UNITED STATES
DEPARTMENT
OF THE NAVY

NAVAL BASE KITSAP
BANGOR
SILVERDALE, WA

COOPERATING AGENCIES:

United States Army
Corps of Engineers

National Oceanic and
Atmospheric Administration,
National Marine
Fisheries Service

LAND-WATER INTERFACE AND SERVICE PIER EXTENSION AT NAVAL BASE KITSAP BANGOR

FINAL ENVIRONMENTAL IMPACT STATEMENT

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FINAL ENVIRONMENTAL IMPACT STATEMENT LAND-WATER INTERFACE AND SERVICE PIER EXTENSION AT NAVAL BASE KITSAP BANGOR

NAVAL BASE KITSAP BANGOR
SILVERDALE, WASHINGTON

JULY 2016

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ABSTRACT:

This final environmental impact statement (FEIS) evaluates the environmental effects of constructing and operating a Land-Water Interface (LWI), and constructing and operating a Service Pier Extension (SPE), on Naval Base (NAVBASE) Kitsap Bangor. The FEIS has been prepared by the United States (U.S.) Department of the Navy (Navy) in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969. The LWI and SPE are independent actions, but are being analyzed in the same environmental impact statement (EIS) due to efficiencies, their geographic proximity, and the potential to affect the same resources. NAVBASE Kitsap is the action proponent for both projects.

LWI

The LWI Proposed Action is to complete the perimeter of the Waterfront Restricted Area (WRA) at NAVBASE Kitsap Bangor by constructing and operating barrier structures connecting the existing on-water Port Security Barrier (PSB) system to the existing on-land Waterfront Security Enclave (WSE). The purpose of the LWI is to comply with Department of Defense (DoD) directives to protect OHIO Class ballistic missile submarines (Section 1.2.1), hereafter referred to as Navy TRIDENT submarines, from increased and evolving threats and to prevent the seizure, damage, or destruction of military assets. The need for the LWI is to enhance security at the WRA and comply with security requirements. Two action alternatives and the No Action Alternative (Alternative 1) are evaluated in the DEIS. The two action alternatives are the Pile-Supported Pier (Alternative 2) and the Port Security Barrier (PSB) Modifications (Alternative 3), which is the Preferred Alternative. Under the No Action Alternative, the construction and operation of LWI would not occur. Under both action alternatives, there would

be two LWI structures, one at the north end and one at the south end of the WRA at NAVBASE Kitsap Bangor. Alternative 2 would construct two piers with a walkway, fence, and towers for lights and equipment. There would be a mesh extending from the bottom of the piers to the seafloor. Alternative 2 would also relocate a portion of the existing floating PSBs at the north and south LWIs. Alternative 3 would not include a fixed structure or an in-water mesh, but instead would entail lengthening and relocating the floating PSB systems to create the entire LWI. Both action alternatives would construct two concrete abutments at the shore cliff to which the LWI structures would attach. Under Alternative 3, each abutment would also include an observation post, and a third, existing observation post on Marginal Wharf would be demolished and replaced without in-water work. In-water and terrestrial construction would occur over approximately 2 years, although there would be only one in-water work season for Alternative 3. In-water work would be subject to timing and seasonal restrictions to avoid and minimize impacts on sensitive species. Project construction would begin in August 2016 and end in August 2018.

SPE

The SPE Proposed Action is to extend the existing Service Pier at NAVBASE Kitsap Bangor and construct associated support facilities. The SPE would provide additional berthing for maintenance of existing homeported and visiting submarines. The associated support facilities would provide logistical support for SEAWOLF, LOS ANGELES, and VIRGINIA Class submarines at the Navy's SSN research, development, test, and evaluation hub, which is currently located on NAVBASE Kitsap Bangor. Two action alternatives and the No Action Alternative (Alternative 1) are evaluated in the EIS. Under the No Action Alternative, the SPE would not be constructed or operated. The action alternatives are the Short Pier (Alternative 2), which is the Preferred Alternative, and the Long Pier (Alternative 3). Alternative 2 would extend the existing 500-foot (152-meter) long Service Pier by 540 feet (165 meters); Alternative 3 would extend it by 975 feet (297 meters). After construction of the SPE, the Service Pier would be 1,040 feet (317 meters) or 1,475 feet (450 meters) long under Alternatives 2 and 3, respectively. Both alternatives would include construction of a 2,100-square foot (195-square meter) Pier Services and Compressor Building on the Service Pier and relocation of the existing PSB system to attach to the end of the pier extension. The upland portions of the two action alternatives would be the same. A new 50,000-square foot (4,645-square meter) Waterfront Ship Support Building would be built at the site of an existing parking lot. Additional new project elements including an approximately 420-space parking lot, utilities, and road improvements would occupy a total of approximately 7 acres (2.8 hectares).

Military Construction projects such as SPE must be authorized and funded by Congress. The SPE project is not currently funded or programmed for implementation, and therefore a future construction schedule has not been determined. This means that the SPE project might be scheduled for construction in the future, but with limited resources and competing priorities, the decision to fund and construct the SPE and associated support facilities has not been made and a time frame for doing so has not been determined. Because the passage of time has the potential to alter the affected environment and anticipated impacts, completion of the NEPA process through a Record of Decision, along with regulatory consultations and permit applications, will be deferred until such time as a decision is made to proceed with the SPE project, so that any relevant supplemental information can be taken into account. However, because the SPE proposed action has already undergone significant analysis, and because the project authorization and scheduling modifications occurred during the EIS preparation process, the Navy continued to include the description and environmental impact analysis of the SPE project in this Final EIS to provide the most comprehensive environmental information and to support the cumulative effects analysis.

Environmental Impacts

This FEIS evaluates direct, indirect, and cumulative impacts on the environment. For the LWI, the principal types of impacts during project construction would include pile driving noise (and its effects on fish and wildlife), turbidity, and habitat impacts. However, Alternative 3 would not involve in-water pile driving but would include pile driving in the dry (during low tides) and on-land for the abutments and observation posts (north and south). Impacts of operation and maintenance would include loss and shading of marine habitat including eelgrass, macroalgae, and the benthic community, as well as interference with migration of juvenile salmon, some species of which are protected under the Endangered Species Act (ESA). Both action alternatives would have the potential to affect fish and bird species protected under the ESA and marine mammals (behavioral harassment only) protected under the ESA and the Marine Mammal Protection Act (MMPA). The above impacts would be greater for Alternative 2 than Alternative 3. Upland construction would be the same for both action alternatives and would result in permanent and temporary vegetation disturbance. Wildlife would be disturbed by construction noise, especially pile driving; measures are proposed to mitigate these impacts. No terrestrial animals or plants protected under the ESA or Migratory Bird Treaty Act (MBTA) would be affected, but bald eagles could be disturbed during construction at the south LWI project site.

For the SPE, the principal types of impacts during project construction would include pile driving noise and its effects on fish, wildlife, and neighboring communities; turbidity; and habitat impacts. Impacts of operation and maintenance would include loss and shading of marine habitat, but minimal interference with migration of juvenile salmon. Both action alternatives would have the potential to affect fish and bird species protected under the ESA and marine mammals (behavioral harassment only) protected under the ESA and the MMPA. In-water impacts would be greater for Alternative 3 than Alternative 2, including greater over-water coverage and more pile driving. Upland impacts would be the same for both alternatives, including permanent and temporary vegetation disturbance. Wildlife would be disturbed by construction noise, especially pile driving; measures are proposed to mitigate these impacts. No wetlands or terrestrial animals or plants protected under the ESA, MBTA, or Bald and Golden Eagle Protection Act would be affected.

Permitting and Consultation

Permitting and consultation for LWI and SPE are being conducted as two independent actions, but in some instances, they are addressed in combined consultation packages due to their proximity. For LWI, the Navy conducted ESA Section 7 consultation to address potential impacts on federally listed species and designated critical habitat. The National Marine Fisheries Service (NMFS) provided its concurrence with the Navy's ***not likely to adversely affect*** determinations under informal consultation on November 13, 2015. NMFS also concurred with the Navy's ***may adversely affect*** determination for Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). NMFS determined that no conservation recommendations were required because implementation of the Navy's best management practices will be sufficient to avoid, mitigate, or offset the impacts of the Proposed Action on intertidal EFH. The Navy also conducted Section 7 consultation with the U.S. Fish and Wildlife Service (USFWS). In a concurrence letter dated March 4, 2016, USFWS stated that for both the LWI and SPE projects impacts to bull trout are not measurable and therefore insignificant, and impacts to marbled murrelets are discountable. For the SPE project, ESA, MSA, and MMPA consultations with NMFS remain ongoing and have not been completed at the time of this publication.

In accordance with the Coastal Zone Management Act, the Navy submitted a Coastal Consistency Determination (CCD) for LWI to the Washington Department of Ecology (WDOE). The Navy also submitted an application for the LWI project to the U.S. Army Corps of Engineers (USACE) for permits under the Clean Water Act (CWA) and the Rivers and Harbors Act, and a request for CWA Section 401 Water Quality Certification from the WDOE. Discussions with these agencies for the LWI project are ongoing at the time of this publication. When the SPE project is programmed and scheduled, the Navy will submit a CCD to WDOE and an application for permits under the CWA and Rivers and Harbors Act for the SPE project to USACE and WDOE. The State Historic Preservation Officer concurred with the Navy's determination of no adverse effect on historic properties under the National Historic Preservation Act (NHPA) for the LWI and the SPE projects on July 30, 2015 and October 7, 2015, respectively. For both projects, the Navy is consulting with the affected American Indian tribes under the NHPA. In accordance with DoD policy and Navy instructions, the Navy invited government-to-government consultation regarding the Proposed Actions with the five federally recognized American Indian tribes that have treaty reserved rights and traditional resources in the project area: the Skokomish Indian Tribe, Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, and Suquamish Tribe.

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EXECUTIVE SUMMARY

INTRODUCTION

Naval Base (NAVBASE) Kitsap Bangor, located on Hood Canal approximately 20 miles (30 kilometers) west of Seattle, Washington (Figure ES–1), provides berthing and support services to United States (U.S.) Department of the Navy (Navy) OHIO Class ballistic missile submarines, hereafter referred to as TRIDENT submarines, as well as a SEAWOLF Class[1] submarine.

The Navy is proposing two separate actions along the NAVBASE Kitsap Bangor waterfront: the Land-Water Interface (LWI) and the Service Pier Extension (SPE) projects. Under the LWI Proposed Action, the Navy proposes to enhance security at the perimeter of the Waterfront Restricted Area (WRA) on NAVBASE Kitsap Bangor by constructing physical barriers through shallow waters and onto the immediate upland areas at the northern and southern extent of the WRA. These structures would tie into the existing Port Security Barrier (PSB) system and the on-land Waterfront Security Enclave (WSE) system. Under the SPE Proposed Action, the Navy proposes to extend the existing Service Pier and construct associated support facilities. The SPE would provide additional berthing for maintenance of existing homeported and visiting submarines. The support facilities that are part of the SPE Proposed Action would provide logistical support for SEAWOLF, LOS ANGELES, and VIRGINIA Class submarines at the Navy's SSN research, development, test, and evaluation hub, which is located at NAVBASE Kitsap Bangor. Figure ES–2 shows the general location of the Proposed Actions.

This final environmental impact statement (FEIS) evaluates the environmental effects of constructing and operating the LWI, and constructing and operating the SPE, on NAVBASE Kitsap Bangor. Following the 45-day public comment period on the draft environmental impact statement (DEIS), the Navy reviewed and responded to comments in writing (Appendix I of this FEIS) and incorporated appropriate changes into the FEIS. The FEIS is being circulated for a 30-day wait period. Following the 30-day wait period, the Navy will prepare a Record of Decision that will address substantive new comments received on the FEIS and formally document the selected alternative for the LWI project and mitigation to be implemented by the Navy. The SPE project, which is currently on hold, will be addressed in a future Record of Decision before it is implemented.

In accordance with DoD policy and Navy instructions, the Navy invited government-to-government consultation regarding the Proposed Actions with the five federally recognized American Indian tribes that have treaty reserved rights and traditional resources in the project area: the Skokomish Indian Tribe, Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, and Suquamish Tribe. On March 3, 2016, the Navy and the Skokomish Indian Tribe completed a Memorandum of Agreement (MOA) to undertake treaty mitigation projects for LWI and SPE by contributing funding to support the Skokomish River Basin restoration, with the terms and conditions of the MOA to apply only after the Navy begins

[1] SEAWOLF is a class of SSN submarine. SSN is the Navy designation for nuclear-powered attack submarines. Other classes of SSNs are LOS ANGELES Class and VIRGINIA Class.

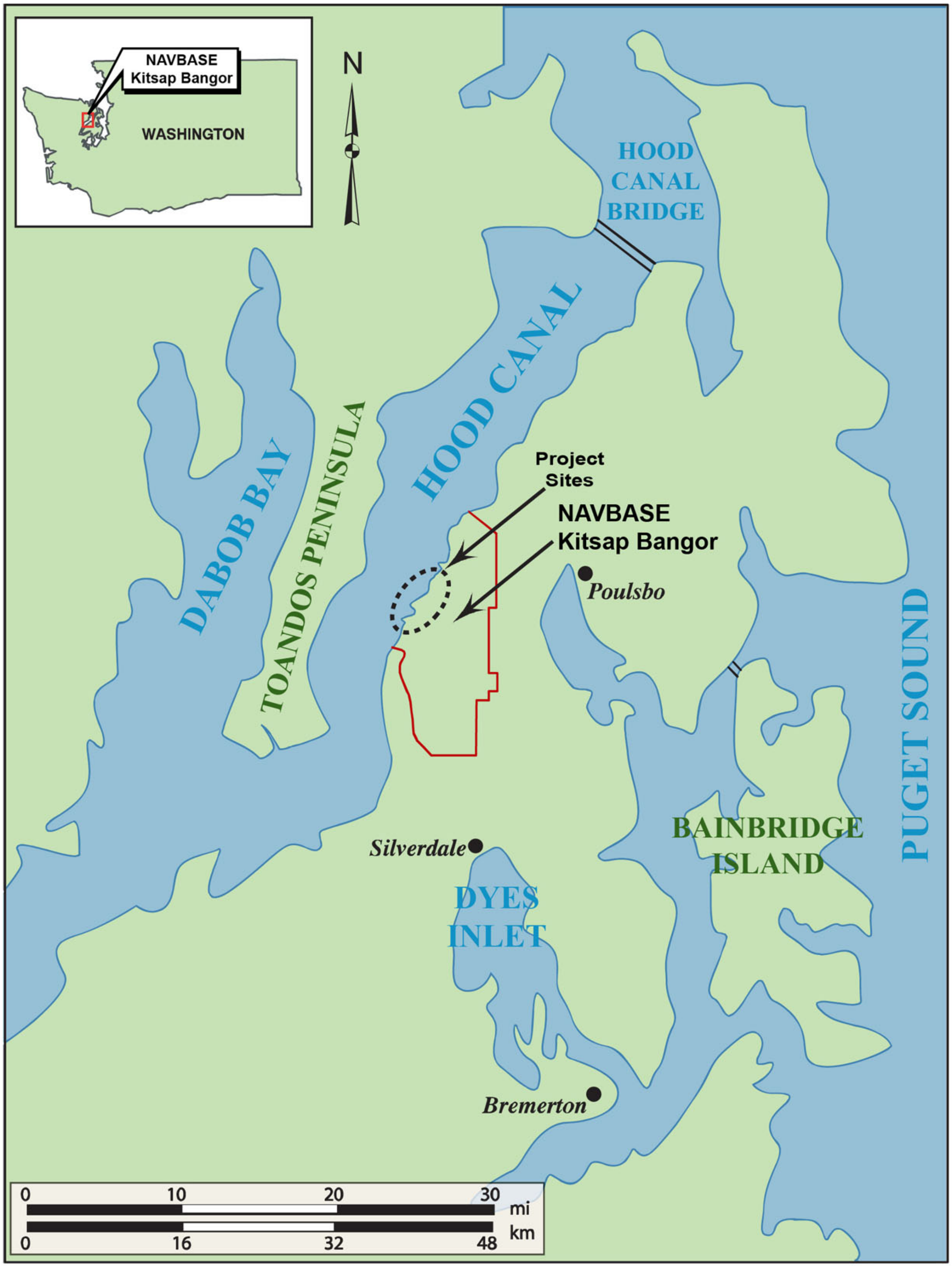

Figure ES–1. Site Location Map for NAVBASE Kitsap Bangor

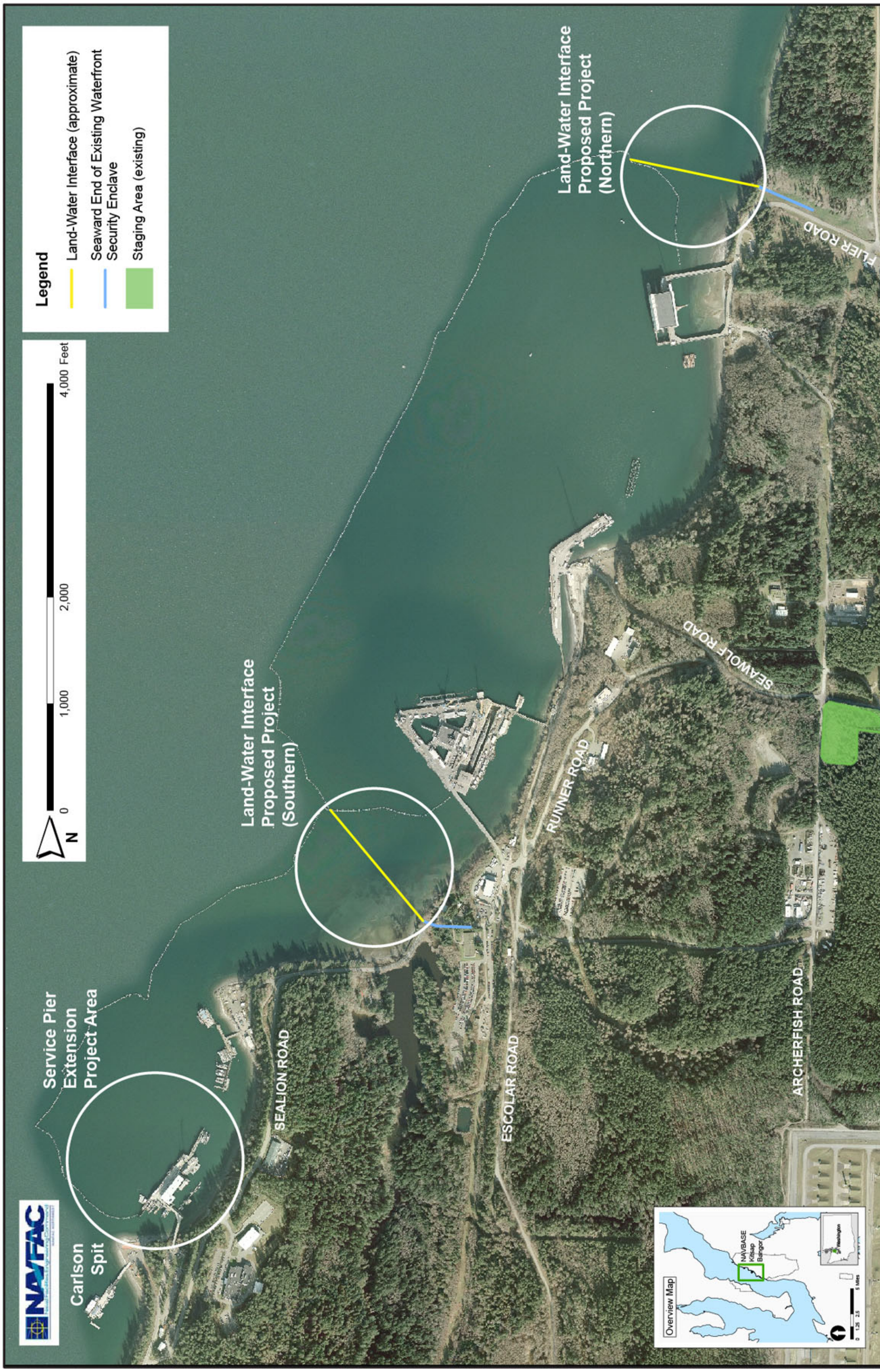

Figure ES–2. Location of the LWI and SPE Projects

in-water construction. The Navy and the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe have conducted government-to-government consultation to discuss the nature, scope, and schedule of the Navy's Proposed Actions since 2008 for the LWI project and 2012 the SPE project. Although the Navy and these Tribes were not able to reach formal agreement on treaty mitigation projects at the time of publication of this FEIS, the Navy carefully considered tribal concerns regarding the Proposed Actions and assessed the potential for significant impact to tribal rights and protected resources. Based on the Navy's assessment, the Navy offered to fund one or more of several proposed treaty mitigation projects.

The U.S. Army Corps of Engineers (USACE) and National Marine Fisheries Service Headquarters (NMFSHQ) are Cooperating Agencies under the National Environmental Policy Act (NEPA) for the Proposed Actions.

The Navy has consulted with, or coordinated with, the following agencies regarding approvals for the Proposed Actions: USACE, NMFSHQ, NMFS West Coast Region office, U.S. Fish and Wildlife Service (USFWS) Washington Fish and Wildlife Office, U.S. Environmental Protection Agency, Washington State Department of Ecology (WDOE), and State Historic Preservation Officer (SHPO).

PURPOSE AND NEED

The LWI and SPE are independent actions, but are being analyzed in the same environmental impact statement (EIS) due to efficiencies, their geographic proximity, and because construction periods for the two projects were initially projected to overlap. However, these are not connected projects. Each Proposed Action fulfills a separate purpose and need, independent of the other Proposed Action.

LWI Purpose and Need

The purpose of the LWI Proposed Action is to comply with Department of Defense (DoD) directives to protect Navy TRIDENT submarines from increased and evolving threats and to prevent the seizure, damage, or destruction of military assets. The LWI is needed to enhance security within the WRA and comply with security requirements.

SPE Purpose and Need

The purpose of the SPE Proposed Action is to provide additional berthing capacity and improve associated support facilities for existing homeported and visiting submarines at NAVBASE Kitsap Bangor. The SPE project is needed to:

- Provide alternative opportunities for berthing to mitigate restrictions at NAVBASE Kitsap Bremerton on navigating SEAWOLF Class submarines through Rich Passage under certain tidal conditions;
- Improve long-term operational effectiveness for the three SEAWOLF Class submarines on NAVBASE Kitsap;

- Provide berthing and logistical support for SEAWOLF, LOS ANGELES, and VIRGINIA submarine classes at the Navy's SSN research, development, test, and evaluation hub, which is currently located on NAVBASE Kitsap Bangor; and
- Improve submarine crew training and readiness through co-location of command functions at NAVBASE Kitsap Bangor submarine training center.

LWI ALTERNATIVES

LWI Alternatives Development and Screening Criteria

The environmental impact statement (EIS) must evaluate all reasonable alternatives in accordance with the Council on Environmental Quality regulations (40 Code of Federal Regulations [CFR] Part 1502.14) and Navy regulations (32 CFR Part 775) that implement the NEPA. The development of reasonable alternatives for analysis is dependent on the stated purpose and need for the Proposed Action. Screening criteria were developed to determine if a potential alternative was reasonable, whether it met the purpose and need, and if it should be carried forward for detailed analysis in the EIS. The screening criteria listed below were used in the identification and evaluation of LWI action alternatives:

- Meets security and TRIDENT program requirements,
- Compatible with existing security features,
- Must be located within the WRA,
- Compatible with a dynamic intertidal environment,
- Supports master planning considerations and does not impact other operational missions on NAVBASE Kitsap, and
- Avoids or minimizes impacts on tribal usual and accustomed harvest areas.

LWI ALTERNATIVE 1: NO ACTION

Under LWI Alternative 1, the No Action Alternative, there would be no construction and operation of LWI structures and existing PSBs would not be relocated. This alternative would not meet security requirements and, therefore, would not meet the purpose and need for the Proposed Action. No environmental impacts are anticipated from the No Action Alternative, as no construction or physical alteration to the waterfront would occur, and there would be no changes in operations. The No Action Alternative is carried forward for analysis because it is required by NEPA and constitutes baseline conditions for environmental analysis of the Proposed Action.

LWI ALTERNATIVE 2: PILE-SUPPORTED PIER ALTERNATIVE

Under LWI Alternative 2, construction and operation of LWI structures would include pile-supported piers built from the base of the shoreline bluff out to a connection point with the existing PSB system (Figures ES–2, 2–2, and 2–3) at both the north and south ends of the WRA. The piers would connect to solid concrete abutments that would be built at the shoreline bluff, and an anchoring structure for the PSBs would be installed at the seaward end of each pier.

Construction is expected to require one barge with a crane plus one supply barge, a tugboat, and work skiffs. Table 2–1 summarizes the physical features of the two LWI action alternatives. Best management practices (BMPs) and impact reduction measures that would be implemented to avoid or minimize potential environmental impacts associated with the LWI Proposed Action are discussed in Section 2.3.

Pier Structures

The LWI pier structures would be 13 feet (4 meters) wide and 280 feet (85 meters) long at the north location and 730 feet (223 meters) long at the south location. The last (seaward) 23 feet (7 meters) of each pier would be 20 feet (6 meters) wide. The piers would include a walkway for their entire length and 40-foot (12-meter) tall steel monopole towers supporting lights and security equipment; there would be 14 towers on the south pier and 6 towers on the north pier. A fence would be installed along the entire length of each pier. A mesh material would extend from the bottom of the walkway into the water and would be anchored to heavy steel plates placed on the seafloor using a barge-mounted crane assisted by divers. The steel plate anchors would remain in place based on their weight and occupy approximately 1,500 square feet (140 square meters) at the north LWI and 4,000 square feet (370 square meters) at the south LWI, for a total area of approximately 5,500 square feet (510 square meters). The pier deck would consist of metal grating that allows 65 percent of light to pass through. The elevation of the pier deck would be approximately 21.5 feet (6.6 meters) above mean lower low water (MLLW), and the elevation of the bottom of the pier structure would be approximately 17 feet (5.2 meters) above MLLW. There would be a floating dock for small boat access approximately 12 by 35 feet (4 by 11 meters) at the end of each pier, on the inside, or secure side, of the pier. This dock would be anchored with four piles (included in the 136 total number of permanent piles) and would have a metal grating deck. Access to the floating dock from the pier would be by means of a gangway 80 feet long by 3 feet wide (24 by 1 meter). The gangway deck would also consist of metal grating.

Pile Installation

The north LWI would require a maximum of 54 hollow steel piles, 24 inches (60 centimeters) in diameter. The south LWI would require a maximum of 82 hollow steel piles, 24 inches in diameter. The estimated total number of permanent piles in the project is therefore 136. Piles primarily would be driven using vibratory methods. An impact hammer would be used to "proof" piles to ensure they provide the required load-bearing capacity. Where geotechnical conditions do not allow piles to be driven to the required depth using vibratory methods, an impact hammer may be used to drive some piles for part or all of their length. Pile driving is expected to take no more than 80 days and would be completed during the first in-water work season (August 1, 2016 through January 15, 2017).

Piles are expected to be installed primarily using a crane on a floating barge. Pile installation in shallow areas would be tidally dependent, such that the hull of the barge would not be permitted to ground or contact the seafloor at any time during the work. Therefore, the barge would move in and out with the tide as necessary to install the piles and decking. The barge would be positioned by means of spuds and anchors. Because the majority of the piles for the south LWI would be in shallow water that would make barge operations difficult, the analysis considered that the contractor would build a temporary trestle adjacent to the LWI structure to install the permanent piles and decking in this shallow area. This temporary trestle would be approximately 300 feet (90 meters) long and 20 feet (6 meters) wide; the deck would be of metal grating that allows 65 percent of light to pass through. Approximately 120 temporary 24-inch (60-centimeter) steel piles would be needed. These piles would be driven in the same manner as the permanent piles, within the same 80 days as the permanent piles. The piles would be extracted by vibratory means.

PSBs

Existing PSB systems close to the proposed LWIs would be relocated and attached to the end of the new piers. For the north LWI, approximately 1,000 feet (300 meters) of the existing PSB system would be relocated and 200 feet (60 meters) would be removed. For the south LWI, approximately 650 feet (200 meters) of the existing PSBs would be relocated and 550 feet (170 meters) would be removed. Existing PSBs that are still serviceable would be configured into the new PSB alignment. When PSBs would be removed, they would be disassembled and recycled as scrap metal. The ends of the remaining PSB systems would be attached to a dolphin near the end of each pier; these dolphins would consist of eight closely spaced 24-inch (60-centimeter) diameter steel piles supporting an 8 by 8-foot (2.5 by 2.5-meter) concrete platform. For each LWI, two existing PSB buoys and associated anchors would be relocated and one would be removed. Each buoy is attached to three anchor legs. Each leg consists of a 120-foot (40-meter) chain attached to a main 10-ton (9-metric ton) concrete anchor (11 feet long, 5.5 feet wide, 5 feet high [3.5 by 1.8 by 1.6 meters]) and two concrete clump anchors, each 3 by 3 feet (1 by 1 meter) and weighing 2 tons (1.8 metric tons) (Figure 2–4).

Shoreline and Upland Construction

The north abutment would be approximately 40 feet (12 meters) high and 72 feet (23 meters) long and extend from an approximate elevation of 13 feet (4 meters) above (landward of) MLLW to the top of the slope at elevation 50 feet (15 meters). The south abutment would be approximately 20 feet high and 72 feet (6 by 22 meters) long and extend from an elevation of approximately 11 feet (3.4 meters) above MLLW to the top of the slope at elevation 24 feet (7 meters). The upper limit of the intertidal zone is considered to be MHHW, approximately 11 feet above MLLW at NAVBASE Kitsap Bangor.

The north abutment would be supported on 15 36-inch (90-centimeter) piles driven on land using vibratory and impact methods. The south abutment would be supported on 16 piles of the same size and also driven on land. Each abutment would include a stairway on one end, from the top of the abutment to the LWI deck and base of the bluff. At each abutment, the stairs would be attached to the abutment wall or supported on piles driven to grade and include a second stairway to the base of the bluff. The abutment stairways would be supported on five 24-inch (60-centimeter) piles each plus 6- by 2-foot (2- by 0.6-meter) concrete pads. The piles for the abutment stairways would be driven at low tide (“in the dry”) using a crane mounted on top of the bluff.

The abutment stair landings would lie below (waterward of) MHHW; the area below MHHW occupied by these new structures would be approximately 12 square feet (1.1 square meters) at each LWI. The total area excavated below MHHW during abutment construction would be approximately 15,600 square feet (1,449 square meters). The total volume of material excavated below MHHW would be approximately 2,889 cubic yards (2,208 cubic meters).[2] Construction of abutment at the south LWI would require removal of approximately 40 feet (12 meters) of creosoted timber anti-torpedo baulk at the base of the bluff. Similar to work for the stairway piles (see above), the abutment and stair work would also be conducted at low tide in the dry. Beach contours would be returned to pre-construction conditions following construction, except for the areas occupied by the new structures and riprap placed at base of abutment wall. All bluff slopes disturbed by construction of the abutment would be stabilized using riprap (see Table 2-1 for quantities). The riprap would be placed below the abutment walls to elevations just below MHHW, ending just above 10 feet (3 meters) above MLLW at the north LWI and just below 9 feet (2.7 meters) above MLLW at the south LWI. The LWI project would utilize the existing beach sediment that was removed for LWI construction and place that over the protective armor rock at grade to preserve the natural shoreline dynamics. Several tidal cycles would be required to sort the material, but it is expected that the beach sediment will mimic existing conditions when the project is completed. Although additional armoring should not be required, if toe protection is needed to prevent erosion at the base of the LWI abutments, the Navy will implement soft armoring techniques such as placement of large woody debris (tree trunks or root wads). The intent of this technique is to add structure and complexity to diminish wave erosion without placing large armor rocks for LWI toe protection. A temporary sheet pile coffer dam would be constructed to create a dry area to install piles for the abutment. The lengths of the proposed coffer dams are 140 feet (43 meters) for the north abutment, 160 feet (49 meters) for the north stairs, 190 feet (58 meters) for the south abutment, and 160 feet long for the south stairs.

