (Golder Associates 2010). Wave energy and the magnitude of sediment transport in Hood Canal are related to the direction and speed of the regional winds. The general wave environment in Hood Canal is characterized as low energy. The NAVBASE Kitsap Bangor shoreline is located in the middle of a 16.5-mile long drift cell (KS 5 in the WDOE digital coastal atlas). Erosional bluffs that range in height from 30 to 55 feet characterize shoreline geomorphology. Feeder bluffs represent a portion of the NAVBASE Kitsap Bangor shoreline (MacLennan and Johannessen 2014), some of which are completely or partially armored to protect overwater and road infrastructure at NAVBASE Kitsap Bangor, resulting in an impediment to sediment input and transport. MacLennan and Johannessen (2014) note that existing structures along the NAVBASE Kitsap Bangor shoreline, as well as other portions of the Hood Canal shoreline, have armored feeder bluffs, thereby reducing the sediment supply compared to historical (pre-development) levels.

A survey of eelgrass and macroalgae was conducted in September 2019. A large and continuous patch of native eelgrass was observed in the path of the HDD on the south side of the action area, from an approximate depth range of 0 MLLW to -20 MLLW (Figure 8).

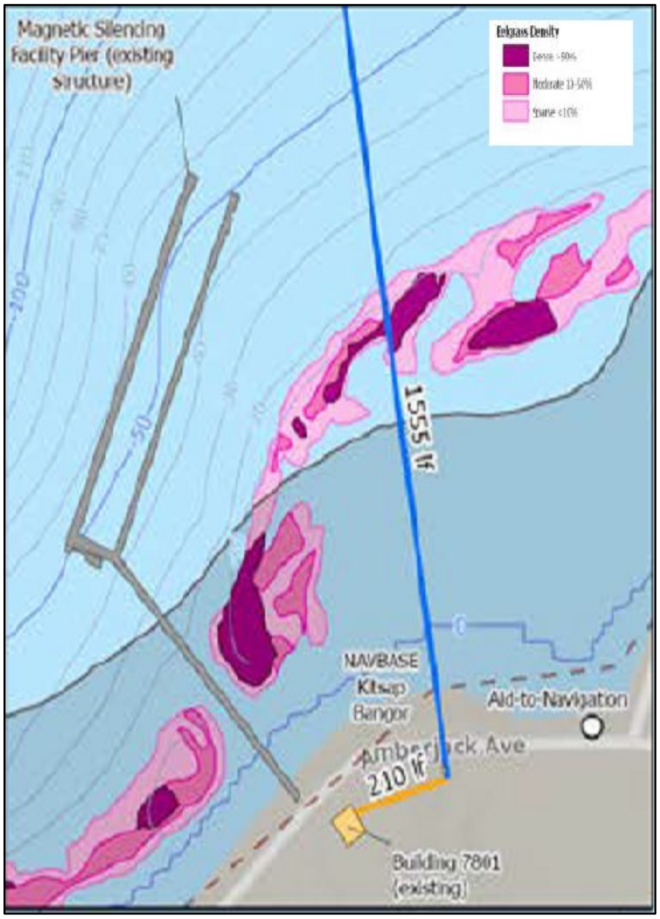

Figure 8. SAV locations

Eelgrass, an important habitat for juvenile salmonids (Williams et al. 2001), is found in lush beds in Hood Canal. Eelgrass is also an important spawning substrate for Pacific herring (*Clupea pallasii*). The Washington Department of Ecology has identified the area along NAVBASE Kitsap Bangor as having both continuous and patchy assemblages of kelp (*Saccharina* spp.).

While eelgrass is traditionally located higher in tidal elevation than kelp, both require direct access to natural overhead lighting, typically provided by sunlight, in order to grow and survive. Both these organisms need fairly high light levels to grow and reproduce, so they are found only in shallow waters, mostly less than 65 feet for kelp, and 32 feet for eelgrass (Mumford 2007). Hence, they are totally dependent on the nearshore environment. With NAVBASE Kitsap Bangor's extensive system of overwater structures, it is highly likely that submerged aquatic vegetation (SAV) colonization, growth and survival are not possible under much of the Navy's facilities currently in place.

The sand/gravel substratum exhibited within the project area is representative of the majority of Hood Canal nearshore. Sediment consists of solid fragments of organic matter derived from biological organisms in the overlying water column and inorganic matter from the weathering of rock that are transported by water, wind, and ice (glaciers) and deposited at the bottom of bodies of water. Sediments range in size from cobble (2.5-10 inches), to pebble (0.15-2.5 inches), to granule (0.08-0.15 inch), to sand (0.002-0.08 inch), to silt (0.00008-0.0002 inch), and to clay (less than 0.00008 inch).

Benthic organisms are abundant and diverse at NAVBASE Kitsap Bangor and are more abundant in the subtidal zone than in the intertidal zone (WDOE 2017). There is no dominant species among mollusks, crustaceans, and polychaetes, but as a larger group, mollusks are dominant in the subtidal zone. Echinoderms comprise only a small percentage (about six percent) of the benthic community along the waterfront. These benthic organisms and the presence of SAV support a diverse assemblage of forage fish along NAVBASE Kitsap Bangor.

Different forage fish spawn in Hood Canal year-round. Common fish species identified as forage fish were recorded in the action area during beach seine surveys conducted in 2005 to 2008 (SAIC 2009). Forage fish captured include, in order of abundance (highest to lowest): Pacific herring, surf smelt, and Pacific sand lance (SAIC 2006). Larval forage fish, consisting of large schools with both surf smelt and Pacific sand lance, were also captured during this time. Forage fish occur during each month surveyed, becoming increasingly abundant in the spring months, reaching a peak in June, largely due to the arrival of large schools of herring, before decreasing in abundance again by July. The forage fish presence increases the probability of occurrence of salmon during in-water activity. Adult forage fish 2 grams or larger, and juveniles and larval forage fish smaller than 2 grams, may be exposed to injurious levels of underwater noise. Thus, we expect small-scale, construction-related reduction in salmonid forage. Considering the larger extent of forage fish spawning on Puget Sound beaches (266 miles of known surf smelt spawning beaches and 118 miles of known sand lance spawning beaches[3]), this small-scale reduction likely results in a is relatively minor reduction of available forage for salmonids – though these number do not directly relate to prey available to Hood Canal salmon.

Currently, the nearest identified forage-fish (salmonid prey) spawning site to the proposed action is an eelgrass bed is in the action area, but approximately 180 feet (55 m) south of the proposed HDD exit hole. The increase of suspended solids during cable laying would not adversely impact the spawning success of this eelgrass bed because of its distance from the construction area and the temporary nature of the impact. However, forage fish that were in the area during this time of construction would be exposed to increased levels of turbidity. In addition, during construction and until recovery of the vegetation and benthic communities, forage fish use of existing prey and refuge habitats would be impacted.

Beach and trawl surveys were conducted along NAVBASE Kitsap Bangor's waterfront and recorded small numbers of Pacific herring during the winter months and large numbers during the summer months (SAIC 2006; Bhuthimethee et al. 2009). In recent years the herring stock in Hood Canal has been rising. The Hood Canal stocks (considered part of the Other Stocks Complex), particularly Quilcene Bay, are boosting the estimated total spawning biomass for all of the stocks. The Quilcene Bay stock's 4-year mean is 125 percent above the 25-year mean and now contributes over half of all Southern Salish Sea herring spawning biomass. While the Quilcene Bay and South Hood Canal stocks are considered increasing or healthy, the Port Gamble stock was Declining in 2000 and 2004, Depressed in 2008 and 2012, and has now fallen

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[3] https://wdfw.wa.gov/commission/meetings/2016/12/dec0916_12_presentation.pdf

to Critical for 2016. A recent remediation project to remove creosote pilings in the bay may help improve water quality and larval herring survival (WDFW 2019).

Surf smelt are expected to be present within the nearshore areas at this location year-round. A high abundance of surf smelt was recorded during the late spring through early summer and juvenile surf smelt were observed within the nearshore areas during the January through mid-summer months. Juvenile sand lance were also observed from January through mid-summer months within nearshore cove areas mixed in with larval sand lance and surf smelt (SAIC 2006; Bhuthimethee et al. 2009; Frierson et al. 2017). WDFW surveys conducted in December 1995, November 1996, and January 1997 documented sand lance spawning along the shoreline including beaches adjacent to Carderock Pier, Service Pier, Keyport Bangor Dock, Delta Pier, Marginal Wharf, Explosives Handling Wharf #1 (EHW-1), and the Magnetic Silencing Facility Pier. Sand lance spawning areas are located north and south of the proposed TPP based on these surveys conducted in the 1990s (WDFW 2019). All life stages of surf smelt and sand lance are expected to be present along the NAVBASE Kitsap Bangor waterfront.

At the northern end of Hood Canal lies the Hood Canal Floating Bridge that carries traffic across the northern outlet of Hood Canal, connecting the Olympic and Kitsap peninsulas and supporting tourism and other economic activities. As a 1.5-mile long floating bridge, its pontoons span over 80% the width of Hood Canal and extend 15 feet underwater. Because of its location, all salmon and steelhead must navigate around or underneath the Hood Canal Bridge on their migration to and from the Pacific Ocean. In September 2020, studies conducted by the Hood Canal Bridge Assessment Team revealed that (Hood Canal Assessment Team 2020):

1. The Hood Canal Bridge significantly contributes to early marine mortality of juvenile Hood Canal steelhead by impeding fish passage and facilitating predation.
2. The bridge impacts other fish species such as juvenile Chinook and chum salmon.
3. The bridge significantly impacts water quality parameters (temperature, salinity, currents) in its vicinity. Although bridge effects on water quality dissipate with increasing distance from the bridge and do not appear to propagate throughout Hood Canal, these near-bridge changes in circulation and flow may be linked to impacts on juvenile salmon and steelhead behavior and mortality.
4. Avian and mammalian predators were documented near the bridge. Harbor seal predation on juvenile steelhead was the most frequent source of mortality based on tagged juvenile steelhead mortality patterns.

Interested stakeholders are working with the Washington State Department of Transportation to explore modifications to the bridge that could alleviate these issues.

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 proposed action would have multiple types of effects, ranging from temporary to enduring. The temporary effects associated with construction include water quality, noise in the aquatic habitat, and benthic communities and forage species diminishment. Also included in this section, are any positive effects of project design features, designed to reduce the impact of a structure, and minimization measures (as described in Section 1.3). We analyze these effects on features of habitat first, including critical habitat, and then we identify the listed species that would encounter these effects.

2.5.1 Temporary Effects during Construction

Construction of the EMMR would include (a) water quality reductions; (b) increased noise in the aquatic environment; and (c) reduction of prey/forage (benthic prey, forage fish, prey fishes).

Water Quality Impairment

Turbidity: Water quality effects during the jet plowing and dredging for the EMMR are likely to include turbid conditions. In estuaries, state water quality regulations (WAC173-201A-400) establish a mixing zone of 300 feet (plus the depth of water over the discharge ports) for dredging activities, as measured during mean lower low water; and 200 feet (plus the depth of water over discharge ports) for non-dredging activities. During the days that the dredging and plowing construction activities occur in the water, approximately 12 weeks total, elevated suspended sediment levels could occur within the action area.

Dredging activities unavoidably disturb the sediment substrates and potentially increase contaminant concentrations by re-suspending particulates, thereby allowing more contaminants to enter into the water column. Consequently, in these cases elevated water column contaminant concentration occur in the vicinity of the dredging, depending on the tidal stage during the dredging activity. In estuary environments, Washington state water quality regulations (WAC173-201A-210) establish that mixing zones do not extend for a distance from the discharge port(s) greater than three hundred feet (plus the depth of water over the discharge port(s)). During proposed dredging activities, we anticipate that elevated suspended sediment levels would occur within these threshold distances.

Reduced Dissolved Oxygen (DO): Suspension of anoxic sediment compounds during in water work can result in reduced DO in the water column within the mixing zone area as the sediments oxidize. Based on a review of six studies on the effects of suspended sediment on DO levels, LaSalle (1988) concluded that, when relatively low levels of suspended material are generated and counterbalancing factors such as flushing exist, anticipated DO depletion around in-water work activities would be minimal. High levels of turbidity would likely have contemporaneous reduction in dissolved oxygen within the same affected area.

Reduced DO is not expected to exceed the established mixing zone of 200 feet (plus the depth of water over discharge ports) for non-dredging activities (the piles). For dredging activities, reduced DO is not expected to exceed the established mixing zone of 300 feet (plus the depth of water over discharge ports).

Increased Noise in the Aquatic Environment

Pile Driving. Pile driving can cause high levels of underwater sound. Pile driving can significantly increase sound waves in the aquatic habitat. The sound pressure levels (SPL) from pile driving and extraction would occur contemporaneous with the work and radiate outward; the effect attenuates with distance. Cumulative sound exposure level (SEL) is a measure of the sound energy integrated across all of the pile strikes. The Equal Energy Hypothesis, described by NMFS (2007b), is used as a basis for calculating cumulative SEL (cSEL). The number of pile strikes is estimated per continuous work period. This approach defines a work period as all the pile driving between 12-hour breaks. NMFS uses the practical spreading model to calculate transmission loss, and define the area affected. Impact noise can create sufficient disturbance to affect the suitability of habitat from a behavioral and physiological sense for listed species.

Benthic Communities and Forage Species Diminishment

Areas where sediment is disturbed by in-water work would disturb and diminish benthic prey communities. In areas where suspended sediment settles on the bottom, some smothering can occur which also disrupts the benthic communities. The speed of recovery by benthic communities is affected by several factors, including the intensity of the disturbance, with greater disturbance increasing the time to recovery (Dernie et al., 2003). Additionally, the ability of a disturbed site to recolonize is affected by whether or not adjacent benthic communities are nearby that can re-seed the affected area. Thus, we expect recovery to range from several weeks to months to years.

When juvenile salmonids are entering the nearshore or marine environment, they must have abundant prey to allow their growth, development, maturation, and overall fitness. As bottom sediments are dislodged, benthic communities are disrupted and in the locations where sediment falls out of suspension and layers on top of adjacent benthic areas. Benthic communities would be impacted and it can take two to three years to fully re-establish their former abundance and diversity. Given that the work would occur across three work windows, we can expect six to nine years in which benthic prey is less available to juveniles, incrementally diminishing the growth and fitness of four separate cohorts of individual juvenile outmigrants from the ESA listed salmonid species that pass through the action area. Juvenile migrants may experience reduce food or increased competition to a degree that impairs their growth, fitness, or survival. Even if several fish from each cohort of each population had diminished foraging success, we anticipate that this would be a transitory condition as they migrate to more suitable forage locations. The level of reduced growth, fitness, or survival would be impossible to detect numerically, and the reduced abundance in juvenile cohorts would probably be insufficient to be discerned as an influence on productivity of the populations.

2.5.2 Enduring Effects

In-water and Overwater Structures: In- and overwater structures influence habitat functions and processes for the duration of the time they are present in habitat areas. These effects are chronic, persistent, and co-extensive with the piles for the platform for 40 years. The actual platform, or overwater structure, is not included in this analysis. The base of the proposed platform is projected to be 22 feet above MLLW. Typically, shade from structures can cast a sharp light/dark contrast that can impair the migration corridor for juvenile salmonids and disrupt other habitat function (Carrasquero 2001). Due to the height of the structure, this platform would cast a shadow that would move quickly through the day. Site-specific factors such as water clarity and depth in concert with the type and use of the structure determine the magnitude of this effect. The WSDOT has data suggesting that bridges higher than 24 feet do not affect vegetation growth due to the fast moving shadow of the bridge (WSDOT 2009). With vegetation growth not a concern at the deep platform location, we focus on light and shadows disrupting migratory pathways. The majority of the platform is high enough (25 feet or more) above the water surface that indirect light conditions can predominate and mute the light/dark contrast in most weather conditions rendering shadowing issues insignificant at this platform.

To assess the enduring effects of the proposed project, NMFS used the NHVM, as described in Section 2.1, which as currently proposed resulted in a debit (or loss of habitat function) of -10 points. The EMMR would result in a total placement of five 24-inch concrete piles (Appendix 1).

Effects of Compensatory Mitigation: To address enduring impacts to aquatic habitats and as required by the US Army Corps of Engineers (USACE) under the Clean Water Act section 404, the Navy would use the HCCC ILF program for compensatory mitigation requirements for the EMMR project. The purchase of mitigation credits would address the loss of ecosystem functions due to the modification of water bottoms, and water column.

The purchased credits are expected to achieve a no-net-loss of habitat function as a result of this proposed action, which are needed to help ensure that PS Chinook salmon do not continue to drop below the existing 1-2 percent juvenile survival rates (Kilduff et al. 2014, Campbell et al. 2017). PS Chinook salmon juvenile survival is directly linked to the quality and quantity of nearshore habitat. Campbell et al. 2017 has most recently added to the evidence and correlation of higher juvenile survival in areas where there is a greater abundance and quality of intact and restored estuary and nearshore habitat. Relatedly, there is emerging evidence that without sufficient estuary and nearshore habitat, significant life history traits within major population groups are being lost. And specific to this action area, there appear to be higher rates of mortality in the fry life stage in the more urbanized watersheds. By contrast, in watersheds where the estuaries are at least 50 percent functioning, fry out-migrants made up at least 30 percent of the returning adults, compared to the 3 percent in watersheds like the Puyallup and the Green rivers, where 95 percent of the estuary has been lost (Campbell et al. 2017).

This also means that for projects that occur in less developed areas and within stretches of functioning habitats, like the EMMR, no net loss is even more crucial. It has been long understood that protection and conservation of existing unimpaired systems is more effective and efficient then full restoration of impaired systems (Goetz et al. 2015). The conservation offsets would not result in adding to the needed nearshore restoration, but they would ensure that the proposed action does not cause nearshore habitat conditions to get worse.