Construction of both abutments would clear a total of approximately 47,000 square feet (4,366 square meters) of upland area and would require excavation of approximately 6,245 cubic yards (4,775 cubic meters) of soil and fill of 6,966 cubic yards (5,326 cubic meters) including the concrete.

The staging area for both LWI construction sites would be 6,562 square feet (610 square meters) within a 5.4-acre (2.2-hectare) site near the intersection of Archerfish and Seawolf Roads (Figure ES-2). This site has been used for staging other construction projects and is highly disturbed.

Construction Schedule

Upland construction would take approximately 540 days; equipment would include backhoes, bulldozers, loaders, graders, trucks, and a crane/pile driver. Project construction would begin in August 2016 and end in August 2018. All in-water pile driving and abutment construction would take place during one in-water work season, August 1, 2016 through January 15, 2017, and would minimize potential impacts on Endangered Species Act (ESA)-listed fish species. Other in-water activities such as installation of the mesh material and relocation of PSB units and anchors would begin in January 2017 and end by August 2018, and could occur either within or

[2] Areas and volumes excavated are the minimum needed to achieve the purpose of the abutment construction.

outside the in-water work season. Materials and equipment for the in-water work would be brought in by barge, while materials and equipment for abutment construction would be brought in by truck. The number of construction workers is estimated at 100.

LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

LWI Alternative 3 is the Preferred Alternative. Under this alternative, the construction and operation of the LWI structures would consist of modifying the existing PSB system to extend across the intertidal zone to attach to concrete abutments at the shoreline that would be the same as the abutments described above for the Pile-Supported Pier Alternative (Figure 2–5). In addition, three observation posts would be installed: one at the north LWI, one at the south LWI, and one on Marginal Wharf. There would be no underwater mesh, which requires a rigid, fixed structure for attachment. As a security requirement, Alternative 3 would use a greater number of security personnel than Alternative 2. However, the frequency of security vessel operations would not increase.

For the north LWI, approximately 1,200 feet (370 meters) of the existing PSB system would be relocated and 100 feet (30 meters) of new PSB would be added (Figure 2–6). Four existing buoys and associated anchors would be relocated. The mooring system for two of the four relocated buoys would be reduced from three anchor legs to two anchor legs, each with one 2-ton (1.8-metric ton) clump anchor (3 by 3 feet [1 by 1 meter]) and one 10-ton (9-metric ton) anchor (11 feet long, 5.5 feet wide, 5 feet high [3.5 by 1.8 by 1.6 meters]). For the south LWI, approximately 1,200 feet of the existing PSB system would be relocated and 200 feet (60 meters) of new PSB would be added (Figure 2–7). Three existing buoys and associated anchors would be relocated. One of these would have its anchor legs reduced from three to two, each with one clump anchor and one 10-ton anchor. One new buoy would be installed with two mooring legs (each with one clump anchor and one 10-ton anchor).

Each PSB unit would be 50 feet (15 meters) long and would support an 8-foot high fence on a metal frame (Figure 2–8). Each unit would be supported on three pontoons: a center pontoon 18 feet (5 meters) long, and two end pontoons each 6 feet (2 meters) long. The pontoons would be 42 inches (107 centimeters) in diameter. A metal grating (guard panel) 42 inches high would be suspended below the metal frame, between the pontoons. Because the height of this guard panel would be the same as the diameter of the pontoons, it would extend into the water the same distance as the pontoons (less than 1 foot [30 centimeters]). Openings in the barrier system to allow vessel passage would be created by disconnecting adjacent PSB units at strategic locations and towing the barrier out of the way.

PSBs at Low Tide

On an average low tide, approximately 11 PSB units including 33 pontoons (north and south LWI combined) would “ground out” in the intertidal zone. Over the long term, which would include extreme low tides, approximately 18 PSB units including 54 pontoons would ground out in the intertidal zone. Five of these PSB units would ground out at the north LWI and 13 would ground out at the south LWI. To minimize the resulting disturbance of the intertidal zone, each center pontoon would be fitted with three “feet” and the outer pontoons would be fitted with two feet that would prevent an entire pontoon from contacting the sediment surface (Figure 2–8).

These feet would be 12 by 24 inches (30 by 60 centimeters) in size and constructed of high-density polyethylene, a durable, inert plastic often used for water mains and sewer systems. Considering a total of 126 such feet (18 intertidal PSBs with 7 feet each), and that these feet would not always ground out at the same location, it is estimated that approximately 2,520 square feet (234 square meters) of the intertidal zone would be disturbed over the long term (700 square feet [65 square meters] at the north LWI, and 1,820 square feet [169 square meters] at the south LWI). In addition, one buoy at the south LWI would ground out on an average low tide. Over the long term, including extreme low tides, three buoys (one at the north LWI and two at the south LWI) would ground out at low tide. These buoys are 30 inches (76 centimeters) in diameter. Over the long term, grounding out by these buoys would disturb approximately 74 square feet (7 square meters) of seafloor.

Shoreline and Upland Construction

The abutments would be the same as described above under Alternative 2. In addition, an observation post would be installed at each LWI location. These posts would be approximately 25 by 45 feet (8 by 14 meters) and would include a separate stairway to the base of the bluff. Each post would require 12 30-inch (76-centimeter) piles that would be driven from land at low tide in the dry using vibratory methods and impact methods as needed. The observation post stairways would be supported on 2 by 2 foot (0.6 by 0.6 meter) concrete pads. Each observation post would require a temporary construction trestle having dimensions of 20 by 50 feet (6 by 15 meters), along with 10 24-inch (60-centimeter) diameter steel pipe piles supporting the temporary trestle at each LWI location. Driving of all piles for LWI Alternative 3 would require a maximum of 30 days of pile driving.

A third observation post 600 square feet (56 square meters) in area would be installed on the deck of Marginal Wharf, at the seaward apex of the wharf (Figure 2-1) and would include removal of an existing observation post. This new observation post would be similar in configuration but smaller than the two shoreline observation posts (Figure 2-5). The post would be constructed of reinforced concrete. There would be no in-water construction, no part of this observation post would extend into the water, and no new over-water area would be created. Lighting would be similar to the existing post. Communication cables would be installed from an existing hub under an existing roadway to access the wharf, using standard construction methods that would include patching of the roadway after construction. The existing observation post is a small pre-engineered steel building that would be removed intact using a crane and truck. The roof has asbestos-containing material and would be handled and disposed of appropriately. The rest of the building would be sent to a metal recycler. Removal of the existing observation post and construction and operation of the replacement observation post would not affect vessel operations at the wharf. There would be no increase in airborne noise over existing conditions on this industrial wharf.

For Alternative 3, two 30-foot (9-meter) tall, on-land towers would be installed by bolting them to concrete foundations, one at the north LWI and one at the south LWI. These towers would be located within the extension of the WSE; no additional ground would be disturbed for the towers.

Construction Schedule

The overall construction schedule for LWI Alternative 3 would be the same as described above for Alternative 2, except only one in-water work season would be needed.

LWI OPERATIONS

Operation of the LWI would consist primarily of maintenance of the in-water and upland structures, including routine inspections, cleaning, repair, and replacement of facility components (no pile replacement) as required. Operation would also include opening and closing of the PSBs for boat traffic, using small tug boats. The presence of the LWI would result in changes in patterns of security vessel movements, but such movements would be within the WRA and would not increase in frequency. For both alternatives, cleaning and replacement of the PSB guard panels (unbolted and re-bolted out of the water) would occur as needed. Cleaning would be accomplished by power washing. Measures would be employed to prevent discharges of contaminants to the environment (see BMPs, Section 2.3.2). Maintenance would require infrequent visits by vehicles to the upland portions and by small boats to the LWI structures (tying up to the floating docks). Operational lighting at the abutments for both alternatives would not exceed one foot candle to a distance of 50 feet (15 meters) from the abutments; these lights would operate continuously. For Alternative 2, operational lighting levels would not exceed 10 foot candles along the immediate pier structure, 0.5 foot candle out to a distance of 50 feet (15 meters) from the LWI structure, and 0.05 foot candle to a distance of 100 feet (30 meters). These lights would operate only during security responses. For Alternative 3, there would be no lighting on the PSB units, only on the abutment towers.

Comparison of LWI Alternatives

Table 2–1 summarizes the physical features of LWI Alternatives 2 and 3. Table 3.17–1 summarizes the environmental impacts of the LWI alternatives. Under Alternative 1, the No Action Alternative, there would be no change to the environment due to construction and operation of an LWI. Therefore, the No Action Alternative is not discussed in this section.

Alternative 3 is the preferred Alternative, in part because it would have fewer environmental impacts than Alternative 2 and, therefore, it is also the environmentally preferred alternative and the Least Environmentally Damaging Alternative according to the Clean Water Act (CWA) Section 404(b)(1) guidelines. The principal reasons for Alternative 2's greater impacts are that it would have a larger number of piles (and thus greater noise impacts), in-water pile driving, greater habitat impacts, and greater potential to affect migration of juvenile salmonids than Alternative 3. Unlike Alternative 2, Alternative 3 would have two observations posts supported by piles in the upper intertidal zone and a third on Marginal Wharf. The upland impacts of the two alternatives would be the same. Alternative 2 would have greater adverse impacts on traffic and greater positive impacts on socioeconomics.

Construction of LWI Alternative 2 would include driving 120 in-water support piles for the permanent piers, 16 permanent piles for the dolphins (8 at each), and 120 in-water piles for the temporary construction trestle, which would generate underwater and airborne noise levels for up to 80 days. In comparison, construction of Alternative 3 would require no in-water pile driving, thus avoiding resulting underwater noise impacts to marine biota. For both alternatives, however, marine mammals (pinnipeds), marbled murrelets, and upland wildlife could be exposed to airborne noise from driving of the abutment piles. In addition to pile driving noise, construction impacts on the marine environment would include minor turbidity from pile driving (LWI Alternative 2 only), PSB mooring anchor removal and placement (both alternatives), and boat movement (both alternatives). For Alternative 2, pile driving noise could result in behavioral disturbance or injury of ESA-listed salmonids (Hood Canal summer-run chum salmon, Puget Sound Chinook salmon, Puget Sound steelhead, and bull trout) or marbled murrelets occurring in the immediate project area, as well as behavioral disturbance of marine mammals. ESA-listed rockfish (bocaccio, yellow-eye rockfish, and canary rockfish) are not expected in the project area. Marine mammals potentially affected by behavioral harassment (Alternative 2 only) would include the following non-ESA-listed species: Steller sea lion, harbor seal, California sea lion, harbor porpoise, and transient killer whales. The ESA-listed humpback whale is not expected to be exposed to behavioral harassment due to the rare occurrence of this species in the project area. The ESA-listed Southern Resident killer whale is not present in the project area. Limiting pile driving and abutment work below MHHW to the first in-water work season of August 1, 2016 through January 15, 2017 would minimize potential impacts on ESA-listed salmonids. Pile driving noise for Alternative 3 (airborne noise only) is not expected to result in behavioral disturbance of pinnipeds or marbled murrelets, and would have no measurable impacts on ESA-listed fish.

Construction of the shoreline abutments would be the same for both alternatives and would require temporary excavation of an area of approximately 15,600 square feet (1,449 square meters) below MHHW. The abutment stair landings and observation post piles for Alternative 3 would lie below MHHW, with a total area of approximately 142 square feet (13.2 square meters). Alternative 2 would not have observation posts, so the area below MHHW would be 24 square feet (2.2 square meters). For both LWI Alternatives, 650 feet (198 meters) of temporary coffer dam would be installed to provide for excavation of the abutment wall and stair landings. Once the abutment foundations were built, the excavated area below MHHW would be backfilled and a 2-foot (0.6-meter) high by approximately 10-foot (3-meter) wide riprap berm (303 cubic yards [232 cubic meters]) would be placed above the natural beach contour. Placement of the steel plate anchors and piles for LWI Alternative 2 would result in permanent loss of 1,040 square feet (97 square meters) of eelgrass habitat. Placement of PSB buoy mooring anchors and PSB grounding under LWI Alternative 3 would result in permanent loss of 580 square feet (54 square meters) of eelgrass habitat. Under Alternative 3, the observation posts would shade benthic habitat (total of 2,000 square feet [186 square meters]), but not marine vegetation or oyster beds. Similarly, the dolphin platforms (Alternative 2 only) would shade benthic habitat (128 square feet [12 square meters]) but not marine vegetation or oysters. The presence of the pier and in-water mesh under Alternative 2 could represent at least a partial barrier to the migration of ESA-listed salmonids along the Bangor waterfront. In contrast, Alternative 3 would have less of a barrier effect on ESA-listed salmonids because it would lack the pier and in-water mesh. The guard panels between PSB pontoons would have negligible impacts on migration of ESA-listed salmonids.

Practices and measures to minimize impacts to ESA-listed species would be implemented as described in the Mitigation Action Plan (Appendix C). Construction and operation of LWI Alternatives 2 and 3 may affect, but is not likely to adversely affect, ESA-listed salmonids, rockfish, marbled murrelets and Southern Resident killer whales. The Navy conducted Section 7 consultation to address potential impacts on federally listed species and designated critical habitat. The National Marine Fisheries Service (NMFS) provided its concurrence with the Navy's ***not likely to adversely affect*** determinations under informal consultation on November 13, 2013. NMFS also concurred with the Navy's ***may adversely affect*** determination for Essential Fish Habitat (EFH) for under the Magnuson-Stevens Fishery Conservation and Management Act (MSA). NMFS determined that no conservation recommendations were required because implementation of the Navy's best management practices will be sufficient to avoid, mitigate, or offset the impacts of the Proposed Action on intertidal EFH. The Navy also conducted Section 7 consultation with the USFWS. In a concurrence letter dated March 4, 2016, USFWS stated that LWI project impacts to bull trout are not measurable and therefore insignificant, and impacts to marbled murrelets are discountable. The preferred alternative would not result in harassment of marine mammal as defined by the MMPA, so MMPA consultation is not required.

For Alternative 2, periodic cleaning of the mesh by power washing would result in minor water quality impacts, which would be minimized by employing appropriate BMPs. Likewise for both alternatives, periodic cleaning of the PSB guard panels would result in minor water quality impacts, which would be minimized by employing appropriate BMPs. Pursuant to the CWA, the Navy submitted a Joint Aquatic Resources Permit Application (JARPA) for permits from USACE for fill associated with the abutment stair landings, and for a Section 401 water quality certification from WDOE. In accordance with the Coastal Zone Management Act (CZMA), the Navy submitted a Coastal Consistency Determination (CCD) to WDOE.

Impacts of both alternatives on the upland environment would be similar and include approximately 1.1 acre (0.44 hectare) of vegetation clearing, construction traffic, air pollutant emissions, and pile driving and conventional construction noise. With the exception of 0.12 acre (0.048 hectare) of new impervious surface and 0.1 acre (0.039 hectare) of permanent pervious surfaces such as aggregate pathways, the disturbed area would be revegetated with native species. There would be no impacts on wetlands. Wildlife could be disturbed by construction noise and lighting, but no terrestrial animals or plants protected under the ESA would be affected. Potential impacts to bald eagles may occur as a result of elevated noise levels or visual disturbance during construction, but no incidental takes are anticipated.

Nearby residential areas and recreational users of the waters off NAVBASE Kitsap Bangor may experience elevated noise levels during construction, but no other impacts on land use or recreation are anticipated. Both alternatives would have minimal impacts on aesthetics; impacts would be greater for Alternative 2 than for Alternative 3, because of the larger structure and larger number of piles for Alternative 2. Both alternatives would be consistent with the NAVBASE Kitsap Bangor TRIDENT Support Site Master Plan. Temporary socioeconomic impacts of construction would be positive: for every $100 million spent by the Navy in construction expenditures, an estimated 919 direct jobs would be created, as well as an estimated 426 indirect and induced jobs. Indirect or induced jobs would be concentrated in the following industries: food services and drinking places, real estate establishment, health care, architecture and engineering, wholesale trade, and retail stores. For Alternative 2, the construction cost is estimated to be approximately $54 million, representing the total economic impact of 500 direct jobs and 233 indirect and induced jobs. Total economic output to the region would be in excess of $80 million. For Alternative 3, the construction cost is estimated to be approximately $33 million, representing the total economic impact of 300 direct jobs and 139 indirect and induced jobs. Total economic output to the region would be in excess of $48 million. Long-term socioeconomic impacts would be minimal. Neither alternative would have disproportionately high and adverse human health or environmental effects on minority populations or low-income populations because the affected areas do not disproportionately contain minority or low-income populations. In addition, because the project is located within a military restricted area, there would be no potential for children to be exposed to pollutants, other hazardous materials, or safety hazards as a result of construction and operation of either LWI alternative.

The cultural setting of Delta Pier and the existing Explosives Handling Wharf (EHW-1), which are eligible to be listed in the National Register of Historic Places (NRHP), would not be adversely affected. In July 2015 the State Historic Preservation Officer (SHPO) concurred with the Navy's determination of no adverse effect of the LWI project on historic properties under the NHPA. There would be a small potential for disturbance of archaeological resources (prehistoric sites) during construction. However, if any such resources were encountered, the Navy would coordinate with the SHPO and tribes. Access to tribal shellfish harvesting areas would be restricted in the construction area only during construction of the LWI. During operations access would not be restricted but the new structures would result in permanent loss of 1,880 square feet (175 square meters) of the shellfish harvesting areas under Alternatives 2 and 3 (Table 3.17–1). Neither alternative would have population-level effects on salmon stocks harvested by the tribes. Construction vessels could interfere with tribal fishing vessels operating in Hood Canal. In accordance with DoD policy and Navy instructions, the Navy invited government-to-government consultation regarding the Proposed Actions with the five federally recognized American Indian tribes that have treaty reserved rights and traditional resources in the project area: the Skokomish Indian Tribe, Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, and Suquamish Tribe.

Construction would generate truck traffic, but this traffic would be within the capacity of the base road system. However, construction traffic for both alternatives would exacerbate existing peak-hour delays at both gates to NAVBASE Kitsap Bangor and roads immediately outside the gates. Alternative 2 would have a greater impact than Alternative 3 on traffic crossing the Hood Canal Bridge because of the larger number of construction barges. Impacts on air quality would not be significant for either alternative because emissions would be well below regulatory thresholds. Air quality in the vicinity of the LWI and SPE project sites, the upland project area, and the greater area of NAVBASE Kitsap Bangor, all of which are located in Kitsap County, is generally rated as good, which is the highest air quality rating. Kitsap County is presently in attainment for all National Ambient Air Quality Standards (NAAQS) for criteria pollutants.

SPE Alternatives

SPE Alternatives Development and Screening Criteria

The screening criteria listed below were used in the identification and evaluation of SPE action alternatives:

- Supports master planning considerations and does not impact other operational missions on NAVBASE Kitsap,

- Avoids or minimizes impacts on tribal usual and accustomed harvest areas,
- Integrates pier and support facilities into existing facilities and infrastructure to the extent practicable, and
- Provides unrestricted access to the ocean.

SPE ALTERNATIVE 1: NO ACTION

Under SPE Alternative 1, the No Action Alternative, no Service Pier extension or associated support facilities would be built at NAVBASE Kitsap Bangor. This alternative would not meet the purpose and need for the Proposed Action. It would not provide alternative opportunities for berthing to mitigate restrictions at NAVBASE Kitsap Bremerton on navigating SEAWOLF Class submarines through Rich Passage under certain tidal conditions, or improve long-term operational effectiveness for the three SEAWOLF Class submarines on NAVBASE Kitsap. The No Action Alternative would not provide berthing and logistical support for SEAWOLF, LOS ANGELES, and VIRGINIA submarine classes at the Navy's SSN research, development, test, and evaluation hub, nor improve submarine crew training and readiness through co-location of command functions on the NAVBASE Kitsap Bangor submarine training center. No environmental impacts would result from the No Action Alternative, as no construction or physical alteration to the waterfront would occur, and there would be no changes in operations. The No Action Alternative is carried forward for analysis because it is required by NEPA and constitutes baseline conditions for environmental analysis of the Proposed Action.

SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

SPE Alternative 2 is the Preferred Alternative. Under this alternative, the Navy would construct and operate an approximately 540-foot (165-meter) long and 68 feet (21 meters) wide, 44,000-square foot (4,090-square meter) surface area extension to the existing Service Pier (Table 2–2) that would be capable of a double-breasted (side-by-side) berthing configuration for submarine maintenance. The new total length of the Service Pier would be 1,040 feet (317 meters). Proposed new facilities would include a pier crane on a 28- by 60-foot (9- by 18-meter) foundation, 2,100-square foot (195-square meter) Pier Services and Compressor Building located on the Service Pier, an upland 50,000-square foot (4,645-square meter) Waterfront Ship Support Building, an approximately 420-car parking lot, and roadway and utility improvements (transmission line upgrades and a new substation) (Figure 2–9). The Waterfront Ship Support Building would be designed and constructed to receive a minimum Leadership in Energy and Environmental Design (LEED) certification of Silver. LEED is a third-party certification program and nationally accepted benchmark for the design, construction, and operation of high-performance green buildings developed by the U.S. Green Building Council. BMPs and impact reduction measures that would be implemented to avoid or minimize potential environmental impacts associated with the SPE Proposed Action are discussed in Section 2.3.

The proposed Pier Services and Compressor Building would house the compressor and would be located at the south end of the existing Service Pier (Figure 2–9). The Pier Services and Compressor Building is needed to house sewage lift stations, and "high pressure" and "low pressure" compressors that would provide an off-hull source of air for charging submarine air banks, as well as breathing quality air needed for purging the ship's ballast tanks to allow entry for maintenance. The compressors need to be located as near to the ship as possible to minimize the accumulation of moisture in the air lines.

Pile Installation and Wave Screen

The existing Service Pier is approximately 500 feet long by 85 feet wide (152 by 26 meters). The proposed extension of the Service Pier would be approximately 540 by 68 feet (165 by 21 meters) and would require installation of approximately 230 36-inch (92-centimeter) diameter steel pipe support piles. After construction of the SPE, the pier would be 1,040 feet (317 meters) long. SSNs would rest against mooring camels which would have 50 24-inch (60-centimeter) diameter steel pipe support piles. Approximately 105 18-inch (45-centimeter) square concrete fender piles would also be installed. Driving of the steel support piles would use a combination of vibratory (primary) and impact methods and would require pile driving on no more than 125 days during the first in-water work season. Driving of the concrete piles would use impact methods only and would require pile driving on no more than 36 days during the second in-water work season. The pier extension would extend to the southwest from the south end of the existing Service Pier and would parallel Carlson Spit in water depths of 30 to 50 feet (9 to 15 meters) below MLLW, such that the berthing areas for the new submarines would be in water depths of approximately 50 to 85 feet (15 to 26 meters) below MLLW. A concrete float 150 feet (46 meters) long and 15 feet (4.6 meters) wide would be attached to the south side of the SPE (Figure 2–10). The existing PSB system would be re-configured to attach to the end of the new pier extension, with approximately 540 feet of existing PSB removed. Removal and disposal of existing PSBs would be as described for the LWI project. Construction is expected to require one barge with a crane, one supply barge, a tugboat, and work skiffs.

Construction would be preceded by removal of an existing wave screen (including piles) and other existing piles from the Service Pier. A total of 36 existing creosote wood piles (19 18-inch [45-centimeter] and 17 15-inch [38-centimeter] piles) would be removed by using a clam shell or similar methods and would be cut at the mudline if splitting or breakage occurs. A floating boom and other measures would be used to protect water quality during this activity (Section 2.3.2). In addition, a new wave screen would be installed under the SPE (Figure 2–10). This screen would be approximately 200 feet (60 meters) long and 27 feet (8 meters) high (20 feet [6 meters] below to 7 feet [2 meters] above MLLW), made of concrete or steel, and attached to the steel support piles for the SPE.

Upland Construction

The proposed Waterfront Ship Support Building would be located on an existing 36,000-square foot (330-square meter) parking lot on the east side of Wahoo Road which has 107 parking spaces. Based on the loss of this lot and related relocation of existing personnel at NAVBASE Kitsap Bangor, a new parking lot of approximately 420 spaces would be needed. This parking lot would be located approximately 1,200 feet (370 meters) south of the proposed Waterfront Ship Support Building within a vegetated area. Road improvements to accommodate changes in traffic patterns along Wahoo and Sealion Roads, repairs to existing roads damaged from construction activity, and electrical utility upgrades would also be included under this alternative. The area permanently occupied by new project elements would be approximately 7 acres (2.8 hectares). Approximately 4 acres (1.6 hectares) would be disturbed temporarily for a construction laydown area and other construction-related disturbance and revegetated with native species following construction. The parking lot, utilities, and laydown area would be located within the area between Sturgeon Street and Sealion Road, as shown on Figure 2–9.

Construction Schedule

The SPE project is currently unprogrammed and a construction schedule has not been determined. Upland construction would take approximately 400 days; equipment would include backhoes, bulldozers, loaders, graders, trucks, and paving equipment. Construction of all proposed facilities is anticipated to take approximately 24 months. Pile driving would occur within the in-water work windows (July 15 to January 15) to minimize potential impacts on ESA-listed fish species. It is not expected that completion of pile driving would require two full 6-month in-water work seasons. Relocation of existing PSB units and anchors could occur outside the in-water work window. There would be no work in the intertidal zone. The number of construction workers is estimated at 225.

SPE ALTERNATIVE 3: LONG PIER

Under this alternative the pier extension would be approximately 975 feet (297 meters) long and 68 feet (21 meters) wide, and would have a surface area of approximately 70,000 square feet (6,500 square meters) (Figure 2–11). The new total length of the Service Pier would be approximately 1,475 feet (450 meters). This design would allow two submarines to be berthed in an in-line configuration rather than breasted (side-by-side). Table 2–2 summarizes the physical features of SPE Alternative 3. The total number of 24-inch (60-centimeter) diameter steel support piles would be approximately 500, including those for small craft and camel mooring; there would be approximately 160 18-inch (45-centimeter) square concrete fender piles. Driving of steel piles would require driving on no more than 155 days and would take place during the first in-water construction season. Driving of concrete piles would require driving on no more than an additional 50 days and would take place during the second in-water work season. The PSB relocation would differ from the relocation under SPE Alternative 2 so as to connect the PSBs to the end of the longer pier extension (approximately 975 feet of existing PSBs would be removed). All other aspects of SPE Alternative 3 would be the same as SPE Alternative 2, including upland features and overall construction schedule. It is expected that completion of in-water work would require two full in-water work seasons. Alternative 3 would meet the purpose and need and screening criteria, but would have greater environmental impacts (Table 2–2) and cost more than Alternative 2.

SPE OPERATIONS

Operation of the SPE would be similar to existing day-to-day operations that currently occur at NAVBASE Kitsap Bangor. With the use of two additional submarine moorage spaces for varying periods, the average daily number of employees on site at the Service Pier is estimated to increase from 390 to 712 (an increase of 322). There would be a corresponding increase in equipment operations, maintenance activities, transfer of materials on and off the submarines, and vehicular traffic. Facilities such as transit, food service, maintenance, housing, and training are already in place to accommodate two additional submarines and associated personnel at NAVBASE Kitsap Bangor. The proposed changes would allow maintenance activities to be performed on three submarines simultaneously. All waste discharges from the submarines would be pumped ashore to the appropriate base waste treatment systems. Drainage water from the SPE would be collected in a trench drain on the pier, treated using an in-line canister system designed to meet the basic treatment requirements of the WDOE *Stormwater Management Manual for Western Washington*, and then discharged to Hood Canal in accordance with a National Pollutant Discharge Elimination System permit.

The average number of one-way Hood Canal transits of submarines to or from the Service Pier would increase from approximately 0.5 per month currently to about 2 per month. These submarines would not be escorted to and from NAVBASE Kitsap Bangor as are the TRIDENT Class submarines, but there would be an increase in small support vessel traffic at the Service Pier.

Operational lighting levels would not exceed 10 foot candles on the pier deck, 0.5 foot candle from the pier deck to a distance of 50 feet (15 meters) from the deck, and 0.05 foot candle to a distance of 100 feet (30 meters).

Comparison of SPE Alternatives

Table 2–2 summarizes the physical features of SPE Alternatives 2 and 3. Table 3.17–3 summarizes the environmental impacts of the SPE alternatives. Under Alternative 1, the No Action Alternative, there would be no change to the environment because extension of the Service Pier and construction and operation of the associated support facilities would not occur. Therefore, the No Action Alternative is not discussed in this section.

SPE Alternative 2 is the Preferred Alternative in part because it would have fewer environmental impacts than Alternative 3 and, therefore, it is also the Environmentally Preferred Alternative and the Least Environmentally Damaging Alternative according to CWA Section 404(b)(1) guidelines. The longer pier under Alternative 3 would result in more pile driving (and associated noise) and habitat impacts. Both alternatives would have minimal effects on juvenile salmon migration and tribal fisheries resources, and no effect on tribal shellfish beds. Upland impacts for both alternatives would be the same. Alternative 3 would have greater impacts on traffic on the Hood Canal Bridge and socioeconomics (positive) because of the larger construction project that would be required for the longer pier extension.

The principal difference between SPE Alternatives 2 and 3 is the length of the pier extension: 540 feet (165 meters) under Alternative 2 and 975 feet (297 meters) under Alternative 3. The width of both alternative pier extensions would be 68 feet (21 meters). SPE Alternative 2 would include driving of fewer piles (total of 385) than Alternative 3 (total of 660) and would generate pile driving noise over a shorter period. Alternative 2 would require up to 125 days of steel pile driving during the first in-water work window, and 36 days of concrete fender pile driving during the second, compared to Alternative 3's maximum of 155 days of steel pile driving during the first in-water work window, and 50 days of concrete pile driving during the second.

Pile driving noise could potentially result in behavioral disturbance or injury of ESA-listed salmon (Hood Canal summer-run chum salmon, Puget Sound Chinook salmon, Puget Sound steelhead, and bull trout) and marbled murrelets occurring in the immediate vicinity of the project. ESA-listed rockfish (bocaccio, yellow-eye rockfish, and canary rockfish) are not expected in the project area. Behavioral disturbance of marine mammals is also possible. Marine mammals potentially affected by behavioral harassment would include the Steller sea lion, harbor seal, California sea lion, harbor porpoise, and transient killer whales. These effects would occur over a shorter period for SPE Alternative 2 than for Alternative 3. The ESA-listed humpback whale is not expected to be exposed to behavioral harassment due to its rare occurrence in the project area. The ESA-listed Southern Resident killer whale is not present in the project area. Limiting pile driving to the established in-water work season (July 15 to January 15) would minimize potential for impacts on ESA-listed fish.

The new overwater coverage created would be less under SPE Alternative 2 (44,000 square feet [4,090 square meters]) than Alternative 3 (70,000 square feet [6,500 square meters]), resulting in less shading of the benthic community. Under both alternatives, new pier structures would lie in water depths greater than 30 feet (9 meters), resulting in no shading of eelgrass or macroalgae habitat and minimal effects on salmon migration.

Practices and measures to minimize impacts to ESA-listed species would be implemented as described in the Mitigation Action Plan (Appendix C). Construction and operation of SPE Alternatives 2 and 3 may affect, but is not likely to adversely affect, ESA-listed salmonids and rockfish, marbled murrelets, and Southern Resident killer whales. The Navy is in ESA Section 7 consultation with the NMFS West Coast Region office and concluded consultation with USFWS Washington Fish and Wildlife Office. In a concurrence letter dated March 4, 2016, USFWS stated that the SPE project impacts to bull trout are not measurable and therefore insignificant, and impacts to marbled murrelets are discountable. Consultations are also ongoing with the NMFS West Coast Region office under the MSA and with the NMFSHQ Office for MMPA compliance. The Navy has submitted an Incidental Harassment Authorization (IHA) application for the first year of construction and will prepare and submit an additional MMPA authorization application for the second year of construction.

Upland features of SPE Alternatives 2 and 3 would be the same, resulting in the same impacts. Construction of new project elements would result in permanent loss of 7 acres (2.8 hectares) of forest vegetation and wildlife habitat (Figures 2–9 and 3.5–3). An additional 4 acres (1.6 hectares) of vegetation would be disturbed temporarily during construction, but revegetated with native species following construction. There would be no impacts on wetlands. Wildlife would be disturbed by pile driving noise for a shorter period under Alternative 2 than under Alternative 3. Four trees potentially suitable for nesting by marbled murrelets may be removed under both alternatives. No other terrestrial animals or plants protected under the ESA would be affected. Wildlife could be disturbed by construction noise and lighting, but no terrestrial animals or plants protected under the ESA would be affected. Potential impacts to foraging bald eagles may occur as a result of elevated noise levels or visual disturbance during construction, but no incidental takes are anticipated.

When the SPE project is programmed and scheduled, the Navy will submit a CCD to WDOE and an application for permits under the CWA and Rivers and Harbors Act for the SPE project to USACE and WDOE.

Nearby residential areas and recreational users of the waters off NAVBASE Kitsap Bangor may experience elevated noise levels during construction, but no other impacts on land use or recreation are anticipated. SPE Alternative 2 would result in a shorter duration of construction, and would have somewhat less potential lighting impacts on residential areas, than SPE Alternative 3. Aesthetic impacts would be slightly greater under SPE Alternative 3, but minimal under both alternatives. Both alternatives would be consistent with the NAVBASE Kitsap Bangor TRIDENT Support Site Master Plan. Temporary socioeconomic impacts would be positive and greater for SPE Alternative 3. The construction cost for SPE Alternative 2 is estimated to be approximately $89 million, representing the total economic impact of 818 direct jobs and 380 indirect and induced jobs. Total economic output to the region would be in excess of $131 million. The construction cost for SPE Alternative 3 is estimated to be approximately $116 million, representing the total economic impact of 1,066 direct jobs and 494 indirect and induced jobs. Total economic output to the region would be in excess of $170 million. Neither alternative would have disproportionate adverse effects on minority or disadvantaged populations.

In October 2015, the SHPO concurred with the Navy's determination of no adverse effect of the SPE project on historic properties under the NHPA. There would be a small potential for disturbance of archaeological resources (prehistoric sites) during construction; if any such resources were encountered, the Navy would coordinate with the SHPO and tribes. Activities of construction vessels and submarine transits could temporarily interfere with operation of tribal fishing vessels in Hood Canal. Neither alternative would affect tribal fishing access, nor have a population-level effect on salmon stocks harvested by the tribes. In accordance with DoD policy and Navy instructions, the Navy invited government-to-government consultation regarding the Proposed Actions with the five federally recognized American Indian tribes that have treaty reserved rights and traditional resources in the project area: the Skokomish Indian Tribe, Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, and Suquamish Tribe.

Construction traffic would exacerbate existing peak-hour delays at both gates to NAVBASE Kitsap Bangor and on roads immediately outside the gates. Construction traffic impacts would persist longer for Alternative 3 than Alternative 2. On-base construction traffic impacts would be minimal. During construction, both alternatives would increase the frequency of openings of the Hood Canal Bridge, an adverse impact on travelers on SR-104; this impact would last longer for Alternative 3 than for Alternative 2. Over the long term, there would be an estimated two additional openings of the Hood Canal Bridge per month under either action alternative. Impacts on air quality would be minimal because emissions would be well below regulatory thresholds. Air quality in the vicinity of the LWI and SPE project sites, the upland project area, and the greater area of NAVBASE Kitsap Bangor, all of which are located in Kitsap County, is generally rated as good, which is the highest air quality rating. Kitsap County is presently in attainment for all NAAQS for criteria pollutants.

After the SPE and associated support facilities become operational, the average number of one-way Hood Canal surface transits of submarines to or from the Service Pier would increase from approximately 0.5 per month currently to about 2 per month. This long-term increase in submarine traffic would present a greater-than-present probability of interaction with tribal or recreational use of Hood Canal. Although the frequency of submarine passages would remain low, there would be an increased potential for interference with fishing gear and wake-related disturbances to small recreational watercraft.

COMBINED IMPACTS OF LWI AND SPE

Although the LWI and SPE projects are independent, if both were implemented it is important to understand their combined impacts on environmental resources (the cumulative impacts of the Proposed Actions in conjunction with other past, present, and reasonably foreseeable actions are discussed in the next section). Under the current schedules, construction of the two projects would not overlap. This would extend the projects' impacts over a longer period than the 2-year period for each project alone. Migratory species would experience construction impacts on water quality in two locations rather than just one. Limiting in-water construction to the in-water work windows would minimize the impacts of these construction impacts on juvenile salmon species protected under the ESA. Construction of the two projects would result in combined economic benefits. Combined construction traffic from the two projects would be within the capacity of the base road system. Combined construction vessel traffic would result in delays of traffic on SR-104 over a longer period than for each project alone, due to openings of the Hood Canal Bridge. In the long term, operations of the two projects would have combined impacts on marine habitats and species, including migrating juvenile salmon. Regarding the combined impacts on terrestrial habitat, most of the impacts would come from the SPE project.

CUMULATIVE IMPACTS

Past, present, and reasonably foreseeable future actions have had and will have adverse impacts on marine habitats and species in Hood Canal. Construction and operation of the LWI and SPE would contribute to regional cumulative impacts in conjunction with past, present, and future actions on marine resources such as shallow-water habitat, including loss of eelgrass, macroalgae, and habitat for juvenile salmon and other fish and invertebrate species. However, through the implementation of proposed compensatory aquatic mitigation actions in the Mitigation Action Plan (Appendix C), the project's contribution to cumulative impacts in conjunction with past, present, and future actions would not be significant.

The other construction impacts of the Proposed Actions, such as air and water quality effects, would be minor and highly localized and, thus, would not contribute significantly to cumulative impacts in conjunction with past, present, and future actions in the region.

Impacts on upland habitats and species from LWI and SPE would be moderate, and all but 7.2 acres (2.9 hectares) would be revegetated; approximately 4.9 acres (2 hectares) would be revegetated. The 7.2 acres would contribute to cumulative impacts to upland habitats in the region. During construction, marine vessel traffic from LWI and SPE would increase the frequency of openings of the Hood Canal Bridge by roughly half, resulting in an adverse impact on travelers on SR-104. The construction and operational impacts of the Proposed Actions on other resources would be minimal and have little potential to contribute to cumulative impacts in conjunction with past, present, and future actions in the region. The multiple projects would have cumulative economic benefits.

It is also possible that construction of the LWI and/or SPE would overlap in time with construction of other waterfront structures on NAVBASE Kitsap Bangor. In this case, pile driving for the multiple projects could result in cumulative noise impacts, as discussed above for the LWI and SPE projects themselves. If more than one construction project occurred at the same time, the predominant noise impact would be expansion of the geographic area affected by maximum sound levels. In limited areas where the noise spheres of influence would overlap, the total sound levels would increase by up to 3 dB. As a result, more individuals of marine species (fish, marine mammals, and marine birds) would be affected, but it is unlikely that population-level effects due to cumulative sound levels would be greater than those of the LWI and SPE projects alone. Noise impacts on nearby residential and recreational areas also would increase slightly due to the separated locations of the multiple construction projects. It is not expected that there would be major marine construction projects outside of NAVBASE Kitsap Bangor that would overlap with the other Navy projects and cause cumulative noise impacts. Concurrent construction of multiple projects would exacerbate traffic impacts on base roads and delays at the gates entering the base, with increased impacts to traffic on adjacent regional roadways.

BEST MANAGEMENT PRACTICES, CURRENT PRACTICES, MITIGATION MEASURES, AND REGULATORY COMPLIANCE

The following are the principal measures proposed for both projects to avoid, minimize, or compensate for the environmental impacts of the Proposed Actions:

Best Management Practices and Current Practices

- To reduce the likelihood of any petroleum products, chemicals, or other toxic or deleterious materials from entering the water, fuel hoses, oil or fuel transfer valves, and fittings will be checked regularly for drips or leaks and will be maintained and stored properly to prevent spills from construction and pile driving equipment into state waters.
- To limit soil erosion and potential pollutants contained in stormwater runoff, a Storm Water Pollution Prevention Plan will be prepared and implemented in conformance with the *Stormwater Management Manual for Western Washington* (WDOE 2014).
- Oil booms will be deployed around in-water construction sites as required by a CWA Section 401 Water Quality Certification for the projects, to minimize water quality impacts during construction.
- Debris will be prevented from entering the water during all demolition or new construction work. During in-water construction activities, floating booms will be deployed and maintained to collect and contain floatable materials that are accidentally released. Any accidental release of equipment or materials will be immediately retrieved and removed from the water. Following completion of in-water construction activities, an underwater survey will be conducted to remove any remaining construction materials that may have been missed previously. Retrieved debris will be disposed of at an appropriate commercial landfill.
- Removed creosote-treated wood piles and associated sediments (if any) will be contained on a barge or, if a barge is not utilized, stored in a containment area near the construction site. All creosote-treated material and associated sediments will be disposed of in a landfill that meets the liner and leachate standards of the Washington Administrative Code.
- Piles will be removed by using a clam shell or similar methods and will be cut at the mudline if splitting or breakage occurs.

- To minimize impacts on marine habitat, limitations will be placed on construction vessel operations, anchoring, and mooring line deployment. A mooring and anchoring plan will be developed and implemented to avoid dragging anchors and lines in special status areas. Spudding/anchoring in existing eelgrass habitat will be avoided whenever possible. Vessel operators will be provided with maps of the construction area with eelgrass beds clearly marked.
- Barges and other construction vessels will not be allowed to run aground. Additionally, vessel operators will be instructed to avoid excess engine thrust in water depths shallower than 30 feet (9 meters) to the extent possible.
- To minimize impacts on ESA-listed fish species, in-water construction will be conducted within the in-water work window (July 15 through January 15). The exception is that mesh installation (LWI Alternative 2), relocation of PSBs, and placement of anchors could occur outside the work window.
- For LWI Alternative 2, the in-water mesh will be cleaned regularly by power washing to minimize impacts on migrating fish. For both alternatives, the grates (guard panels) between the pontoons will be cleaned regularly.
- Applicable measures described above for Construction (Section 2.3.2.1) to protect water quality and habitats will be implemented during operational procedures.
- Low impact development and integrated management practices will be developed and implemented.

Mitigation Measures

- Pile driving of steel piles would be done using vibratory rather than impact methods whenever feasible, which would reduce noise levels by approximately 20 decibels root mean square (dB RMS) at 33 feet (10 meters) from the source.
- Bubble curtains would be used around steel piles being driven by impact methods to attenuate in-water sound pressure of the pile driving activity. The Navy would also consider other equally or more effective noise attenuation methods that may become available. Noise attenuation would not be used for driving concrete piles (SPE only), because of the much lower level of noise generated by driving of concrete piles compared to steel piles, and the resulting much lower potential for impacts to biota.
- During impact pile driving, a soft-start approach would be used to induce marine mammals to leave the immediate area. This soft-start approach requires contractors to initiate noise from hammers at reduced energy, followed by a waiting period. Due to mechanical limitations, soft starts for vibratory driving would be conducted only with drivers equipped with variable moment features. Typically, this feature is not available on larger, high-power drivers. The Navy would use the driver model most appropriate for the geologic conditions at the project location, and would perform soft starts if the hammer is equipped to conduct them safely.
- Construction activities would not be conducted during the hours of 10:00 p.m. and 7:00 a.m. Between July 15 and September 23, impact pile driving would only occur between 2 hours after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Between September 24 and January 15, in-water construction activities

would occur during daylight hours (sunrise to sunset). The Navy would notify the public about upcoming construction activities and noise at the beginning of each construction season.

- Construction in the upper intertidal zone (LWI abutments and observation posts) would be conducted at low tide ("in the dry") to minimize impacts to marine water quality and underwater noise.
- To avoid impacts on marine mammals protected by ESA and MMPA and marine birds protected by ESA, monitoring of shut down and buffer zones around in-water pile driving locations would be implemented. Detailed marine mammal and marbled murrelet monitoring plans would be developed and implemented in consultation with NMFS and the USFWS.
- To protect potential breeding marbled murrelets, tree removal for the SPE project would not be conducted during the marbled murrelet breeding season of April 1 through September 23. Tree removal would be conducted in a manner that is protective of all migratory birds.
- A revegetation plan would be developed with the objective of restoring native vegetation to the areas temporarily cleared for the construction laydown area and construction of new roads. A monitoring and maintenance program (such as once a month) would be implemented until the native plants are sufficiently established to minimize invasion by noxious weeds.
- The Navy would develop a local Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity. Barge trips and associated bridge openings would be scheduled to avoid peak commuting hours. The Notice to Mariners would also serve to notify divers, including tribal divers, of potential underwater noise impacts.
- The Navy would, as part of the Proposed Actions, undertake Compensatory Mitigation to offset unavoidable adverse impacts on aquatic resources under the provisions of the CWA Final Rule for Compensatory Mitigation for Losses of Aquatic Resources. The Navy would purchase habitat credits from the Hood Canal In-Lieu Fee Program, which would implement appropriate mitigation in the Hood Canal watershed.
- The Navy would undertake mitigation projects proposed to address potential effects of the Proposed Actions on reserved treaty rights and resources of the involved federally recognized American Indian tribes.

Regulatory Compliance

The Navy must comply with a variety of federal environmental laws, regulations, and Executive Orders (EOs). These include the following:

- Bald and Golden Eagle Protection Act
- Clean Air Act
- Clean Water Act
- Coastal Zone Management Act
- Endangered Species Act
- Magnuson-Stevens Fishery Conservation and Management Act

- Marine Mammal Protection Act
- Migratory Bird Treaty Act
- National Historic Preservation Act
- Rivers and Harbors Act
- Energy Independence and Security Act
- EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*
- EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*
- EO 13175, *Consultation and Coordination with Indian Tribal Governments*
- EO 13653, *Preparing the United States for the Impacts of Climate Change*
- EO 13693, *Planning for Federal Sustainability in the Next Decade*

Chapter 3 discusses the applicability of and compliance with these laws and regulations, as well as the laws and regulations of the state of Washington, that apply to the Proposed Actions. Regulatory compliance is summarized in Chapter 5.

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LIST OF ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
°F	degrees Fahrenheit
µg/kg	micrograms per kilogram
$\mu g/m^3$	micrograms per cubic meter
AAQS	ambient air quality standards
ACHP	Advisory Council on Historic Preservation
AIRFA	American Indian Religious Freedom Act
APE	Area of Potential Effect
AQI	air quality index
BMP	best management practice
BOD	biochemical oxygen demand
CAA	Clean Air Act
CCD	Coastal Consistency Determination
CDP	Census Designated Place
CDF	cumulative distribution functions
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH_4	methane
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COMNAVREGNWINST	Commander Navy Region Northwest Instruction
CP	current practices
CSDS-5	Commander, Submarine Development Squadron Five
CSL	Cleanup Screening Level
cu m	cubic meter
cu yd	cubic yard
CVN	aircraft carrier
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Program
DAHP	Department of Archaeology and Historic Preservation
dB re 1 µPa	decibels referenced at 1 micropascal
dB	decibel
dBA	A-weighted decibel
DDESB	Department of Defense Explosives Safety Board
DEIS	draft environmental impact statement
DO	dissolved oxygen
DoD	Department of Defense
DPS	distinct population segment
dw	dry weight
EA	Environmental Assessment

List of Acronyms and Abbreviations (continued)

EFH	Essential Fish Habitat
EHW-1	Explosives Handling Wharf
EHW-2	Explosives Handling Wharf-2
EIS	environmental impact statement
EISA	Energy Independence and Security Act
ELWS	extreme low water of spring tides
EO	Executive Order
EQ	Extraordinary Quality
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FEIS	final environmental impact statement
FEMA	Federal Emergency Management Agency
FMC	Fishery Management Council
FMP	Fishery Management Plan
FR	*Federal Register*
FRD	Formerly Restricted Data
ft	foot/feet
FY	fiscal year
g	gravitational acceleration
GHG	greenhouse gas
GIS	Geographic Information System
gpd	gallons per day
gpm	gallons per minute
GWP	global warming potential
HAP	hazardous air pollutants
HAPC	Habitat Areas of Particular Concern
HCCC	Hood Canal Coordinating Council
HCDOP	Hood Canal Dissolved Oxygen Program
HDPE	high density polyethylene
HLUC	Historic Land Use Complexes
HPAH	high molecular weight polycyclic aromatic hydrocarbon
Hz	hertz
IHA	Incidental Harassment Authorization
IMP	integrated management practices
IMPLAN	Impact Analysis for Planning
INRMP	Integrated Natural Resources Management Plan
JARPA	Joint Aquatic Resources Permit Application
KB	Keyport/Bangor
kHz	kilohertz
km	kilometer
kph	kilometers per hour
kVA	kilovolt-ampere
kW	kilowatt

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

LAA	likely to adversely affect
LEED	Leadership in Energy and Environmental Design
Leq	equivalent sound level
LOA	Letter of Authorization
LOS	level of service
Lmax	maximum sound level
LPAH	low molecular weight polycyclic aromatic hydrocarbon
LWI	Land-Water Interface
m	meter
MBTA	Migratory Bird Treaty Act
mg/kg	milligrams per kilogram
mg-N/kg	ammonia
mg/L	milligrams per liter
mgd	million gallons per day
MHHW	mean higher high water
MHWS	mean high water of spring tides
mi	mile
mL	milliliters
MLI	minority and low-income
MLLW	mean lower low water
mm	millimeter
MM	mitigation measures
MMO	marine mammal observer
MMPA	Marine Mammal Protection Act
MOA	Memorandum of Agreement
mph	miles per hour
MPN	most probable number
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSF	Magnetic Silencing Facility
MSGP	Multi-Sector General Permit for Stormwater Discharges Associated with Industrial Activity
MSL	mean sea level
MTCA	Model Toxics Control Act
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NAM	not adversely modify
NAVBASE	Naval Base
NAVFAC	Naval Facilities Engineering Command Northwest
Navy	U.S. Department of the Navy
NCP	National Oil and Hazardous Substances Contingency Plan
ND	not detected
NE	no effect
NEPA	National Environmental Policy Act

List of Acronyms and Abbreviations (continued)

NHPA	National Historic Preservation Act
NLAA	not likely to adversely affect
NMFS	National Marine Fisheries Service
NMFSHQ	National Marine Fisheries Service Headquarters
NMSDD	Navy Marine Species Density Database
NO_2	nitrogen dioxide
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOC	Notice of Construction
NOI	Notice of Intent
NOSSA	Naval Ordnance Safety and Security Activity
NO_x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRHP	National Register of Historic Places
NSWCCD	Navy Surface Warfare Center Carderock Division
NTU	Nephelometric Turbidity Units
NWTT	Northwest Training and Testing
O_3	ozone
OA	Operational Area
OPNAVINST	Chief of Naval Operations Instruction
OSHA	Occupational Safety and Health Administration
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PBDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyl
PCE	Primary Constituent Element
PFC	properly functioning condition
PFMC	Pacific Fishery Management Council
PGA	peak ground acceleration
PM	respirable particulate matter
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PNPTT	Point No Point Treaty Tribes
PNPTC	Point No Point Treaty Council
ppm	parts per million
ppt	parts per thousand
PSAMP	Puget Sound Ambient Monitoring Program
PSAT	Puget Sound Action Team
PSB	Port Security Barrier
PSCAA	Puget Sound Clean Air Agency
PSD	prevention of significant deterioration
PSTRT	Puget Sound Technical Recovery Team
PSU	practical salinity unit

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

PTRCIT	Property of Traditional Religious and Cultural Importance to an Indian Tribe
PTS	permanent threshold shift
Qal	alluvium, colluviums, and fill material
Qva	advanced outwash
Qvgl	Vashon glacio-lacustrine
Qvt	Vashon till
RCW	Revised Code of Washington
RMS	root mean square
ROD	Record of Decision
ROI	Region of Influence
SAIC	Science Applications International Corporation
SARA	Superfund Amendments and Reauthorization Act
SECNAVINST	Secretary of the Navy Instruction
SEL	Sound Exposure Level
SEPA	State Environmental Policy Act
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SL	source level
SLR	sea level rise
SMA	Shoreline Management Act
SMP	Shoreline Management Plan
SMS	Sediment Management Standards
SO_2	sulfur dioxide
SOx	sulfur oxides
SPCC	Spill Prevention, Control, and Countermeasure
SPE	Service Pier Extension
SPL	sound pressure level
sq ft	square feet
sq km	square kilometers
sq m	square meters
sq mi	square miles
SQS	sediment quality standards
SR	State Route
SSBN	OHIO Class Ballistic Missile submarines
SSN	SEAWOLF Class submarine (This document does not address other classes of attack submarines)
SSP	Strategic Systems Program
SUBASE	Naval Submarine Base
SWPPP	Stormwater Pollution Prevention Plan
TCP	Traditional Cultural Property
TL	transmission loss
TMDL	total maximum daily load
TOC	total organic carbon
TPP	Test Pile Program
TPS	Transit Protection System

LIST OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

TRIDENT	TRIDENT Fleet Ballistic Missile
T-ROC	Thorndyke Resources Operation Complex
TSS	total suspended solids
TTS	temporary threshold shift
U&A	Usual and Accustomed
U.S.	United States
UCNI	Department of Defense Unclassified Controlled Nuclear Information
USACE	U.S. Army Corps of Engineers
USC	United States Code
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGBC	U.S. Green Building Council
USGS	U.S. Geological Survey
VOC	volatile organic compound
W	Watts
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WDOE	Washington Department of Ecology
WDOH	Washington Department of Health
WISAARD	Washington Information System for Architectural and Archaeological Records Data
WRA	Waterfront Restricted Area
WSDOT	Washington State Department of Transportation
WSE	Waterfront Security Enclave
ZOI	zone of influence

CHAPTER 1

INTRODUCTION

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1.0 INTRODUCTION

Naval Base (NAVBASE) Kitsap Bangor, located on Hood Canal approximately 20 miles (30 kilometers) west of Seattle, Washington (Figure 1–1), provides berthing and support services to United States (U.S.) Department of the Navy (Navy) OHIO Class ballistic missile submarines, hereafter referred to as TRIDENT submarines, as well as a SEAWOLF Class submarine.[1]

The Navy is proposing two separate actions along the NAVBASE Kitsap Bangor waterfront: the Land-Water Interface (LWI) and the Service Pier Extension (SPE) projects. Under the LWI Proposed Action, the Navy proposes to enhance the perimeter security of the Waterfront Restricted Area (WRA) on NAVBASE Kitsap Bangor by constructing physical barriers through shallow waters and onto the immediate upland areas at the northern and southern extent of the WRA. These structures would tie into the existing Port Security Barrier (PSB) system and the on-land Waterfront Security Enclave (WSE) system. Under the SPE Proposed Action, the Navy proposes to extend the existing Service Pier and construct associated support facilities. The SPE would provide additional berthing for maintenance of existing homeported and visiting submarines. The support facilities that are part of the SPE Proposed Action would provide logistical support for SEAWOLF, LOS ANGELES, and VIRGINIA Class submarines at the Navy's SSN research, development, test, and evaluation hub, which is currently located on NAVBASE Kitsap Bangor. Figure 1–1 shows the general location of the Proposed Actions. Detailed descriptions of the Proposed Actions are provided in Sections 2.1 and 2.2.

NAVBASE Kitsap is the action proponent. The LWI project is for the use of the Navy's Strategic Systems Programs, which directs research, development, manufacturing, testing, evaluation, and operational support of the TRIDENT program. The SPE and supporting facilities are for the use of Commander, Submarine Development Squadron Five (CSDS-5). CSDS-5 is the Immediate Superior in Command for all SEAWOLF Class submarines and four Navy research and development detachments on NAVBASE Kitsap Bangor. Military Construction projects such as SPE must be authorized and funded by Congress. The SPE project is not currently funded or programmed for implementation, and therefore a future construction schedule has not been determined. This means that the SPE project might be scheduled for construction in the future, but with limited resources and competing priorities, the decision to fund and construct the SPE and associated support facilities has not been made and a time frame for doing so has not been determined. Because the passage of time has the potential to alter the affected environment and anticipated impacts, completion of the NEPA process through a Record of Decision, along with regulatory consultations and permit applications, will be deferred until such time as a decision is made to proceed with the SPE project, so that any relevant supplemental information can be taken into account. However, because the SPE proposed action has already undergone significant analysis, and because the project authorization and scheduling modifications occurred during the EIS preparation process, the Navy continued to include the description and environmental impact analysis of the SPE project in this Final EIS to provide the most comprehensive environmental information and to support the cumulative effects analysis.

[1] SEAWOLF is a class of SSN submarine; other classes of SSNs are LOS ANGELES Class and VIRGINIA Class.

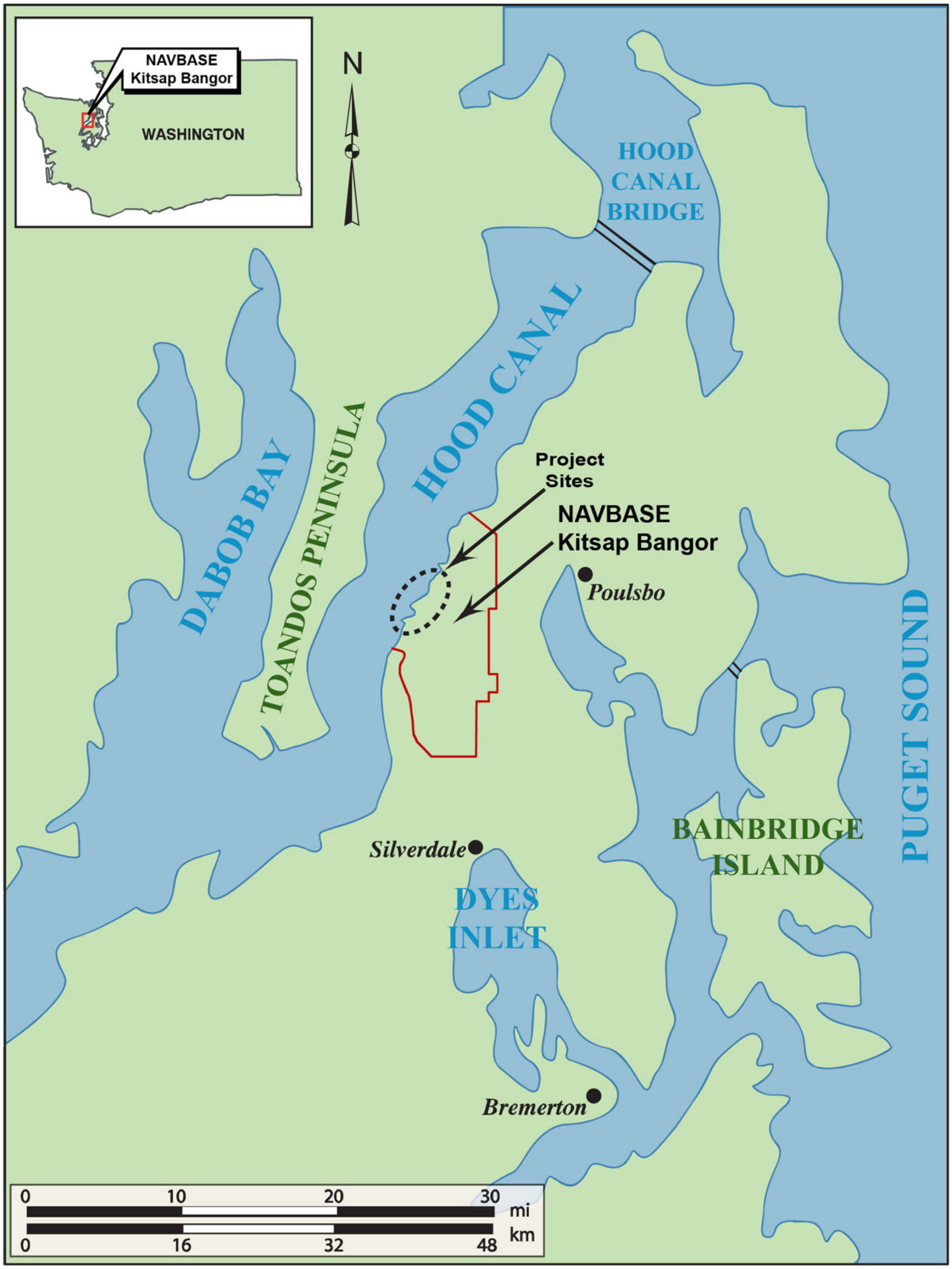

Figure 1–1. Site Location Map for NAVBASE Kitsap Bangor

The National Environmental Policy Act (NEPA) requires federal agencies to provide environmental impact information to decision makers and the public before decisions are made and actions are taken (Public Law 91-190, 42 United States Code [USC] 4321-4347, as amended by Public Law 94-52, 94-83, 97-238 §4(b), 40 Code of Federal Regulations [CFR] 1502.14, 1505.1(e)). The Navy has determined that an environmental impact statement (EIS) is the appropriate level of NEPA analysis for each of the Proposed Actions. Although the two actions are independent, the Navy has chosen to analyze both Proposed Actions in one EIS due to efficiencies, their geographic proximity, and their potential to impact the same resources. The Department of the Navy is the lead agency for NEPA compliance for the Proposed Action as defined in NEPA regulations 40 CFR 1501.5, Navy regulations 32 CFR Part 775, and Chief of Naval Operations Instruction (OPNAVINST) 5090.1D CH-1, §5-3.10. This EIS has been prepared to meet NEPA and OPNAVINST requirements. The U.S. Army Corps of Engineers (USACE) and National Marine Fisheries Service (NMFS) are serving as Cooperating Agencies under NEPA for the Proposed Actions. NMFS is a cooperating agency because of its expertise and regulatory authority over living marine resources. In addition, NMFS intends to use the EIS as the NEPA documentation associated with the issuance of an Incidental Harassment Authorization to the Navy. The USACE is a cooperating agency because of its jurisdictional authority over provisions of the Clean Water Act (CWA), including the regulation of filling, grading, mechanized land clearing, ditching, other excavation activity, and the Rivers and Harbors Act, including piling installation in waters of the United States and other disturbance or modification of a navigable waterway. The dates of the acceptance letters were March 26, 2013, for NMFS and July 26, 2013 for the USACE.