2.5.3 Effects on Habitat

As mentioned in Section 2.2.1, critical habitat for PS chinook and HCSR chum salmon, and bocaccio occurs within the action area along portions of the shoreline in Hood Canal. However, DoD lands and associated easements and rights-of-way can be exempted from critical habitat designation when there is an approved Integrated Natural Resources Management Plan (INRMP) that outline species protection measurements (33 CFR 334). In the action area, some critical habitat is exempted on DoD lands, most is not.

Whether or not habitat is designated as critical, the full range of the action area provides accessible habitat to the various listed fishes considered in this opinion, and it is certain that the features of the habitat, would be altered either temporarily, or for the foreseeable future. Given the mixture of critical and non-critical habitat within the action area, in the following section, we will review effects to all habitat features, whether or not the habitat is designated as critical, as this analysis is foundational to our review of the effects of the proposed action on the listed species themselves.

The temporary effects on features of habitat associated with construction are:

1. Water quality impairment
2. Increased noise in the aquatic environment
3. Benthic communities and forage species diminishment

The enduring effects on features of habitat associated with in water structures are:

Clean Water Act Compensatory Mitigation "Hood Canal In-lieu fee program"

Critical Habitat: The NMFS reviews the effects on critical habitat affected by the proposed action by examining changes of the project to the condition and trends of physical and biological features identified as essential to the conservation of the listed species. The salmonid PBFs present in the action area are:

> Nearshore marine areas free of obstruction and excessive predation with
> (1) water quality and quantity conditions and foraging opportunities, including aquatic invertebrates and fishes, supporting growth and maturation, and
> (2) natural cover including submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.

Rockfish critical habitat features are distinguished between adults and juveniles, as each life history stage has different location and habitat need. Only juvenile critical habitat is in the action area. PBFs essential to the conservation of juvenile bocaccio rockfish include:

> Juvenile settlement habitats located in the nearshore with substrates such as sand, rock and/or cobble compositions that also support kelp are essential for conservation because these features enable forage opportunities and refuge from predators and enable behavioral and physiological changes needed for juveniles to occupy deeper adult habitats. Several attributes of these sites determine the quality of the area; these attributes include: (1) quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; and (2) water quality and sufficient levels of DO to support growth, survival, reproduction, and feeding opportunities.

2.5.3.1 Temporary effects on features of habitat associated with construction:

1. Water quality impairment

Pile driving, dredging, plowing, sediment replacement and cable armoring would cause short-term and localized increases in turbidity and TSS as the bottom materials are displaced from the intrusion of the pile structures; from the percussive effect of the driving; and from escaped sediment removed during dredging and plowing of the seafloor surface. This affects water quality and benthic prey communities.

The activities would re-suspend bottom sediments within the immediate area of each activity, resulting in temporary and localized increases in suspended sediment concentrations that, in turn, would increase turbidity levels. The suspended sediment/turbidity plumes would be generated periodically throughout an in-water work window. For pile driving, they would be generated over a five-day consecutive window. Suspended sediments could spread up to an estimated 500 feet from jet-plowing, though most sediment (80 to 90 percent) would be expected to settle out within 20 feet of the cable trench corridor within several hours following completion of jet-plowing operations (BPA 2007).

In-water work could produce measurable increases in turbidity and sedimentation, and could cause fish to temporarily avoid critical habitat near construction. However, construction activities would not result in persistent increases in turbidity levels or cause changes that would violate water quality standards because processes that generate suspended sediments, which result in turbid conditions, would be short-term and localized, and suspended sediments would disperse and/or settle rapidly (within a period of minutes to hours after construction activities cease).

2. Increased noise in the aquatic environment

During construction of the EMMR, five 24-inch concrete piles would be installed for permanent support of the platform. All pile driving would be completed over five days in one of the three in-water work windows. A single pile would require no more than 45 minutes and 600 pile strikes during a workday.

All pile driving would increase sound waves that disrupt the upper shore zone, lower shore zone, and deep shore zone of the aquatic habitat in the action area. The sound pressure level (SPL) from pile driving and extraction would occur contemporaneous with the work and radiate outward; the effect attenuates with distance. Cumulative sound exposure level (SEL, or cSEL) is a measure of the sound energy integrated across all of the pile strikes. The Equal Energy Hypothesis, described by NMFS (2007b), is used as a basis for calculating cSEL. The number of pile strikes is estimated per continuous work period. This approach defines a work period as all the pile driving between 12-hour breaks. NMFS uses the practical spreading model to calculate transmission loss, and define the area affected. Impact noise with high amplitude can create sufficient disturbance that the action area is impaired as a migratory area, but this persists only for the duration of the pile driving. Because work ceases each day, migration values are re-established during the evening, night, and early morning hours.

The proposed action is likely to affect PS Chinook and HCSR chum salmon, and bocaccio critical habitat. Pile driving would produce noise detectible by the protected species during impact pile driving in the portion of the action area and project area. The increased noise levels would be temporary, lasting five days total.

Sound in Salmon Critical Habitat - Because the impact pile driving of concrete piles would be conducted during the timeframe when juvenile salmon are least likely to be present migration value impairment would be minimized. However, the area does have resident Chinook salmon (sometimes referred to as “black mouth”) that could be affected by the pile driving.

Sound in Rockfish Critical Habitat - Noise caused by the proposed action may affect PS/GB bocaccio nearshore habitat. Habitat may be affected because noise levels detectable to rockfish, beyond background noise levels, and above the cSEL injury threshold would be confined to the immediate project area.

<u>Sound Impairment of Salmonid Prey/Forage</u>***:*** Different forage fish spawn in Hood Canal year-round. Common fish species identified as forage fish were recorded at NAVBASE Kitsap Bangor during beach seine surveys conducted in 2005 to 2008 (SAIC 2009). Forage fish captured include, in order of abundance (highest to lowest): Pacific herring, surf smelt, and Pacific sand lance (SAIC 2006). Larval forage fish, consisting of large schools with both surf smelt and Pacific sand lance, were also captured during this time. Forage fish occur in each month surveyed, becoming increasingly abundant in the spring months, reaching a peak in June, largely due to the arrival of large schools of herring, before decreasing in abundance again by July. The forage fish presence increases the probability of occurrence of salmon during in-water activity. However, the Navy would only work during defined windows when juvenile salmon abundance is minimal. Adult forage fish 2 grams or larger, and juveniles and larval forage fish

smaller than 2 grams, may be exposed to injurious levels of underwater noise. However, Halvorsen et al. (2021) determined that fish like sand lance that do not have swim bladders, may be less susceptible to injury from simulated impact pile driving. The majority of potential impacts to sand lance and other forage fish are expected to be limited to minor behavioral disturbance and these responses would not reduce the forage base for ESA-listed species.

3. Benthic Communities and Forage Species Diminishment

Dredging activities cause a short-term change in the characteristics of the benthic in-faunal biota, of which the majority are expected to recover within a few months up to three years after each dredge event, based on the results of studies in other areas. For example, Wilson and Romberg (1996), studying a subtidal sand cap placed to isolate contaminated sediments in Elliott Bay, identified 139 species of invertebrates five months after placement of the sand cap. The benthic community reached its peak population and biomass approximately two and one-half years after placement of the cap, and then decreased, while the number of species increased to 200 as long-lived species recruited to the population (Wilson and Romberg 1996).

Project activities would cause short-term and localized increases in turbidity and total suspended solids (TSS) as the bottom materials are displaced during the intrusion of the pile structures, from the percussive effect of the driving, jet plowing, and multiple dredging sites. This affects water quality and benthic prey communities.

Pile installation, dredging, plowing, backfilling, and placement of articulated concrete cable armoring mat activities are anticipated to disrupt sediment and create at least partial loss of the benthic community in the affected area. The benthic habitat in the piles footprint would be eliminated when the piles are installed. This work would cause temporary fragmentation of the benthos, to include rugosity, with anticipated recovery within three years. The project was relocated to avoid a large geoduck area. The potential area that would be disturbed by construction activity, in this case 1.78 acres, was estimated by adding the area within 300 feet of the proposed structure to the structure footprint (WDOE 2016). Construction activities would result in the temporary disturbance of benthic habitat within the construction corridor.

Marine macroinvertebrates and other organisms have a demonstrated ability to recolonize disturbed substrates (Dernie et al. 2003); most of the benthic habitat, with the exception of very small areas displaced by piles, would begin to recover within months after construction is completed. Previous studies of dredged, sediment capped, and other disturbed sites show that many benthic and epibenthic invertebrates rapidly recolonize disturbed bottom areas as soon as two years after disturbance (Romberg et al., 1995; Parametrix, 1994, 1999; Vivan et al., 2009). Many benthic organisms lost due to turbidity and bottom disturbances by barges, tugboats, and anchors recolonize the construction areas quickly, for example, mobile species such as crabs and short-lived species such as polychaetes and become reestablished over a 3-year period after sediment disturbance at the site has ceased. Less mobile, longer-lived benthic species such as clams can take two to three years to reach sexual maturity (Chew and Ma, 1987; Goodwin and Pease, 1989) and may require five years to recover from disturbance such as smothering by sediment. Therefore, shellfish communities under the impacted by construction are expected to recover within approximately five years after construction. Ecological productivity would be reduced during the five-year recovery period. Any geoduck or other clams lost in the pile footprints during construction would no longer be available to contribute as seed stock for future generations.

The forage fish species with documented spawning habitat occurring along the Bangor shoreline near the action area is the Pacific sand lance. The closest Pacific sand lance spawning habitat has been documented approximately 3000 feet north of the proposed EMMR and 1,500 feet south of the HDD/plow convergence area. Due to strong nearshore currents and nearshore wind waves, the small portion of suspended fine sediments that would settle out of the water column onto intertidal beaches are not expected to be high enough to adversely impact the spawning success of the nearest forage fish (sand lance) spawning habitat near the project site.

However, forage fish that occur in the immediate project vicinity during in-water construction would be exposed to increased levels of turbidity. Based on recent nearshore beach seine data, it is reasonable to assume that forage fish, primarily sand lance, utilize the shoreline at the project site. The Pacific sand lance spawning work window in Tidal Reference Area 13 is March 2 to October 14, which means that the Navy would be conducting its project during the sand lance spawning period. Therefore, forage fish could be present and potentially affected by construction activities. In general, behavioral response including shoreline avoidance from visual stimuli of nearshore-occurring pre-spawn adult sand lance would not be expected from the offshore construction activity.

2.5.3.2 Enduring Effects on Habitat

Clean Water Act Compensatory Mitigation

The NMFS NHVM outputs reflect -10 debits (Appendix 1). In a previous opinion (NMFS 2021) NMFS, compared the HCCC ILF calculation with the NHVM calculations and found them to be relatively compatible in the evaluation of habitat function. While the HCCC ILF use plan for the EMMR is still in development, for the purposes of this opinion, NMFS will rely on previous experience and assume that the Navy's purchase of credits from the HCCC ILF, the resulting habitat restoration would completely offset the loss of habitat functions reflected in the NHVM debits.

The primary goal of the HCCC ILF program is to increase aquatic resource functions in the Hood Canal watershed. This is accomplished by improving existing mitigation requirements with rigorous site assessment and selection processes that fully link with consensus priorities for conserving and restoring Hood Canal. While mitigation seeks to offset the impacts of development projects resulting in no net loss, this program aspires to add value to mitigation processes by implementing projects in a coordinated and strategic manner, consistent with existing regulations and legal limitations relating to mitigation proportionality. To accomplish this goal the HCCC would provide a viable option to ensure the availability of high-quality mitigation for unavoidable, site-specific impacts to freshwater wetlands and marine/nearshore aquatic resources in the Hood Canal watershed to ensure at a minimum no net loss of aquatic functions and values in Hood Canal. Additionally, HCCC promotes "net resource gain" when practical, defined as restoration of ecological processes and a lift in the ecological functions of the Hood Canal watershed.

The purchase of credits provides a high level of certainty that the benefits of a credit purchase would be realized because the NMFS approved ILF considered in this opinion has mechanisms in place to ensure credit values are met over time. Such mechanisms include legally binding conservation easements, long-term management plans, detailed performance standards, credit release schedules that are based on meeting performance standards, monitoring plans and annual monitoring reporting to NMFS, non-wasting endowment funds that are used to manage and maintain the bank and habitat values in perpetuity, performance security requirements, a remedial action plan, and site inspections by NMFS.

In addition, HCCC has a detailed credit schedule and credit transactions and credit availability are tracked on the Regulatory In-lieu Fee and Bank Information Tracking System (RIBITS). RIBITS was developed by the U.S. Army Corps of Engineers with support from the Environmental Protection Agency, the U.S. Fish and Wildlife Service, the Federal Highway Administration, and NOAA Fisheries to provide better information on mitigation and conservation banking and in-lieu fee programs across the country. RIBITS allows users to access information on the types and numbers of mitigation and conservation bank and in-lieu fee program sites, associated documents, mitigation credit availability, service areas, as well information on national and local policies and procedures that affect mitigation and conservation bank and in-lieu fee program development and operation.

Summary of Effects on Habitat and Critical Habitat

Multiple habitat features would be adversely affected by the proposed action. The adversely affected areas of habitat would be affected over three in-water work windows. Affects in the form of water quality impairment, noise in the aquatic habitat, benthic communities and forage species diminishment, all of which would temporarily reduce forage value of the habitat, but at a time when migration use is expected to be quite low. The enduring effects would be completely offset by the proposed compensatory mitigation credits purchased from the HCCC ILF.

2.5.4 Effects on Listed Species

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

The temporary effects on species associated with construction are:

1. Water quality impairment
2. Increased noise in the aquatic environment
3. Benthic communities and forage species diminishment

The enduring effects on species associated with in water structures are:

1. In-water structure
2. Clean Water Act Compensatory Mitigation "Hood Canal In-lieu fee program"

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

Species Presence and Exposure

As described in Section 1.3, all work would occur from July 16 through January 15, over three in-water work windows. These work windows are designed to minimize juvenile salmonid exposure to construction effects. However, they would not completely avoid exposure to construction. Rockfish could be present in the area at any time.

Each of the following species uses the action area, but is present at differing life history stages, and with variable presence. In order to determine effects on species, we must evaluate when each species would be present and the nature (duration and intensity) of their exposure to those effects of the action in their habitat, which were described above. It should be noted; an effect exists even if only one individual or habitat segment may be affected (Fish and Wildlife Service and the National Marine Fisheries Service 1998).

Puget Sound Chinook salmon

The Puget Sound Technical Recovery Team identified two independent populations of Chinook salmon within Hood Canal, the Skokomish River and Mid-Hood Canal Rivers (Dosewallips, Duckabush, and Hamma Hamma) (Ruckelshaus et al. 2006). These two PS Chinook salmon populations use the action area for a portion of their life histories. The greatest abundance of adult PS Chinook salmon along the NAVBASE Kitsap Bangor waterfront occurs from early August to October as the adults return from the ocean to their natal streams and rivers.

Generally, PS Chinook salmon juveniles emigrate from freshwater natal areas to estuarine and nearshore habitats from January through April as fry, and from April through early July as larger subyearlings. Captures of juvenile Chinook salmon were rare in beach seine surveys conducted at NAVBASE Kitsap Bangor during the large winter/spring emigration of the more abundant species (e.g., chum and pink salmon) and were only slightly more prevalent in the summer months. Juvenile Chinook salmon were captured in very low numbers (26 fish total) during weekly beach seine surveys conducted from mid-July through early September 2005 (SAIC 2006). However, as juvenile Chinook salmon increase in size they occupy deeper, offshore waters in search of larger prey. By July juvenile PS Chinook salmon are sufficiently large to no longer orient to the shoreline and thus would be less likely to be caught during beach seine surveys. Juvenile PS Chinook salmon are likely present in the action area during the in-water work window, but in the deeper, offshore waters.

Although the majority of Chinook salmon originating from Puget Sound migrate to the Pacific Ocean to feed and grow, approximately a third reside in the Salish Sea for much of their marine rearing phase (O'Neill et al 2018). Those parr migrants, which would otherwise rear for 3 to 4 months before migrating directly from rivers to the ocean, may rear extensively in Puget Sound, including Hood Canal. The delayed rearing may last several months or several years. These migrants are often referred to as "blackmouth." The blackmouth in Hood Canal can be found year-round.

PS/GB Bocaccio and Yelloweye Rockfish
Due to the habitat characteristics of Hood Canal, the closest adult ESA-listed rockfish are likely several thousand feet away from the NAVBASE Kitsap Bangor waterfront, within waters deeper than 120 feet, outside of the action area. If any juvenile and sub-adult bocaccio were within the action area, they would be expected to be found near benthic areas with steep slopes, rock, or kelp beds; there is kelp habitat along some sections of the NAVBASE Kitsap Bangor nearshore that may be seasonally used by juvenile and sub-adult bocaccio. It is unlikely that juvenile yelloweye rockfish would occur within the action area because they do not use the nearshore for rearing. It is possible that larval yelloweye rockfish or bocaccio occur within the action area during project activities. Larval rockfish likely remain within the basin they are released (Drake et al. 2010) but may be broadly dispersed from the place of their birth (NMFS 2003) and could occur within the action area during project activities. An effect exists, regardless of their magnitude, even if only one individual or habitat segment may be affected.

2.5.4.1 Temporary effects on species associated with construction

1. Water Quality Impairment

Pile driving, dredging, plowing, sediment replacement and cable armoring cause short-term and localized increases in turbidity and total suspended solids (TSS) as the bottom materials are displaced from the intrusion of the pile structures; from the percussive effect of the driving; and from escaped sediment removed during dredging and plowing of the seafloor surface.