1.1. PROJECT LOCATION

The WRA is a designated area that encompasses, among other things, TRIDENT support facilities. The in-water perimeter of the WRA is already physically secured by a floating barrier system known as a PSB. The on-land perimeter of the Bangor WRA is physically secured by a fencing system, known as the WSE. The LWI would be located across shallow waters and the adjacent upland areas, creating a physical barrier on the perimeter of the WRA along the Bangor waterfront and tying into the existing WRA PSB and WSE. The existing Service Pier is outside the WRA (approximately 0.7 mile [1.1 kilometer]) but is located within the extended PSB system (Figure 1–2).

There are two areas in which vessel traffic is restricted along the Bangor waterfront: Naval Restricted Areas 1 and 2 (Title 33 of the CFR, Part 334.1220 [33 CFR 334.1220]) (Figure 1–2). Naval Restricted Area 1 covers the area to the north and south along Hood Canal encompassing the Bangor waterfront, including the proposed LWI and Service Pier project sites. The regulations associated with Naval Restricted Area 1 state that no person or vessel shall enter this area without permission from the Commander, NAVBASE Kitsap Bangor or his/her authorized representative. The WRA is located within Restricted Area 1.

Naval Restricted Area 2 encompasses the waters of Hood Canal within a circle of 3,000 feet (914 meters) diameter centered at the north end of NAVBASE Kitsap Bangor and partially overlapping Naval Restricted Area 1. The regulations associated with Naval Restricted Area 2 state that navigation will be permitted within that portion of this circular area not lying within Naval Restricted Area 1 at all times except when magnetic silencing operations are in progress.

Figure 1–2. NAVBASE Kitsap Bangor Restricted Areas

"Bedlands" are those aquatic lands that are submerged at all times and that include navigable salt/fresh waters of the state. The bedlands adjacent to NAVBASE Kitsap Bangor are under the ownership of the Washington Department of Natural Resources (WDNR). Nevertheless, the United States retains a navigational servitude in all navigable waters regardless of the ownership of submerged lands. Thus, the United States may take actions concerning navigation over any navigable channel such as Hood Canal, to include effects on the submerged lands beneath the water column. At the Bangor waterfront, restrictions on access to waters immediately adjacent to the base are a valid exercise of the navigational servitude, as would be the construction of any facility relating to navigation, such as the LWI structures and PSB modifications.

There are multiple manmade structures along the Bangor waterfront (Figure 1–2). Nevertheless, much of the Bangor shoreline is in relatively natural condition, with only 6 percent classified as "modified" by the Kitsap County Nearshore Habitat Assessment (Judd 2009). The substrate ranges from sand and gravel to cobble and rock in intertidal and shallow subtidal areas, with silty or muddy substrate predominating in deeper zones.

Beds of macroalgae and eelgrass are present along much of the shoreline to depths of approximately 20 feet (6 meters) below mean lower low water (MLLW), although some species of macroalgae occur sparsely as deep as 60 feet (18 meters) below MLLW. A shoreline cliff ranging from a few feet to over 20 feet in height separates the marine from the terrestrial environment. The upland area of the base is primarily forested (68 percent of the base), while 27 percent is developed. There are numerous wetlands, as well as surface water drainages discharging to Hood Canal.

NAVBASE Kitsap Bangor is surrounded by private communities along its north, south, and east borders, as well as on the opposite (west) side of Hood Canal. The closest off-base communities are approximately 1.5 miles (2.4 kilometers) north of the LWI project area and 0.6 mile (1.0 kilometer) south of the SPE project area. The entirety of NAVBASE Kitsap Bangor, including the land areas and adjacent water areas in Hood Canal, is restricted from general public use.

The project area is also within the Usual and Accustomed (U&A) fishing area of several American Indian tribes, including the Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, Lower Elwha Klallam, and Suquamish Tribes. In the cooperative agreement of 1997, signed between the Navy and the Point No Point Treaty Council (Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, and the Lower Elwha Klallam Tribes), the Navy permitted tribal access to the intertidal beach south of Delta Pier for the "enhancement, perpetuation, and harvest of shellfish" (Navy 1997).

1.2. PURPOSE AND NEED

The LWI and SPE are independent actions, but are being analyzed in the same environmental impact statement (EIS) due to efficiencies, their geographic proximity, and because construction periods for the two projects were initially projected to overlap. However, these are not connected projects. Each Proposed Action fulfills a separate purpose and need, independent of the other Proposed Action.

1.2.1. LWI Purpose and Need

The purpose of the LWI Proposed Action is to comply with Department of Defense (DoD) directives to protect Navy TRIDENT submarines from increased and evolving threats and to prevent the seizure, damage, or destruction of military assets. The LWI project is needed to enhance security within the WRA and comply with security requirements contained in the following documents:

- *Nuclear Weapon Security Manual: The DoD Nuclear Weapon Security Program*, DoD 5210.41M, Secret/Rel to USA and NATO;
- *United States Nuclear Weapons Command and Control, Safety, and Security*/NSPD-28, Secret; and
- Naval Nuclear Weapons Security Policy, SECNAVINST S8126.1, Secret.

Enclosure of the WRA would be completed by installing LWI structures and modifying the PSB system at the waterfront. The LWI project would include construction of abutments at the shoreline cliff at the north and south ends of the WRA. The new LWI structures would attach to the abutments, as would the on-land WSE, thus completing enclosure of the WRA.

Protection of strategic military assets is a vital national security concern. Aggressive security improvements within the Navy pre-date the USS COLE incident and the terrorist attacks of September 11, 2001, and continue today. The Navy continues to improve security along the Bangor waterfront to protect its submarines and critical support facilities. The proposed LWI structures and PSB modifications have been designed and located to meet DoD and Navy security requirements and minimize, to the extent practicable, environmental impacts.

1.2.2. SPE Purpose and Need

The purpose of the Proposed Action is to provide additional berthing capacity and improve associated support facilities for existing homeported and visiting submarines at NAVBASE Kitsap Bangor. The SPE project is needed to:

- Provide alternative opportunities for berthing to mitigate restrictions at NAVBASE Kitsap Bremerton on navigating SEAWOLF Class submarines through Rich Passage under certain tidal conditions;
- Improve long-term operational effectiveness for the three SEAWOLF Class submarines on NAVBASE Kitsap;
- Provide berthing and logistical support for SEAWOLF, LOS ANGELES, and VIRGINIA submarine classes at the Navy's SSN research, development, test and evaluation hub, which is currently located on NAVBASE Kitsap Bangor; and
- Improve submarine crew training and readiness through co-location of command functions at NAVBASE Kitsap Bangor submarine training center.

The SPE and supporting facilities would address a number of infrastructure deficiencies on NAVBASE Kitsap (both NAVBASE Kitsap Bangor and NAVBASE Kitsap Bremerton) to ensure its capability to support the SEAWOLF fleet. These deficiencies, described below, include inadequate support services facilities, parking, and berthing space at the existing NAVBASE Kitsap Bangor Service Pier.

The proposed SPE and supporting facilities are needed to address existing deficiencies and are not intended to increase existing submarine vessel movement nor permanently change homeports of the additional SEAWOLF, VIRGINIA, or LOS ANGELES class submarines to NAVBASE Kitsap Bangor. If significant changes in type or tempo of submarine vessel movement, or the permanent relocation of submarines is proposed, additional NEPA environmental analysis would be required to address the potential associated impacts of those actions.

1.2.2.1. CURRENT INFRASTRUCTURE DEFICIENCIES ON NAVBASE KITSAP BANGOR

Inadequate Support Services Facilities. The existing Service Pier received upgrades in August 2005 that included widening of the pier and construction of a waterfront support facility (Navy 2003). Existing space is not adequate to consolidate parts testing, maintenance activities, and storage of equipment. Currently, temporary trailers, a barge, and several makeshift structures located on the Service Pier house the production and engineering support services. Additionally, shore power and emergency shore power facilities require upgrading to meet current DoD Unified Facilities Criteria UFC-4-150-02 (DoD 2003).

Inadequate Parking. Parking available to maintenance workers, CSDS-5 crew, and mission essential personnel is located upland from the Service Pier and is spread across four different locations as well as along Sealion Road (Figure 2–1). Overflow parking, when the closer parking lots fill, requires the use of a shuttle service to transport personnel to and from the Service Pier. Because the new Waterfront Ship Support Building would be built on the site of an existing parking lot, additional parking capacity would be required for approximately 420 spaces.

Inadequate Berthing Space. In addition to the existing Service Pier, the waterfront area includes Marginal Wharf and the Delta Pier. Visiting SSN capability at Marginal Wharf is limited by increased security measures that have been in place since 2001 and by its proximity to the Explosives Handling Wharves (EHW 1 and 2), which prohibit maintenance on visiting ships during EHW operations. Delta Pier is fully utilized and has no extra berthing capacity. The Service Pier is the only other SSN-capable pier on NAVBASE Kitsap Bangor, and it cannot concurrently accommodate the USS JIMMY CARTER and visiting SSNs.

1.2.2.2. CURRENT DEFICIENCIES ON NAVBASE KITSAP BREMERTON

Operational Constraints. The location of NAVBASE Kitsap Bremerton poses operational constraints to the SEAWOLF fleet deployment schedule. Submarines depart NAVBASE Kitsap Bremerton via Rich Passage where transiting time is dictated by tides and currents. SEAWOLF Class submarines are not visible after dark, which creates a safety hazard. For maximum safe navigation through Rich Passage, SEAWOLF Class submarines require daylight hours and slack high tides.

These restrictions adversely affect deployment of the SEAWOLF fleet and create operational and maintenance constraints. On 144 days per year, the window to transit Rich Passage is less than 90 minutes; on 12 days per year, there is no acceptable transit window. In 2012, 4 of 9 submarine transits were delayed from 12 to 48 hours, resulting in the loss of 5 operational days.

In the event that maintenance is required and returning to NAVBASE Kitsap Bremerton is impossible due to a tidal constraint through Rich Passage, emergency maintenance is performed at Naval Magazine Indian Island. While emergency maintenance can be performed at Naval Magazine Indian Island, this facility is not equipped or staffed to conduct regular submarine maintenance.

Inadequate Waterfront Facilities. Pier D on NAVBASE Kitsap Bremerton currently supports berthing of SSN-21 and SSN-22. The pier's primary use is an aircraft carrier Homeporting Pier and it is not configured for submarine pier-side maintenance and emergent ordnance handling activities. The configuration of Pier D infrastructure is inefficient for supporting routine submarine maintenance for the following reasons:

- Weapons are stored at magazines off base, thereby requiring the transportation of ordnance through urban areas. This issue does not affect submarines berthed on NAVBASE Kitsap Bangor, which load and unload ordnance at Naval Magazine Indian Island.
- It requires the partial disassembly of weapons at Pier D prior to loading.
- It lacks dedicated waterfront support maintenance facilities for homeport-level maintenance.
- It requires configuration of shore power for each evolution (3.5 hours of preparation time to connect each time a submarine is berthed at the pier).
- Personnel are required to travel from Pier D to NAVBASE Kitsap Bangor for training and maintenance, as well as command functions.

These factors result in reduced productivity, reduced efficiency, and fewer deployments across the life of the class.

1.3. EIS SCOPE

Table 1–1 presents a summary of the comments received during the scoping process (Section 1.5). These comments were taken into account in defining the scope of this EIS; not all comments were determined to be within the scope of NEPA. Commenters included private citizens, tribes, regulatory agencies, and elected officials.

This EIS presents alternatives that meet the purpose and need of the Proposed Actions, describes existing baseline conditions, and evaluates the environmental impacts on the resources listed below.

- Marine Water Resources
- Marine Vegetation and Invertebrates
- Fish

Table 1–1. Summary of Comments Received During Scoping

Category	Comment Summary
Purpose and Need	• Effect of recent Strategic Arms Reduction Treaty and resulting reduction in nuclear weapons on purpose of and need for the projects • General support for or opposition to the Proposed Actions • Unnecessary spending of taxpayer money
Alternatives	• Preference for short pier configuration for the Service Pier Extension to minimize impacts • Alternatives to proposed shoreline abutments for the LWI project
General	• Informative meeting materials and project staff • Naval Base Kitsap Bangor is a good neighbor • Concerns about the increased threat of attack due to the presence of SSN submarines
Hydrology	• Impacts on littoral drift (sediment transport)
Natural Resources	• Impacts Proposed Actions would have on wildlife, sensitive seabirds, and marine habitats and resources • Effect of proposed LWI mesh structure on salmon migration • Request to minimize impacts on fish in the Hood Canal
Land Use/Noise	• Impact of Proposed Actions on vehicular traffic • Impact of Proposed Actions on recreation in Jefferson County • Impact on nearby residential areas due to noise, light and glare, and visual changes
Cultural Resources	• Impacts on tribal treaty rights • Impacts on tribal resources, such as fish and shellfish
Transportation	• Impacts on marine traffic • Impacts on vehicular traffic
Cumulative Impacts	• Need to consider the impacts of the LWI and SPE in conjunction with other projects in the region

- Marine Mammals
- Marine Birds
- Terrestrial Biological Resources
- Geology, Soils, and Water Resources
- Land Use and Recreation
- Airborne Acoustic Environment
- Aesthetics and Visual Quality
- Socioeconomics
- Environmental Justice and Protection of Children
- Cultural Resources

- American Indian Traditional Resources and Tribal Treaty Rights
- Traffic
- Air Quality

Two action alternatives and a No Action Alternative are analyzed for each project. These resources were identified based on their potential to be affected by the Proposed Actions and on their potential for public interest. The EIS evaluates the potential impacts on these resources separately for the two projects, but also evaluates their combined impacts. The cumulative impacts of the Proposed Actions in combination with past, present, and future Navy and non-Navy actions are also analyzed. Issues related to public health and safety are addressed under Airborne Acoustic Environment, Land Use and Recreation, and American Indian Traditional Resources.

1.4. REGULATORY CONSIDERATIONS

This section identifies the principal federal laws and implementing regulations that are applicable to the Proposed Actions. The Navy must comply with a variety of federal environmental laws, regulations, and Executive Orders (EOs). These include the following:

- Bald and Golden Eagle Protection Act
- Clean Air Act
- Clean Water Act
- Coastal Zone Management Act
- Endangered Species Act
- Magnuson-Stevens Fishery Conservation and Management Act
- Marine Mammal Protection Act
- Migratory Bird Treaty Act
- National Historic Preservation Act
- Rivers and Harbors Act
- Energy Independence and Security Act
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations
- EO 13045, Protection of Children from Environmental Health Risks and Safety Risks
- EO 13175, Consultation and Coordination with Indian Tribal Governments
- EO 13653, Preparing the United States for the Impacts of Climate Change
- EO 13693, Planning for Federal Sustainability in the Next Decade

Chapter 3 discusses the applicability of and compliance with these laws and regulations, as well as the laws and regulations of the state of Washington, that apply to the Proposed Actions. Regulatory compliance is summarized in Chapter 5.

1.5. Environmental Review Process

NEPA requires that environmental information be made available to the public, agencies, and other stakeholders before decisions are made. The Navy's public involvement process for the Proposed Action is designed to inform stakeholders of the Navy's Proposed Actions early in the NEPA process, to provide stakeholders with the opportunity to comment on the Navy's Proposed Actions, and to keep stakeholders informed throughout the NEPA process. The Navy's public involvement plan includes the following:

- **Publish Notice of Intent (NOI).** An NOI was published in the *Federal Register* (FR) on February 1, 2013, to announce the Navy's intent to prepare an EIS and to announce public scoping meetings (May 20–21, 2013, in Chimacum and Poulsbo, WA). Additional public notices were published in local newspapers (e.g., *Kitsap Sun, Seattle Times*).
- **Conduct Scoping.** Scoping provides an early and open process for determining the scope of issues and for identifying the significant issues related to a Proposed Action. The 45-day public scoping period for this EIS occurred from February 1 to March 17, 2013. Throughout the scoping period, the Navy sought to engage and involve the public, tribes, and agencies in the decision-making process. Their input and comments were solicited through press releases; newspaper advertisements; and letters to the public, local governments, federal and state agencies, and American Indian tribes. Two scoping meetings were held in Chimacum and Poulsbo, Washington, on February 20 and 21, 2013, respectively. Both written and oral comments were sought during scoping. Comments were also accepted by mail and through the project website (https://www.nbkeis.com/lwi/). Comments received during the scoping period were considered in preparing the DEIS.
- **Establish and Sustain Regulatory Communication and Coordination.** The Navy will continue to meet with key regulatory agencies. Federal agencies include the NMFS, U.S. Fish and Wildlife Service, and USACE. State agencies include the Washington Department of Ecology, WDNR, and the Washington Department of Archaeology and Historic Preservation. The USACE and NMFSHQ have agreed to be Cooperating Agencies on the EIS.
- **Conduct Government-to-Government Consultation.** The Navy is engaged in Government-to-Government consultation with American Indian tribes that use traditional resources in the vicinity of the project area, including the Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, Lower Elwha Klallam, and Suquamish Tribes.
- **Prepare a DEIS.** The DEIS describes the purpose and need of the proposed LWI and SPE projects, explains the actions and alternatives being proposed, presents the existing conditions in the region potentially affected, and provides an analysis of the environmental consequences, including cumulative impacts, of the Proposed Actions and each alternative, including a No Action Alternative. To ensure the widest dissemination possible, the DEIS was distributed to agencies, American Indian tribes, local libraries, members of the public who requested copies, and all stakeholders on the mailing list. The DEIS was also posted to the project website (www.nbkeis/lwi/).
- **Allow for Public/Agency Review.** The DEIS was made available on February 13, 2015, for public, government agency, American Indian tribes, and other stakeholder review and comment for 60 calendar days following FR publication of the U.S. Environmental

Protection Agency's Notice of Availability (NOA) for the DEIS. The public hearings were held in Chimacum and Poulsbo, Washington, on March 3 and March 4, 2015, respectively. The hearings allowed the public, agencies, American Indian tribes, and other stakeholders an opportunity to provide both oral and written comments on the DEIS. Comments received during the DEIS public comment period were considered in preparing this final environmental impact statement (FEIS). All comments submitted at the public hearings, received by mail, and by the LWI/SPE website were given equal consideration in preparation of this FEIS. A summary of the comments is provided in Table 1–2. Appendix I includes all of the public comments received on the DEIS as well as responses to those comments.

- **Prepare an FEIS.** This FEIS was prepared to reflect all substantive comments received during the public comment period and public hearings from the public, Federal and state agencies, American Indian tribes, and other stakeholders. The FEIS considers the Navy's responses to comments; information from project development/design and analysis; and additional information received from reviewers. The FEIS provides the decision maker with a comprehensive review of the potential environmental consequences of each alternative for each of the two Proposed Actions and identifies a preferred alternative for each Proposed Action. The Navy's response to each substantive DEIS public comment is included as Appendix I. Where appropriate, FEIS sections were updated to respond to public comments. EPA's publication of the NOA for the FEIS will begin the 30-calendar-day wait (no action) period.
- **Allow for Additional Public Involvement.** The Navy is distributing this FEIS to all stakeholders on the mailing list, including those that made substantive comments on the DEIS or requested a copy. New substantive comments received during the 30-day wait period will be addressed in the Record of Decision (ROD).
- **Issue a Record of Decision.** The final step in the NEPA process is signing of a ROD for both Proposed Actions. For each action, the ROD will state the Navy's decision, identify alternatives considered, address any additional substantive comments received that were not addressed in the FEIS, and discuss other considerations influencing the decision. Each ROD will also describe efforts planned to avoid or minimize the environmental impacts resulting from the Navy's decision.

1.6. PROJECTED SCHEDULE

An overview of the projected EIS schedule is provided in Table 1–3. (Note: This is subject to change.)

Table 1–2. Summary of Public Comments on the DEIS

Category	Comment Summary
General/Process	• Military spending • Impacts on the health of Hood Canal
Purpose and Need	• SPE purpose not justified in DEIS
Proposed Action	• Include more information on riprap • Concerns about parking and available and adequate equipment for pier maintenance and activities for SPE
Alternatives	• Consider Alternative 3 for the Service Pier • Alternative locations for south LWI
Hydrography, Water Quality and Sediment Quality	• Impacts on littoral drift (longshore sediment transport) • Changes in sediment accumulation and erosion patterns • Request for additional sediment contamination testing • Impacts on water quality during construction and operations
Marine Vegetation, Plankton and Benthic Community	• Impacts on eelgrass and other marine vegetation • Mitigation of eelgrass, macroalgae, and benthic impacts • Impacts on commercially important shellfish and mitigation/compensation
Marine Fish	• Impacts from pile driving noise • Impacts on migration of juvenile salmon • Loss of fish habitat • Impacts on forage fish • Impacts from attracting marine mammals to the area
Marine Birds and Mammals	• Impacts from pile driving noise and measures to minimize such impacts • Impacts on fish prey • Calculation of marine mammal takes underestimated
Terrestrial Biological Resources	• Impacts on wildlife from pile driving noise • Loss of upland vegetation for roads and buildings
Geology, Soils, Surface and Groundwater	• Impacts of stormwater runoff from increased impervious surfaces
Underwater and Airborne Noise	• Impacts of pile driving noise on fish, marine birds, and marine mammals • Impacts of construction noise on nearby residents
Cultural Resources and American Indian Traditional Resources and Treaty Rights	• Impacts on tribal access to fishing areas • Impacts on tribal traditional resources (salmon and shellfish) • Impacts on tribal treaty rights • Visual impacts at Devil's Hole harvest area
Land Use, Recreation, and Coastal Zone Management	• Aesthetic impacts of a large new structure • Compliance with the Coastal Zone Management Act

Table 1–3. Actual and Projected Schedule with Key Dates Identified

Milestone	Date
Notice of Intent Published in *Federal Register*	February 1, 2013
Scoping Period (45 days)	February 1 – March 17, 2013
Scoping Meeting Dates	Poulsbo, WA: February 21, 2013 Chimacum, WA: February 20, 2013
NOA DEIS published in *Federal Register*	February 13, 2015
DEIS Public Comment Period (60 days)	February 13 – April 13, 2015
Public Hearings	Poulsbo, WA: March 4, 2015 Chimacum, WA: March 3, 2015
NOA FEIS published in *Federal Register*	Summer 2016
Record of Decision (ROD) signed for LWI only[2]	Summer 2016

[2] Military Construction projects such as SPE must be authorized and funded by Congress. The SPE project is not currently funded or programmed for implementation, and therefore a future construction schedule has not been determined. This means that the SPE project might be scheduled for construction in the future, but with limited resources and competing priorities, the decision to fund and construct the SPE and associated support facilities has not been made and a time frame for doing so has not been determined. Because the passage of time has the potential to alter the affected environment and anticipated impacts, completion of the NEPA process through a Record of Decision, along with regulatory consultations and permit applications, will be deferred until such time as a decision is made to proceed with the SPE project, so that any relevant supplemental information can be taken into account. However, because the SPE proposed action has already undergone significant analysis, and because the project authorization and scheduling modifications occurred during the EIS preparation process, the Navy continued to include the description and environmental impact analysis of the SPE project in this Final EIS to provide the most comprehensive environmental information and to support the cumulative effects analysis.

CHAPTER 2

PROPOSED ACTIONS AND ALTERNATIVES

TABLE OF CONTENTS

2.0 PROPOSED ACTIONS AND ALTERNATIVES

This section describes the Proposed Actions and alternatives considered for implementing each Proposed Action. For each of the Land-Water Interface (LWI) and Service Pier Extension (SPE) Proposed Actions, the United States (U.S.) Department of the Navy (Navy) identified a range of alternatives to meet the action's purpose and need. After applying screening criteria, two action alternatives for each project are carried forward for detailed analysis in this environmental impact statement (EIS), along with the No Action Alternative for each project. These two projects are independent, and the decisions on whether to implement each of the projects will be independent. The two Proposed Actions, including alternatives considered, are described separately in the following sections.

2.1. LWI PROPOSED ACTION

Under the LWI Proposed Action, the Navy proposes to secure the perimeter of the Waterfront Restricted Area (WRA) at NAVBASE Kitsap Bangor by constructing and operating physical barriers through shallow waters and onto the immediate upland areas at the northern and southern extent of the WRA (Figure 2−1). These structures would tie into the existing Port Security Barrier (PSB) system and the on-land Waterfront Security Enclave (WSE) system, thereby securing the entire perimeter of the WRA. Construction would occur over a 2-year period, August 2016 through August 2018. Operations would consist of maintenance and periodic cleaning of the structures and the periodic opening and closing of sections for boat egress/ingress. The design life of the LWI Proposed Action is 50 years.

2.1.1. LWI Alternatives

2.1.1.1. ALTERNATIVES DEVELOPMENT AND SCREENING CRITERIA

The EIS must evaluate all reasonable alternatives in accordance with the Council on Environmental Quality regulations (40 Code of Federal Regulations [CFR] Part 1502.14) and Navy regulations (32 CFR Part 775) that implement the National Environmental Policy Act (NEPA). The development of reasonable alternatives for analysis is dependent on the stated purpose and need for the Proposed Action. Screening criteria were developed to determine if alternatives meeting the purpose and need were reasonable and should be carried forward for detailed analysis in the EIS. The screening criteria listed below were used in the identification and evaluation of LWI action alternatives:

- Meets security and TRIDENT Fleet Ballistic Missile (TRIDENT) program requirements,
- Compatible with existing security features,
- Must be located within the WRA,
- Compatible with a dynamic intertidal environment,
- Supports master planning considerations and does not impact other operational missions on NAVBASE Kitsap, and
- Avoids or minimizes impacts on tribal usual and accustomed harvest areas.

Figure 2–1. Location of the LWI and SPE Projects

2.1.1.2. ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

Using the above screening criteria, the following LWI alternatives were considered but eliminated from further analysis in the EIS.

- *Constructing the structures at another location within the Bangor WRA.* The LWI must be constructed in the WRA to meet the purpose and need and the screening criteria, including the ability to connect the existing floating PSB system to the WSE. Alternative locations within the WRA were considered for the south and north LWIs. The Bangor waterfront has constrained development space for alternative LWI locations, as described below.
  - *South LWI Location.* The Navy considered alternative locations north and south of the proposed location of the south LWI. Alternative locations north of the proposed south LWI site would not meet security requirements. Three alternative locations for the south LWI structure were considered: South Location (south of Devil's Hole), Far South Location (near Keyport/Bangor [KB] Dock), and KB Point (Figure 2–1). These three south location alternatives were not carried forward for further analysis because they would require re-routing of the WSE, an action not compatible with existing security features. In addition, compared to the alternatives carried forward for detailed analysis, these three locations would result in greater adverse effects on tribal shellfishing and tribal beach access.
  - *North LWI Location.* Locations south of the proposed north LWI site would not meet security requirements. Locations north of the proposed site would have a greater impact (more excavation and larger abutment required) on bluffs that provide input of substrate material to the intertidal zone (greater environmental impact). In addition, locations north of the proposed site would require re-routing of the WSE, an action which is not compatible with existing security features.
- *Alternatives to structure design.* Alternatives with different designs for the LWI structures, such as a pile-supported pier structure with a solid pier deck, a pile-supported pier structure that required a dredge construction method, and an earthen berm, were considered. The pile-supported pier structure with a solid pier deck would have used a concrete deck. The pile- supported pier structure requiring dredging would have used a stiffer in-water mesh that would have consisted of metal grating resting on a concrete foundation buried into the seafloor. These alternative designs were eliminated from further consideration because they would have resulted in greater environmental impacts, particularly to marine habitats and species, compared to the alternatives carried forward. Dredging and foundation construction for the stiff metal grating would have resulted in much more disruption of marine habitat than the proposed flexible mesh alternative. The earthen berm would have displaced 2.6 acres (1 hectare) of seafloor compared to the pile-supported pier structures which would result in minimal seafloor displacement. Concerns for sediment transport and juvenile fish migration served to eliminate the berm from further consideration. An alternative consisting of PSB modifications with an in-water mesh was not carried forward because the mesh would have required a rigid, fixed structure for attachment.
- *Abutments extending waterward of mean higher high water*. A preliminary design concept for the PSB Modifications alternative included concrete abutments extending waterward of the MHHW. In evaluating this concept, the designers concluded that no functionality would

be lost by moving the abutments landward of MHHW. This was a design refinement in the development of Alternative 3, the Preferred Alternative.

2.1.1.3. LWI ALTERNATIVES EVALUATED IN EIS

Two action alternatives were identified as meeting the purpose and need and the screening criteria. These alternatives consist of pile-supported piers with associated PSB modifications, and PSB modifications alone. These action alternatives and the No Action Alternative are described below.

2.1.1.3.1. LWI ALTERNATIVE 1: NO ACTION

Under LWI Alternative 1, the No Action Alternative, the LWI structures would not be constructed and existing PSBs would not be relocated. This alternative would not meet security requirements and, therefore, would not meet the purpose and need for the Proposed Action. No environmental impacts would result from the No Action Alternative, as no construction or physical alteration to the waterfront would occur, and there would be no changes in operations. The No Action Alternative is carried forward for analysis because it is required by NEPA and constitutes baseline conditions for environmental analysis of the Proposed Action.

2.1.1.3.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

Under LWI Alternative 2, construction and operation of LWI structures would include pile-supported piers built from the base of the shoreline bluff out to a connection point with the existing PSB system (Figures 2–1, 2–2, and 2–3) at both the north and south ends of the WRA. The piers would connect to solid concrete abutments that would be built at the shoreline bluff, and an anchoring structure for the PSBs would be installed at the seaward end of each pier. Construction is expected to require one barge with a crane, one supply barge, a tugboat, and work skiffs. Table 2–1 (presented at the end of Section 2.1.1.3.3) summarizes LWI Alternative 2.[1] Best management practices (BMPs) and impact reduction measures that would be implemented to avoid or minimize potential environmental impacts associated with the LWI Proposed Action are discussed in Section 2.3.

Pier Structures

The LWI pier structures would be 13 feet (4 meters) wide and 280 feet (85 meters) long at the north location and 730 feet (223 meters) long at the south location. The last (seaward) 23 feet (7 meters) of each pier would be 20 feet (6 meters) wide. The piers would include a walkway for their entire length and 40-foot (12-meter) tall steel monopole towers supporting lights and security equipment; there would be 14 towers on the south pier and 6 towers on the north pier. A fence would be installed along the entire length of each pier. A mesh material would extend from the bottom of the walkway into the water and would be anchored to heavy steel plates placed on the seafloor. The steel plate anchors would occupy approximately 1,500 square feet (140 square meters) at the north LWI and 4,000 square feet (370 square meters) at the south LWI, for a total area of approximately 5,500 square feet (510 square meters). (Dimensions and numbers are based on preliminary design and are approximate and subject to change.)

[1] Under LWI Alternative 1, the No Action Alternative, there would be no change to the environment due to construction and operation of an LWI. Therefore, the No Action Alternative is not included in Table 2–1.

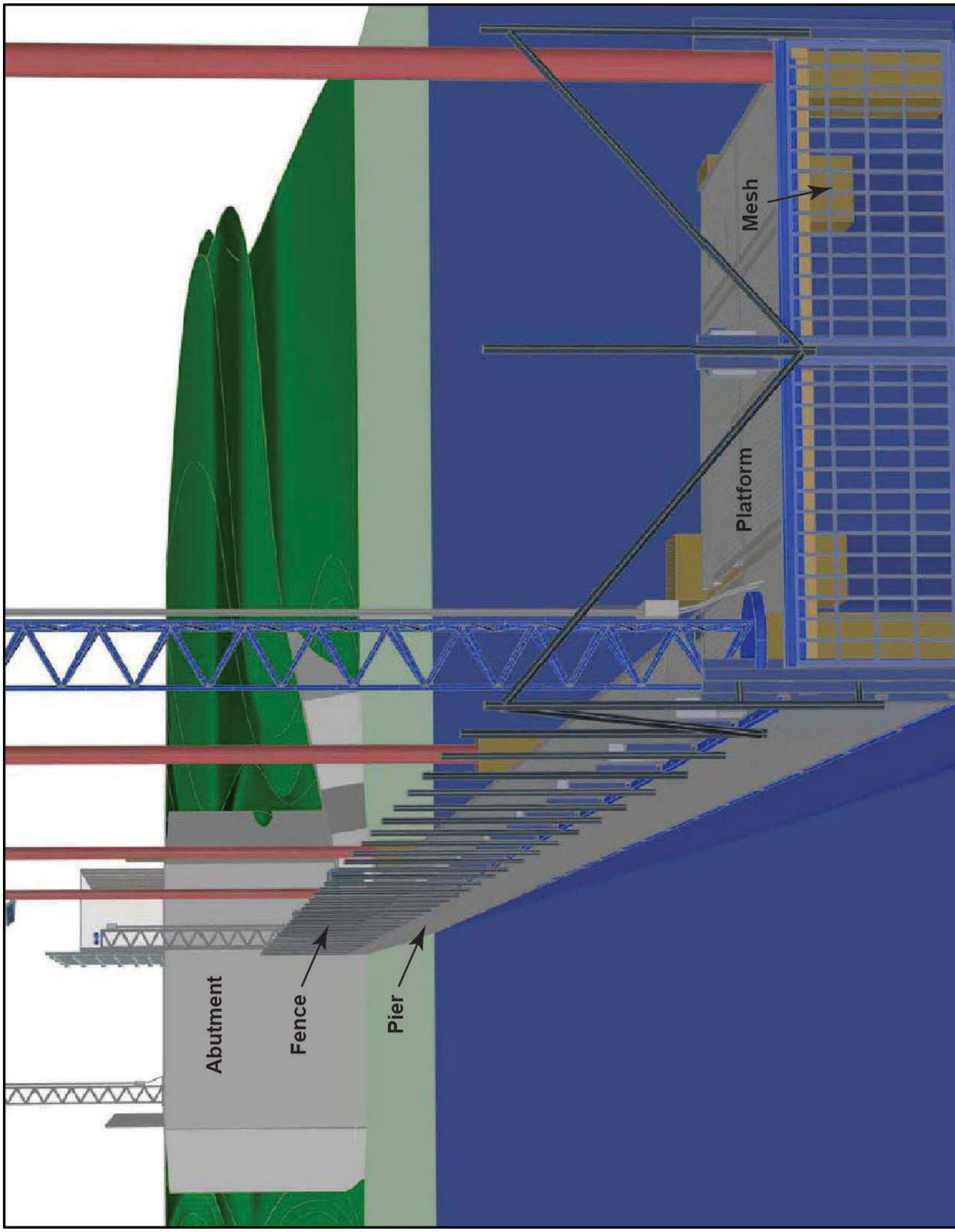

Figure 2–2. LWI Alternative 2: Pile-Supported Pier Alternative (end view, North LWI)

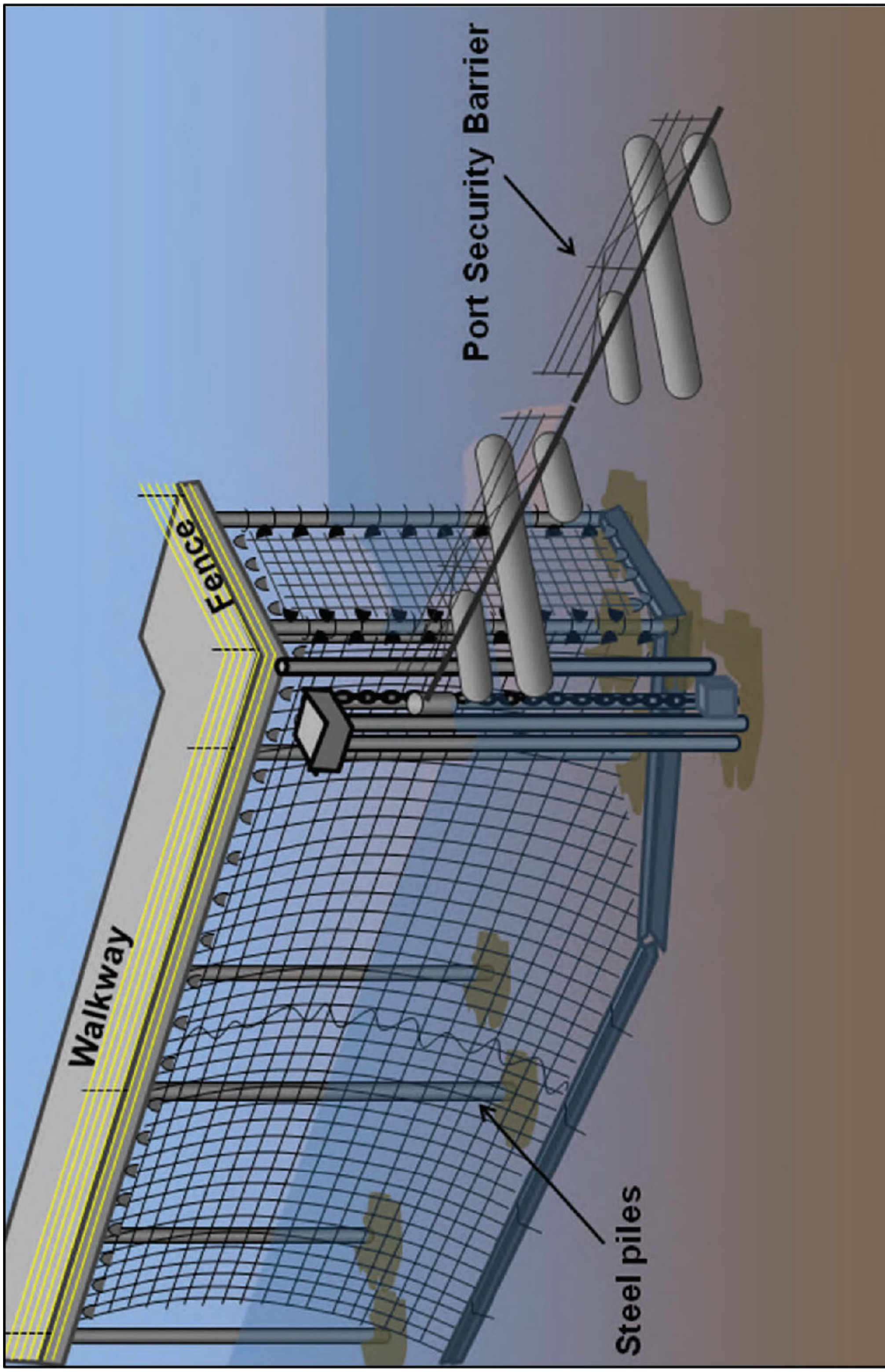

Figure 2–3. LWI Alternative 2: Attachment of PSBs to Pile-Supported Pier

The pier deck would consist of metal grating that allows 65 percent of the light to pass through. The elevation of the pier deck would be approximately 21.5 feet (6.6 meters) above mean lower low water (MLLW), and the elevation of the bottom of the pier structure would be approximately 17 feet (5.2 meters) above MLLW. There would be a floating dock for small boat access approximately 12 by 35 feet (4 by 11 meters) at the end of each pier, on the inside, or secure side, of the pier. This dock would be anchored with four piles (included in the 136 total number of permanent piles) and would have a metal grating deck. Access to the floating dock from the pier would be by means of a gangway 80 feet long by 3 feet wide (24 by 1 meter). The gangway deck would also consist of metal grating.

Pile Installation

The north LWI would require a maximum of 54 hollow steel piles, 24 inches (60 centimeters) in diameter. The south LWI would require a maximum of 82 hollow steel piles, 24 inches in diameter. This equates to an estimated 136 total number of number of permanent piles for the project. Piles primarily would be driven using vibratory methods. An impact hammer would be used to “proof” piles to ensure that they provide the required load-bearing capacity. Where geotechnical conditions do not allow piles to be driven to the required depth using vibratory methods, an impact hammer may be used to drive some piles for part or all of their length. Pile driving would be completed in no more than 80 days during the first in-water work season (August 1, 2016 through January 15, 2017).

Piles are expected to be installed primarily using a crane on a floating barge. Pile installation in shallow areas would be tidally dependent, such that the hull of the barge would not be permitted to ground or contact the seafloor at any time during the work. Therefore, the barge would move in and out with the tide as necessary to install the piles and decking. The barge would be positioned by means of spuds and anchors. Because the majority of the piles for the south LWI would be in shallow water that would make barge operations difficult, the analysis considered that the contractor would build a temporary trestle adjacent to the LWI structure to install the permanent piles and decking in this shallow area. This temporary trestle would be approximately 300 feet (90 meters) long and 20 feet (6 meters) wide; the deck would be of metal grating that allows 65 percent of light to pass through. Approximately 120 temporary 24-inch (60-centimeter) steel piles would be needed. These piles would be driven in the same manner as the permanent piles, within the same 80 days as the permanent piles. The piles would be extracted by vibratory means.

PSBs

Existing PSB systems close to the proposed LWIs would be relocated and attached to the end of the new piers. For the north LWI, approximately 1,000 feet (300 meters) of the existing PSBs would be relocated and approximately 200 feet (60 meters) would be removed. For the south LWI, approximately 650 feet (200 meters) of the existing PSBs would be relocated and 550 feet (170 meters) would be removed. Existing PSB units and anchors would be removed using a barge-mounted crane, stored on the barge, and then placed at new locations as needed using the same crane. Existing PSBs that are still serviceable would be configured into the new PSB alignment. When PSBs would be removed, they would be disassembled and recycled as scrap metal. The ends of the remaining PSB systems would be attached to a dolphin near the end of each pier; these dolphins would consist of eight closely spaced 24-inch (60-centimeter) diameter steel piles supporting an 8 by 8-foot (2.5 by 2.5-meter) concrete platform. For each LWI, two existing PSB buoys and associated anchors would be relocated and one would be removed. Each buoy is attached to three anchor legs. Each leg consists of a 120-foot (40-meter) chain attached to a main 10-ton (9-metric ton) concrete anchor (11 feet long, 5.5 feet wide, 5 feet high [3.5 by 1.8 by 1.6 meters]) and two concrete clump anchors, each 3 by 3 feet (1 by 1 meter) and weighing 2 tons (1.8 metric tons) (Figure 2–4).

Shoreline and Upland Construction

The north abutment would be approximately 40 feet (12 meters) high and 72 feet (22 meters) long. It would extend from an approximate elevation of 13 feet (4 meters) above (landward of) MLLW to the top of the slope at elevation 50 feet (15 meters). The south abutment would be approximately 20 feet high by 72 feet long (6 by 22 meters). This abutment would extend from an elevation of approximately 11 feet (3.4 meters) above MLLW to the top of the slope at elevation 24 feet (7 meters). The upper limit of the intertidal zone is considered to be MHHW, approximately 11 feet (3.4 meters) above MLLW at NAVBASE Kitsap Bangor.

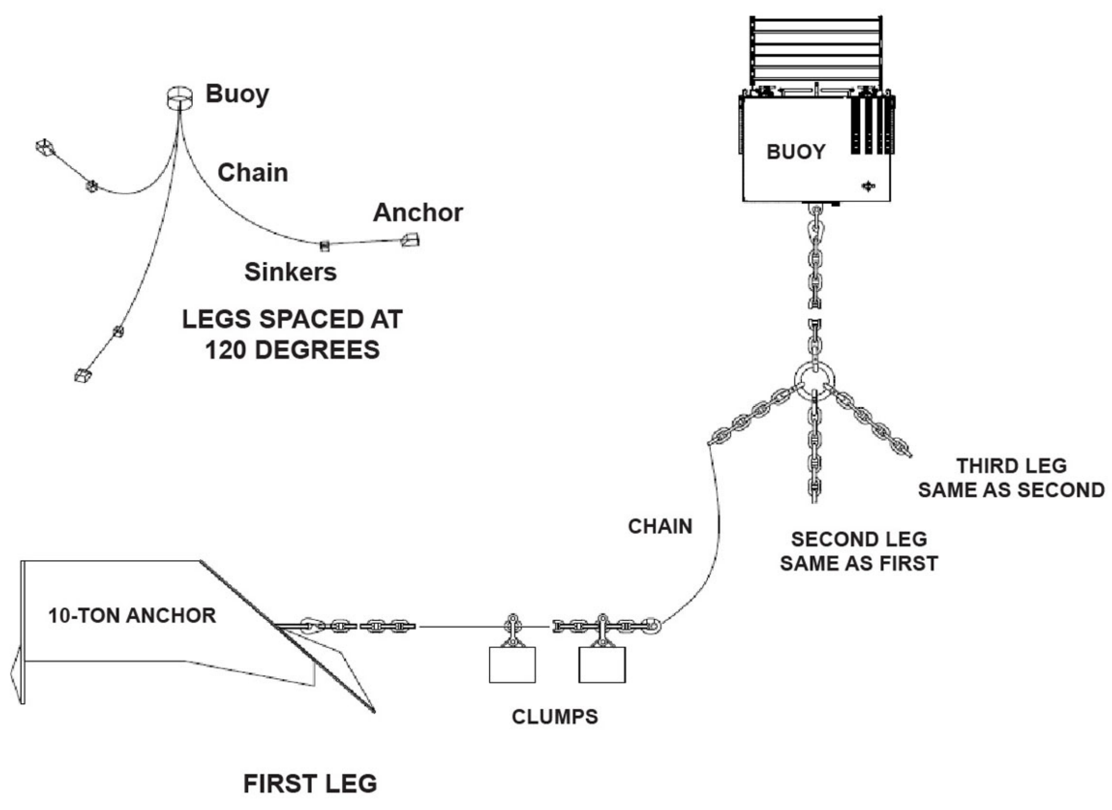

Figure 2–4. Typical 3-Leg Mooring Buoys

The north abutment would be supported on 15 36-inch (90-centimeter) piles driven on land using vibratory and impact methods. The south abutment would be supported on 16 piles of the same size and also driven on land. Each abutment would include a stairway on one end, from the top of the abutment to the LWI deck and base of the bluff. At each abutment the stairs would be attached to the abutment wall or supported on piles driven to grade and include a second stairway to the base of the bluff. The abutment stairways would be supported on five 24-inch (60-centimeter) piles each plus 6- by 2-foot (2- by 0.6-meter) concrete pads. The piles for the abutment stairways would be driven at low tide ("in the dry") using a crane mounted on top of the bluff.

The abutment stair landings would lie below (waterward of) MHHW; the area below MHHW occupied by these new structures would be approximately 12 square feet (1.1 square meters) at each LWI. The total area excavated below MHHW during abutment construction would be approximately 15,600 square feet (1,449 square meters). The total volume of material excavated below MHHW would be approximately 2,889 cubic yards (2,208 cubic meters). [2] Construction of the abutment at the south LWI would require removal of approximately 40 feet (12 meters) of creosoted timber anti-torpedo baulk at the base of the bluff. Similar to work for the stairway piles (see above), the abutment and stair work would also be conducted at low tide in the dry. Beach contours would be returned to pre-construction conditions following construction, except for the areas occupied by the new structures and riprap placed at base of abutment wall. All bluff slopes disturbed by construction of the abutment would be stabilized using riprap (see Table 2-1 for quantities). The riprap would be placed below the abutment walls to elevations just below MHHW, ending just above 10 feet (3 meters) above MLLW at the north LWI and just below 9 feet (2.7 meters) above MLLW at the south LWI. A temporary sheet pile cofferdam would be constructed to create a dry area to install piles for the abutment. The lengths of the proposed coffer dams are 140 feet (43 meters) for the north abutment, 160 feet (49 meters) for the north stairs, 190 feet (58 meters) for the south abutment, and 160 feet long for the south stairs. The LWI project would utilize the existing beach sediment that was removed for LWI construction and place that over the protective armor rock at grade to preserve the natural shoreline dynamics. Several tidal cycles would be required to sort the material, but it is expected that the beach sediment will mimic existing conditions when the project is completed. Although additional armoring should not be required, if toe protection is needed to prevent erosion at the base of the LWI abutments, the Navy will implement soft armoring techniques such as placement of large woody debris (tree trunks or root wads). The intent of this technique is to add structure and complexity to diminish wave erosion without placing large armor rocks for LWI toe protection. Construction of both abutments would clear a total of approximately 47,000 square feet (4,366 square meters) of upland area and would require excavation of approximately 6,245 cubic yards (4,775 cubic meters) of soil and fill of 6,966 cubic yards (5,326 cubic meters) including the concrete.

The staging area for both LWI construction sites would be 6,562 square feet (610 square meters) within a 5.4-acre (2.2-hectare) site near the intersection of Archerfish and Seawolf Roads (Figure 2–1). This site has been used for staging other construction projects and is highly disturbed.

[2] Areas and volumes excavated are the minimum needed to achieve the purpose of the abutment construction.

Construction Schedule

Upland construction would take approximately 540 days; equipment would include backhoes, bulldozers, loaders, graders, trucks, and a crane/pile driver. Project construction would begin in August 2016 and end in August 2018. All in-water pile driving and abutment construction would take place during one in-water work season, August 1, 2016 through January 15, 2017, and would minimize potential impacts on Endangered Species Act (ESA)-listed fish species. Other in-water activities such as installation of the mesh material and relocation of PSB units and anchors would begin in January 2017 and end by August 2018, and could occur either within or outside the in-water work season. Materials and equipment for the in-water work would be brought in by barge, while materials and equipment for abutment construction would be brought in by truck. The number of construction workers is estimated at 100.

2.1.1.3.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

LWI Alternative 3 is the Preferred Alternative, in part because it would have fewer environmental impacts than Alternative 2 and, therefore, it is also the environmentally Preferred Alternative and the Least Environmentally Damaging Practicable Alternative according to the Clean Water Act (CWA) Section 404 (b)(1) guidelines.

Under this alternative, the construction and operation of the LWI structures would consist of modifying the existing PSB system to extend across the intertidal zone to attach to concrete abutments at the shoreline that would be the same as the abutments described above for the Pile-Supported Pier Alternative (Figure 2–5). In addition, three observation posts would be installed: one at the north LWI, one at the south LWI, and one on Marginal Wharf (Alternative 2 would not require observations posts because it would include piers with full-length walkways and towers with lighting and security equipment, as described in Section 2.1.1.3.2). There would be no underwater mesh, which would require a rigid, fixed structure for attachment. As a security requirement, Alternative 3 would use a greater number of security personnel than Alternative 2. However, the frequency of security vessel operations would not increase.

Table 2–1 summarizes LWI Alternative 3. For the north LWI, approximately 1,200 feet (370 meters) of the existing PSB system would be relocated and 100 feet (30 meters) of new PSB would be added (Figure 2–6). Existing PSB units and anchors would be removed using a barge-mounted crane, stored on the barge, and then placed at new locations as needed using the same crane. New components would be brought in by a tug-towed barge and placed by a barge-mounted crane. Four existing buoys and associated anchors would be relocated. The mooring system for two of the four relocated buoys would be reduced from three anchor legs to two anchor legs, each with one 2-ton (1.8-metric ton) clump anchor (3 by 3 feet [1 by 1 meter]) and one 10-ton (9-metric ton) anchor (11 feet long, 5.5 feet wide, 5 feet high [3.5 by 1.8 by 1.6 meters]). For the south LWI, approximately 1,200 feet of the existing PSB system would be relocated and 200 feet (60 meters) of new PSB would be added (Figure 2–7). Three existing buoys and associated anchors would be relocated. One of these would have its anchor legs reduced from three to two, each with one clump anchor and one 10-ton anchor. One new buoy would be installed with two mooring legs (each with one clump anchor and one 10-ton anchor).

Each PSB unit would be 50 feet (15 meters) long and would support an 8-foot (2.5-meter) high fence on a metal frame (Figure 2–8). Each unit would be supported on three pontoons: a center pontoon 18 feet (5 meters) long, and two end pontoons each 6 feet (2 meters) long. The pontoons would be 42 inches (107 centimeters) in diameter. A metal grating (guard panel) 42 inches high would be suspended below the metal frame, between the pontoons. Because the height of this guard panel would be the same as the diameter of the pontoons, it would extend into the water the same distance as the pontoons (less than 1 foot [30 centimeters]). Openings to allow vessel passage through the barrier system would be created by disconnecting adjacent PSB units at strategic locations and towing the barrier out of the way.

Table 2–1. Summary of the Action Alternatives for the LWI Project

LWI Facility Feature[1]	LWI Alternative 2: Pile-Supported Pier	LWI Alternative 3 (Preferred): PSB Modifications
Length of LWI structure (13 feet [4 meters] wide with last [seaward] 23 feet [7 meters] of each pier 20 feet [6 meters] wide)	North LWI: 280 feet (85 meters) South LWI: 730 feet (223 meters)	Included in total length of PSBs below
Size of floating docks and gangway	At both LWIs at the ends of the piers: 12- by 35-foot (4- by 11-meter) dock with 80- by 3-foot (24- by 1-meter) gangway	N/A
Dolphins	At both LWIs: one 8- by 8-foot (2.4- by 2.4-meter) concrete platform supported by 8 24-inch (60-cm) piles	N/A
On-pier towers	North LWI: 6 40-foot (12-meter) tall towers South LWI: 14 40-foot tall towers	N/A
Length of relocated PSBs	North LWI: 1,000 feet (300 meters) South LWI: 650 feet (200 meters)	North LWI: 1,200 feet (370 meters) [2] South LWI: 1,200 feet (370 meters) [2]
Length of PSBs removed	North LWI: 200 feet (60 meters) South LWI: 550 feet (170 meters)	N/A
Length of PSBs added	N/A	North LWI: 100 feet (30 meters) South LWI: 200 feet (60 meters)
Total number of permanent in-water piles (hollow steel)[3]	North LWI: up to 54 24-inch (60 cm) piles South LWI: up to 82 24-inch piles	North LWI: up to 12 30-inch (76 cm) piles South LWI: up to 12 30-inch piles
Area displaced by permanent piles (not including abutment piles)	North LWI: 170 sq ft (16 sq m) South LWI: 258 sq ft (24 sq m)	North LWI: 59 sq ft (5.5 sq m) South LWI: 59 sq ft (5.5 sq m)
Size of temporary trestle for pier	300 by 20 feet (90 by 6 meters)	N/A
Number of temporary trestle piles for pier (hollow steel)	North LWI: N/A South LWI: 120 24-inch	N/A
Size of temporary trestles for observation posts	N/A	At both LWIs: 20 by 50 feet (6 by 15 meters)
Number of temporary trestle piles for observation posts (hollow steel)	N/A	North LWI: 10 24-inch (60-cm) South LWI: 10 24-inch (60cm)
Area displaced by temporary piles	South LWI only: 380 sq ft (35 sq m)	North LWI: 32.3sq ft (3 sq m) South LWI: 32.3 sq ft (3 sq m)
Area of partial shading[4]	North LWI: 4,450 sq ft (413 sq m) South LWI: 10,300 sq ft (957 sq m)	North LWI: 980 sq ft (91 sq m) South LWI: 2,090 sq ft (194 sq m)
Area of full shading[5]	North LWI: 64 sq ft (6 sq m) South LWI: 64 sq ft (6sq m)	North LWI: 1,000 sq ft (93 sq m) South LWI: 1,000 sq ft (93 sq m)
LWI footprint (benthic habitat displaced by structures)[6]	North LWI: 1,682 sq ft (156 sq m) South LWI: 4,270 sq ft (397 sq m)	North LWI: 71 sq ft (6.6 sq m) South LWI: 71 sq ft (6.6 sq m)

Table 2–1. Summary of the Action Alternatives for the LWI Project (continued)

LWI Facility Feature[1]	LWI Alternative 2: Pile-Supported Pier	LWI Alternative 3 (Preferred): PSB Modifications
Area occupied by steel plates anchoring in-water mesh	North LWI: 1,500 sq ft (140 sq m) South LWI: 4,000 sq ft (370 sq m)	N/A
Area below MHHW excavated for abutment	North LWI: 6,800 sq ft (632 sq m) South LWI: 8,800 sq ft (818 sq m)	Same as Alternative 2
Cut volume below MHHW for two abutments and two stair landings	2,889 cu yd (2,209 cu m)	Same as Alternative 2
Fill volume below MHHW for two abutments and two stair landings excluding riprap cover	2,911 cu yd (2,226 cu m)	Same as Alternative 2
Temporary Sheet pile cofferdam dimensions	North Abutment: 140 feet (43 meters) North Stairs: 160 feet (49 meters) South Abutment: 190 feet (58 meters) South Stairs: 160 feet	Same as Alternative 2
Riprap length	North Abutment: 100 feet (30 meters) North Stairs: 80 feet (24 meters) South Abutment: 150 feet (46 meters) South Stairs: 80 feet (24 meters)	Same as Alternative 2
Riprap width	Approximately 10 feet (3 meters)	Same as Alternative 2
Riprap volume below MHHW (placed above natural beach contour)	303 cu yd (232 cu m)	Same as Alternative 2
Riprap area below MHHW	4,100 sq ft (381 sq m)	Same as Alternative 2
PSB anchors 10-ton (9-metric ton) anchors: 11 by 5.5 feet (3.5 by 1.8 meters) 2-ton (1.8-metric ton) clump anchors: 3 by 3 feet (1 by 1 meter)	Both LWIs: relocation of two existing mooring anchor systems and removal of one mooring anchor system; net reduction of three 10-ton anchors and six 2-ton anchors at each LWI	North LWI: relocation of four existing anchor systems with reconfiguration of two of these systems; net reduction of two 10-ton anchors and eight 2-ton anchors South LWIs: relocation of three existing mooring anchor systems plus addition of one mooring anchor system; net addition of one 10-ton anchor and reduction of two 2-ton anchors
Barge trips (total round trips)	16	3
Size of abutment	North LWI: 40 feet high by 72 feet long (12 by 23 meters) South LWI: 20 feet high by 72 feet long (4 by 26 meters)	Same as Alternative 2
Number of piles for abutment stairs (driven in the dry)	North LWI: 15 36-inch (90-cm) piles South LWI: 16 36-inch piles	Same as Alternative 2
Number of piles for stairs (driven in the dry)	North LWI: 5 24-inch (60 –cm) piles South LWI: 5 24-inch piles	Same as Alternative 2
Number of permanent piles for observation posts (driven in the dry)	N/A	North LWI: 12 30-inch (76-cm) South LWI: 12 30-inch
Upland area cleared for abutment	North LWI: 29,000 sq ft (2,694 sq m) South LWI: 18,000 sq ft (1,672 sq m)	Same as Alternative 2
Upland excavation volume for abutment	6,245 cubic yards (4,775 cu m)	Same as Alternative 2
Upland fill volume for abutment	6,966 cubic yards (including concrete) (5,326 cu m)	Same as Alternative 2

Table 2–1. Summary of the Action Alternatives for the LWI Project (continued)

LWI Facility Feature[1]	LWI Alternative 2: Pile-Supported Pier	LWI Alternative 3 (Preferred): PSB Modifications
On-land towers	N/A	One 30-foot (9-meter) tower on each abutment
New impervious surface	North LWI: 2,720 sq ft (253 sq m) South LWI: 2,466 sq ft (229 sq m)	Same as Alternative 2
Riprap volume above MHHW	North LWI: 205 cu yd (158 cu m) South LWI: 199 cu yd (153 cu m)	Same as Alternative 2
Upland staging area (already disturbed)	6,562 square feet (610 square meters)	Same as Alternative 2
Overall construction duration	24 months, including up to 80 days of pile driving; upland construction 540 days	24 months, including up to 30 days of pile driving; upland construction 540 days
Duration of in-water work[7]	In-water pile driving and abutment construction in one in-water work season; mesh installation and relocation of PSBs and anchors could occur up to 24 months. Two in-water work seasons would be needed for all in-water work.	One in-water work season would be needed for PSB modifications and in-water abutment construction.

cm = centimeter; cu m = cubic meter; cu yd = cubic yard; MHHW = mean higher high water; N/A = not applicable; sq ft = square feet; sq m = square meter

1. Numbers are based on preliminary design and are approximate and subject to change.
2. Total lengths (1,300 feet [400 meters] for the North LWI and 1,400 feet [430 meters] for the South LWI) are slightly greater than total length of LWI plus PSBs under Alternative 2 to allow for slack in the PSB systems.
3. Number includes the potential for a modest increase in the number of piles in the final design. All Alternative 3 piles would be driven in the dry at low tides.
4. Partial shading for Alternative 2 would be from the piers, floating docks, and gangways; partial shading for Alternative 3 would be from the nearshore PSB pontoons and observation post and abutment stairs.
5. Full shading for Alternative 2 would be from the dolphins; full shading for Alternative 3 would be from the observation posts.
6. Habitat displacement for Alternative 2 would be from permanent in-water piles, steel mesh anchors, and abutment stair landings. Habitat displacement for Alternative 3 would be from observation post piles and abutment stair landings.
7. The first in-water work season would be August 1, 2016 to January 15, 2017, and the second in-water work season would be July 15, 2017 through January 15, 2018. Installation of mesh and relocation of PSB units and anchors would occur in the range of January 2017 – August 2018 and could occur either within or outside of the in-water work seasons.