The construction of EMMR would require installation of up to five piles total. Pile installation would disturb bottom sediments within the immediate project construction area during the in-water work period and localized increases in suspended sediment concentrations. In general, the predominately coarse-grained sediments that occur in most areas of the project site are more resistant to resuspension and have a higher settling speed than fine-grained sediments. Resuspension of sediments would be limited to a small area around each pile.

Water Quality Reduction: The effects of suspended sediment on fish increase in severity with sediment concentration and exposure time and can progressively include behavioral avoidance and/or disorientation, physiological stress (e.g., coughing), gill abrasion, and death—at extremely high concentrations. Newcombe and Jensen (1996) analyzed numerous reports on documented fish responses to suspended sediment in streams and estuaries and identified a scale of ill effects based on sediment concentration and duration of exposure, or dose. Exposure to concentrations of suspended sediments expected during the proposed pile driving could elicit sublethal effects such as a short-term reduction in feeding rate or success, or minor physiological stress such as coughing or increased respiration. Studies show that salmonids have an ability to detect and distinguish turbidity and other water quality gradients (Quinn, 2005; Simenstad, 1988), and that larger juvenile salmonids are more tolerant to suspended sediment than smaller juveniles (Servizi and Martens, 1991; Newcombe and Jensen, 1996).

To consider how the TSS generated from pile driving might affect the species consulted on in this biological opinion, NMFS used the Weston Solutions (2006) data as an estimate for the range of expected TSS and Newcombe and Jensens (1996) 'scale of ill effects' to determine likely associated biological responses. For an exposure duration of up to two hours, and an increase in TSS over background of up to 240 mg/L, the calculated severity of ill effect for juvenile salmon does not exceed a behavioral effect of short-term reduction in feeding rates and feeding success (the fish is startled, experiences reduced vision, stops feeding to reorient, and may swim away). The maximum increase in TSS reported in Weston Solutions (2006) is 83 mg/L. Even if the pile driving that is part of this proposed project would result in double the TSS as reported for vibratory pile driving in Weston Solutions (2006), the likely level of TSS is well below levels and durations that could result in injurious physiological stress. Further, any elevations in turbidity and TSS generated by the pile driving would be localized, short-term and similar to the variations that occur normally within the environmental baseline of the marine nearshore—which is regularly subject to strong winds and currents that generate suspended sediments. Thus, the juvenile salmonids and rockfish likely would have encountered similar turbidity before. Turbidity from pile driving would be negligible.

The dredging and jet plowing, however, would produce much more suspended sediment and cover a far greater area over the anticipated work windows (12 weeks total). The blackmouth Chinook are likely to be present during in-water construction activities and likely to be exposed to the temporary construction effects, most notably elevated levels of suspended sediment. Turbidity and TSS levels would return to background levels quickly and be localized to the in-water construction areas after 12 weeks. Decreased DO is expected to be contemporaneous with and in the same footprint of the suspended sediment. While blackmouth Chinook salmon are likely to encounter these areas, they can detect and avoid areas of high turbidity. Thus, duration and intensity of exposure of blackmouth Chinook salmon is likely to cause injury or a harmful response.

While there is little information regarding the habitat requirements of rockfish larvae, other marine fish larvae biologically similar to rockfish larvae are vulnerable to low dissolved oxygen levels and elevated suspended sediment levels that can alter feeding rates and cause abrasion to gills (Boehlert 1984; Boehlert and Morgan 1985; Morgan and Levings 1989). Because the work window will overlap with one peak in larval presence, which is a several month pelagic stage without significant capacity for avoidance behavior. Larval rockfish can swim at a rate of roughly 2 cm per second (Kashef et al. 2014) but are likely passively distributed with prevailing currents (Kendall and Picquelle 2003).

2. Increased noise in aquatic environment

The pile work includes impact driving which produces a response in exposed species. The response between species to sound varies based on their hearing acuity, their size, and their body composition. Based on the best scientific information available, we used the following assumptions for estimating the effects of the pile driving component of the proposed action on juvenile and adult PS chinook, larval yelloweye rockfish, and larval and juvenile bocaccio:

- PS Chinook salmon juveniles near pile driving activity during the work window will weigh more than 2 grams. This is based on fork length data of juvenile salmonids passing through the PS nearshore (Rice, 2011). After July 2, juvenile Chinook can be expected to be longer than 80 mm fork length (FL). Weight of 80 mm FL Chinook ranges above 4 grams (McFarlane and North, 2002).
- Densities of PS Chinook juveniles in the PS nearshore average 25 fish per hectare in July and 14 fish per hectare in August (Rice 2011).
- Larval yelloweye and bocaccio, and juvenile listed bocaccio may be present in the nearshore during impact pile driving. Exposure of adult rockfish to construction effects is considered very unlikely since they do not occupy the nearshore.
- The tidal reference 13 salmon work window is July 16 – March 1. The Navy would be working July 16 through January 15.
- Adults of listed salmonids may be present during piling installation.
- When the impact hammer is used to drive the pilings, the following method would be employed: the piles would do a "soft start". This method slowly starting pile driving allows the older fish nearby to startle and leave the area.

Sound during pile driving is likely to have a range of direct effects on fish. Behavioral effects are observed at far lower noise levels than those associated with injury. Using the practical spreading loss model for underwater sound, we calculated the range at which sound pressure generated by the pile driving. The noise would intersect with the canal shorelines before it attenuates to background levels.

RMS SPLs are commonly used in behavioral studies. For analytical purposes, Caltrans (2015) presumes that SPLs in excess of 150 dB RMS (re: 1μPa) are likely to elicit temporary behavioral changes, including a startle response or other behaviors, which may alter their behavior in such a way as to delay migration, increase risk of predation, reduce foraging success, or reduce spawning success, indicative of stress and recommends this value as a threshold for possible behavioral effects. While SPLs of this magnitude are unlikely to lead to permanent injury, depending on a variety of factors (e.g., duration of exposure) they can still indirectly result in potentially lethal effects. NMFS' overall synthesis of the best available science leads us to our findings. Studies in which these effects have been studied for salmonids and rockfish include, Grette 1985 (on Chinook and sockeye salmon), Feist et al. 1996 (on chum salmon), Ruggerone et al. 2008 (on coho salmon), Popper 2003 (on behavioral responses of fishes), Pearson et al.1992 (on rockfish), and Skalski et al. 1992 (on rockfish).

Although numerous studies have attempted to discern behavior effects to different type of fish species from elevated sound levels that are below harm levels but above ambient levels, relatively few papers have linked this exposure to effects on fish (Popper et al. 2014). Under some conditions, with some species, elevated sound may cause an effect but it is not possible to extrapolate to other conditions and other species (Popper and Hastings 2009). Davidson et al. (2009) indicated that studies have shown that salmonids do not have a wide hearing bandwidth or hearing sensitivity to SPL and are therefore not as likely to be impacted by increased ambient sound.

Impact Driving – Listed Fish Response
Fishes with swim bladders (including salmonids and rockfish) are sensitive to underwater impulsive sounds (*i.e.*, sounds with a sharp sound pressure peak occurring in a short interval of time) such as those produced by impact pile driving. As a pressure wave passes through a fish, the swim bladder is rapidly compressed due to the high pressure, and then rapidly expanded as the "under pressure" component of the wave passes through the fish. The injuries caused by such pressure waves are known as barotraumas. They include the hemorrhage and rupture of internal organs, damage to the auditory system, and death for individuals that are sufficiently close to the source (Abbott et al. 2002; Caltrans 2009). Death can occur instantaneously, within minutes after exposure, or several days later.

A multi-agency work group identified criteria to define SPLs where effects to fish are likely to occur from pile driving activities (Hydroacoustic Working Group, 2008). These thresholds represent the initial onset of injury, and not the levels at which fish would be severely injured or killed. The most harmful level of effects is where a single strike generates peak noise levels greater than 206 dB_{peak}[13] where direct injury or death of fish can occur. Besides peak levels, SEL (the amount of energy dose the fish receive) can also injure fish. These criteria are either 187 dB_{SEL}[14] for fish larger than 2 grams or 183 dB_{SEL} for fish smaller than 2 grams for cumulative strikes (Hydroacoustic Working Group, 2008). In addition, any salmonid within a certain distance of the source would be exposed to levels that change the fish's behavior or cause physical injury (*i.e.* harm). The result of exposure could be a temporary threshold shift (TTS) in hearing due to fatigue of the auditory system, which can increase the risk of predation and reduce foraging or spawning success (Stadler and Woodbury, 2009). When these effects take place, they are likely to reduce the survival, growth, and reproduction of the affected fish.

The Washington and California Departments of Transportation have compiled acoustic monitoring data for various pile driving projects within their respective states (WSDOT unpublished data; Illingworth and Rodkin 2007, updated in 2012). Data can vary substantially between locations due to site-specific conditions (e.g. water depth, soft mud, sand, cobble, depth to bedrock, etc.). As a result, the use of site-specific data is critically important. The observed increased single strike sound pressure at 10 m for impact driving 24-inch concrete piles in a marine environment are; 185 decibel (dB) peak, 176 dB RMS, 166 dB SEL.

Adverse effects on survival and fitness can occur even in the absence of overt injury. Exposure to elevated noise levels, which can be caused by attenuated impact driving, can cause a temporary shift in hearing sensitivity, decreasing sensory capability for periods lasting from hours to days (Turnpenny et al. 1994; Hastings et al. 1996). Popper et al. (2005) found TTS in hearing sensitivity after exposure to cSELs as low as 184 dB. TTSs reduce the survival, growth, and reproduction of the affected fish by increasing the risk of predation and reducing foraging or spawning success. To discern the duration and intensity of species exposure, we consider specific elements of the proposed project.

NMFS uses a Sound Pressure Exposure spreadsheet or calculator to estimate the area around each pile where fish would be considered at risk of injury or behavioral disruption during pile driving. Table 4 lists the expected sound levels that could be generated by the largest proposed steel pile driving associated with the project.

Table 4. Expected sound levels with attenuation reduction

ONSET OF PHYSICAL INJURY			BEHAVIOR
Peak Threshold	SEL_{cum} Threshold**		RMS Threshold
	Fish ≥ 2 g	Fish < 2 g	
0	28	52	541

Cumulative SEL is intended as a measure of the risk of injury from exposure to multiple pile strikes. A sound exposure formula based on the Equal Energy Hypothesis is used to calculate cumulative SEL exposure:

Cumulative SEL = Single-strike SEL + 10*log (number of pile strikes)

Using this calculation and the worst-case scenario of the 24-inch pile sound levels (largest piles with highest expected sound levels), assuming an estimated 600 strikes per day, the maximum distance to the 185 dB peak injury threshold is calculated to 0 meters or less. The maximum distance to the 187 dB (fish ≥ 2) and 183 dB (fish < 2 g) cumulative SEL thresholds is calculated to 28 meters and 52 meters, respectively.

We expect that some death or injury of ESA-listed salmonids and rockfish is likely to occur. Although the proposed pile driving is scheduled to occur at a time when most salmonid species, excluding the blackmouth, are not actively migrating through the action area, we expect some salmon to be present during this time and these are reasonably certain to be injured or killed if they are within 28 meters of construction. Likewise, larval or juvenile bocaccio or larval yelloweye may be in the action are during this time period as an effect exists even if only one individual or habitat segment may be affected.

3. Benthic Communities and Forage Species Diminishment

When juvenile salmonids are entering the nearshore or marine environment, they must have abundant prey to allow their growth, development, maturation, and overall fitness. As pile driving, dredging, and plowing dislodges bottom sediments, benthic communities are also disrupted, both in the location where the installation occurs, and in the locations where sediment falls out of suspension and layers on top of adjacent benthic areas. As was noted above, benthic communities would be impacted and it can take up to three years to fully re-establish their former abundance and diversity. Given that the work would occur across three in-water work windows, we can expect six years in which benthic prey is less available to juveniles, incrementally diminishing the growth and fitness of four separate cohorts of individual outmigrants that pass through the action area.

2.5.4.2 Enduring effects on species associated with in-water structures:

In-water Structures, Piles

As discussed in Section 2.5.3 above, due to the height of the platform the shadow effects of overwater platform is not included in this analysis. However, the placement of the piles would still fill currently open water critical habitat. The fill would require migrating species to travel around the structure for the lifetime of the structure (40 years). Nonetheless, in the larger scale of habitat availability in the area, this vertical fill would have a discountable effect on the species. The individual fish would have to travel around the piles, but the difference would not be much more than traveling around a stump.

Clean Water Act Compensatory mitigation

The objective of compensatory mitigation is to restore, establish, enhance, or preserve aquatic resources for the purpose of offsetting unavoidable losses to aquatic resources resulting from activities authorized by USACE permits. The USEPA and USACE issued a final rule under 33 CFR Parts 325 and 332 governing compensatory mitigation for authorized impacts to wetlands, streams, and other waters of the U.S. under section 404 of the CWA and other USACE permits. The amount of compensatory mitigation required for a proposed project depends on the size of the project footprint, the quality of habitat at the project site, and the type of compensatory mitigation proposed.

The Navy is currently working with the USACE to identify and develop compensatory mitigation for the loss of aquatic resource, as required by USACE/USEPA Rule on Loss of Aquatic Resources. NMFS assumes that compensatory mitigation (purchase of the credits through the HCCC ILF and resulting restoration project) would offset the loss of habitat that would occur from the proposed project's in-water coverage of the piles.

Summary of Species Response

Viability
The range of responses to temporary and enduring effects is presented at the individual scale but must be considered collectively at the population or species scale in order to determine the effects on the four viability parameters. As presented in the above section, the most acute effects would be response to sound, which has the potential to alter behavior, injure, and kill listed juvenile fishes, primarily salmonids due to their size and body structure. However, given the timing of the pile installation to avoid outmigration, we expect this effect would occur among a small number of juveniles from any of the ESUs/DPS.

We then assess the importance of habitat effects in the action area to the ESUs/DPSs by examining the influence of those effects to the characteristics of abundance, population growth rate (productivity), spatial structure, and diversity. While these characteristics are described as unique components of population dynamics, each characteristic exerts significant influence on the others. For example, declining abundance can reduce spatial structure of a population; and when habitats are less varied, then diversity among the population declines.

Abundance
The proposed action results in temporary suppression of habitat quality due to the EMMR construction. We anticipate that a small number of juvenile and adult PS Chinook salmon, and a very small number of larval or juvenile PS/GB bocaccio and larval yelloweye rockfish would be injured or die because of the reduced habitat quality. These impacts would be offset with the purchase of HCCC ILF credits and resulting restoration. As such, we anticipate no population-scale effects to these species.

We expect that the HCCC ILF credits and resulting mitigation would result in a net zero loss of function within the Hood Canal.

Productivity
The long-term changes to the nearshore environment are expected to exert a sustained downward pressure on nearshore habitat function in Hood Canal and, proportionally to the relatively small amount of nearshore habitat affected, reduce the rearing and foraging capacity of the action area. The habitat impacts from the construction of EMMR would likely have adverse effects on individuals in the early marine life-history stages in the populations of PS Chinook salmon, PS/GB bocaccio, and PS/GB yelloweye rockfish.

The proposed compensatory mitigation is expected to completely replace the lost habitat function, and thus we do not expect any downward pressure on productivity from a decrease in adult spawners.

Spatial Structure
We do not expect the proposed project to affect the spatial structure of any of the five affected ESUs/DPSs. The affected salmonid populations spread across the nearshore and mix when they enter PS (Fresh et al., 2006), and rockfish spread through nearshore habitats with larval drift. The proposed permanent structures in combination with its compensatory mitigation would likely not disproportionately affect any one population and thus no diminishment in spatial structure would be attributable to the proposed action.

Diversity
The proposed action would concentrate the effects on resident PS Chinook, and larval bocaccio and yelloweye rockfish. Once juvenile Chinook salmon leave estuarine/delta habitats and enter Hood Canal, they can be found along all stretches of shoreline, at some point during the year, as they make their way to the ocean. We anticipate that over the life of the structure, most of the PS Chinook salmon in Hood Canal will have multiple members from each cohort exposed to the habitat effects in the nearshore, irrespective of proximity to natal streams (Fresh 2006).

Salmonids have complex life histories and changes in the nearshore environment have a greater effect on specific life-history traits that make prolonged use of the nearshore. The proposed in-water construction would occur when most juvenile PS Chinook salmon and PS steelhead have moved away from the nearshore, utilizing deeper water. However, annually many juvenile PS Chinook salmon and some PS steelhead would be exposed to long-term impacts of the enduring structures on habitat conditions. The impacts are expected to be greatest on juvenile PS Chinook salmon because they spend a longer period of time in nearshore environments (i.e. rearing) and on PS/GB bocaccio because their larval and juvenile life stages rely on nearshore features. Over time, selective pressure on one component of a life-history strategy tends to eliminate that divergent element from the population, reducing diversity in successive generations and the ability of the population to adapt to new environmental changes (McElhany et al. 2000). Any specific populations that experience increased mortality or survival from the proposed action would have their life-history strategy selected against or for, respectively. The proposed compensatory mitigation is expected to offset this impact.

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 earlier in the discussion of environmental baseline (Section 2.4).

The action area, in Hood Canal, is influenced by actions in the nearshore, along the shoreline, in deeper parts of the waterway, and also in tributary watersheds of which effects extend into the action area. Actions in the project area nearshore and along the shoreline are mainly commercial development, a U.S. Naval Base, shoreline modifications, road construction and maintenance, but also include some agricultural development. Federal actions dominate current and future impacts in the action area because the vast majority of activities that may affect listed species in the action area would require an approval under the Clean Water Act. Future federal actions would be subject to the section 7(a)(2) consultation under the ESA.

Other actions, in the nearshore as well as in tributary watersheds, would cause long-lasting environmental changes and would continue to harm ESA-listed species and their critical habitats. Especially relevant effects include the loss or degradation of nearshore habitats and pocket estuaries (the action area is a pocket estuary). We consider human population growth to be the main driver for most of the future negative effects on salmon, steelhead, rockfish and their habitat.

Future private and public development actions are very likely to continue on the uplands adjacent to the project area, perhaps on the on the opposing bank from the naval base also owned by the Navy, including associated in and over water activities, such as bulkheads and boat docks. As the human population continues to grow, demand for commercial and residential development and supporting public infrastructure is also likely to grow. We believe the majority of environmental effects related to future growth will be linked to these activities, in particular land clearing, associated land-use changes (i.e., from forest to impervious, lawn or pasture), increased impervious surface, and related contributions of contaminants to area waters. Land use changes and development of the built environment that are detrimental to salmonid habitats are likely to continue under existing regulations. Though the existing regulations could decrease potential adverse effects on salmon habitat, as currently constructed and implemented, they still will likely allow substantial degradation to occur.

In addition to these growth-related habitat changes, climate change has become an increasing driver for infrastructure development and changes to protect against sea level rise in coastal areas. These changes to nearshore habitat can include sea walls like the one currently being constructed in Venice, Italy and considered for many major US cities including New York (Marshall 2014). Regardless of the environmental effects, the cost of flooding has been predicted to be higher than the cost of building such sea walls (Lehmann 2014) which increases the likelihood of more flood protection projects coming to PS in the future. These flood protection projects will likely include, filling, raising of habitat, dikes, dunes, revetments, flood gates, pump stations, and sea walls; all habitat modifications that will be detrimental to salmon. Over the 40-year anticipated design life of the EMMR, we expect the effects of climate change in the action area will include decreasing salinity, modified temperature regime, increasing acidity, and sea-level rise. It should be noted that the 40-year design life is the target for which the structure could be used with only routine or limited maintenance, after which a broader repair project may become necessary, which will trigger a re-initiation.

In June 2005, the Shared Strategy presented its recovery plan for PS Chinook salmon and the HCCC presented its recovery plan for Hood Canal summer-run chum salmon to NMFS who adopted and expanded the recovery plans to meet its obligations under the ESA. Together, the joint plans comprise the 2007 PS Chinook and Hood Canal summer-run chum Recovery Plan. Several not-for-profit organizations and state and federal agencies are implementing recovery actions identified in these recovery plans.

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.

The PS/GB bocaccio rockfish is endangered. Bocaccio rockfish are critically endangered because they have been overfished. They are also accidentally caught as bycatch, which is when fishers catch species that they are not targeting. Each of the other species considered in this opinion was listed as threatened with extinction because of declines in abundance, poor productivity, reduced spatial structure and diminished diversity. Systemic anthropogenic detriments in fresh and marine habitats are limiting the productivity for PS Chinook salmon. Bocaccio live only in the marine environment. Both PS/GB bocaccio and yelloweye rockfish are long lived with late sexual maturity, which makes increasing productivity very difficult to enhance by any human endeavor. Over harvest, water pollution, climate-induced changes to rockfish habitat, and small population dynamics are limiting the productivity of rockfish.

The environmental baseline in the action area is a large industrial/military complex with over-water and in-water structures, approximately 2.3 miles of shoreline, a small amount of which is armored. There are existing in-water structures along the waterfront. An attendant feature of the structures is lighting. Within the action area, artificial light is produced from the NAVBASE Kitsap Bangor waterfront, residential properties, the moon, and passing vessels. Fish surveys have captured large numbers of salmonids along the Bangor shoreline (SAIC 2006, SAIC 2009).

To this context of species status and baseline conditions, we add the temporary effects of the proposed action, together with cumulative effects (which are anticipated to include future nonpoint sources of water quality impairment associated with upland development and stressors associated with climate change), in order to determine the effect of the project on the likelihood of species' survival and recovery. We also evaluate if the project's habitat effects will appreciably diminish the value of designated critical habitat for the conservation of the listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features.

The Navy plans to use the Hood Canal Coordinating Council's In-lieu Fee program for mitigation. While the exact project that would offset EMMR has yet to be chosen, we do know the HCCC's mission and the types of projects often covered by the ILF.

The HCCC works with partners and communities to advance a shared regional vision to protect and recover Hood Canal's environmental, economic, and cultural wellbeing. Nearshore areas within Hood Canal support multiple species and stocks of salmon. The nearshore and estuaries in particular, have been termed the life support system for juvenile salmon feeding, rearing, and migrating (Healey, 1982). The HCCC ILF uses a comprehensive strategy to identify, prioritize, and carry out nearshore habitat restoration and protection actions in Hood Canal and the Eastern Strait of Juan de Fuca to improve VSP criteria for PS Chinook salmon and HCSR chum salmon and advance their recovery.

Hood Canal is home to all eight salmon and trout species in Puget Sound. Hood Canal salmon strive to survive while facing multiple changes to their natural environment, including impacts of population growth, climate change, and habitat degradation or loss. HCCC facilitates implementation of three salmonid recovery plans, including summer chum salmon, Skokomish River and Mid-Hood Canal Chapters of the PS Chinook Salmon Recovery Plan, and the Hood Canal Chapter of the Puget Sound Steelhead Recovery Plan. The Navy's mitigation fees would aid in the different recovery plan goals.

Habitat
Effects to habitat features that are not included in the critical habitat designations include temporary diminishment of benthic communities and forage fish (i.e., prey abundance and diversity). Impact pile driving would produce daily noise in the aquatic habitat detectable by fish, this habitat alteration would be short-term within the five days of pile driving, and localized to within areas not exempt from critical habitat designation. Therefore, the temporary impacts of sound to critical habitat would not diminish the features of critical habitat in a manner that impairs conservation values of that habitat for PS Chinook salmon, HCSR chum salmon, or rockfish.

Compensatory mitigation, through purchase of HCCC ILF credits, is reasonably certain to offset the loss of habitat function from the EMMR resulting in a net zero loss of habitat function in the Hood Canal. The structure would also impede benthic communities for the foreseeable future (pile placement) and temporarily (pile driving turbidity). The temporary impacts that disrupt benthic environments would diminish the rockfish larval/juvenile rearing habitats and food sources in the action area; however, when scaled up to the designation scale, the effects are not expected to impact the ESU or DPS because it is likely that a very small number of fish would be impacted. Reduced diversity or density of epibenthic mesofauna also reduces prey resources for juvenile salmon – but again would be offset by the proposed compensatory mitigation.

The effects of the proposed actions would primarily impact nearshore habitats for PS Chinook salmon, HCSR chum salmon, and PS/GB bocaccio. The remainder of our integration and synthesis for critical habitat would focus on how the effects of the proposed actions, when added to environmental baseline and cumulative effects, impact the ability of PBFs to support conservation of PS Chinook salmon, HCSR chum salmon and PS/GB bocaccio.

Modification of nearshore habitat in Puget Sound has resulted in a substantial decrease in critical habitat quality for PS Chinook salmon and PS/GB bocaccio. The effect on critical habitat for HCSR chum salmon is similar, but more of the critical habitat for this species remains in good condition. Shoreline development is the primary cause of this decline in habitat quality. Development includes shoreline armoring, filling of estuaries and tidal wetlands, and construction of overwater structures. Currently, only 31 percent of Puget Sound's shorelines remain undeveloped.

Once developed, shoreline areas tend to remain developed due to the high residential, commercial, and industrial demand for use of these areas. New development continues and as infrastructure deteriorates, it is rebuilt. Shoreline bulkheads, marinas, residential PRFs, and port facilities are quickly replaced as they reach the end of their useful life. Although designs of replacement infrastructure are often more environmentally friendly, replacement of these structures ensures their physical presence would causes adverse impacts to nearshore habitat into the future. This is evidenced by the continued requests for consultation on these types of actions. As a result, shoreline development causes a "press disturbance" in which habitat perturbations accumulate without periods of ecosystem recovery. This interrupts the natural cycles of habitat disturbance and recovery crucial for maintenance of critical habitat quality over time. Although the occasional restoration project would improve nearshore habitat quality, the area impacted by these projects is tiny compared to the developed area. The general trend of nearshore habitat quality is downward and is unlikely to change given current management of these areas. Nearshore habitat modification has caused broad-scale ecological changes, reducing the ability of critical habitat to support PS Chinook salmon juvenile migration and rearing. The loss of submerged aquatic vegetation, including eelgrass and kelp, has reduced cover, an important PBF of critical habitat for PS Chinook salmon. Degradation of sand lance and herring spawning habitat has reduced the quality of the forage PBF. Construction of overwater structures throughout Puget Sound has degraded PS Chinook salmon critical habitat by creating artificial obstructions to free passage in the nearshore marine area. Habitat modification reduces juvenile survival and in some cases has eliminated PS Chinook salmon life history strategies that rely on rearing in nearshore areas during early life history.

Changes to nearshore areas in Puget Sound have also reduced the ability of critical habitat to support juvenile life stages of PS/GB bocaccio. Loss of submerged aquatic vegetation has reduced cover available for larval and juvenile rockfish. Changes in physical character of nearshore areas and loss of water quality reduce the amount of prey available for juvenile rockfish. Although loss of nearshore habitat quality is a threat to bocaccio, the recovery plan for this species lists the severity of this threat as low (NMFS 2017a). Other factors, such as overfishing, are more significant threats to PS/GB bocaccio.

For PS/GB bocaccio habitat, the proposed actions would degrade the quality of PBFs in the nearshore. This would likely reduce juvenile survival in some areas of affected critical habitat. However, given the low severity of this threat, in context with other limiting factors for this species, we do not expect the adverse effects of the proposed action to be significant enough to reduce the conservation value of critical habitat for this species.

Species

Salmonids - Pile driving would temporarily produce sound and create turbid conditions. Noise and turbidity would temporarily impair salmonid visual acuity impacting cover and forage for salmonids. Although the noise effects of impact pile driving are expected to be acute, these effects are limited to five days, and cease each time pile driving has stopped for the day. Because the work window is timed when juvenile salmon migration is largely avoided, we expect that the numbers of fish from each species would be low, and that no particular population among the species of salmonids would be disproportionately affected. Turbidity would be more confined than sound but persist for minutes to hours at each pile site, and salmonids that are present should be able to avoid the individual pulses of suspended sediment. The diminishment in forage base would persist the longest, and we expect that multiple listed salmonids from each population of each species would need to modify their forage locations to compensate for the reduction, but that sufficient prey is available throughout the action area.

Rockfish – As mentioned above, an effect exists even if only one individual or habitat segment may be affected (USFWS and NMFS 1998). Pile driving is a temporary effect of the proposed project that would kill or injure individual larval fish from of each of the PS/Georgia Basin DPSs of rockfish (bocaccio and yelloweye). However, rockfish losses would be limited to the larval life stage and would be few in number as there are very few juvenile or larval bocaccio and larval yelloweye rockfish in the action area at any given time; therefore, adverse effects resulting from the project on this life stage are not likely to adversely influence the abundance of adult fish.

Accordingly, NMFS expects the very small reduction in numbers of PS Chinook salmon and ESA-listed rockfish by the temporary effects, even when considered with cumulative effects, are insufficient to alter the productivity, spatial structure, or genetic diversity of any of the species. Therefore, when considered with the environmental baseline in the action area and cumulative effects, the proposed action does not increase risk to the affected populations to a level that would appreciably reduce the likelihood for survival and recovery of the PS Chinook salmon ESU or yelloweye and bocaccio rockfish DPSs.

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, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of PS Chinook salmon, PS/GB bocaccio, and PS/GB yelloweye rockfish, or destroy or adversely modify PS Chinook, HCSR chum, or PS/GB bocaccio, designated critical habitats.

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 ITS.

2.9.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur. Harm of PS Chinook salmon (juvenile and adult), PS/GB DPS of bocaccio (larvae and juvenile), and PS/GB DPS of yelloweye rockfish (larvae) from temporary construction-related actions.

For this Opinion, even using the best available science, NMFS cannot predict with meaningful accuracy the number of listed species that are reasonably certain to be injured or killed annually by exposure to these stressors. The distribution and abundance of the fish that occur within the 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 a proposed action. Thus, the distribution and abundance of fish within the action area cannot be attributed entirely to habitat conditions, nor can NMFS precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by the proposed action. Additionally, NMFS knows of no device or practicable technique that would yield reliable counts of individuals that may experience these impacts. In such circumstances, NMFS uses the causal link established between the activity and the likely extent of timing, duration and area of changes in habitat conditions to describe the extent of take as a numerical level. Many of the take surrogates identified below could be construed as partially coextensive with the proposed action; however, they also function as effective re-initiation triggers. If any of the take surrogates established here are exceeded, they are considered meaningful reinitiation triggers.

TAKE FROM CONSTRUCTION-RELATED AND TEMPORARY EFFECTS

Many of the take surrogates identified below could be construed as partially coextensive with the proposed action; however, they also function as effective re-initiation triggers. If any of the take surrogates established here are exceeded, they are considered meaningful reinitiation triggers and exceeding any of the surrogates would suggest a greater level of effect than was considered by NMFS in its analysis.

Construction Timing and Duration Surrogates

The timing (in-water work window) is applicable to construction related stressors described below because the in-water work windows for specific geographic regions are designed avoid the expected peak presence of listed species in the action area. Construction outside of the in-water work window could increase the number of fish that would be exposed to construction related stressors, as would working for longer than planned. Therefore, for all stressors below that identify a timing and duration take surrogate, they would be synonymous with the defined in-water work window.

Impact pile driving would occur in one work window, July 16 through January 15. The take surrogate for incidental take associated with pile-driving underwater sound relates to the area within which underwater sound created by the proposed EMMR platform is expected to harm spawning forage fish, larval rockfish and resident Chinook by causing auditory and other tissue damage as well as the number of days that pile-driving is expected to occur.

Harm from Pile Driving Activities - Noise

PS Chinook salmon (juvenile and adult), bocaccio (larvae and juvenile), and yelloweye (larvae) and would be exposed to construction-related noise resulting from pile installation. Disruption of normal feeding and migration, and injury and death can occur from this exposure. The maximum number of individual pile strikes per day (600) over five days (one pile per day) is the best available surrogates for the extent of take from exposure to pile installation.

The surrogates for take caused by underwater sound generated by pile driving are proportional to the anticipated amount of take. These surrogates are also the most practical and feasible indicators to measure. In particular, the number of pile strikes with an impact hammer is directly correlated to the potential for harm due to hydroacoustic impacts, and thus the number of individuals harmed due to pile driving. Each pile strike creates underwater sound and a pressure wave that can kill, injure, or significantly impair behavior of listed species addressed by this Opinion. Numerous strikes occurring in temporal proximity also increase the likelihood of injury, death, or behavior modification due to cumulative exposure to underwater sound. Thus, the number of pile strikes is closely related to the amount of incidental take that would be caused by the proposed action. In some cases, persistent noise can make an affected area inhospitable for normal behaviors such as migrating and foraging. The duration of this disturbance is related to the number of animals potentially affected as well as the intensity of the disturbance. As the duration of noise increases, a larger number of animals migrating or traveling through the affected area are likely to be exposed. Likewise, the longer the noise persists, the longer the affected area may remain incapable of supporting the normal behaviors of salmon.

Harm from Suspended Sediments

PS Chinook salmon (juvenile and adult), bocaccio (larvae and juvenile), and yelloweye (larvae) would be exposed to suspended sediments during pile installation and plow dredging. Impairment of normal patterns of behavior and potential injury such as gill abrasion and cough.

The levels of suspended sediments are expected to be proportional to the amount of injury that the proposed action is likely to cause through physiological stress from elevated suspended sediments and contaminants throughout the duration of the projects' in-water activities. In estuaries, state water quality regulations (WAC173-201A-400) establish a mixing zone of 300 feet plus the depth of water over the discharge port(s) as measured during mean lower low water. As such, NMFS expects that for projects with sediment disturbing activities, that elevated levels of suspended sediment and re-suspended contaminants resulting from construction actions would reach background levels within a 300-foot buffer from the point of suspended sediment generation. Listed fish and their prey resources can be harmed from a wide range of elevated sediment levels and expect that at the point where sediment levels return to background levels that the harm would cease. Thus, the maximum extent of take is defined as within the 300-foot buffer around the outer boundaries of each of the project footprint, where construction would suspend sediment. Elevated suspended sediment levels beyond 300-foot buffer would indicate exceedance of take.

The surrogate measures of incidental take identified in this section can be reasonably and reliably measured and monitored and all serve as meaningful reinitiation triggers.

The take surrogates are as follows:

1. Take from pile driving underwater sound.
    a. The numbers of fish likely to experience take will be larger than we have evaluated in the foregoing analysis and the take surrogate will be exceeded if:
    b. Duration of such sound exceeds five days;
    c. Duration of such impact driving sound exceeds 600 strikes per pile/day

2. Take from suspended sediment
    a. The maximum extent of take is defined as within the 300-foot buffer around the outer boundaries of each of the project footprint, where construction will suspend sediments and re-suspend contaminants. Elevated suspended sediment levels would indicate exceedance of take if:
    b. Beyond a 300-foot buffer;
    c. For over 90 days

For each of the above surrogate measures, or "extents" of take, the Navy, as owner and operator, has continuing jurisdiction to correct the exceedances and thus, to the extent any of the surrogates are coextensive with the proposed action, they nevertheless function as effective reinitiation triggers.

The surrogates described above are each proportional to the amount of take considered to result from the action and each extent serves as a measure that can be monitored. Therefore, if any surrogate is exceeded, reinitiation of consultation will be required. The four surrogates each will function as an effective reinitiation trigger because, unlike the undiscerned number of salmon harassed, injured, or killed, each of the above measures can be measured for compliance.