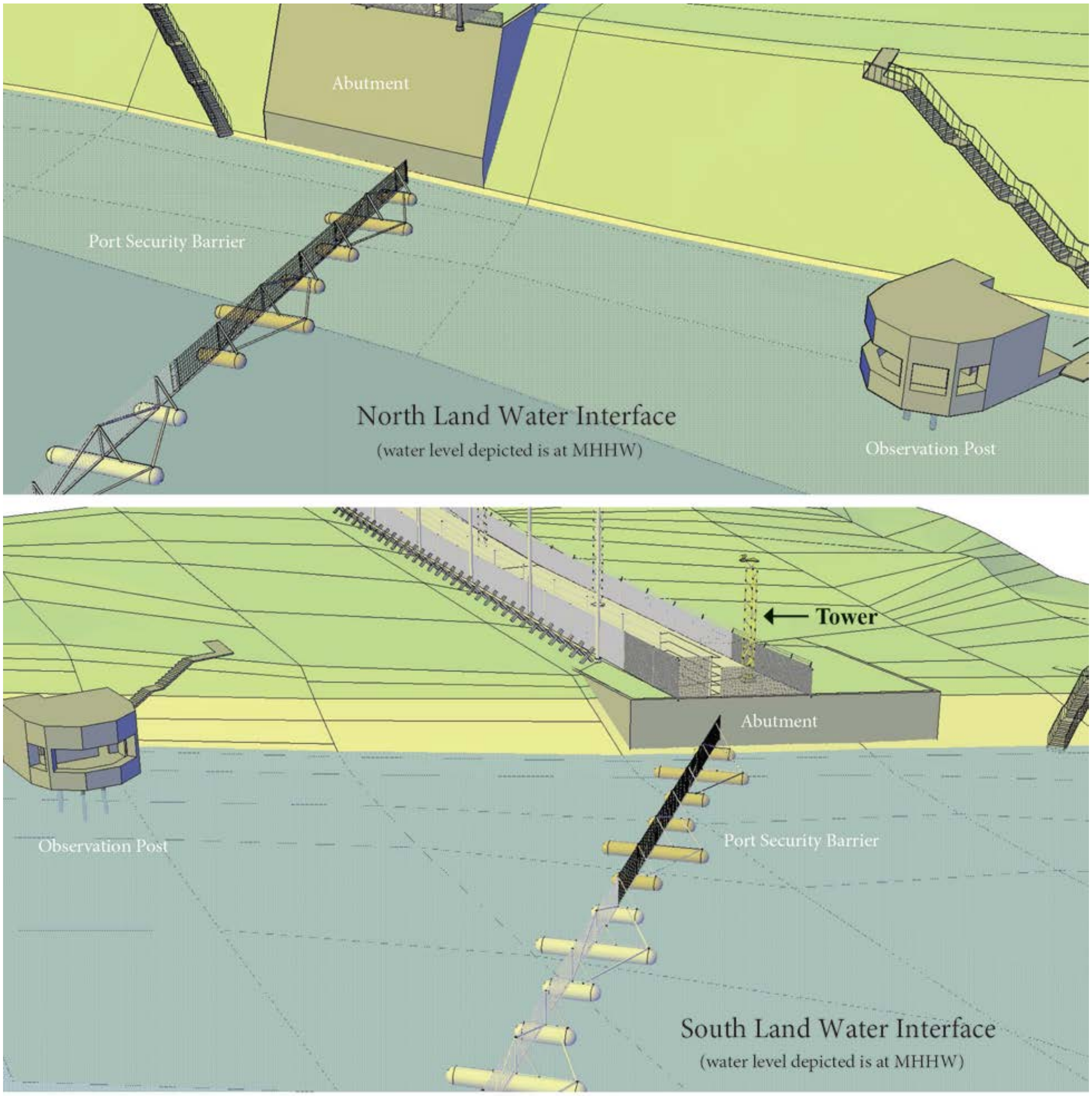

Figure 2-5. LWI Alternative 3: PSB Modifications

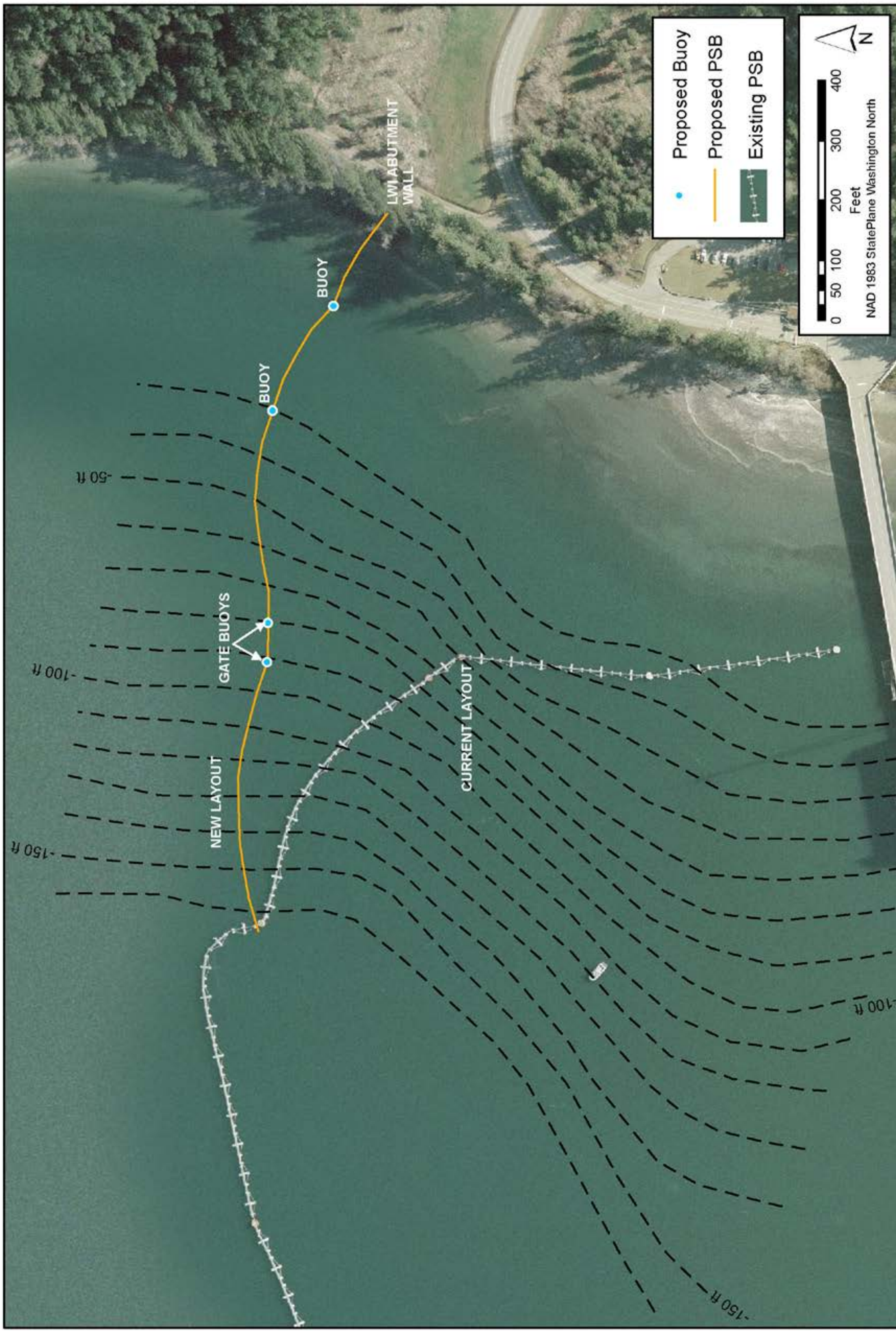

Figure 2-6. North LWI PSB Layout

Figure 2-7. South LWI PSB Layout

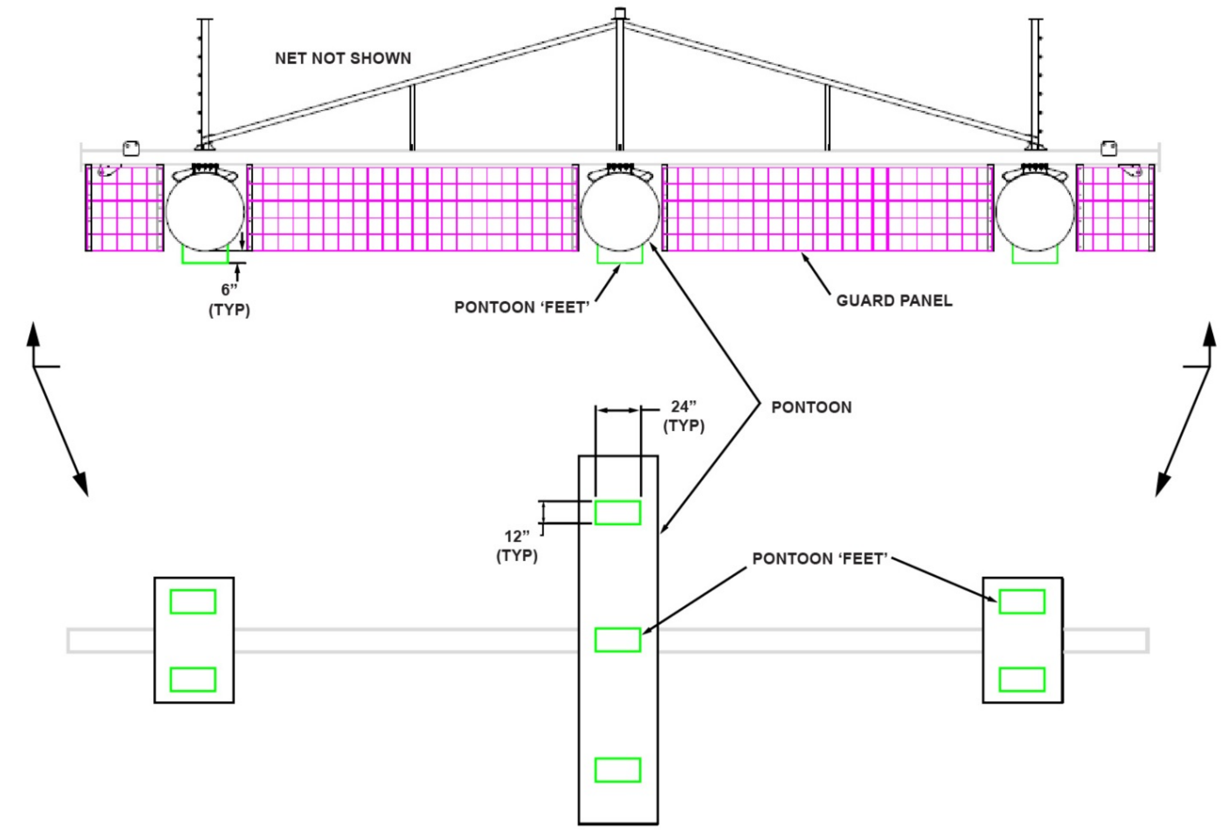

Figure 2–8. PSB Unit

PSBs at Low Tide

On an average low tide, approximately 11 PSB units including 33 pontoons (north and south LWI combined) would “ground out” in the intertidal zone. Over the long term, which would include extreme low tides, approximately 18 PSB units including 54 pontoons would ground out in the intertidal zone. Five of these PSB units would ground out at the north LWI and 13 would ground out at the south LWI. To minimize the resulting disturbance of the intertidal zone, each center pontoon would be fitted with three “feet” and the outer pontoons would be fitted with two feet that would prevent an entire pontoon from contacting the sediment surface (Figure 2–8). These feet would be 12 by 24 inches (30 by 60 centimeters) in size and constructed of high-density polyethylene, a durable, inert plastic often used for water mains and sewer systems. Considering a total of 126 such feet (18 intertidal PSBs with 7 feet each), and that these feet would not always ground out at the same location, it is estimated that approximately 2,520 square feet (234 square meters) of the intertidal zone would be disturbed over the long term (700 square feet [65 square meters] at the north LWI, and 1,820 square feet [169 square meters] at the south LWI). In addition, one buoy at the south LWI would ground out on an average low tide. Over the long term, including extreme low tides, three buoys (one at the north

LWI and two at the south LWI) would ground out at low tide. These buoys are 30 inches (76 centimeters) in diameter. Over the long term, grounding out by these buoys would disturb approximately 74 square feet (7 square meters) of seafloor.

Shoreline and Upland Construction

The abutments would be the same as described above under Alternative 2. In addition, an observation post would be installed at each LWI location. These posts would be approximately 25 by 45 feet (8 by 14 meters) and would include a separate stairway to the base of the bluff. Each post would require 12 30-inch (76-centimeter) piles that would be driven from land at low tide ("in the dry") using vibratory methods and impact methods as needed. The observation post stairways would be supported on 2 by 2 foot (0.6 by 0.6 meter) concrete pads. Each observation post would require a temporary construction trestle having dimensions of 20 by 50 feet (6 by 15 meters) at each LWI location, along with 10 24-inch (60-centimeter) diameter steel pipe piles supporting the temporary trestle at each LWI location. Driving of all piles for LWI Alternative 3 would require a maximum of 30 days of pile driving.

A third observation post 600 square feet (56 square meters) in area would be installed on the deck of Marginal Wharf, at the seaward apex of the wharf (Figure 2-1) and would include removal of an existing observation post. This new observation post would be similar in configuration, but smaller than the two shoreline observation posts (Figure 2-5). The post would be constructed of reinforced concrete. There would be no in-water construction, no part of this observation post would extend into the water, and no new over-water area would be created. Lighting would be similar to the existing post. Communication cables would be installed from an existing hub under an existing roadway to access the wharf, using standard construction methods that would include patching of the roadway after construction. The existing observation post is a small pre-engineered steel building that would be removed intact using a crane and truck. The roof has asbestos-containing material and would be handled and disposed of appropriately. The rest of the building would be sent to a metal recycler. Removal of the existing observation post and construction and operation of the replacement observation post would not affect vessel operations at the wharf. There would be no increase in airborne noise over existing conditions on this industrial wharf.

For Alternative 3, two 30-foot (9-meter) tall, on-land towers would be installed by bolting them to concrete foundations, one at the north LWI and one at the south LWI. These towers would be located within the extension of the WSE; no additional ground would be disturbed for the towers.

Construction Schedule

The construction schedule for LWI Alternative 3 would be the same as described above for LWI Alternative 2 except that only one in-water construction season would be needed.

2.1.1.3.4. LWI OPERATIONS

Operation of the LWI would consist primarily of maintenance of the in-water and upland structures, including routine inspections, cleaning, repair, and replacement of facility components (no pile replacement) as required. Operation would also include opening and closing of the PSBs for boat traffic, using small tug boats. The presence of the LWI would result in changes in patterns of security vessel movements, but such movements would be within the WRA and would not increase in frequency. For both alternatives, cleaning and replacement of the PSB guard panels (unbolted and re-bolted out of the water) would occur as needed. Cleaning would be accomplished by power washing. Measures would be employed to prevent discharges of contaminants to the environment (see BMPs, Section 2.3.2). For Alternative 2 (Pile-Supported Pier), annual cleaning would include removal of fouling organisms from the in-water mesh. Maintenance would require infrequent visits by vehicles to the upland portions and by small boats to the LWI structures (tying up to the floating docks). Operational lighting at the abutments for both alternatives would not exceed one foot candle to a distance of 50 feet (15 meters) from the abutments; these lights would operate continuously. For Alternative 2, operational lighting levels would not exceed 10 foot candles along the immediate pier structure, 0.5 foot candle out to a distance of 50 feet (15 meters) from the LWI structure, and 0.05 foot candle to a distance of 100 feet (30 meters). These lights would operate only during security responses. For Alternative 3, there would be no lighting on the PSB units, only on the abutment towers.

2.2. SPE PROPOSED ACTION

The SPE Proposed Action is to extend the existing Service Pier at NAVBASE Kitsap Bangor and construct associated support facilities. The SPE would provide additional berthing for maintenance of existing homeported and visiting submarines. The associated support facilities would provide logistical support for SEAWOLF, LOS ANGELES, and VIRGINIA Class submarines at the Navy's SSN research, development, test, and evaluation hub, which is currently located on NAVBASE Kitsap Bangor. Two action alternatives and the No Action Alternative (Alternative 1) are evaluated in the EIS. Under the No Action Alternative, the SPE would not be constructed or operated. The action alternatives are the Short Pier (Alternative 2), which is the Preferred Alternative, and the Long Pier (Alternative 3). Alternative 2 would extend the existing 500-foot (152-meter) long Service Pier by 540 feet (165 meters); Alternative 3 would extend it by 975 feet (297 meters). After construction of the SPE, the Service Pier would be 1,040 feet (317 meters) or 1,475 feet (450 meters) long under Alternatives 2 and 3, respectively. Both alternatives would include construction of a 2,100 square foot (195-square meter) Pier Services and Compressor Building on the Service Pier and relocation of the existing PSB system to attach to the end of the pier extension. The upland portions of the two action alternatives would be the same. A new 50,000-square foot (4,645-square meter) Waterfront Ship Support Building would be built at the site of an existing parking lot. Additional new project elements including an approximately 420-space parking lot, utilities, and road improvements would occupy a total of approximately 7 acres (2.8 hectares). The design life of the SPE Proposed Action is 50 years.

Military Construction projects such as SPE must be authorized and funded by Congress. The SPE project is not currently funded or programmed for implementation, and therefore a future construction schedule has not been determined. This means that the SPE project might be scheduled for construction in the future, but with limited resources and competing priorities, the decision to fund and construct the SPE and associated support facilities has not been made and a time frame for doing so has not been determined. Because the passage of time has the potential to alter the affected environment and anticipated impacts, completion of the NEPA process through a Record of Decision, along with regulatory consultations and permit applications, will be deferred until such time as a decision is made to proceed with the SPE project, so that any relevant supplemental information can be taken into account. However, because the SPE Proposed Action has already undergone significant analysis, and because the project authorization and scheduling modifications occurred during the EIS preparation process, the Navy continued to include the description and environmental impact analysis of the SPE project in this Final EIS to provide the most comprehensive environmental information and to support the cumulative effects analysis.

2.2.1. SPE Alternatives

2.2.1.1. ALTERNATIVES DEVELOPMENT AND SCREENING CRITERIA

Screening criteria were developed to determine if a potential alternative was reasonable, whether it met the purpose and need, and if it should be carried forward for detailed analysis in the EIS. The screening criteria listed below were used in the identification and evaluation of SPE action alternatives:

- Supports master planning considerations and does not impact other operational missions on NAVBASE Kitsap,
- Avoids or minimizes impacts on tribal usual and accustomed harvest areas,
- Integrates pier and support facilities into existing facilities and infrastructure to the extent practicable, and
- Provides unrestricted access to the ocean.

2.2.1.2. ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

Using the above screening criteria, the following alternatives were considered but eliminated from further analysis in the EIS.

- *Pier placement on NAVBASE Kitsap Bangor separate from existing Service Pier.* Because of the requirements of other missions at Bangor, the waterfront is constrained from new pier development south of Carlson Spit and north of the Service Pier (Figure 2–1). This alternative was not carried forward for further analysis because it would impact other operational missions and could not be integrated into existing facilities and infrastructure.
- *Alternative building layouts for Service Pier Extension.* The Navy considered constructing a 19,000-square foot (1,765-square meter) pile-supported Waterfront Support Building on the south side of the pier extension. This alternative was eliminated because of the greater environmental impacts compared to the proposed on-land facility, particularly overwater shading impacts.

2.2.1.3. SPE ALTERNATIVES EVALUATED IN EIS

Two action alternatives were identified as meeting the purpose and need and the screening criteria. These alternatives consist of a short pier configuration and a long pier configuration. These action alternatives and the No Action Alternative are described below.

2.2.1.3.1. SPE ALTERNATIVE 1: NO ACTION

Under SPE Alternative 1, the No Action Alternative, no Service Pier extension or associated support facilities would be built at NAVBASE Kitsap Bangor. This alternative would not meet the purpose and need for the Proposed Action. It would not provide alternative opportunities for berthing to mitigate restrictions at NAVBASE Kitsap Bremerton on navigating SEAWOLF Class submarines through Rich Passage under certain tidal conditions, or improve long-term operational effectiveness for the three SEAWOLF Class submarines on NAVBASE Kitsap. The No Action Alternative would not provide berthing and logistical support for SEAWOLF, LOS ANGELES, and VIRGINIA submarine classes at the Navy's SSN research, development, test and evaluation hub, nor improve submarine crew training and readiness through co-location of command functions on the NAVBASE Kitsap Bangor submarine training center. No environmental impacts would result from the No Action Alternative, as no construction or physical alteration to the waterfront would occur, and there would be no changes in operations. The No Action Alternative is carried forward for analysis because it is required by NEPA and constitutes baseline conditions for environmental analysis of the Proposed Action.

2.2.1.3.2. SPE ALTERNATIVE 2: SHORT PIER CONFIGURATION (PREFERRED)

SPE Alternative 2 is the Preferred Alternative, in part because it would have fewer environmental impacts than Alternative 3 and, therefore, it is also the environmentally Preferred Alternative and the Least Environmentally Damaging Practicable Alternative according to the CWA Section 404 (b)(1) guidelines. Table 2–2 (presented at the end of Section 2.2.1.3.3) summarizes SPE Alternative 2.[3]

Under SPE Alternative 2, the Navy would construct and operate an approximately 540-foot (165-meter) long and 68 feet (21 meters) wide, 44,000-square foot (4,090-square meter) surface area extension to the existing Service Pier (Table 2–2) that would be capable of a double-breasted (side-by-side) berthing configuration for submarine maintenance. The new total length of the Service Pier would be 1,040 feet (317 meters). Proposed new facilities would include a pier crane on a 28- by 60-foot (9- by 18-meter) foundation, a 2,100-square foot (195-square meter) Pier Services and Compressor Building located on the Service Pier, an upland 50,000-square foot (4,645-square meter) Waterfront Ship Support Building, an approximately 420-car parking lot, and roadway and utility improvements (transmission line upgrades and a new substation) (Figure 2–9). The Waterfront Ship Support Building would be designed and constructed to be eligible to receive a minimum Leadership in Energy and Environmental Design (LEED) certification of Silver. LEED is a third-party certification program and nationally accepted benchmark for the design, construction, and operation of high-performance green buildings developed by the U.S. Green Building Council. BMPs and impact reduction measures that would be implemented to avoid or minimize potential environmental impacts associated with the SPE Proposed Action are discussed in Section 2.3.

The proposed Pier Services and Compressor Building would house the compressor and would be located at the south end of the existing Service Pier (Figure 2–9). The Pier Services and Compressor Building is needed to house sewage lift stations, and "high pressure" and "low

[3] Under SPE Alternative 1, the No Action Alternative, there would be no change to the environment due to construction and operation of an SPE. Therefore, the No Action Alternative is not included in Table 2–2.

pressure" compressors that would provide an off-hull source of air for charging submarine air banks, as well as breathing quality air needed for purging the ship's ballast tanks to allow entry for maintenance. The compressors need to be located as near to the ship as possible to minimize the accumulation of moisture in the air lines.

Pile Installation and Wave Screen

The existing Service Pier is approximately 500 feet long by 85 feet wide (152 by 26 meters). The proposed extension of the Service Pier would be approximately 68 by 540 feet (21 by 165 meters) and would require installation of approximately 230 36-inch (90-centimeter) diameter steel pipe support piles. After construction of the SPE, the pier would be 1,040 feet (317 meters) long. Approximately 50 24-inch (60-centimer) diameter steel pipe piles would be used for mooring of existing small craft and mooring camels for the SSNs. Approximately 105 18-inch (45-centimeter) square concrete fender piles would also be installed. Driving of the steel support piles would use a combination of vibratory (primary) and impact methods and would require pile driving on no more than 125 days during the first in-water work season. Driving of the concrete piles would use impact methods only and would require pile driving on no more than 36 days during the second in-water work season. The pier extension would extend to the southwest from the south end of the existing Service Pier and would parallel Carlson Spit in water depths of 30 to 50 feet (9 to 15 meters) below MLLW, such that the berthing areas for the new submarines would be in water depths of approximately 50 to 85 feet (15 to 26 meters) below MLLW. A concrete float 150 feet (46 meters) long and 15 feet (4.6 meters) wide would be attached to the south side of the SPE (Figure 2–10). The existing PSB system would be re-configured slightly to attach to the end of the new pier extension, with approximately 540 feet (165 meters) removed. Removal and disposal of existing PSBs would be done as described for the LWI project. Construction is expected to require one barge with a crane, one supply barge, a tugboat, and work skiffs.

Construction would be preceded by removal of an existing wave screen (including piles) and other existing piles from the Service Pier. A total of 36 existing creosote timber piles (19 18-inch [45-centimeter] and 17 15-inch [38-centimeter] piles) would be removed by using a clam shell or similar methods and would be cut at the mudline if splitting or breakage occurs. A floating boom and other measures would be used to protect water quality during this activity (Section 2.3.2). In addition, a new wave screen would be installed under the SPE (Figure 2–10). This screen would be about 200 feet (60 meters) long and 27 feet (8 meters) high (20 feet [6 meters] below to 7 feet [2 meters] above MLLW), made of concrete or steel, and attached to steel support piles for the SPE.

Upland Construction

The proposed Waterfront Ship Support Building would be located on an existing 36,000-square foot (330-square meter) parking lot on the east side of Wahoo Road which has 107 parking spaces. Based on the loss of this lot and the related relocation of existing personnel at NAVBASE Kitsap Bangor, a new 6-acre (2.4-hectare) parking lot of approximately 420 spaces would be needed. This parking lot would be located approximately 1,200 feet (370 meters) south of the proposed Waterfront Ship Support Building within a vegetated area. Road improvements to accommodate changes in traffic patterns along Wahoo and Sealion Roads, repairs to existing roads damaged from construction activity, and electrical utility upgrades would also be included under this alternative. The area permanently occupied by new project elements would be approximately 7 acres (2.8 hectares). Approximately 4 acres (1.6 hectares) would be disturbed temporarily for a construction laydown area and other construction-related disturbance and revegetated with native species following construction. The parking lot, utilities, and laydown area would be located within the area between Sturgeon Street and Sealion Road, as shown on Figure 2–9.

Construction Schedule

The SPE project is currently unprogrammed, and the construction schedule has not been determined. Upland construction would take approximately 400 days; equipment would include backhoes, bulldozers, loaders, graders, trucks, and paving equipment. Construction of all proposed facilities is anticipated to take approximately 24 months. Pile driving would occur within the in-water work windows (July 15 to January 15) to minimize potential impacts on ESA-listed fish species. It is not expected that completion of pile driving would require two full 6-month in-water work seasons. Relocation of existing PSB units and anchors could occur outside the in-water work window. There would be no work in the intertidal zone. The number of construction workers is estimated at 225.

2.2.1.3.3. SPE Alternative 3: Long Pier Configuration

Under this alternative the pier extension would be approximately 975 feet (297 meters) long and 68 feet (21 meters) wide and would have a surface area of approximately 70,000 square feet (6,500 square meters) (Figure 2–11). The new total length of the Service Pier would be approximately 1,475 feet (450 meters). This design would allow two submarines to be berthed in an in-line configuration rather than breasted (side-by-side). Table 2–2 summarizes SPE Alternative 3. The total number of 24-inch (60-centimeter) diameter steel support piles would be approximately 500, including those for small craft and camel mooring; there would be approximately 160 18-inch (40-centimeter) square concrete fender piles. Driving of steel piles would require driving on no more than 155 days and would take place during the first in-water construction season. Driving of concrete piles would require driving on no more than an additional 50 days and would take place during the second in-water work season. The PSB relocation would differ from the relocation under SPE Alternative 2 so as to connect the PSBs to the end of the longer pier extension; approximately 975 feet (297 meters) of existing PSBs would be removed. All other aspects of SPE Alternative 3 would be the same as SPE Alternative 2, including upland features and overall construction schedule. It is expected that completion of in-water work would require two full in-water work seasons. Alternative 3 would meet the purpose and need and screening criteria, but would have greater environmental impacts (Section 2.4.2) and cost more than Alternative 2.

2.2.1.3.4. SPE Operations

Operation of the SPE that would occur following project completion would be similar to existing day-to-day operations that currently occur at NAVBASE Kitsap Bangor. All waste discharges from submarines moored at the SPE would be pumped ashore to the existing base waste treatment systems. Drainage water from the SPE would be collected in a trench drain on the pier, treated using an in-line canister system designed to meet the basic treatment requirements of the Washington Department of Ecology (WDOE) *Stormwater Management Manual for Western Washington*, and then discharged to Hood Canal in accordance with a National Pollutant Discharge Elimination System (NPDES) permit.

Table 2–2. Summary of the Action Alternatives for the SPE Project

SPE Facility Feature[1]	SPE Alternative 2 (Preferred): Short Pier Configuration	SPE Alternative 3: Long Pier Configuration
Length and width of pier extension	540 feet (165 meters) long 68 feet (21 meters) wide	975 feet (297 meters) long 68 feet (21 meters) wide
Number of steel support piles	230 36-inch (90-cm)	500 24-inch (60-cm)
Number of concrete fender piles	105 18-inch (45-cm)	160 18-inch (45-cm)
Number of small craft mooring steel piles	50 24-inch (60-cm)	50 24-inch (60-cm)[2]
Number of creosote-treated timber piles removed	19 18-inch (45-cm) 17 15-inch (38-cm)	Same as SPE Alternative 2
Total area displaced by piles[3]	1,965 sq ft (183 sq m)	1,876 sq ft (174 sq m)
Size of float	150 feet long by 15 feet wide (46 by 4.6 meters), 2,250 sq ft (209 sq m)	Same as SPE Alternative 2
Total over-water area	44,000 sq ft (4,090 sq m)	70,000 sq ft (6,500 sq m)
New wave screen	Approx. 200 feet (60 meters) long and 27 feet (8 meters) high, concrete or steel, attached to existing piles	Same as SPE Alternative 2
Barge trips (round trips)	6 per month on average	Same as SPE Alternative 2
Upland area permanently occupied by new structures (maximum)	7 acres (2.8 hectares)	Same as SPE Alternative 2
Upland area temporarily disturbed by construction (maximum)	4 acres (1.6 hectares)	Same as SPE Alternative 2
New facilities	• Pier crane • 2,100 sq ft (195 sq m) Pier Services & Compressor Building • 50,000 sq ft (4,645 sq m) Waterfront Support Building • Approx. 420-space parking lot	Same as SPE Alternative 2
Roadway and utilities improvements	Transmission line upgrades, switch gear, and new substation (included in upland area disturbed above)	Same as SPE Alternative 2
Overall construction duration	24 months	Same as SPE Alternative 2
Duration of in-water work[4]	Two in-water work seasons including up to 125 days of driving of steel support piles and 36 days of driving concrete fender piles	Two in-water work seasons including up to 155 days of driving of steel support piles and 50 days of driving concrete fender piles

cm = centimeter; cu yd = cubic yard; N/A = not applicable; sq ft = square feet; sq m = square meter

1. Numbers are based on preliminary design and are approximate and subject to change.
2. Included in the total number of 24-inch steel support piles.
3. Includes the area displaced by the proposed pier extension piles minus the area of piles being removed from the existing Service Pier.
4. In-water work season would be July 15 to January 15.

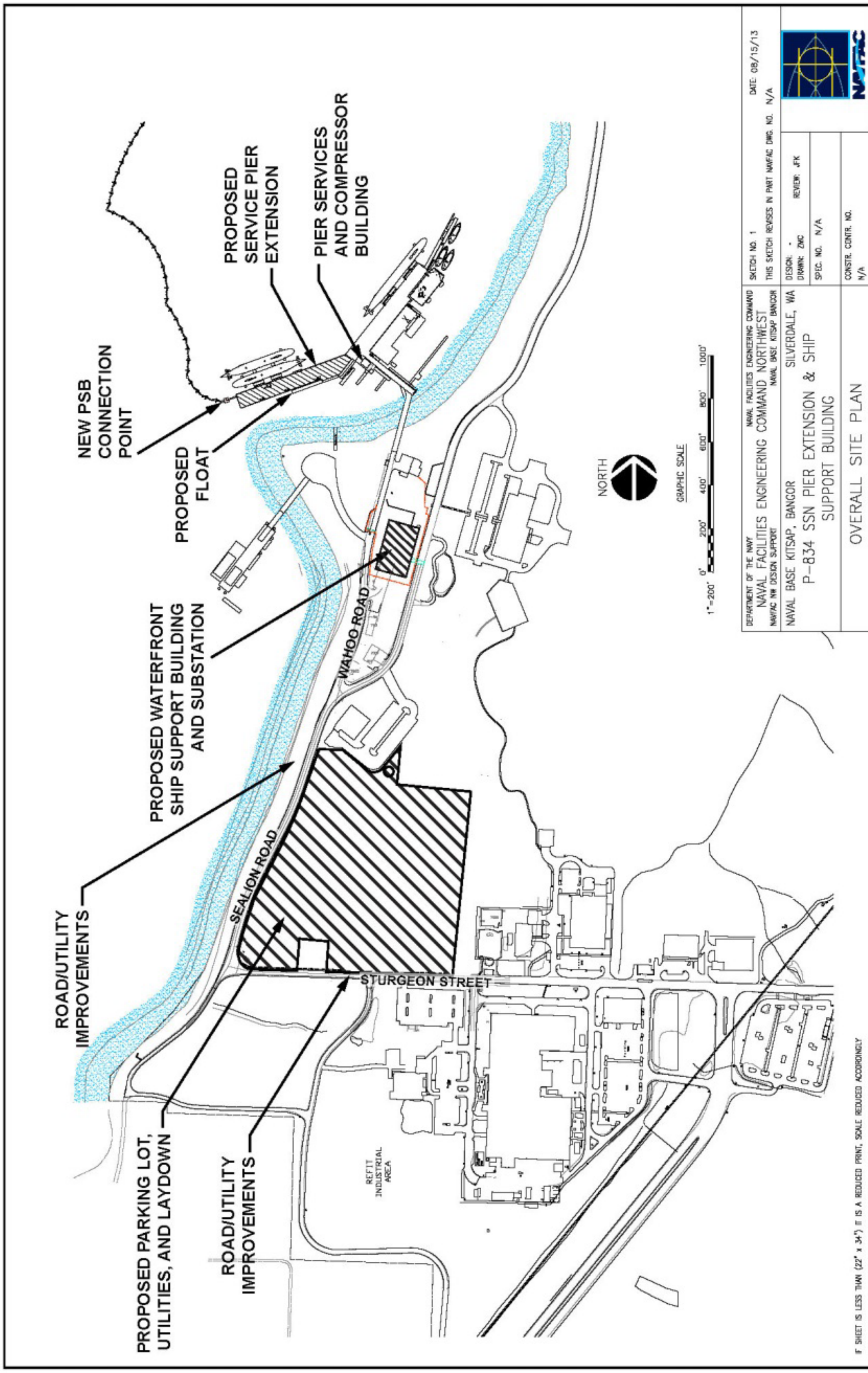

Figure 2–9. Service Pier Extension Alternative 2 (Short Pier)

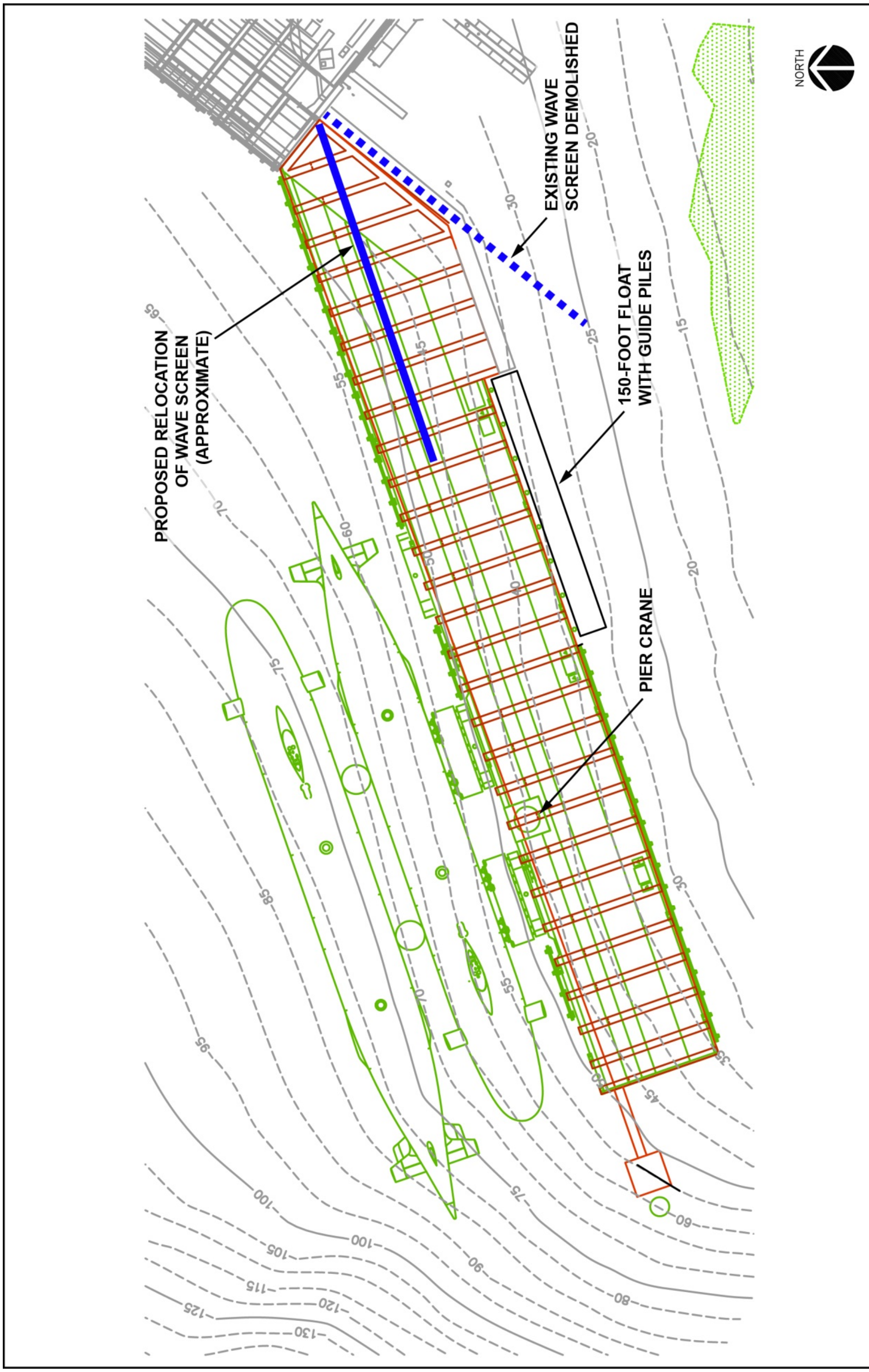

Figure 2–10. Location of 150-foot Float, Wave Screen to be Removed, and New Wave Screen for SPE Project

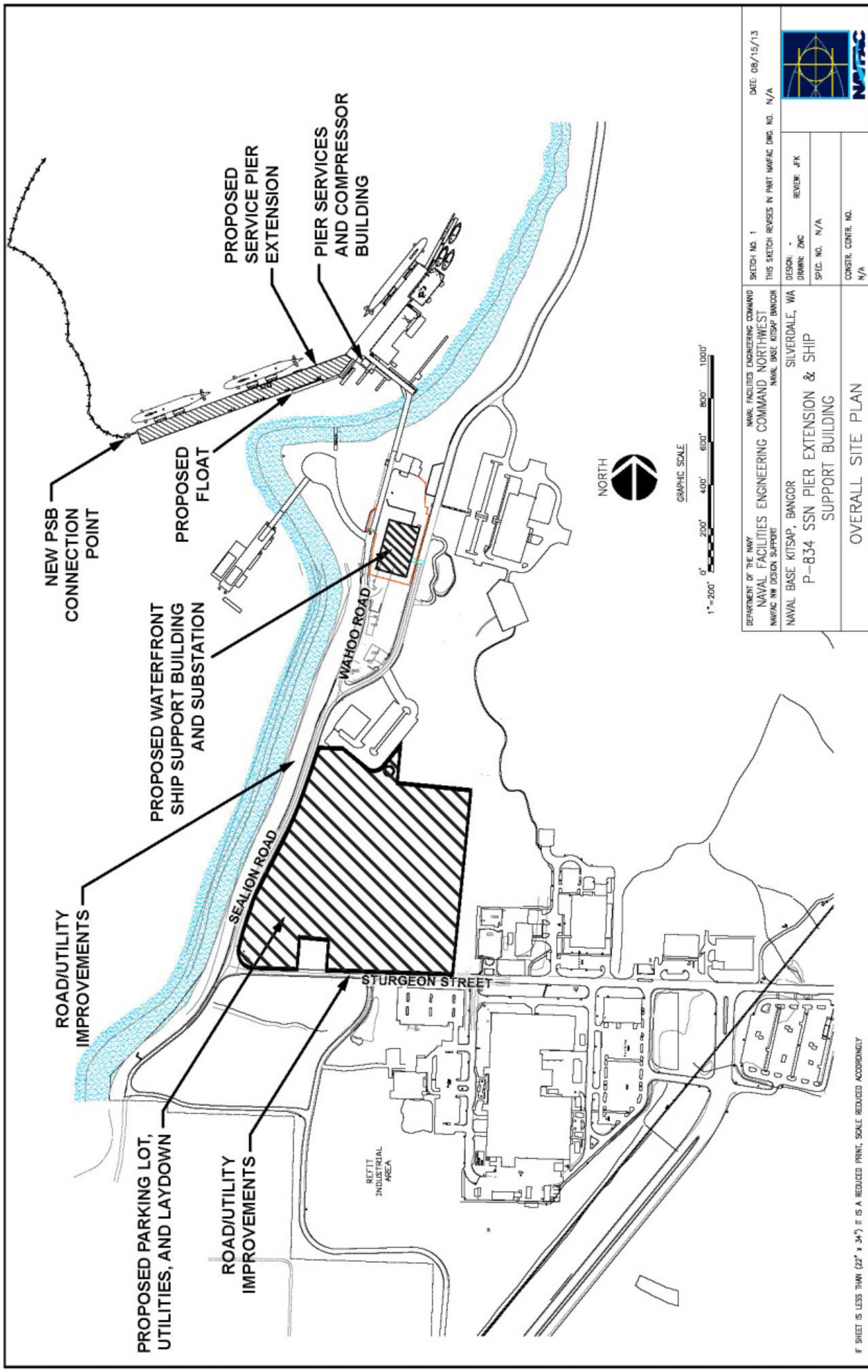

Figure 2–11. Service Pier Extension Alternative 3 (Long Pier)

The average number of one-way Hood Canal transits of SSN submarines to or from the Service Pier would increase from approximately 0.5 per month currently to 2 per month. These submarines are not escorted to and from NAVBASE Kitsap Bangor as are the TRIDENT Class submarines, but there would be an increase in small, existing support vessel traffic at the Service Pier.

Operational lighting levels would not exceed 10 foot candles on the pier deck, 0.5 foot candle from the pier deck to a distance of 50 feet (15 meters) from the pier deck, and 0.05 foot candle to a distance of 100 feet (30 meters).

2.3. DESIGN AVOIDANCE AND MINIMIZATION MEASURES, BMPS, AND CURRENT PRACTICES

The proposed projects would incorporate the following design avoidance and minimization measures, BMPs, and current practices as part of construction and operation to avoid or minimize potential environmental impacts.

2.3.1. Design Avoidance and Minimization Measures

For both the LWI and SPE, the Navy carefully analyzed all alternatives and modified their design to minimize environmental impacts to the extent feasible. For both projects, the preferred alternative was selected in part because it would have fewer environmental impacts than the other alternatives carried forward for detailed analysis in this EIS. Therefore, the two preferred alternatives are also the environmentally preferred alternatives. In addition, impact avoidance and minimization measures were included in the design of the various alternatives, as listed below:

- For both projects, the number of piles and anchors was minimized while still meeting structural, safety, and security requirements.
- For LWI Alternative 2, the piers were designed to minimize overwater coverage and maximize light transmittance. The pier was limited to pedestrian access, which allows it to be narrower and have a grated deck, as well as fewer, more widely spaced piles.
- For LWI Alternative 2, a mesh anchoring system was developed that did not require dredging.
- For LWI Alternative 2, the mesh size was maximized to facilitate fish passage while still meeting security requirements.
- For both LWI alternatives, the shoreline abutments are the minimum size, and located to minimize environmental impacts to the extent feasible, while still meeting the required security function.
- For LWI Alternative 3, the PSB pontoons would be fitted with “feet” to minimize disturbance of the seafloor when the pontoons bottom out at low tide.
- For both SPE alternatives, the pier extension was placed in deep water to minimize impacts on marine vegetation and habitat, and interference with nearshore fish migration.

- For both SPE alternatives, as many facilities as possible were sited on land versus on the pier to minimize the size of the pier.

2.3.2. BMPs and Current Practices

This section summarizes BMPs and current practices that would be implemented during the Proposed Actions to minimize environmental impacts. More detailed descriptions of these measures can be found in the various resource sections (Sections 3.1, 3.2, etc.) of Chapter 3 and in the Mitigation Action Plan (Appendix C).

2.3.2.1. CONSTRUCTION

- To reduce the likelihood of any petroleum products, chemicals, or other toxic or deleterious materials from entering the water, fuel hoses, oil or fuel transfer valves, and fittings will be checked regularly for drips or leaks and will be maintained and stored properly to prevent spills from construction and pile driving equipment into state waters.
- To limit soil erosion and potential pollutants contained in stormwater runoff, a Storm Water Pollution Prevention Plan (SWPPP) will be prepared and implemented in conformance with the *Stormwater Management Manual for Western Washington* (WDOE 2014) (applies to Operations also).
- Oil booms will be deployed around in-water construction sites as required by a Clean Water Act (CWA) Section 401 Water Quality Certification for the projects, to minimize water quality impacts during construction.
- Debris will be prevented from entering the water during all demolition or new construction work. During in-water construction activities, floating booms will be deployed and maintained to collect and contain floatable materials released accidentally. Any accidental release of equipment or materials will be immediately retrieved and removed from the water. Following completion of in-water construction activities, an underwater survey will be conducted to remove any remaining construction materials that may have been missed previously. Retrieved debris will be disposed of at an upland disposal site.
- Removed creosote-treated piles and associated sediments (if any) will be contained on a barge or, if a barge is not utilized, stored in a containment area near the construction site. All creosote-treated material and associated sediments will be disposed of in a landfill that meets the liner and leachate standards of the Washington Administrative Code (WAC).
- Piles will be removed by using a clam shell or similar methods and will be cut at the mudline if splitting or breakage occurs.
- To minimize impacts on marine habitat, limitations will be placed on construction vessel operations, anchoring, and mooring line deployment. A mooring and anchoring plan will be developed and implemented to avoid dragging anchors and lines in special status areas. Spudding/anchoring in existing eelgrass habitat will be avoided whenever possible. Vessel operators will be provided with maps of the construction area with eelgrass beds clearly marked. Resulting seafloor disturbance will be confined to a 100-foot (30-meter) wide corridor on each side of the structure under construction.

- Barges and other construction vessels will not be allowed to run aground. Additionally, vessel operators will be instructed to avoid excess engine thrust in water depths shallower than 30 feet (9 meters) to the extent possible.
- To minimize impacts on ESA-listed fish species, in-water construction will be conducted within the in-water work window (July 15 through January 15). The exception is that mesh installation (LWI Alternative 2), relocation of PSBs, and placement of anchors could occur outside the work window.

2.3.2.2. OPERATIONS

- For LWI Alternative 2, the in-water mesh will be cleaned regularly by power washing to minimize impacts on migrating fish. For both alternatives, the guard panels between PSB pontoons will be cleaned regularly.
- Applicable measures described above for Construction (Section 2.3.2.1) to protect water quality and habitats will be implemented during operational procedures.
- Low impact development and integrated management practices will be developed and implemented.

2.3.3. Mitigation Measures

This section summarizes mitigation measures that would be implemented during the Proposed Actions to minimize environmental impacts. Although these measures are identified in this Final EIS, they remain discretionary until committed to in the Record of Decision. More detailed descriptions of these measures can be found in the various resource sections (Sections 3.1, 3.2, etc.) of Chapter 3 and in the Mitigation Action Plan (Appendix C).

- Pile driving of steel piles would be done using vibratory rather than impact methods whenever feasible, which would reduce noise levels by approximately 20 decibels root mean square (dB RMS) at 33 feet (10 meters) from the source.
- Bubble curtains would be used around steel piles being driven by impact methods to attenuate in-water sound pressure of the pile driving activity. The Navy would also consider other equally or more effective noise attenuation methods that may become available. Noise attenuation would not be used for driving concrete piles (SPE only), because of the much lower noise levels generated by driving of concrete piles compared to steel piles and the resulting much lower potential for impacts to biota.
- During impact pile driving, a soft-start approach would be used to induce marine mammals to leave the immediate area. This soft-start approach requires contractors to initiate noise from hammers at reduced energy, followed by a waiting period. Due to mechanical limitations, soft starts for vibratory driving would be conducted only with drivers equipped with variable moment features. Typically, this feature is not available on larger, high power drivers. The Navy would use the driver model most appropriate for the geologic conditions at the project location, and would perform soft starts if the hammer is equipped to conduct them safely.
- Construction activities would not be conducted during the hours of 10:00 p.m. and 7:00 a.m. Between July 15 and September 23, impact pile driving would only occur between 2 hours

after sunrise and 2 hours before sunset to protect foraging marbled murrelets during the breeding season. Between September 24 and January 15, in-water construction activities would occur during daylight hours (sunrise to sunset). The Navy would notify the public about upcoming construction activities and noise at the beginning of each construction season.

- Construction in the upper intertidal zone (LWI abutments and observation posts) would be conducted at low tide ("in the dry") to minimize impacts to marine water quality and underwater noise.
- To avoid impacts on marine mammals protected by ESA and Marine Mammal Protection Act (MMPA) and marine birds protected by ESA, monitoring of injury (shutdown) and buffer zones around in-water pile driving locations would be implemented. Pile driving would be stopped whenever a protected animal enters the shutdown zone. Detailed marine mammal and marbled murrelet monitoring plans would be developed and implemented in consultation with National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS).
- To protect potential breeding marbled murrelets, tree removal for the SPE project would not be conducted during the marbled murrelet breeding season of April 1 through September 23. Tree removal would be conducted in a manner that is protective of all migratory birds.
- A revegetation plan would be developed with the objective of restoring native vegetation to the areas temporarily cleared for the construction laydown area and construction of new roads. A monitoring and maintenance program (such as once a month) would be implemented until the native plants are sufficiently established to minimize invasion by noxious weeds.
- The Navy would develop a local Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity. Barge trips and associated bridge openings would be scheduled to avoid peak commuting hours. The Notice to Mariners would also serve to notify divers, including tribal divers, of potential underwater noise impacts.
- The Navy would, as part of the Proposed Actions, undertake Compensatory Mitigation to offset unavoidable adverse impacts on aquatic resources under the provisions of the CWA Compensatory Mitigation for Losses of Aquatic Resources, Final Rule (U.S. Army Corps of Engineers [USACE] and U.S. Environmental Protection Agency [USEPA] 2008). The Navy would purchase habitat credits from the Hood Canal In-Lieu Fee Program, which would implement appropriate mitigation in the Hood Canal watershed. The In-Lieu Fee Program is described in Section 6 of Appendix C, Mitigation Action Plan.
- The Navy would undertake mitigation projects proposed to address potential effects of the Proposed Actions on reserved Treaty rights and resources of the involved federally recognized American Indian Tribes. The Navy's proposed Treaty mitigation projects are described in Section 9 of Appendix C, Mitigation Action Plan.

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CHAPTER 3

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

TABLE OF CONTENTS

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

In this chapter, discussions of the affected environment for each resource provide general descriptions of regional conditions followed, as appropriate, by project site-specific discussions for the Land Water Interface (LWI) and Service Pier Extension (SPE) projects. Because the LWI and SPE projects are independent, their environmental impacts are evaluated separately in this chapter. The combined impacts that would occur if both projects are implemented are evaluated at the end of each resource section in Chapter 3. Construction of the two projects would not overlap, extending the duration of impacts beyond what would occur under either of the projects alone. The contributions of the Proposed Actions to cumulative impacts in the region are evaluated in Chapter 4.

3.1 MARINE WATER RESOURCES

3.1.1 Affected Environment

Marine water resources focus on hydrography (circulation and sediment transport patterns), water quality (physical and chemical properties of a water body), and sediment quality (physical and chemical properties of bottom sediments).

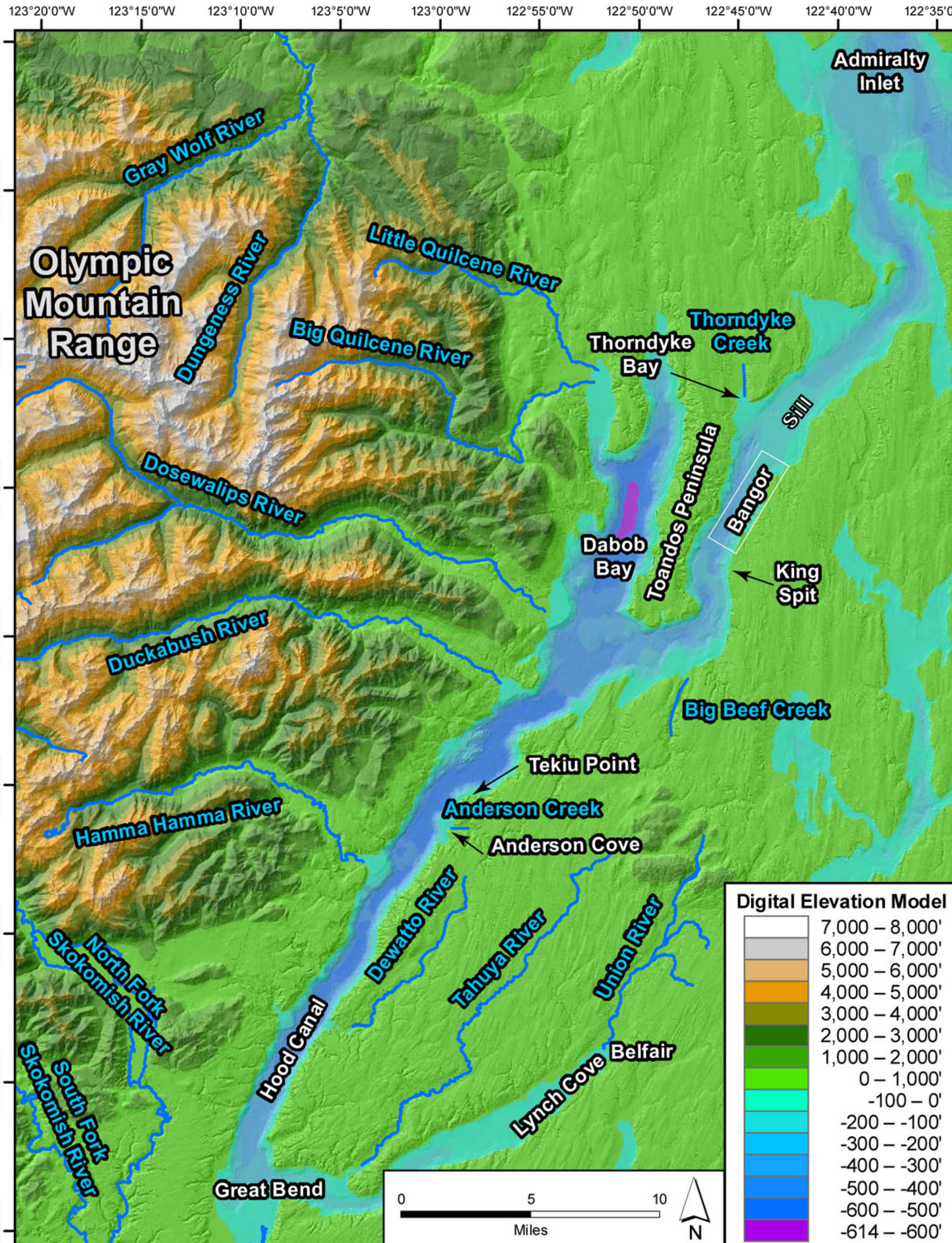
3.1.1.1 EXISTING CONDITIONS

3.1.1.1.1 HYDROGRAPHY

Hydrography focuses on circulation (water movement) patterns as affected by the seafloor topography (bathymetry), currents, and tides, as well as the characteristics (density) of the different water masses in the project vicinity. Hydrographic processes are important because they affect the dispersion and mixing of sediments resuspended from in-water construction activities, the rate of sediment accumulation or erosion from the seafloor, and processes that transport sediments along the shoreline. Hydrographic processes also influence other resources such as water quality, marine vegetation, fish, and benthic communities. This section summarizes the hydrographic setting of Hood Canal and areas around the LWI and SPE project sites.

Hood Canal is a long, narrow, fjord-like basin in western Puget Sound. Oriented northeast to southwest, the canal is 52 miles (84 kilometers) long from Admiralty Inlet to the Great Bend, at Skokomish, Washington. East of the Great Bend, the canal extends an additional 15 miles (24 kilometers) to the headwaters at Belfair (Figure 3.1–1). Throughout its 67-mile (110-kilometer) length, the width of Hood Canal varies from approximately 1 to 2 miles (1.6 to 3.2 kilometers). The entire length of Hood Canal basin shoreline, inclusive of the many embayments and coves, is approximately 288 miles (460 kilometers).

Although no official boundaries exist along the waterway, the northeastern section of the canal extending from the mouth of the canal at Admiralty Inlet to the southern tip of Toandos Peninsula is referred to as northern Hood Canal, while the region from Toandos Peninsula south to Great Bend is considered mid-Hood Canal, and the reach from Great Bend to Lynch Cove is referred to as southern Hood Canal. The Naval Base (NAVBASE) Kitsap Bangor project sites are located in northern Hood Canal.



Source: Morris et al. 2008

NOTE:
Coordinate System: WA State Plane (North)
Horizontal Datum: NAD83
Vertical Datum: MHW
Units: feet
DEM provided by University of Washington

Figure 3.1–1. Hood Canal Bathymetry, Surface Water, and Physical Relief

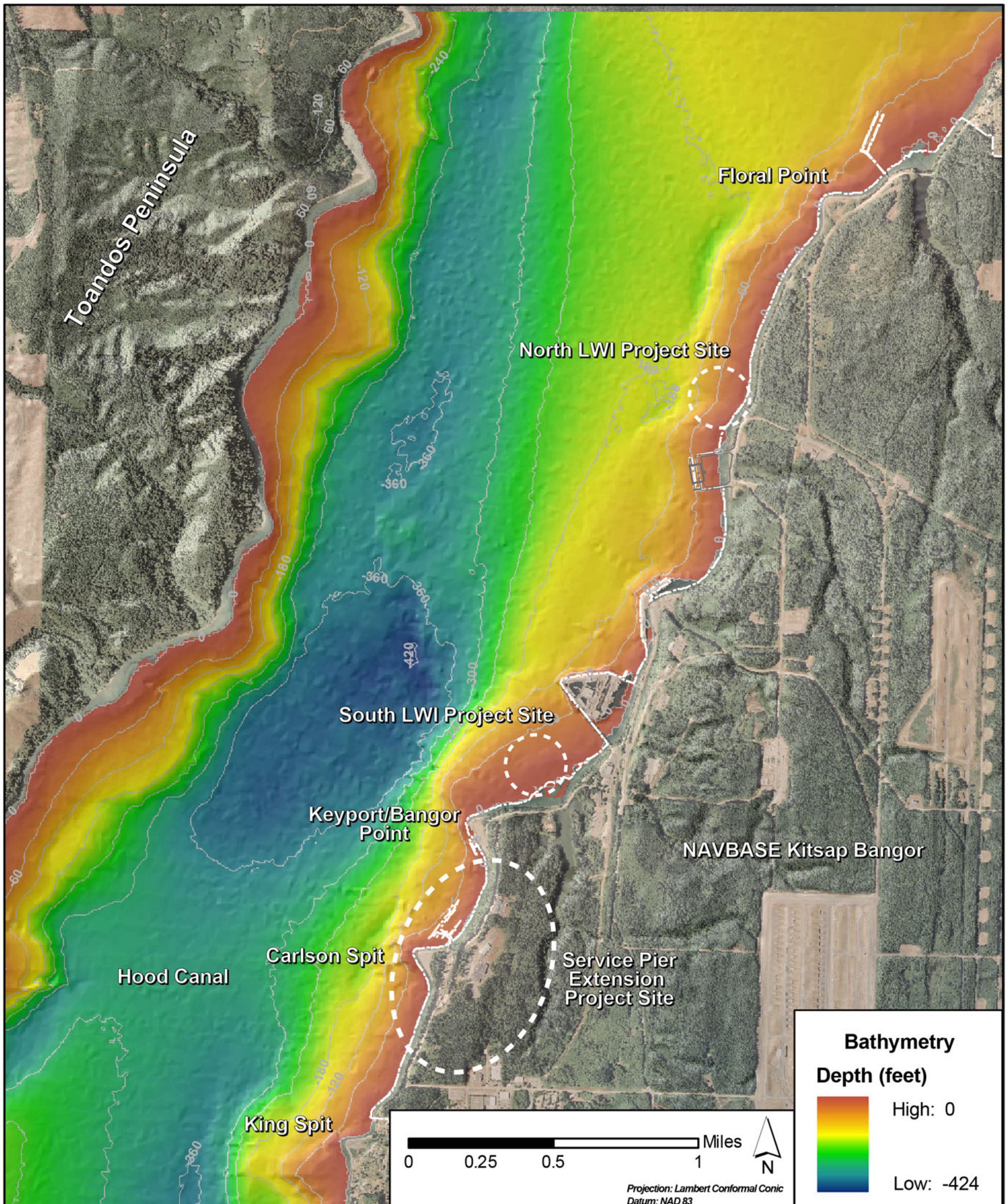
BATHYMETRIC SETTING

Hood Canal is characterized by relatively steep sides and irregular seafloor topography. In northern Hood Canal, water depths in the center of the waterway near Admiralty Inlet vary from 300 to 420 feet (91 to 128 meters). As the canal extends southwestward toward the Olympic Mountain Range and Thorndyke Bay, the water depth decreases to approximately 160 feet (49 meters) over a moraine deposit. This deposit forms a sill across the canal in the vicinity of Thorndyke Bay, which limits seawater exchange with the rest of Puget Sound. Southwest of Thorndyke Bay, the seafloor rapidly falls away to depths in excess of 300 feet (91 meters) adjacent to Brown Point on the Toandos Peninsula. The NAVBASE Kitsap Bangor waterfront occupies approximately 5 miles (8 kilometers) of the shoreline within northern Hood Canal (1.7 percent of the entire Hood Canal coastline) and lies just south of the sill feature. The width of the canal near the project sites ranges from approximately 1 to 2 miles (1.6 to 3.2 kilometers) (Figure 3.1–2).

Globally, sea level has been rising for the past 10,000 years as a result of the end of the last glacial epoch (Gornitz 2007). However, there is evidence that the rate of sea level rise (SLR) is accelerating due to ocean warming (thermal expansion), continental ice melt, and land elevation changes (Cayan et al. 2006). U.S. Army Corps of Engineers (USACE) guidance for incorporating sea level change considerations in civil works programs recommends evaluating project alternatives using three scenarios for SLR: low, intermediate, and high (USACE 2011). Projections of SLR for Puget Sound under low and high scenarios range from 3 to 22 inches (0.08 to 0.6 meter) by 2050 and from 6 to 50 inches (0.15 to 1.3 meters) by 2100 (Littell et al. 2009). For the proposed SPE project alternatives, SLR is not an issue because the pier and pile caps are designed to match those of the existing structure, and the pier is high enough above the water level to not be impacted within the design life of the project (50 years). The elevation of the bottom of the Service Pier deck is approximately 16 feet (4.9 meters) above mean lower low water (MLLW) or approximately 5 feet (1.5 meters) above current mean higher high water (MHHW). With a worst-case SLR of 22 inches by the year 2050, the pier bottom would be approximately 3.2 feet (1 meter) above the new MHHW. With a worst-case SLR of 50 inches by 2100, the pier bottom would still be above the new MHHW. The most likely scenario is that the pier bottom would be several feet above the new MHHW over the 50-year design life of the project. Similarly, over the 50-year design life of the proposed LWI piers (Alternative 2), the pier bottoms would be high enough above the water (17 feet [5.2 meters] above MHHW) that they would not be affected. Effects on the north and south LWI abutments and observation posts would be negligible under any SLR scenario. In addition, the floating Port Security Barriers (PSBs) would not be affected by SLR. For these reasons, the effects of SLR on the LWI and SPE project alternatives are not addressed further in this environmental impact statement (EIS).