2.9.2 Effect of the Take

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

2.9.3 Reasonable and Prudent Measures

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

The Navy shall:

1. Minimize the incidental take of listed salmonid and rockfish species from the effects of pile driving.
2. The Navy shall minimize incidental take of listed species resulting from suspended sediment during construction.

3. Monitor, prepare and provide NMFS with plans and reports describing how impacts of the incidental take on listed species in the action area would be monitored and documented.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the U.S. Navy or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). The U.S. Navy 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.

The Navy must fully comply with the following terms and conditions that implement the RPMs described above:

1. To implement RPM number 1 (pile driving), the Navy shall:
    a. Monitor to ensure:
        i. Pile amounts do not exceed five support piles
        ii. During each day of pile driving, impact driving will last no more than 45 minutes in total time each day.
        iii. Concrete piles receive no more than 600 pile strikes per day, using a strike rate of 38 strikes/minutes for concrete.

2. To implement RPM number 2 (suspended sediment) the Navy shall:
    a. Comply with Washington State water quality standards by conducting water quality monitoring during construction activities. At point of compliance (per state permit), turbidity levels shall not exceed 5 nephelometric turbidity units (NTUs) more than background turbidity when the background turbidity is 50 NTUs or less, or there shall not be more than a 10 percent increase in turbidity when the background turbidity is more than 50 NTUs.
    b. Develop and implement a Water Quality Monitoring and Protection Plan. See monitoring specification under T&Cs 3.

3. To implement RPM number 3 (monitoring and reporting) the Navy shall:
    a. Provide Monitoring Report(s) that include:
        i. A description of construction activities conducted and duration of activities. Specifically:
            1. Water Quality Monitoring report: Monitoring and reporting will be in accordance with the Washington Department of Ecology (WDOE) 401 WQC and Water Quality Monitoring and Protection Plan.
            2. A summary/verification BMPS and conservation measures as described in the proposed action were achieved.
            3. The report(s) shall be submitted to NMFS within 6 months of completion of construction. All reports shall contain the NMFS

tracking number (WCRO-2020-03674) and be sent by electronic copy to NOAA's reporting system email address at: projectreports.wcr@noaa.gov.

b. Report to NMFS final use plan and credits purchased from the HCCC.

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 following conservation measures are intended to assist the Navy in avoiding or minimizing the effects to listed species from this action and in fulfilling the Navy's legal obligation to conserve listed species and the ecosystems on which they depend:

1. The NMFS recommends that the Navy investigate sound attenuation technologies that are potentially superior to current standard practices and use the best available underwater sound attenuation technology for any actions involving impact pile driving in the presence of ESA-listed species.

2. The Navy's INRMP should include nearshore habitat improvement projects consistent with Recover Plan Objectives for PS Chinook and HCSR Chum. Proposed projects should be guided and coordinated with HCCC and local watershed groups to ensure parity in prioritized recover actions.

3. Limit in-water work to times of year when forage fish are expected to be in fewer numbers and not spawning in the action area (March 2 - October 14) or conduct weekly forage fish surveys, per Washington Department of Fish and Wildlife protocol, along the beach of the project area beginning in late September during the in-water work window, and commence work only if forage fish eggs are not found.

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

2.11 Reinitiation of Consultation

This concludes formal consultation for the U.S. Department of the Navy.

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

Construction impacts to HCSR chum and PS steelhead populations would be minimized by adhering to the in-water work period designated for Northern Hood Canal waters, when less than five percent of all juvenile salmonids that occur in NAVBASE Kitsap Bangor nearshore waters would be expected to be present (SAIC 2006; Bhuthimethee et al. 2009). As the cable and sensor array would be buried, operational impacts to ESA-listed salmonids would not be expected. As for permanent effects, the five 24-inch piles might slightly interfere with migration passage. However, the pile size would mimic trees/stumps and the fish can easily swim around the structures. Therefore, we conclude that the effects to the PS steelhead and HCSR chum are likely to be fully discountable, but if any exposure to project effects did occur, response would be insignificant.

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

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

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

3.1 Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described above in Sections 1.3 (Proposed Federal Action) and 2.3 (Action Area). The action area for the proposed project includes habitat which has been designated as EFH for various life stages of Pacific coast groundfish, coastal pelagic species, and Pacific salmon (Table 5).

The action area also includes habitat which has been designated as habitat areas of particular concern (HAPC) for groundfish. Estuaries, sea grass beds, canopy kelp, rocky reefs, and other "areas of interest" (e.g., seamounts, offshore banks, Puget Sound and canyons) are designated HAPCs for groundfish. In general, there is a lack of kelp beds in Hood Canal, with only 0.3 to 0.5 percent of the coastline containing kelp. Eelgrass has a patchy distribution along the subtidal and intertidal areas of the project site and is abundant along the subtidal and intertidal areas of the entire Hood Canal arm as well as Dabob Bay. Groundfish HAPCs within the action area include estuaries and sea grass beds.

A survey of eelgrass and macroalgae was conducted in August 2019 (Navy 2019). A large and continuous patch of native eelgrass was observed in the proposed HDD area an approximate depth range of 0 MLLW to -20 MLLW.

Table 5. EFH species and life history stage associated with shallow nearshore water in PS.

Scientific Name	Common Name	Adult	Juvenile	Larvae	Egg
Groundfish Species					
Anoplopoma fimbria	Sablefish	X	X	X	X
Citharichthys sordidus	Pacific sanddab	X			
Eopsetta jordani	Petrale sole	X			
Glyptocephalus zachirus	Rex sole	X			
Hexagrammos decagrammus	Kelp greenling	X		X	
Hippoglossoides elassodon	Flathead sole	X			
Hydrolagus colliei	Spotted ratfish	X	X		
Isopsetta isolepis	Butter sole	X			
Lepidopsetta bilineata	Rock sole	X			
Merluccius productus	Pacific hake	X	X		
Ophiodon elongates	Lingcod			X	
Parophrys vetulus	English sole	X	X		
Platichthys stellatus	Starry flounder	X	X		
Psettichthys melanostictus	Sand sole	X	X		
Raja binoculata	Big skate	X			
Raja rhina	Longnose skate	X	X		X
Scorpaenichthys marmoratus	Cabezon	X	X	X	X
Sebastes auriculatus	Brown rockfish	X			
Sebastes caurinus	Copper rockfish	X	X		
Sebastes diploproa	Splitnose rockfish		X	X	
Sebastes entomelas	Widow rockfish		X		
Sebastes flavidus	Yellowtail rockfish	X			
Sebastes maliger	Quillback rockfish	X	X		

Scientific Name	Common Name	Adult	Juvenile	Larvae	Egg
Sebastes melanops	Black rockfish	X	X		
Sebastes mystinus	Blue rockfish	X	X	X	
Sebastes nebulosus	China rockfish	X	X		
Sebastes nigrocinctus	Tiger rockfish	X			
Sebastes paucispinis	Bocaccio		X	X	
Sebastes pinniger	Canary Rockfish		X	X	
Sebastes ruberrimus	Yelloweye rockfish			X	
Squalus acanthias	Spiny dogfish	X			
Coastal Pelagic Species					
Engraulis mordax	Anchovy	X	X	X	X
Scomber japonicas	Pacific mackerel	X			
Loligo opalescens	Market squid	X	X	X	
Pacific Salmon					
Oncorhynchus tshawytscha	Chinook salmon	X	X		
Oncorhynchus kisutch	Coho salmon	X	X		
Oncorhynchus gorbuscha	Pink salmon	X	X		

Habitat areas of particular concern (HAPC) are specific habitat areas, a subset of the much larger area identified as EFH, that play an important ecological role in the fish life cycle or that are especially sensitive, rare, or vulnerable.

Three coastal pelagic species are known to occur in the greater Puget Sound: northern anchovy, Pacific mackerel, and market squid and have been documented in Hood Canal. The definition for coastal pelagic species EFH is based on the geographic range and in-water temperatures where these species are present during a particular life stage (67 Federal Register 2343-2383). EFH for these species includes all estuarine and marine waters above the thermocline where sea surface temperatures range from 50 to 68°F. These boundaries include Hood Canal. Coastal pelagic species have value to commercial Pacific fisheries, and are also important as food for other fish, marine mammals, and birds (63 Federal Register 13833). Coastal pelagic species do not have designated HAPCs.

In estuarine and marine areas, salmon EFH extends from the extreme high tide line in nearshore and tidal submerged environments within state territorial waters out to the exclusive economic zone (200 nautical miles) offshore of Washington (Pacific Fishery Management Council 2014). Within these areas, EFH consists of four major components: (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and adult holding habitat. The action area also includes habitat which has been designated as HAPC for Pacific salmon and include marine SAV.

3.2 Adverse Effects on Essential Fish Habitat

Effects on Forage, Cover, and Predation

SAV was documented in the project footprint during the last survey. There is a high likelihood that SAV patches will come and go within the action area within the life of the structure. SAV is important in providing cover and a food base for fish.

Coastal pelagics, like Northern anchovy, use estuarine habitats such as the intertidal zone, eelgrass, kelp, and macroalgae and could therefore be affected by the impacts on their designated EFH. If any juvenile and sub-adult groundfish were within the action area, some would be expected to be found near the kelp habitat along NAVBASE Kitsap Bangor nearshore. The presence of new structures in the water column at the site would alter the suitability for recruitment of some groundfish EFH species, with different species preferring different types of habitat. Juvenile rockfish use habitats that include macroalgae-covered rocks or sandy areas with eelgrass or macroalgae as well as manmade in-water structures. Manmade structures also serve as habitat for sub-adult and adult lingcod, rockfish, and greenling, which are potential predators of juvenile rockfish. Operation of the EMMR would result in conversion of soft-bottom substrate to hard substrate (piles) reducing the local availability of these habitats to groundfish EFH species.

Water Quality

Pile driving, dredging, plowing, sediment replacement and cable armoring cause short-term and localized increases in turbidity and total suspended solids (TSS) as the bottom materials are displaced from the intrusion of the pile structures; from the percussive effect of the driving; and from escaped sediment removed during dredging and plowing of the seafloor surface.

Pile installation, dredging and plowing would resuspend bottom sediments within the immediate area of each activity, resulting in temporary and localized increases in suspended sediment concentrations that, in turn, would increase turbidity levels. The suspended sediment/turbidity plumes would be generated periodically throughout the in-water work window. For pile driving, they would be generated only over a five-day consecutive window. Suspended sediments could spread up to an estimated 500 feet from jet-plowing, though most sediment (80 to 90 percent) would be expected to settle out within 20 feet of the cable trench corridor within several hours following completion of jet-plowing operations (BPA 2007).

In-water work could produce measurable, temporary increases in turbidity and sedimentation, and could cause fish to temporarily avoid areas near construction. However, construction activities would not result in persistent increases in turbidity levels or cause changes that would violate water quality standards because processes that generate suspended sediments, which result in turbid conditions, would be short-term and localized, and suspended sediments would disperse and/or settle rapidly (within a period of minutes to hours after construction activities cease). Effects on water quality are expected to be minimal, short-term and localized [or insignificant] and unlikely to result in changes to growth, survival, reproduction or forage opportunities.

Benthic Communities
Temporary impacts would disrupt benthic environments and larval/juvenile rearing habitats and food sources. Reduced diversity or density of epibenthic meiofauna reduces prey resources. Marine benthos would be removed where it is growing attached to existing piles. The cumulative impact of numerous and contiguous urban marine structures may be detrimental to the long-term success of numerous species, particularly recovery efforts for anadromous fish species that migrate along shorelines. There would be some loss of benthic habitat, some slow recovery, but other areas would rebound after the disturbance.

Hydroacoustic Obstruction of Habitat
Construction-generated noise has the potential to degrade groundfish, salmon, and coastal pelagic EFH by exposing the EFH to noise above behavioral and possibly injurious thresholds. The proposed action would increase cause sound waves that disrupt the aquatic habitat. The SPL from pile driving and extraction would occur contemporaneous with the work and radiate outward; the effect attenuates with distance. Both vibratory noise with high frequency and impact noise with high amplitude can create sufficient disturbance that the action area is impaired as a migratory area, but this persists only for the duration of the pile driving or removal. Because work ceases each day, migration values are re-established during the evening, night, and early morning hours.

As stated in Section 2.5.5 in the accompanying Biological Opinion, the installation of five 24-inch piles would be permanently installed to support the platform. EFH would experience temporary increases in underwater sound levels during construction. It should be noted that impact pile driving of concrete piles is estimated to last a maximum of 45 minutes in a day. Coastal pelagic, Pacific coast groundfish, and Pacific coast salmon EFH present within this threshold would be exposed to detectable noise in the water column. Pacific coast groundfish and salmon EFH would be exposed to noise above the injurious threshold as these distances would extend over existing eelgrass shoreward of the project area.

Conservation Actions
The proposed project would have temporary and enduring effects on EFH water bottoms and water columns. These effects culminate in short-term (construction-related) and long-term adverse effects on Pacific Coast groundfish, coastal pelagic species, and Pacific Coast salmon EFH. The proposed action incorporates a number of minimization measures to avoid, reduce, and minimize the adverse effects of the action on EFH. To offset the remaining negative habitat effects, the Navy proposes mitigation though the HCCC ILF program. NMFS ran the NHVM which can be found in Appendix 1. The Navy plans to purchase credits (or the HCCC ILF equivalent) to offset the impacts to EFH.

Summary

Table 6a-c. EMMR impacts to EFH.

Pacific coast groundfish species are considered sensitive to overfishing, the loss of habitat, and reduction in water and sediment quality.

Pacific Coast Groundfish	All waters and substrate in areas less than or equal to 3,500 m to mean higher high water level or the upriver extent of saltwater intrusion Seamounts in depth greater than 3,500 m as mapped in the EFPH assessment geographic information system	HAPC: Estuaries, canopy kelp, seagrass, rocky reefs, and "areas of interest"
Migratory Pathway Obstruction/Shading	No Effect	No Effect
Forage, Cover, and Predation	No Effect	No Effect
Water Quality	Will adversely affect	Will adversely affect
Benthic Communities	Will adversely affect	Will adversely affect
Hydroacoustics	Will adversely affect	Will adversely affect

Pacific salmon EFH is primarily affected by the loss of suitable spawning habitat, barriers to fish migration (habitat access), reduction in water quality and sediment quality, changes in estuarine hydrology, and decreases in prey food source

Pacific Coast Salmon Species	All waters from the ocean extent of the EEZ to the shore, and inland up to all freshwater bodies occupied of historically accessible to salmon in Alaska, Washington, Oregon, Idaho, and California	HAPC: Marine and Estuarine Submerged Aquatic Vegetation
Migratory Pathway Obstruction/Shading	No Effect	No Effect
Effects on Forage, Cover, and Predation	No Effect	No Effect
Water Quality	Will adversely affect	Will adversely affect
Benthic Communities	Will adversely affect	Will adversely affect
Hydroacoustic	Will adversely affect	Will adversely affect

Coastal pelagic species are considered sensitive to overfishing, loss of habitat, reduction in water and sediment quality, and changes in marine hydrology.

Coastal Pelagic Species	All marine and estuarine waters above the thermocline from the shoreline offshore to 200 nm offshore	HAPC: None
Migratory Pathway Obstruction/Shading	No Effect	NA
Effects on Forage, Cover, and Predation	No effect	NA
Water Quality	Will adversely affect	NA
Benthic Communities	Will adversely affect	NA
Hydroacoustic	Will adversely affect	NA

3.3 Essential Fish Habitat Conservation Recommendations

Section 305 (b)(4)(A) of the MSA requires NMFS to provide EFH Conservation Recommendations for any federal action or permit that may result in adverse impacts to EFH. Therefore, NMFS recommends the following to ensure the conservation of EFH and associated marine fishery resources:

1. Monitor for spawning forage fish when work is being conducted between October 15 and January 15;
2. Utilize sound attenuation measure(s) (double walled piles, wooden block, bubble curtain, etc.) for all steel impact pile driving;
3. Reduce, dim, or turn off nighttime lighting when not necessary for operations (ATN and platform);
4. Preserve and enhance EFH by providing new gravel for spawning areas (beach nourishment);
5. Fit all pilings and navigational aids, such as moorings and channel markers, with devices to prevent perching by piscivorous birds and mammals.

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this Opinion is the USACE. Other interested users could include permit applicants, citizens of affected areas, and other parties interested in the conservation of the affected ESUs/DPS. Individual copies of this Opinion were provided to the USACE. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

4.2 Integrity

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

4.3 Objectivity

Information Product Category: Natural Resource Plan

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

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this Opinion and the 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.

5. REFERENCES

Abatzoglou, J.T., Rupp, D.E. and Mote, P.W. 2014. Seasonal climate variability and change in the Pacific Northwest of the United States. Journal of Climate 27(5): 2125-2142.

Abbott, R., E. Bing-Sawyer, and R. Blizard. 2002. Assessment of Pile Driving Impacts on the Sacramento Blackfish (Orthodon Microlepidotus). Caltrans.

Barton, A., B. Hales, G.G. Waldbuster, C. Langdon, and R. Feely. 2012. The Pacific Oyster, Crassostrea gigas, Shows Negative Correlation to Naturally Elevated Carbon Dioxide Levels: Implications for Near-Term Ocean Acidification Effects. Limnology and Oceanography. 57:12.

Beamish, R.J., C. Mahnken, and C.M. Neville. 2004. Evidence That Reduced Early Marine Growth Is Associated with Lower Marine Survival of Coho Salmon. Transactions of the American Fisheries Society. 133:26-33.

Berejikian, B.A. 2019. Research summary presentation at the joint Washington Department of Fish and Wildlife and the Department of Fisheries and Oceans, Canada Workshop: Synthesizing scientific knowledge about population dynamics and diet preferences of harbor seals, Steller sea lions and California sea lions, and their impacts on salmon in the Salish Sea. November 20–21, 2019.

Bhuthimethee, M., Hunt, C., Ruggerone, G., Nuwer, J., & Hafner, W. 2009. NAVBASE Kitsap Bangor fish presence and habitat use, Phase III field survey report, 2007-2008. Prepared by Science Applications International Corporation, Bothell, WA, and Natural Resources Consultants, Inc. (Ruggerone), Seattle, WA. Prepared for BAE Systems Applied Technologies, Inc., Rockville, MD.

Boehlert, G. W., 1984. Abrasive effects of Mt. St. Helens ash upon epidermis of yolk-sac larvae of Pacific herring, *Clupea harengus pallasi*. Mar. envir. Res. 12: 113–126.

Boehlert, G.W., Morgan, J.B. 1985. Turbidity enhances feeding abilities of larval Pacific herring, *Clupea harengus pallasi* . Hydrobiologia 123, 161–170.

Cacela, D., J. Lipton, D. Beltman, J. Hansen, and R. Wolotira. 2005. Associating ecosystem service losses with indicators of toxicity in habitat equivalency analysis. Environmental management. 35:343-351.

California Department of Transportation (CalTrans). 2009. Final Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Including the Oct 2012 update to the Appendix 1 - Compendium of Pile Driving Sound Data. Prepared for: California Department of Transportation 1120 N Street Sacramento, CA 94274. Prepared by: ICF Jones & Stokes 630 K Street, Suite 400 Sacramento, CA 95818 and: Illingworth and Rodkin, Inc. 505 Petaluma Blvd. South Petaluma, CA 94952. February 2009. 367 pp.

California Department of Transportation (CalTrans). 2015. Technical guidance for assessment and mitigation of the hydroacoustics effects of pile driving on fish. p. 532. Sacramento, CA.

Campbell et al. 2017. Successful juvenile life history strategies in returning adult Chinook from five Puget Sound populations; Age and growth of Chinook salmon in selected Puget Sound and coastal Washington watersheds. SSMSP Technical Report.

Carrasquero, J. 2001. Over-water Structures: Freshwater Issues. Washington State Department of Fish and Wildlife White Paper. Report of Herrera Environmental Consultants to Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation.

Chew, K.P., and A.P. Ma. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Northwest): common littleneck clam. USFWS Biological Report 82(11.78), USACE TR EL-82-4. Prepared by University of Washington School of Fisheries Division of Fishery Science and Aquaculture, Seattle, WA. Prepared for U.S. Dept. of the Interior, Fish and Wildlife Service, Research and Development, National Wetlands Research Center, Washington, DC; Coastal Ecology Group, Waterways Experiment Station, U.S. Army Corps of Engineers, Vicksburg, MS. August 1987.

Crozier, L.G., Hendry, A.P., Lawson, P.W., Quinn, T.P., Mantua, N.J., Battin, J., Shaw, R.G. and Huey, R.B. 2008. Potential responses to climate change in organisms with complex life histories: evolution and plasticity in Pacific salmon. Evolutionary Applications 1(2): 252-270.

Crozier, L. G., M. D. Scheuerell, and E. W. Zabel. 2011. Using Time Series Analysis to Characterize Evolutionary and Plastic Responses to Environmental Change: A Case Study of a Shift Toward Earlier Migration Date in Sockeye Salmon. The American Naturalist 178 (6): 755-773.

Davidson, J., J Bebak, and P. Mazik. 2009. The effects of aquaculture production noise on the growth, condition factor, feed conversion, and survival of rainbow trout, Oncorhynchus mykiss. Aquaculture. Volume 288, Issues 3–4, 20 March 2009, Pages 337–343 http://www.sciencedirect.com/science/article/pii/S0044848608008934

Dernie, K.M., M.J. Kaiser, E.A. Richardson, and R.M. Warwick. 2003. Recovery of soft sediment communities and habitats following physical disturbance. Journal of experimental Marine Biology and Ecology 285-286: 415-434.

Drake J.S., E.A. Berntson, J.M. Cope, R.G. Gustafson, E.E. Holmes, P.S. Levin, N. Tolimieri, R.S. Waples, S.M. Sogard, and G.D. Williams. 2010. NOAA Technical Memorandum NMFS59 NWFSC-108. Status of five species of rockfish in Puget Sound, Washington: Bocaccio (Sebastes paucispinis), Canary Rockfish (Sebastes pinniger), Yelloweye Rockfish (Sebastes ruberrimus), Greenstriped Rockfish (Sebastes elongatus) and Redstripe Rockfish (Sebastes proriger). U.S. Dept. Commer. NOAA Tech. Memo. NMFS-NWFSC-108, 234 p.

Dominguez, F., E. Rivera, D. P. Lettenmaier, and C. L. Castro. 2012. Changes in Winter Precipitation Extremes for the Western United States under a Warmer Climate as Simulated by Regional Climate Models. Geophysical Research Letters 39(5).

Doney, S. C., M. Ruckelshaus, J. E. Duffy, J. P. Barry, F. Chan, C. A. English, H. M. Galindo, J. M. Grebmeier, A. B. Hollowed, N. Knowlton, J. Polovina, N. N. Rabalais, W. J. Sydeman, and L. D. Talley. 2012. Climate Change Impacts on Marine Ecosystems. Annual Review of Marine Science 4: 11-37.

Dunford RW, Ginn TC, Desvousges WH. The use of habitat equivalency analysis in natural resource damage assessments. Ecological Economics. 2004. 48:49–70. doi: 10.1016/j.ecolecon.2003.07.011.

Ehinger, S. I., J. P. Fisher, R. McIntosh, D. Molenaar and J. Walters. 2015. Working Draft, April 2015: Use of The Puget Sound Nearshore Habitat Values Model with Habitat Equivalency Analysis for Characterizing Impacts and Avoidance Measures for Projects that Adversely Affect Critical Habitat of ESA-Listed Chinook and Chum Salmon.

Feist, B.E., J.J. Anderson, and R. Miyamoto. 1996. Potential impacts of pile driving on juvenile pink (Oncorhynchus gorbuscha) and chum (O. keta) salmon behavior and distribution. Fisheries Research Institute Report No. FRI-UW-9603:66 pp.

Feely, R.A., T. Klinger, J.A. Newton, and M. Chadsey (editors). 2012. Scientific summary of ocean acidification in Washington state marine waters. NOAA Office of Oceanic and Atmospheric Research Special Report.

Fresh, K.L. 2006. Juvenile Pacific Salmon in Puget Sound. In Valued Ecosystem Components Report Series.

Fresh K., M. Dethier, C. Simenstad, M. Logsdon, H. Shipman, C. Tanner, T. Leschine, T. Mumford, G. Gelfenbaum, R. Shuman, J. Newton. 2011. Implications of Observed Anthropogenic Changes to the Nearshore Ecosystems in Puget Sound. Prepared for the Puget Sound Nearshore Ecosystem Restoration Project. Technical Report 2011-03.

Frierson, T., W Dezan, D. Lowry, L. LeClair, L. Hillier, R. Pacunski, J. Blaine, A. Hennings, A. Phillips, P. Campbell. 2017. Final Assessment of Threatened and Endangered Marine and Anadromous Fish Presence Adjacent to the NAVBASE Kitsap Bangor: 2015-16 Beach Seine Survey Results. The WDFW Marine Fish Science Unit.

Fish and Wildlife Service and the National Marine Fisheries Service. 1998. Endangered Species Act Section 7 Consultation Handbook. Fish and Wildlife Service and the National Marine Fisheries Service. Endangered Species Act Section 7 Consultation Handbook. 315p.

Glick, P., J. Clough, and B. Nunley. 2007. Sea-Level Rise and Coastal Habitats in the Pacific Northwest: An analysis for Puget Sound, southwestern Washington, and northwestern Oregon. National Wildlife Federation, Seattle, WA.

Goetz, F. A., Jeanes, E., Moore, M. E., and Quinn, T. P. 201). Comparative migratory behavior and survival of wild and hatchery steelhead (Oncorhynchus mykiss) smolts in riverine, estuarine, and marine habitats of Puget Sound, Washington. Environmental Biology of Fishes, 98(1), 357-375. doi:http://dx.doi.org/10.1007/s10641-014-0266-3

Golder Associates. 2010. Coastal processes analysis for Devil's Hole Mitigation Site, Naval Base Bangor, P977 Project. Prepared by Golder Associates, Redmond, WA. Prepared for Otak, Inc., Kirkland, WA. February 23, 2010.

Goode, J.R., Buffington, J.M., Tonina, D., Isaak, D.J., Thurow, R.F., Wenger, S., Nagel, D., Luce, C., Tetzlaff, D. and Soulsby, C., 2013. Potential effects of climate change on streambed scour and risks to salmonid survival in snow-dominated mountain basins. Hydrological Processes 27(5): 750-765.

Goodwin, C.L., and B. Pease. 198). Species profiles: life histories and environmental requirements of coastal fish and invertebrates (Pacific Northwest): Pacific geoduck clam. USFWS Biological Report 82(11); USACE TR EL-82-4. U.S. Army Corps of Engineers, Coastal Ecology Group, Waterways Experiment Station, Vicksburg, MS; U.S. Fish and Wildlife Service, Research and Development, National Wetlands Research Center, Washington, DC. December 1989.

Grette, G.B. 1985. Fish monitoring during pile driving at Hiram H. Chittenden Locks, August-September 1985. Seattle District Army Corps of Engineers. Evans-Hamilton, Inc.

Halvorsen, M. B., Casper, B. M., Woodley, C. M., Carlson, T. J., and Popper, A. N. 2012. Threshold for onset of injury in Chinook salmon from exposure to impulsive pile driving sounds. PLoS One, 7(6), e38968.

Hanson MB, Emmons CK, Ford MJ, Everett M, Parsons K, Park LK, et al. 2021. Endangered predators and endangered prey: Seasonal diet of Southern Resident killer whales. PLoS ONE 16(3): e0247031. https://doi.org/10.1371/journal.pone.0247031

Hastings, M.C., A.N. Popper, J.J. Finneran, and P. Lanford. 1996. Effects of low-frequency underwater sound on hair cells of the inner ear and lateral line of the teleost fish Astronotus ocellatus. Journal of the Acoustical Society of America, 99(3):1759–1766.

Hood Canal Bridge Assessment Team. 2020. Hood Canal Bridge Ecosystem Impact Assessment: Phase 1 Report. Long Live the Kings, Seattle, WA.

Hood Canal Coordinating Council. 2005. Hood Canal & Eastern Strait of Juan de Fuca summer chum salmon recovery plan. Hood Canal Coordinating Council. Poulsbo, Washington.

Hydroacoustic Working Group, F. 2008. Agreement in Principle for Interim Criteria for Injury to Fish from Pile Driving Activities.

ISAB (editor). 2007. Climate change impacts on Columbia River Basin fish and wildlife. In: Climate Change Report, ISAB 2007-2. Independent Scientific Advisory Board, Northwest Power and Conservation Council. Portland, Oregon.

Intergovernmental Panel on Climate Change (IPCC). 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Isaak, D.J., Wollrab, S., Horan, D. and Chandler, G., 2012. Climate change effects on stream and river temperatures across the northwest US from 1980–2009 and implications for salmonid fishes. Climatic Change 113(2): 499-524.

Johnson, D.H., and T.A. O'Neil. 2001. Wildlife-habitat relationships in Washington and Oregon. Corvallis, OR: Oregon State University Press. Karl, T.R., J. Melillo, and T.e. Peterson. 2009. Global Climate Change Impacts in the United States. Cambridge University Press.

Kashef, N. S., S. M. Sogard, R. Fisher, and J. Largier. 2014. Ontogeny of critical swimming speeds for larval and pelagic juvenile rockfishes (Sebastes spp., family Scorpaenidae). Marine Ecology Progress Series. 500. 231-243. 10.3354/meps10669.

Kendall, A. W. Jr., and S. J. Picquelle. 2003. Marine protected areas and the early life history of fishes. AFSC Processed Rep. 2003-10, 30 p. Alaska Fish. Sci. Cent., Natl. Mar. Fish. Serv., Seattle, WA.

Kilduff, P., L. W. Botsford, and S. L. H. Teo. 2014. Spatial and temporal covariability in early ocean survival of Chinook salmon (Oncorhynchus tshawytscha) along the west coast of North America. ICES Journal of Marine Science. 71. 10.1093/icesjms/fsu031.

Kunkel, K. E., L. E. Stevens, S. E. Stevens, L. Sun, E. Janssen, D. Wuebbles, K. T. Redmond, and J. G. Dobson. 2013. Regional Climate Trends and Scenarios for the U.S. National Climate Assessment: Part 6. Climate of the Northwest U.S. NOAA Technical Report NESDIS 142-6. 83 pp. National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service, Washington, D.C.

Lawson, P. W., Logerwell, E. A., Mantua, N. J., Francis, R. C., & Agostini, V. N. 2004. Environmental factors influencing freshwater survival and smolt production in Pacific Northwest coho salmon (Oncorhynchus kisutch). Canadian Journal of Fisheries and Aquatic Sciences 61(3): 360-373

Lehmann, E. 2014. Research suggests that flooding from sea level rise will prove more costly than building barriers to protect coastlines. ClimateWire and Scientific American.

MacLennan, A., & Johannessen, J. 2014. Bangor Beach Littoral Drift Assessment: Kitsap County, WA. Prepared by Coastal Geologic Services, Bellingham, WA. Prepared for Port Gamble S'Klallam Tribe, Port Gamble, WA. October 8, 2014.

Mantua, N., I. Tohver, and A. Hamlet. 2009. Impacts of Climate Change on Key Aspects of Freshwater Salmon Habitat in Washington State. In the Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a Changing Climate, edited by M. M. Elsner, J. Littell, L. Whitely Binder, 217-253. The Climate Impacts Group, University of Washington, Seattle, Washington.

Mantua, N., I. Tohver, and A. Hamlet. 2010. Climate change impacts on streamflow extremes and summertime stream temperature and their possible consequences for freshwater salmon habitat in Washington State. Climatic Change 102(1): 187-223.

Marshall, C. 2014. Massive Seawall May Be Needed to Keep New York City Dry. ClimateWire and Scientific American.

Marx D, Carilli J, Young A. 2020. Naval Base Kitsap Bangor Electromagnetic Measurement Ranging System Macroalgae Survey. August 2020. Naval Information Warfare Center Pacific Technical Report.

McElhany, P. 2000. Estimating minimum viable population sizes for Pacific salmonids.

McFarlane, B.R., and E.C. North. 2002. Physiological ecology of juvenile Chinook salmon (Oncorhynchus tshawytscha) at the southern end of their distribution, the San Francisco Estuary and Gulf of the Farallones, California. Fisheries Bulletin. 100:13.

McMahon, T.E., and G.F. Hartman. 1989. Influence of cover complexity and current velocity on winter habitat use by juvenile Coho salmon (Oncorhynchus kisutch). Canadian Journal of Fisheries and Aquatic Sciences 46: 1551–1557.

Meyer, J.L., M.J. Sale, P.J. Mulholland, and N.L. Poff. 1999. Impacts of climate change on aquatic ecosystem functioning and health. JAWRA Journal of the American Water Resources Association 35(6): 1373-1386.

Milon, J.W., Dodge R.E. 2001. Applying habitat equivalency analysis for coral reef damage assessment and restoration. Island Press, Washington, DC. 155p. MEA 2005b

Morley, S.A., J.D. Toft, and K.M. Hanson. 2012. Ecological Effects of Shoreline Armoring on Intertidal Habitats of a Puget Sound Urban Estuary. Estuaries and Coasts. 35:774-784.

Moore, M.E., B.A. Berejikian, and E.P. Tezak. 2010. Early marine survival and behavior of steelhead smolts through Hood Canal and the Strait of Juan de Fuca. Transactions of the American Fisheries Society 139: 49-61.

Moore, M.E., B.A. Berejikian, and E.P. Tezak. 2013. A Floating Bridge Disrupts Seaward Migration and Increases Mortality of Steelhead Smolts in Hood Canal, Washington State. PloS one. 8.

Morgan, J. D. and C. D. Levings. 1989. Effects of suspended sediment on eggs and larvae of lingcod *Ophiodon elongatus*, Pacific herring *Clupea harengus pallasi*, and surf smelt *Hypomesus pretiosus*. Canadian Technical Report of Fisheries & Aquatic Sciences, 1729:I-VII; 1-31.

Morris, J. T., Osychny, V. I., & Luey, P. J. 2008. Naval Base Kitsap Bangor – Supplemental Current Measurement Survey: August 2007 field data report. Final. Prepared by Science Applications International Corporation, Newport, RI. Prepared for BAE Systems Applied Technologies, Inc., Rockville, MD.

Mote, P.W, A. K. Snover, S. Capalbo, S.D. Eigenbrode, P. Glick, J. Littell, R.R. Raymondi, and W.S. Reeder. 2014. Ch. 21: Northwest. In Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, T.C. Richmond, and G.W. Yohe, Eds., U.S. Global Change Research Program, 487-513.

Mote, P.W., D.E. Rupp, S. Li, D.J. Sharp, F. Otto, P.F. Uhe, M. Xiao, D.P. Lettenmaier, H. Cullen, and M. R. Allen. 2016. Perspectives on the cause of exceptionally low 2015 snowpack in the western United States, Geophysical Research Letters, 43, doi:10.1002/2016GLO69665

Mumford, T.F. 2007. Kelp and Eelgrass in Puget Sound in Valued Ecosystem Component Reports Series. Washington Department of Natural Resources.

Navy. 2019. Eelgrass survey report: Naval Base Kitsap Bangor, Silverdale, WA. Prepared by Grette Associates for Leidos for the Department of the Navy.

Newcombe, C.P., and J.O.T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management. 16:34.

NMFS. 2003. Alaska Fishery Science Center, processed report 2003-10. Marine protected areas and early life-history of fishes.

NMFS. 2006. Final supplement to the Shared Strategy's Puget Sound salmon recovery plan. National Marine Fisheries Service, Northwest Region. Seattle

NMFS. 2007. Final Supplement to the recovery plan for the Hood Canal and eastern Strait of Juan de Fuca summer chum salmon (Oncorhynchus keta). National Marine Fisheries Service, Northwest Region. Portland, Oregon

NMFS. 2008. Recovery plan for Southern Resident killer whales (Orcinus orca). National Marine Fisheries Service, Northwest Region, Seattle, Washington.

NMFS. 2015. Endangered Species Act Section 7(a)(2) Informal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Coweeman Habitat Bank. 6th Field HUC 1708000508, Lower Columbia. Cowlitz County, Washington. WCR-2015-3100. 32pp

NMFS. 2016. Draft Rockfish Recovery Plan: Puget Sound / Georgia Basin yelloweye rockfish (Sebastes ruberrimus) and bocaccio (Sebastes paucispinis). National Marine Fisheries Service. Seattle, WA.

NMFS. 2016b. Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation and Fish and Wildlife Coordination Act Recommendations. NOAA's National Marine Fisheries Service's Response for the Regional General Permit 6 (RGP6): Stuctures in Inland Marine Waters of Washington State. September 13, 2016. NMFS Consultation No.: WCR-2016-4361. 115p.

NMFS. 2021. Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation. NOAA's National Marine Fisheries Service's Response for the Issuance of Permits for 11 Projects under Section 404 of the Clean Water Act and Section 10 of the River and Harbors Act for actions related to Stuctures in the Nearshore Environment of Puget Sound. September 30, 2021. NMFS Consultation No.: WCRO-2021-01620. 298p.

Northwest Fisheries Science Center (NWFSC). 2015. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest.

O'Neill S.M., A.J. Carey, R. Fisk, M. Langness, G.M. Ylitalo, L.A. Niewolny, J.E. West. Contaminants reveal spatial segregation of sub-adult Chinook salmon in Puget Sound. Salish Sea Conference. 2018.

Parametrix. 1994. Metro North Beach epibenthic operational monitoring program, 1994 surveys. Prepared by Parametrix, Inc., Kirkland, WA. Prepared for King County Department of Metropolitan Services, Seattle, WA.

Parametrix. 1999. St. Paul Waterway area remedial action and habitat restoration project. 1998 monitoring report. Prepared by Parametrix, Inc., Kirkland, WA. Prepared for Simpson Tacoma Kraft Co., Tacoma, WA.

Pearson, W.H., J.R. Salaski, and C.I. Malme 1992. Effects of Sound from a Geophysical Survey Devise on Behavior of Captive Rockfish (Sebastes spp.). Canadian Journal of Fisheries and Aquatic Science 49:1343–1356.

Penttila, D. 2007. Marine Forage Fishes in Puget Sound. In Valued Ecosystem Components Report Series. Washington Department of Fish and Wildlife. 30.

PFMC (Pacific Fishery Management Council). 1998. Description and identification of essential fish habitat for the Coastal Pelagic Species Fishery Management Plan. Appendix D to Amendment 8 to the Coastal Pelagic Species Fishery Management Plan. Pacific Fishery Management Council, Portland, Oregon. December.

PFMC (Pacific Fishery Management Council). 2014. Appendix A to the Pacific Coast Salmon Fishery Management Plan, as modified by Amendment 18 to the Pacific Coast Salmon Plan: Identification and description of essential fish habitat, adverse impacts, and recommended conservation measures for salmon. Pacific Fishery Management Council, Portland, OR. September 2014. 196 p. + appendices.

Popper, A.N. 2003. Effects of anthropogenic sounds on fishes. Fisheries 28(10): 24-31. doi: 10.1577/1548-8446(2003)28[24:EOASOF]2.0.CO;2

Popper, A.N., M.E. Smith, P.A. Cott, B.W. Hanna, A.O. MacGillivray, M.E. Austin, and D.A. Mann. 2005. Effects of exposure to seismic airgun use on hearing of three fish species. Journal of the Acoustical Society of America, 117:3958–3971.

Popper, A. N. and M. C. Hastings. 2009 The effects of anthropogenic sources of sound on fishes. Journal of Fish Biology (2009) 75, 455–489 doi:10.1111/j.1095-8649.2009.02319.

Popper A.N. A. D. Hawkins, R. R. Fay, D. A. Mann, S. Bartol, T. J. Carlson, S. Coombs, W. T. Ellison, R. L. Gentry, M. B. Halvorsen, S. Løkkeborg, P. H. Rogers, B. L. Southall, D. G. Zeddies, and W. N. Tavolga . 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. Springer Briefs in Oceanography. Springer, Cham

Quinn, T.P. 2005. The Behavior and Ecology of Pacific Salmon and Trout. UW Press.

Raymondi, R.R., J.E. Cuhaciyan, P. Glick, S.M. Capalbo, L.L. Houston, S.L. Shafer, and O. Grah. 2013. Water Resources: Implications of Changes in Temperature and Precipitation. In Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities, edited by M.M. Dalton, P.W. Mote, and A.K. Snover, 41-58. Island Press, Washington, DC.

Reeder, W.S., P.R. Ruggiero, S.L. Shafer, A.K. Snover, L.L Houston, P. Glick, J.A. Newton, and S.M Capalbo. 2013. Coasts: Complex Changes Affecting the Northwest's Diverse Shorelines. In Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities, edited by M.M. Dalton, P.W. Mote, and A.K. Snover, 41-58. Island Press, Washington, DC

Rice, C.A., C.M. Greene, P. Moran, D.J. Teel, D.R. Kuligowski, R.R. Reisenbichler, E.M. Beamer, J.R. Karr, and K.L. Fresh. 2011. Abundance, Stock Origin, and Length of Marked and Unmarked Juvenile Chinook Salmon in the Surface Waters of Greater Puget Sound. Transactions of the American Fisheries Society. 140:170-189.

Romberg, P.G., C. Homan, and D. Wilson. 1995. Monitoring at two sediment caps in Elliott Bay. In: Puget Sound Research Conference 1995. January 12-14, Bellevue, WA. 289-299. Royal Society, T. 2005. Ocean acidification due to increasing atmospheric carbon dioxide contents.

Roni, P. T.J. Beechie, R.E. Bilby, F.E. Leonetti, M.M. Pollock, and G. R. Pess. 2002. A review of stream restoration techniques and a hierarchical strategy for prioritizing restoration in Pacific Northwest watersheds. North American Journal of Fisheries Management 22, 1-20.

Ruckelshaus, M.H., K.P. Currens, W.H. Graeber, R.R. Fuerstenberg, K. Rawson, N.J. Sands, and J.B. Scott. 2006. Independent populations of Chinook salmon in Puget Sound. U.S. Dept. Commer. NOAA Tech. Memo. NMFS-NWFSC-78, 125p.

Ruggerone, G. T., S. Goodman, and R. Miner. 2008. Behavioral Response and Survival of juvenile Coho Salmon Exposed to Pile Driving Sounds. Prepared for the Port of Seattle, Seattle, Washington.

SAIC (Science Applications International Corporation). 2006. Naval Base Kitsap-Bangor fish presence and habitat use, combined phase I and II field survey report. Prepared by Science Applications International Corporation, Bothell, WA. Prepared for BAE Systems Applied Technologies, Inc., Rockville, MD.

SAIC (Science Applications International Corporation). 2009. Naval Base Kitsap-Bangor fish presence and habitat use, combined phase III field survey report, 2007-2008. Prepared by Science Applications International Corporation, Bothell, WA. Prepared for BAE Systems Applied Technologies, Inc., Rockville, MD.

Scheuerell, M.D., and J.G. Williams. 2005. Forecasting climate-induced changes in the survival of Snake River spring/summer Chinook salmon (Oncorhynchus tshawytscha). Fisheries Oceanography 14:448-457.Shared Strategy for Puget Sound. 2007. Puget Sound salmon recovery plan. Volume 1, recovery plan. Shared Strategy for Puget Sound. Seattle.

Servizi, J.A., and D.W. Martens. 1991. Effect of temperature, season, and fish size on acute lethality of suspended sediments to Coho salmon (Oncorhynchus kisutch). Canadian Journal of Fisheries and Aquatic Sciences. 48:493-497.

Shipman, H., Dethier, M. N., Gelfenbaum, G., Fresh, K. L. and Dinicola, R. S. (Eds.). 2010. Puget Sound Shorelines and the Impacts of Armoring-- Proceedings of a State of the Science Workshop, May 2009. U.S. Geological Survey, Scientific Investigations Report 2010-5254.

Simenstad, C.A. 1988. Summary and Conclusions from Workshop and Working Group Discussions. Pages 144-152 in Proceedings, Workshop on the Effects of Dredging on Anadromous Pacific Coast Fishes, Seattle, Washington, September 8-9, 1988. C.A. Simenstad, ed., Washington Sea Grant Program, University of Washington, Seattle, Washington.

Skalski, J.R., W.H. Pearson, and C.I. Malme 1992. Effects of Sounds from a Geophysical Survey Device on Catch-Per-Unit-Effort in a Hook-and-Line Fishery for Rockfish (Sebastes spp.). Canadian Journal of Fisheries and Aquatic Science 49:1357–1365.

Stadler, J.H., and D.P. Woodbury. 2009. Assessing the effects to fishes from pile driving: Application of new hydroacoustic criteria. 8 pp.

Strange, Elisabeth, H. Galbraith, S. Bickel, D. Mills, D. Beltman, J. Lipton. 2002. Environmental Assessment. Determining Ecological Equivalence in Service-to-Service Scaling of Salt Marsh Restoration. Environmental Management Vol. 29, No.2, pp. 290- 300

Sunda, W. G., and W. J. Cai. 2012. Eutrophication induced CO2-acidification of subsurface coastal waters: interactive effects of temperature, salinity, and atmospheric p CO2. Environmental Science & Technology, 46(19): 10651-10659

Tabor, Roger A. 2017. Phototaxic Behavior of Subyearling Salmonids in the Nearshore Area of Two Urban Lakes in Western Washington State. Transactions of the American Fisheries Society. 146.4 (2017): 753-761

Tague, C. L., Choate, J. S., & Grant, G. 2013. Parameterizing sub-surface drainage with geology to improve modeling streamflow responses to climate in data limited environments. Hydrology and Earth System Sciences 17(1): 341-354

Thur, S. M. 2006. Resolving oil pollution liability with restoration-based claims: the United States' experience. Institut oceanographique, Paris (France).

Tillmann, P., and D. Siemann. 2011. Climate Change Effects and Adaptation Approaches in Marine and Coastal Ecosystems of the North Pacific Landscape Conservation Cooperative Region. National Wildlife Federation.

Turnpenny, A.W.H., K.P. Thatcher, and J.R. Nedwell. 1994. The effects on fish and other marine animals of high-level underwater sound. Fawley Aquatic Research Laboratory, Ltd., Report FRR 127/94, United Kingdom. October.

Vivan, J.M., T.C.M. de Almeida, and M. Di Domenico. 2009. Effects of dredged material disposal on benthic macrofauna near Itajaí Harbour (Santa Catarina, South Brazil). Ecological Engineering. 35(10): 1435-1443.

WDFW (Washington Department of Fish and Wildlife).2019. 2016 Washington State Herring Stock Status Report. https://wdfw.wa.gov/sites/default/files/publications/02105/wdfw02105.pdf

WDOE 2014. Stormwater Management Manual for Western Washington, as Amended in December 2014. Publication Number 14-10-055. Washington State Department of Ecology, Water Quality Program, Olympia, WA. December 2014.

WDOE 2016. Water Quality Standards for Surface Waters of the State of Washington Chapter 173-201A WAC Adopted August 1, 2016. Revised October 2017. https://fortress.wa.gov/ecy/publications/documents/0610091.pdf

WDOE. 2017. Washington State's Current Water Quality Assessment listing for waters adjacent to NAVBASE Kitsap Bangor. Retrieved from https://fortress.wa.gov/ecy/wqamapviewer/map.aspx.

Wainwright, T. C., and L. A. Weitkamp. 2013. Effects of climate change on Oregon Coast coho salmon: habitat and life-cycle interactions. Northwest Science 87(3): 219-242.

Weston Solutions. 2006. Jimmycomelately piling removal monitoring project, Final Report. Prepared for Jamestown S'Klallam Tribe, Port Townsend, Washington. 109.

Williams, G. D., and R. M. Thom. 2001. Marine and Estuarine Shoreline Modification Issues. White paper submitted to Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation. 99p. http://chapter.ser.org/northwest/files/2012/08/WDFW_marine_shoreline_white_paper.pd

Winder, M. and D. E. Schindler. 2004. Climate change uncouples trophic interactions in an aquatic ecosystem. Ecology 85: 2100–2106

WSDOT. 2009. Wetland Response to Shade. Special study technical memorandum. 110 pp.

Zabel, R.W., M.D. Scheuerell, M.M. McClure, and J.G. Williams. 2006. The interplay between climate variability and density dependence in the population viability of Chinook salmon. Conservation Biology 20(1):190-200

APPENDIX 1

Blue cells contain Section Headings	
Rose cells contain questions that need to be answered to fill out calculator.	
Grey cells contain units requested for entry.	
Yellow cells indicate user entry fields.	
Green cells contain additional explanations and resource links.	
Maroon cells contain summary values.	
Action Agency Reference #	NAVBASE Kitsap Bangor
FWS or NMFS #	WCR-2021-03674
Project Name	EMMR
Prepared on and by:	Lisa Abernathy

Puget Sound Nearshore Conservation Calculator

Version: 3/10/2021

This calculator estimates conservation points for the Puget Sound nearshore.

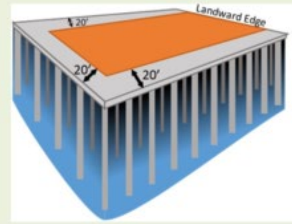
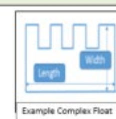
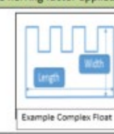
		Conservation Credits/Debits	DSAYs	Notes
Overwater Structures	Debit	-10	-0.10	
	Credit	0	0.00	Includes credits from creosote removal
	Balance	-10	-0.10	
Shoreline Armoring	Debit	0	0.00	
	Credit from Armor Removal	0	0.00	
	Credit from Creosote Removal	0	0.00	
	Balance	0	0.00	
Maintenance Dredging	**Balance**	0	0.00	
Boatramps, Jetties, Rubble	Debit	0	0.00	
	Credit	0	0.00	
	Balance	0	0.00	
Beach Nourishment	Credit	0	0.00	
Riparian Enhancement/Degradation	**Conservation Points**	0	0.00	
Total Points		-10	-0.10	

Impact and Benefit Determination for Overwater Structure Elements

xpand an entry block for data entry click on the + sign on the left. Clicking the 2 will expand all entry blocks. **Version:** 3/10/2021

Entry Block I: Overwater structure Entry for New or Expansion Overwater Structure Elements

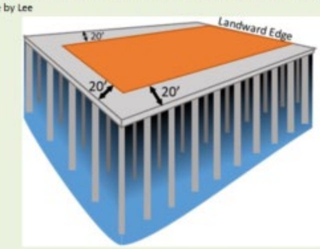
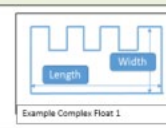
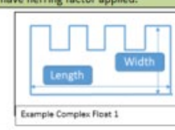
new overwater structure elements in this entry block and all areas that are considered expansions with replacements. Enter replacement overwater structure elements in Entry block II below.

Description	OWS Element	Units	Quantity	Total Conservation Debits	Buffer Area	Notes and Examples
Must enter vegetation scenario for LSZ	Enter LSZ SAV scenario 0-3		0	Reference: LSZ SAV Scenarios		Addition of USZ vegetation scenarios planned for next version
Enter dimensions of elevated pier and ramp in respective shore zone. If a pier has partial grating, enter dimensions of grated and ungrated portions into respective fields. Enter central portions of piers wider than 40 feet as floats as there is little side lighting in such structures.	Pier & Ramp USZ fully grated	SqFt	0	0.00		To account for the dark center on wide decks, enter the deck area within 20 feet from the edge as pier, and enter the deck area more than 20 feet from the edge as a float. See Figure below. FYI: Forage fish credit factors do not apply to piers and ramps. Figure by Lee Corum (USFWS) 
	Pier & Ramp USZ solid	SqFt	0	0.00		
	Pier & Ramp LSZ fully grated	SqFt	0	0.00		
	Pier & Ramp LSZ solid	SqFt	0	0.00		
	Pier & Ramp DZ fully grated	SqFt	0	0.00		
Reference: Delineation of Shore Zones	Pier & Ramp DZ solid	SqFt	0	0.00		
Piles can be steel, concrete, plastic, untreated wood or, outside of DNR land, ACZA-treated and urea coated piles. Installation of creosote wood is not included. Use pile calculator below to determine average pile diameter.	Enter number of piles in USZ		0	0.00		
	Enter average diameter of piles in USZ.	[inches]	0			
	Enter number of piles in LSZ		0	0.00		
	Enter average diameter of piles in LSZ.	[inches]	0			
	Enter number of piles in DZ		5	-9.77		
	Enter average diameter of piles in DZ.	[inches]	24			
Enter the outside dimensions of new floats with at least 50% grating and 60% or more open space as grated floats (Compliant with WAC 220-660-280). For simplicity and as we expect floats to meet state regulations, grated floats are not split between grated and ungrated portions. For complex floats, enter the longest outside dimensions of the float. See Example Complex Float 1.	USZ Outside dimensions of new float or expanded portion of float.	Length [feet]	0	Enter length and width of floats for buffer determination. Lenth is the longer dimension. For complex floats, enter the sum of the length of each float and the average width of the floats. **Set length and width to 0 for zones where no structure present.**		 Example Complex Float
		Width [feet]	0			
	LSZ Outside dimensions of new float or expanded portion of float.	Length [feet]	0			
		Width [feet]	0			
	DZ Outside dimensions of new float or expanded portion of float.	Length [feet]	0			
		Width [feet]	0	Reference: Complex Floats	**Buffer Area**	
The area of the float in each respective shore zone is calculated from length and width entered above. For complex floats, the user should directly enter the square footage of the float in the appropriate zone. BMP: Floats should not be located in the USZ and cannot ground out.	Grated Float USZ	SqFt	0	0.00	-	For complex floats the calculated SqFt will not match the actual SqFt. Enter SqFt manually in column E.
	Grated Float LSZ	SqFt	0	0.00	-	
	Grated Float DZ	SqFt	0	0.00	-	Floats in the DZ in herring spawning & holding areas may have herring factor applied.
Solid float have higher adverse effects on the nearshore environment compared to grated floats. We highly encourage applicants to grate overwater structures as much as possible. Because of the higher impacts from solid floats compared to grated floats, resulting conservation debits are higher. Enter the length and width of the float in the appropriate shore zone (see Table 2). For complex floats, enter longest outside dimensions of float. See Example Complex Float 1.	USZ Outside dimensions of new float or expanded portion of float.	Length [feet]	0	Enter length and width of floats for buffer determination. For complex floats, enter the sum of the length of each float and the average width of the floats. **Set length and width to 0 for zones where no structure present.**		 Example Complex Float
		Width [feet]	0			
	LSZ Outside dimensions of new float or expanded portion of float.	Length [feet]	0			
		Width [feet]	0			
	DZ Outside dimensions of new float or expanded portion of float.	Length [feet]	0			
		Width [feet]	0	Reference: Complex Floats	**Buffer Area**	
The area of a new float is calculated by shore zone from the length and width entered above. For irregularly shaped floats, enter the square footage of the float in the appropriate zone (see Notes for more information on irregularly shaped floats). BMP: Floats should not be located in the USZ and cannot ground out.	Solid Float USZ	SqFt	0	0.00	0	For complex floats the calculated SqFt will not match the actual SqFt. Enter SqFt manually in column E.
	Solid Float LSZ	SqFt	0	0.00	0	
	Solid Float DZ	SqFt	0	0.00	0	Floats in the DZ in herring spawning & holding areas may have herring factor applied.
Sub-Total: Conservation Debits Owed for New Structure Elements				-9.77		

Reference: Delineation of Shore Zones

Entry Block II: Overwater Entry Block for Repair and Replacement of Overwater Structure Elements

eplacement and repair of overwater structure elements in this entry block. Enter areas that are considered expansions of the to be replaced structure in Entry Block I above.

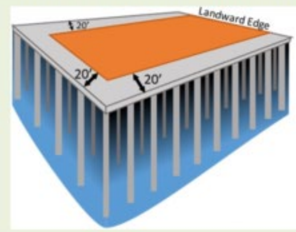
Description	OWS Element	Units	Quantity	Conservation Debits	Notes and Examples
Must enter vegetation scenario for LSZ	Enter SAV scenario 0-3		1	Reference: LSZ SAV Scenarios	
Enter dimensions of elevated pier and ramp in respective shore zone. If a pier has partial grating, enter dimensions of grated and ungrated portions into respective fields. Enter central portions of piers wider than 40 feet as floats as there is little side lighting in such structures.	Pier & Ramp USZ fully grated	SqFt	0	0.00	To account for the dark center on wide decks, enter the deck area within 20 feet from the edge as pier, and enter the deck area more than 20 feet from the edge as a float. See Figure below. FYI: Forage fish credit factors do not apply to piers and ramps. Figure by Lee 
	Pier & Ramp USZ solid	SqFt	0	0.00	
	Pier & Ramp LSZ fully grated	SqFt	0	0.00	
	Pier & Ramp LSZ solid	SqFt	0	0	
	Pier & Ramp DZ fully grated	SqFt	0	0.00	
Reference: Delineation of Shore Zones	Pier & Ramp DZ solid	SqFt	0	0.00	
Piles can be steel, concrete, plastic, untreated wood or, outside of DNR land, ACZA-treated and urea coated piles. Installation of creosote wood is not included. Use pile calculator below to determine average pile diameter.	Enter number of piles in USZ		0	0.00	
	Enter average diameter of piles in USZ	[inches]	0		
	Enter number of piles in LSZ		0	0.00	
	Enter average diameter of piles in LSZ	[inches]	0		
	Enter number of piles in DZ		0	0.00	
	Enter average diameter of piles in DZ	[inches]	0		
Enter the outside dimensions of replacement floats with at least 50% grating and 60% or more open space as grated floats (Compliant with WAC 220-660-280). For simplicity and as we expect floats to meet state regulations, grated floats are not split between grated and ungrated portions. For complex floats, enter the longest outside dimensions of the float. See Example Complex Float 1.	USZ Outside dimensions of replacement float.	Length [feet]	0	Enter length and width of floats for buffer determination. For complex floats, enter the sum of the length of each float and the average width of the floats. **Set length and width to 0 for zones where no structure present.**	 Example Complex Float 1
		Width [feet]	0		
	LSZ Outside dimensions of replacement float.	Length [feet]	0		
		Width [feet]	0		
	DZ Outside dimensions of replacement float.	Length [feet]	0		
		Width [feet]	0	Reference: Complex Floats	**Buffer Area**
The area of the float in each respective shore zone is calculated from length and width entered above. For irregularly shaped floats, user should directly enter the square footage of the float in the appropriate zone (see Notes for more information on irregularly shaped floats). BMP: Floats should not be located in the USZ and cannot ground out.	Grated Float USZ	SqFt	0	0.00	0 — For complex floats the calculated SqFt will not match the actual SqFt. Enter SqFt manually in column E.
	Grated Float LSZ	SqFt	0	0.00	0
	Grated Float DZ	SqFt	0	0.00	0 — Floats in the DZ in herring spawning & holding areas may have herring factor applied.
Solid float have higher adverse effects on the nearshore environment compared to grated floats. We highly encourage applicants to grate overwater structures as much as possible. Because of the higher impacts from solid floats compared to grated floats, resulting conservation debits are higher. Enter the length and width of the float in the appropriate shore zone (see Table 2). For complex floats, enter longest outside dimensions of float. See Example Complex Float 1	USZ Outside dimensions of new float or expanded portion of float.	Length [feet]	0	Enter length and width of floats for buffer determination. For complex floats, enter the sum of the length of each float and average width of floats. **Set length and width to 0 for zones where no structure present.**	 Example Complex Float 1
		Width [feet]	0		
	LSZ Outside dimensions of new float or expanded portion of float.	Length [feet]	0		
		Width [feet]	0		
	DZ Outside dimensions of new float or expanded portion of float.	Length [feet]	0		
		Width [feet]	0	Reference: Complex Floats	**Buffer Area**
The area of a float is calculated by shore zone from the length and width entered above. For irregularly shaped floats, enter the square footage of the float in the appropriate zone (see Notes for more information on irregularly shaped floats). BMP: Floats should not be located in the USZ and cannot ground out.	Solid Float USZ	SqFt	0	0.00	0 — For complex floats the calculated SqFt will not match the actual SqFt. Enter SqFt manually in column E.
	Solid Float LSZ	SqFt	0	0.00	0
	Solid Float DZ	SqFt	0	0.00	0 — Floats in the DZ in herring spawning & holding areas may have herring factor applied.
Sub-Total: Conservation Debits Owed for Replacement Structure Elements				0.00	

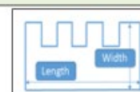
Debit Factors associated with Installation of OWS			
Site Specific Debit Factors for OWS Installation	**Percent more credit**		**Notes and Examples**
Is the project located within 5 miles of a Puget Sound Chinook natal estuary zone or within 1 mile of a Hood Canal summer-chum estuary zone? Puget Sound Natal & Pocket Estuaries	No	0%	Reference: Application of Credit Factors Projects located within a natal Chinook or HC summer chum estuary zone will owe 50% more debits. If a project is in a pocket estuary and within a natal Chinook or HC summer chum estuary zone, a combined 90% more debits apply.
Is the project is located within a pocket estuary/embayment? Puget Sound Natal & Pocket Estuaries	No	0%	Projects located within a pocket estuary/embayment owe 30% more conservation debits. If the pocket estuary is within 5 miles of a natal Chinook estuary, 40% more debits apply.
Is there observed (as mapped or determined by WDFW) sand lance or surf smelt spawning on the project site? WDFW Forage Fish Spawning Map	No	0%	In areas with forage fish spawning, 50% more conservation debits apply to forage fish affecting action elements.
Is there herring spawning on the project site? WDFW Forage Fish Spawning Map	No	0%	In areas with forage fish spawning, 50% more conservation debits apply to forage fish affecting action elements.

Entry Block III: Overwater Entry Block for Removal, Removal as Part of Replacements, and Repair of Overwater Structure Elements

Determine benefits from both structures to be removed as part of replacements or from structures in close proximity to be removed as mitigation for new structures.

Must enter vegetation scenario for LSZ	Enter SAV scenario 0-3		0	Reference: LSZ SAV Scenarios	
Description	**OWS Element**	**Units**	**Quantity**	**Conservation Credits for removal of Existing Structures**	**Notes and Examples**
Enter dimensions of elevated pier and ramp in respective shore zone. If a pier has partial grating, enter dimensions of grated and ungrated portions into respective fields. Enter central portions of piers wider than 40 feet as floats as there is little side lighting in such structures.	Pier & Ramp USZ fully grated	SqFt	0	0.00	To account for the dark center on wide decks, enter the deck area within 20 feet from the edge as pier, and enter the deck area more than 20 feet from the edge as a float. See Figure below. FYI: Forage fish credit factors do not apply to piers and ramps.
	Pier & Ramp USZ solid	SqFt	0	0.00	
	Pier & Ramp LSZ fully grated	SqFt	0	0.00	
	Pier & Ramp LSZ solid	SqFt	0	0.00	
	Pier & Ramp DZ fully grated	SqFt	0	0.00	
Reference: Delineation of Shore Zones	Pier & Ramp DZ solid	SqFt	0	0.00	
Include all piles to be removed including creosote. The amount of creosote is credited separately below. Use pile calculator below to determine average pile diameter.	Enter number of piles in USZ		0	0.00	
	Enter average diameter of piles in USZ	[inches]	0		
	Enter number of piles in LSZ		0	0.00	
	Enter average diameter of piles in LSZ	[inches]	0		
	Enter number of piles in DZ		0	0.00	
	Enter average diameter of piles in DZ	[inches]	0		
Creosote removal: Enter tons of creosote to be removed including all in- and over water creosote between HAT and -30 meters. Usually a 70-ft long 12-inch average diameter pile weighs about 1 ton. A volume calculator is provided below.	Tons of Creosote to be removed in USZ	Total in tons	0	0.00	Benefit duration for creosote removal is 100 years. Absent removal of piles, we assume that derelict piles on average break off after 40 years. Thus site specific credit factors apply for 40 years, only.
	Tons of Creosote to be removed in LSZ & DZ	Total in tons	0	0.00	
Enter the outside dimensions of to be removed or replaced floats with at least 50% grating and 60% or more open space as grated floats (Compliant with WAC 220-660-280). Grated floats are not split between grated and ungrated portions. For complex floats, enter the longest outside dimensions of the float. See Example Complex Float 1.	USZ Outside dimensions of float area	Length [feet]	0	Set length and width to 0 for zones where no structure present.	
		Width [feet]	0		
	LSZ Outside dimensions of float area.	Length [feet]	0		
		Width [feet]	0		
	DZ Outside dimensions of float area.	Length [feet]	0		
		Width [feet]	0		Buffer Area
The area of a float in each shore zone is calculated from the length and width entered above. For irregularly shaped floats, enter the square footage of the float directly in the appropriate zone. BMP: Floats should not be located in the USZ and cannot ground out.	Grated Float USZ	SqFt	0	0.00	0 — For complex floats the calculated SqFt will not match the actual SqFt. Enter SqFt manually in column E.
	Grated Float LSZ	SqFt	0	0.00	0
	Grated Float DZ	SqFt	0	0.00	0 — Floats in herring spawning and holding areas may have herring spawning factor applied.





Example Complex Float 1

Complex Float 1.	DZ Outside dimensions of float area.	Length [feet]	0			Example Complex Float 1
		Width [feet]	0		Buffer Area	
The area of a float in each shore zone is calculated from the length and width entered above. For irregularly shaped floats, enter the square footage of the float directly in the appropriate zone. BMP: Floats should not be located in the USZ and cannot ground out.	Grated Float USZ	SqFt	0	0.00	0	For complex floats the calculated SqFt will not match the actual SqFt. Enter SqFt manually in column E.
	Grated Float LSZ	SqFt	0	0.00	0	
	Grated Float DZ	SqFt	0	0.00	0	Floats in herring spawning and holding areas may have herring spawning factor applied.
Enter the length and width of the to be removed or replaced float in the appropriate zone. For complex floats, enter the longest outside dimensions of the float. See Example Complex Float 1	USZ Outside dimensions of solid float.	Length [feet]	0	Set length and width to 0 for zones where no structure present.	Enter length and width of floats for buffer determination. For complex floats, used sum of length of each float and average width of floats .	
		Width [feet]	0			
	LSZ Outside dimensions of solid float	Length [feet]	0			
		Width [feet]	0			
	DZ Outside dimensions of solid float	Length [feet]	0			
		Width [feet]	0		Buffer Area	
The area of a float is calculated by shore zone from the length and width entered above. For irregularly shaped floats, enter the square footage of the float in the appropriate zone (see Notes for more information on irregularly shaped floats). BMP: Floats should not be located in the USZ and cannot ground out.	Solid Float USZ	SqFt	0	0.00	0	For complex floats the calculated SqFt will not match the actual SqFt. Enter SqFt manually in column E.
	Solid Float LSZ	SqFt	0	0.00	0	
	Solid Float DZ	SqFt	0	0.00	0	Floats in herring spawning and holding areas may have herring spawning factor applied.
Sub-Total: Conservation Credits for Removal of Existing Structures				0.00		

Credit Factors associated with Removal of OWS - modified application for creosote removal

Site Specific Credit Factors for OWS Removals	Percent more credit		Notes and Examples
Is the project located within 5 miles of a Puget Sound Chinook natal estuary zone or within 1 mile of a Hood Canal summer-chum estuary zone? Puget Sound Natal & Pocket Estuaries	No	0%	Reference: Application of Credit Factors Projects located within a natal Chinook or HC summer chum estuary zone will receive 50% more credits. If a project is in a pocket estuary and within a natal Chinook or HC summer chum estuary zone, a combined 90% more credits apply.
Is the project is located within a pocket estuary/embayment? Puget Sound Natal & Pocket Estuaries	No	0%	Reference: Explanation of Pocket Estuaries and Embayments Projects located within a pocket estuary or embayment owe/receive 30% more conservation debits/credits. If the pocket estuary is within a natal Chinook or Hood Canal summer chum estuary zone, 40% more debits/credits apply.
Is there observed (as mapped or determined by WDFW) sand lance or surf smelt spawning on the project site? WDFW Forage Fish Spawning Map	No	0%	In areas with forage fish spawning, 50% more removal credits will be awarded to forage fish affecting action elements.
Is there herring spawning on the project site? WDFW Forage Fish Spawning Map	No	0%	In areas with herring spawning, 50% more removal credits will be awarded to forage fish affecting action elements.

Average Diameter Pile Calculator

ects with multiple piles and pile diameters use the entry area below to determine the average pile diameter. The average pile diameter will then be used above with the total number of piles proposed.

Description	Quantity	Pile Size: Diameter in inches
Number of piles with one diameter size	1	8
Number of piles with one diameter size	0	10
Number of piles with one diameter size	0	12
Number of piles with one diameter size	0	14
Number of piles with one diameter size	0	16
Number of piles with one diameter size	0	18
Number of piles with one diameter size (fill in diameter as needed)		
Number of piles with one diameter size (fill in diameter as needed)		
Total number of piles and average pile size	1	8.00

APPENDIX 2

Navy EMMR WCR-2021-03674

PROJECT INFORMATION	PEAK	SELss	RMS
Attenuated Single strike level (dB)	185	166	176
Distance to single strike level (meters)	10	10	10
Transmission loss constant	15		
Number of piles per day	1		
Number of strikes per pile	600		
Number of strikes per day	600		
Cumulative SEL at measured distance	194		

OTHER INFO: Five 24' concrete piles, impact driving.

NOTES: 0

Attenuation: 0

ISOPLETHS (meters)

FISHES

ONSET OF PHYSICAL INJURY			BEHAVIOR
Peak Threshold	SEL_{cum} Threshold**		RMS Threshold
	Fish ≥ 2 g	Fish < 2 g	
0	28	52	541

SEA TURTLES

PTS ONSET		TTS ONSET		BEHAVIOR
Peak Threshold	SEL_{cum} Threshold	Peak Threshold	SEL_{cum} Threshold	RMS Threshold
0	2	0	21	12

MARINE MAMMALS

Hearing Group	LF Cetacean	MF Cetaceans	HF Cetaceans	PW Pinniped	OW Pinnipeds
PTS Onset Peak Threshold	0	0	1	0	0
PTS Onset SEL_{cum} Threshold	52	2	62	28	2
TTS Onset Peak Threshold	0	0	2	0	0
TTS Onset SEL_{cum} Threshold	523	19	623	280	20
RMS Threshold	117	117	117	117	117