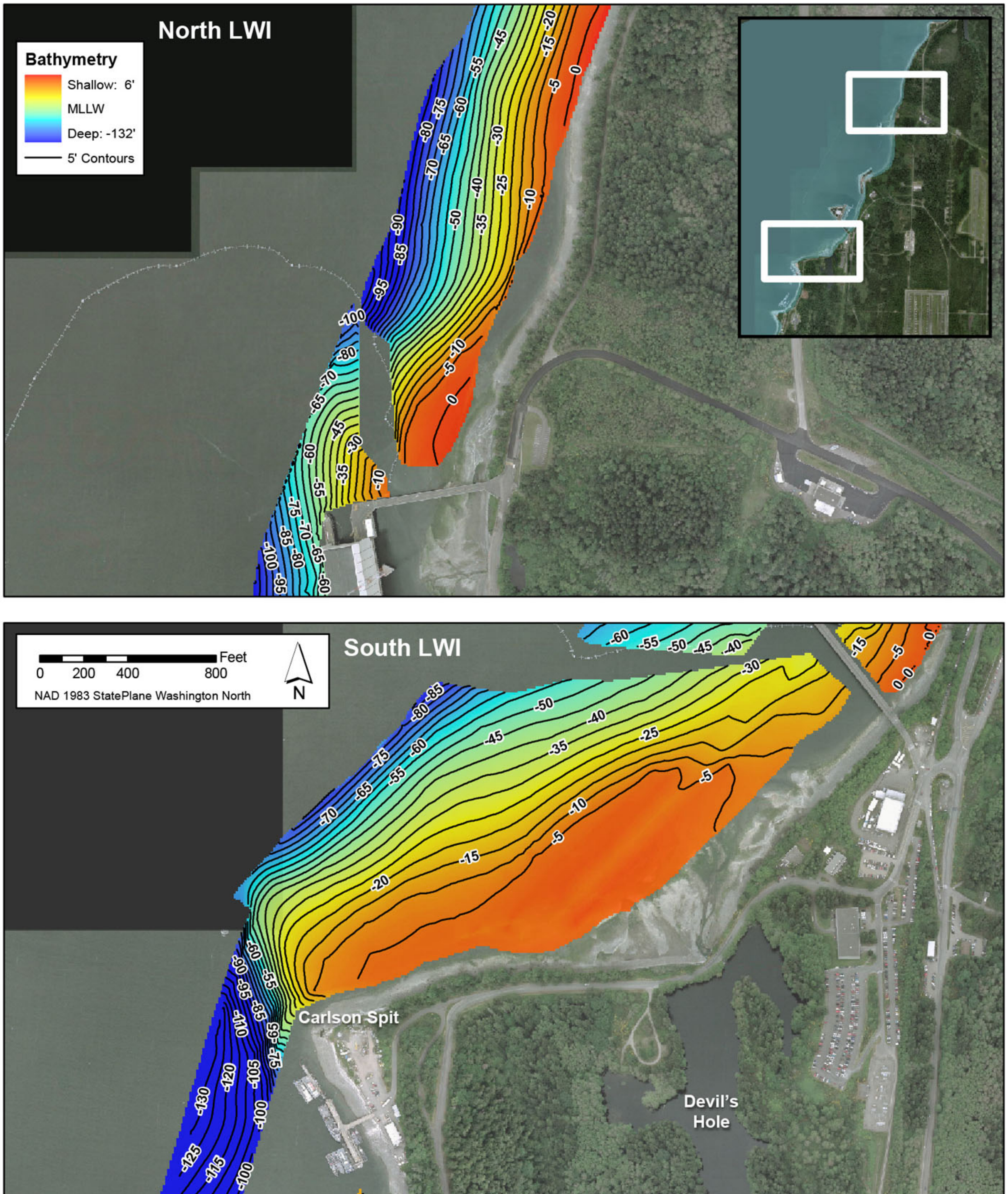
BATHYMETRY OF THE LWI PROJECT SITES

The bathymetry of the Bangor waterfront is illustrated in Figure 3.1–2, and the nearshore bathymetry of the north and south LWI project sites is shown in Figure 3.1–3. At the south LWI project site, the deltaic formation immediately offshore from Devil’s Hole slopes gradually with distance from the shore, whereas at the north LWI project site the slope of the intertidal and shallow subtidal areas is comparatively steeper. The -15 feet (-5 meter) MLLW depth contours occur at distances of approximately 300 and 700 feet (91 and 213 meters) from shore at the



Source: Morris et al. 2008

Figure 3.1–2. Bathymetry in the Vicinity of the NAVBASE Kitsap Bangor Shoreline



Source: SAIC 2009

Figure 3.1–3. LWI Project Site Bathymetry

north and south LWI project sites, respectively. Mean high water (MHW) and MHHW elevations at the LWI project sites are approximately 7 feet above MLLW and 11 feet above MLLW, respectively.

BATHYMETRY OF THE SPE PROJECT SITE

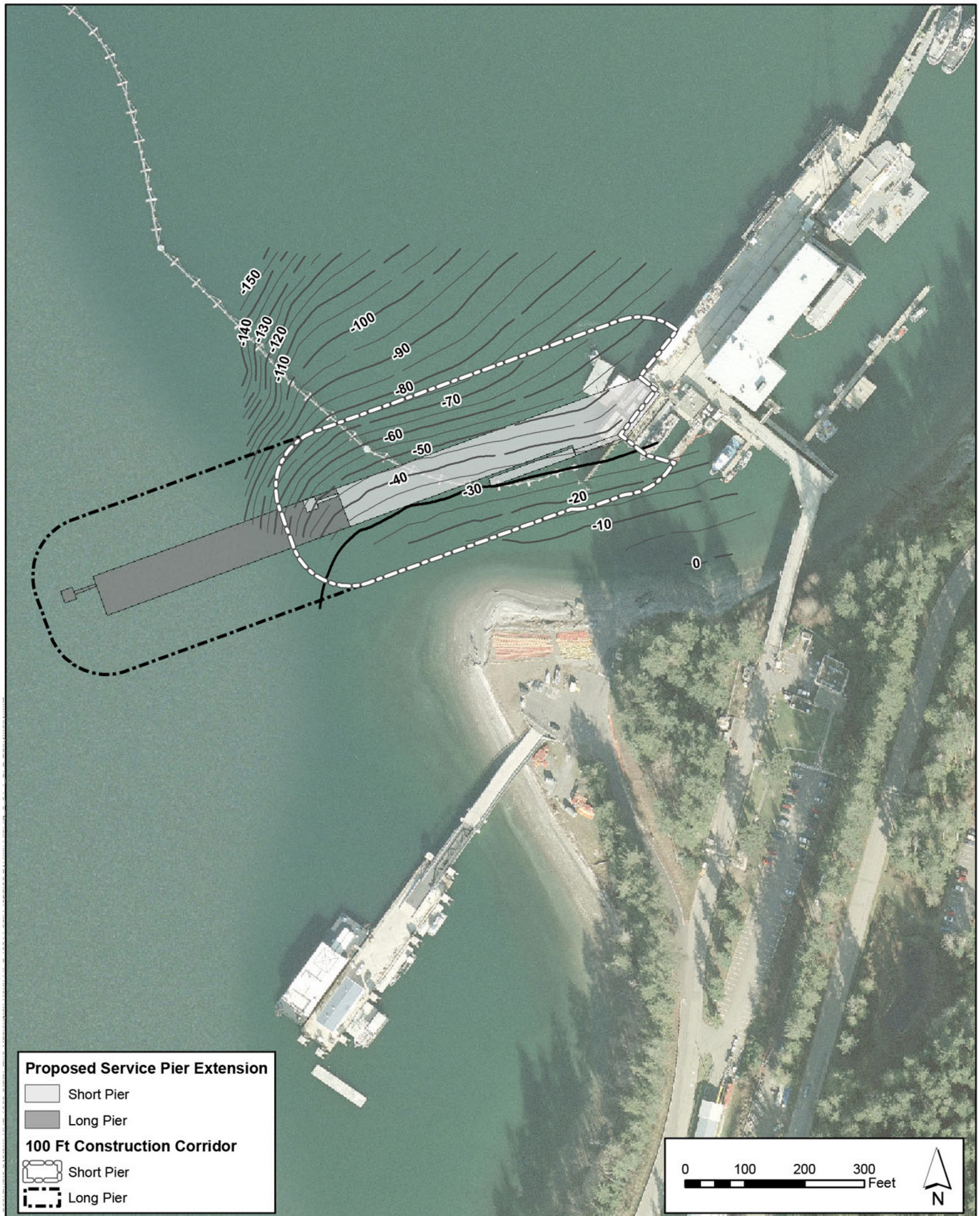
Bathymetry in the vicinity of the SPE project site is shown in Figure 3.1–4. Depth contours generally follow the shape of Carlson Spit that extends into Hood Canal immediately south of the existing Service Pier. Water depths at the southern end of Service Pier are approximately 40 feet (13 meters), and depths increase to approximately 100 feet (30 meters) at a distance of about 400 feet (120 meters) from the tip of Carlson Spit.

CIRCULATION AND CURRENTS

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 (1 to 6 feet [0.3 to 2 meters]) and a second flood and second ebb with a larger range (8 to 16 feet [2 to 5 meters]) 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 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 3 percent of the total canal volume is exchanged over a 6-hour period. Due to the wide range of tidal heights, the actual seawater exchange volume for Hood Canal ranges from 1 percent during a minor tide to 4 percent during a major tide.

The shallow sill feature near Thorndyke Bay does not inhibit surface water flows into and out of the canal as part of normal tidal exchange. However, the sill restricts deep-water circulation and the outflow volume into Puget Sound during major ebb tide events. Seawater that enters the canal from Puget Sound during an incoming flood tide tends to be cooler, more saline, and well-oxygenated compared to Hood Canal waters. As a result of its higher density, incoming Puget Sound water has a tendency to sink to the bottom of the canal as it flows over the sill and moves south during each flood tide, while the lower density Hood Canal water tends to remain in the upper water column. Despite the large volume of water that moves into and out of Hood Canal with each tidal cycle, this density-driven circulation contributes to net inward flow at depths greater than 160 feet (49 meters) and a net outward flow at depths shallower than 160 feet. Historical values for average current velocities and transport measured along the axis of the Hood Canal trough are low, with a net subsurface (below 100 feet [30 meters]) southeastward (inward) flow of 0.07 foot/second (2 centimeters per second), and a net northward (outward) surface (0 to 30 feet [0 to 9 meters]) flow of 0.11 foot/second (3 centimeters per second) (Evans Hamilton and D.R. Systems 1987). This circulation pattern affects the overall flushing of the mid and southern portions of Hood Canal. Despite considerable tidally driven seawater influx within the basin, water residence times in the southern and middle portions of Hood Canal can be up to one year due to the natural limitation (i.e., bathymetry) on seawater exchange (Warner et al. 2001; Warner 2007).



Source: Informed Land Survey 2012

Figure 3.1–4. SPE Project Site Bathymetry

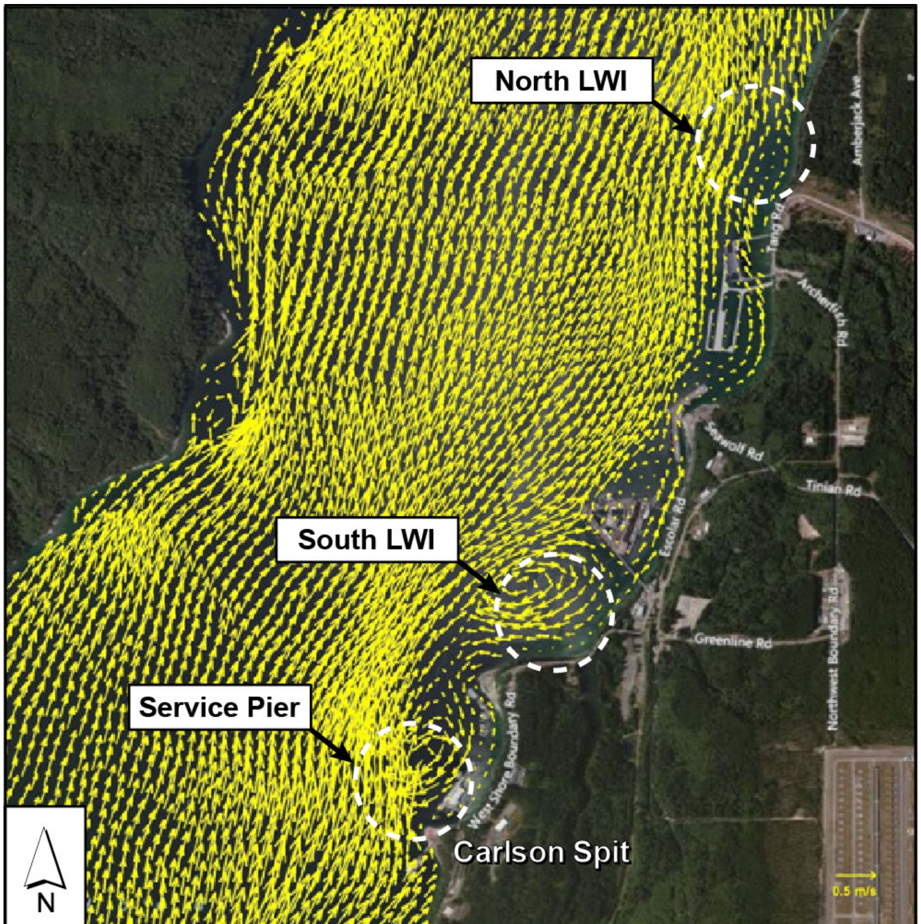
Due to the shape of the basin and local bathymetry, seawater within Hood Canal has a tendency to move easterly into the Bangor waterfront area during both flood and ebb tides (Morris et al.2008). As the water mass driven by each phase of the tide begins to interact with the sloping seafloor and headland features along the eastern shoreline of Hood Canal (e.g., Floral Point, Keyport/Bangor (KB) Point, and Carlson Spit), hydrostatic pressure increases, resulting in a reduction in linear flow velocity toward the shore. As the tidal flow into the area continues and resulting pressure builds against the beach face, the water mass over the shallow (less than 50 feet [15 meters]) areas tends to move in the direction of least resistance. Consequently, depending on the phase of the tide and conditions at the time of the observation, the water mass over the shallower areas occupied by NAVBASE Kitsap Bangor can move along shore in the opposite direction from the water mass over the deeper portions of northern Hood Canal. This accounts for the northeasterly currents during flood tides and southwesterly currents during ebb tides in nearshore areas of NAVBASE Kitsap Bangor (Morris et al. 2008).

Historical drift studies performed near pier structures at the Bangor waterfront observed the formation of distinct eddies (URS 1994). Eddies were readily apparent on the water surface during both strong flood and ebb tides and were attributed to the complexity in flow dynamics along the shoreline. Anticyclonic (clockwise) eddies formed immediately south of two major waterfront wharves during ebb tides and cyclonic (counterclockwise) eddies formed north of these wharves during flood tide (URS 1994). Eddies were also established adjacent to many of the headland features (e.g., Carlson Spit, KB Point, and Floral Point). Modeled ebb tide current patterns in portions of Hood Canal (cbec 2013) illustrate the nearshore eddies and complexity of flows adjacent to NAVBASE Kitsap Bangor (Figure 3.1–5). These eddies serve as pumps that move water along the shoreline and around the pier structures on NAVBASE Kitsap Bangor and, consequently, are an important factor for increasing suspended load transport and seawater mixing in shallow water (less than 50 feet [15 meters]) near the shoreline.

Seasonal variability in Hood Canal circulation patterns can occur as a result of strong meteorological events (e.g., storms, high winds) in the winter. Regardless of direction, winds with velocities in excess of 25 knots (42 feet/second) occur relatively infrequently in the Puget Sound region (Morris et al. 2008). The surrounding highlands (Olympic and Cascade Mountain Ranges), coupled with the fetch-limited environment of Hood Canal, result in relatively calm wind conditions throughout most of the year. However, during the winter months, storm events associated with the passing of frontal systems, predominantly from the south, are more common and are responsible for stronger winds in the region. The topography adjacent to Hood Canal results in funneling of strong southwesterly winds during periods of southerly flow (Figure 3.1–6). Due to the southwest to northeast orientation of the northern and middle sections of Hood Canal, and increased fetch, southwesterly flows with wind speeds in excess of 20 knots (34 feet/second) have the capability of generating wind waves and/or altering normal tidal flow within the basin. Sustained wind events over the long axis of Hood Canal can disrupt the normal surface current patterns and vertically mix the water column, which tends to break down stratification and promote upwelling of colder, saline subsurface waters (Golder Associates 2010).

Circulation and Currents at the LWI Project Sites

Currents (speed and direction) at the LWI project sites are primarily a function of tidal action based on the phase and range of each tide within the mixed semidiurnal regime, although seafloor

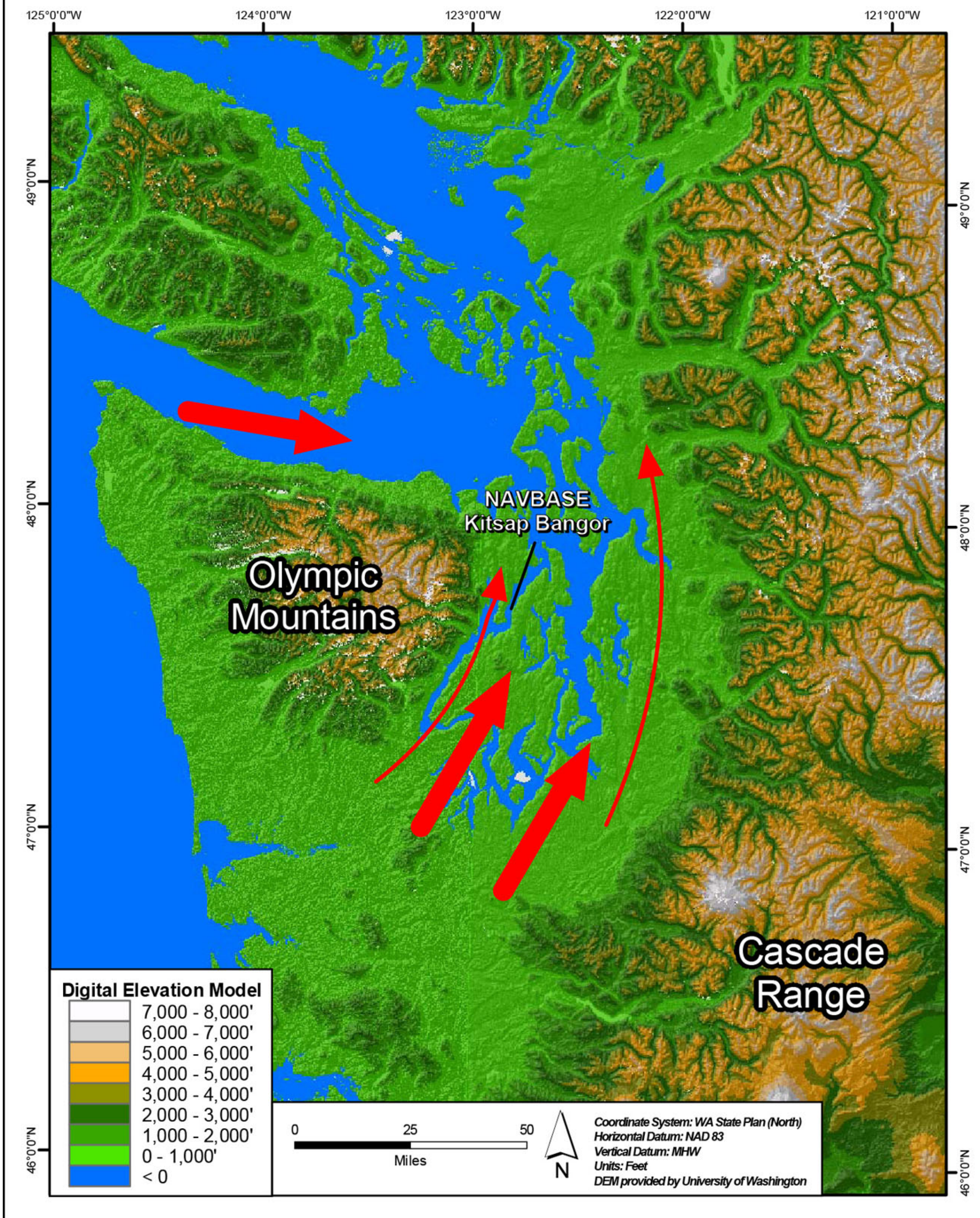


Source: cbec 2013

Figure 3.1–5. Modeled Current Patterns, Ebb Tide during a Peak 2-Year Storm Event

topography and the presence of fixed structures along the shoreline also affect nearshore current patterns along the Bangor waterfront (Morris et al. 2008). Currents in shallower (less than 50 feet [15 meters]) portions of the sites are weak and complex as related to the irregular bathymetry and shoreline features such as headlands and embayments. The time-averaged net flow is within the 0.07 to 0.10 foot/second (2 to 3 centimeters per second) range in the upper water column and less than 0.03 foot/second (1 centimeter per second) close to the seafloor. The magnitude or instantaneous velocity of fluctuating water column currents ranges from 0 to 0.88 foot/second (0 to 27 centimeters per second) within the 30- to 65-foot (9- to 20-meter) water depth interval (Morris et al. 2008). However, current flow in any one direction is short-lived and inconsistent in magnitude, with relatively few time periods when current velocities are sufficient (approximately 0.7 foot/second [20 centimeters per second]) to exceed the threshold for resuspending deposits of unconsolidated material on the seafloor (Boggs 1995).

In deeper portions of the LWI project sites (i.e., water depths from 13 to 59 feet [4 to 18 meters]), currents are variable in direction and magnitude within the mid and upper water



Source: Morris et al. 2008

Figure 3.1–6. Major Wind Patterns in the Puget Sound Region

column throughout each tidal phase, while flow in the lower water column is more consistent (Morris et al. 2008). Although variability is present in both the magnitude and direction of water column currents, the general flow trends are in north-northeast and south-southwest directions. Maximum flows in excess of 0.7 foot/second (20 centimeters/second) were documented in the upper (13 feet [4 meters]), mid (36 feet [11 meters]), and lower (59 feet [18 meters]) water column and typically corresponded to the time of high tide (maximum water level). Current velocities were also elevated at the time of low tide (minimum water level), but at speeds that ranged from 0.3 to 0.5 foot/second (9 to 15 centimeters/second) (Morris et al. 2008).

The majority of the daily volume of seawater exchange at the LWI project sites flows directly across the Bangor waterfront area. As a result, the degree of flushing that occurs at the LWI project sites is relatively high. Due to the substantial seawater exchange in this portion of Hood Canal, the hydrographic conditions at the LWI project sites are more similar to those of Puget Sound than to the southern portions of Hood Canal.

Annual and seasonal variability of circulation and currents near the LWI project sites follows the same patterns as the remainder of Hood Canal. Winter storm events originating from the southwest, as well as fair weather systems producing higher winds out of the northeast, have the capability to affect normal circulation patterns dominated by tidal flow based on the southwest to northeast orientation of Hood Canal. However, the project sites are afforded some protection by the coastlines of both Kitsap and Toandos Peninsulas (Figure 3.1–7).

CIRCULATION AND CURRENTS AT THE SPE PROJECT SITE

Currents at the SPE project site are similar to those discussed for the LWI sites, although the presence of Carlson Spit deflects flows to the west during ebb tides and promotes the formation of eddies in the lee (downcurrent side) of the headland (Figure 3.1–5). These features contribute to variability in current flows as well as mixing of water masses in the vicinity of the Service Pier (Morris et al. 2008).

Similar to the LWI sites, water movement in the vicinity of Service Pier is primarily related to tidal action. However, the structure of water flow varies at different locations along the Bangor waterfront, suggesting that the dynamics controlling water mass movement are strongly affected by localized seafloor topography and shoreline structures (Morris et al. 2008).

LONGSHORE SEDIMENT TRANSPORT

Storm waves are the principal mechanism driving longshore sediment transport and are responsible for shaping many of the coastal morphologic features such as spits and points along the 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. Significant wave heights (the average wave height of the one-third largest waves) range from approximately 0.16 to 0.49 foot (0.05 to 0.15 meter). The primary wave directions in the vicinity of NAVBASE Kitsap Bangor are from the southwest and northeast, parallel to the axis of Hood Canal. Waves from northerly storms tend to be locally larger than waves generated by the more severe southerly storms due to longer fetch to the north. While northerly waves are of greater magnitude, the probability of occurrence of the extreme winds from northerly directions is appreciably lower than from the

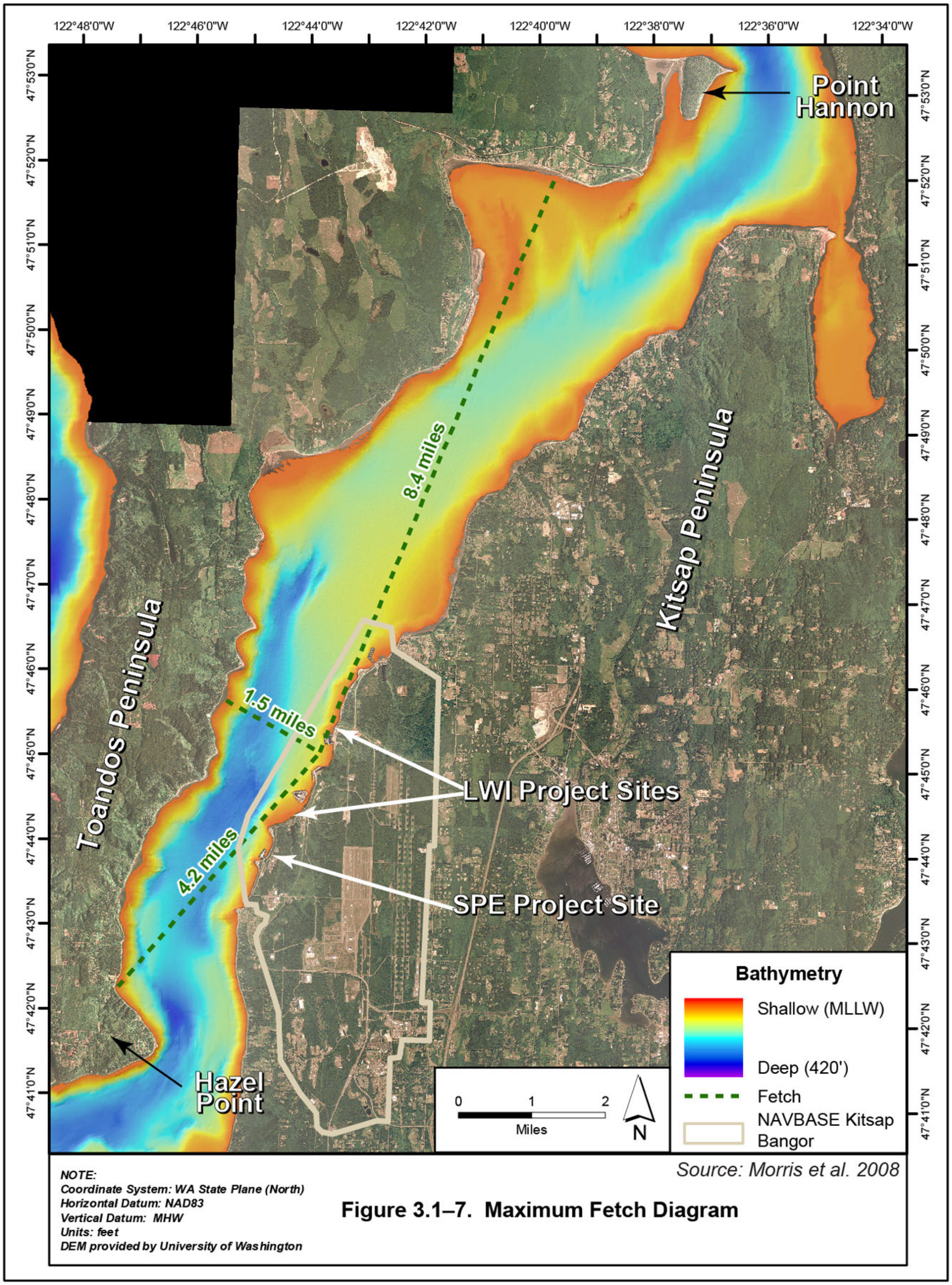


Figure 3.1–7. Maximum Fetch Diagram

south. Using a maximum fetch of 8.4 miles (14 kilometers) between the NAVBASE Kitsap Bangor project site and the north shore of Thorndyke Bay to the north-northeast, a 20-knot (34 feet/second) sustained wind has the capability of generating average wave heights of 1.9 feet (0.6 meter), and a 30-knot (45 feet/second) wind event could produce wave heights of 3.1 feet (0.4 meter) (Coastal Engineering Research Center 1984). The maximum fetch to the southwest is one-half that to the northeast (4.2 miles [6.8 kilometers]), and could yield average waves of 1.3 feet (1 meter) in height in a 20-knot (34 feet/second) wind, and 1.9 feet (0.6 meter) in a 30-knot (45 feet/second) wind. Maximum wave heights expected from these weather conditions would actually be 67 percent higher than the average wave heights.

Because tidal currents rarely exceed 0.6 foot/second (20 centimeters per second) (Morris et al. 2008), surface waves likely are the primary source of energy that prevents the long-term deposition of fine-grained sediments and results in the well-sorted sandy seafloor and gravel beaches within the shallow (<33 feet [10 meters]) seabed and intertidal zones at the project sites. The instantaneous velocity associated with passing waves is likely sufficient to lift finer-grained unconsolidated sediments (silt and clay) into the water column. Once in suspension, the speed and direction of sediment transport is a function of exposure to tidal current flow. Unconsolidated material transported toward the center of Hood Canal likely remains in suspension indefinitely as water column currents closer to the centerline of northern Hood Canal provide sufficient energy to keep fine-grained sediments in suspension and prevent settlement and deposition. Entrained sediments that are transported closer to the shoreline and away from areas displaying coherent current flow are subject to re-deposition when energy levels associated with the local wave field diminish. Over time, fine-grained sediments are systematically resuspended and transported with subsequent storm-related wave events until they reach the centerline of Hood Canal or are deposited along the shoreline in locations offering sufficient protection from wave action.

The NAVBASE Kitsap Bangor shoreline is located in the middle of a 16.5-mile (26-kilometer) long drift cell (KS 5 in the Washington Department of Ecology [WDOE] digital coastal atlas). Shoreline geomorphology is characterized by erosional bluffs that range in height from 30 to 55 feet (10 to 18 meters). Feeder bluffs represent an estimated 22 percent of the NAVBASE Kitsap Bangor shoreline (MacLennan and Johannessen 2014). Feeder bluffs refer to eroding shoreline bluffs that provide the majority of sediment to Puget Sound beaches and littoral cells (Johannessen 2010). Typical sediment delivery rates from feeder bluffs in Hood Canal are approximately 1.5 to 4 inches (3.8 to 10 centimeters)/year (Keuler 1988). 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.

MacLennan and Johannessen (2014) stated that 46 percent of the most industrialized portion of the NAVBASE Kitsap Bangor shoreline is armored, whereas Judd (2010) indicated that approximately 6 percent of the entire base shoreline has been armored with bulwarks, riprap, or other structures. In comparison, an estimated 27 percent of the Hood Canal shoreline (Puget Sound Partnership 2008) and 25 percent of the shoreline for the Kitsap County portions of Hood Canal (Judd 2010) have been modified.

Kitsap County conducted an assessment of nearshore habitat in West Kitsap County that included the NAVBASE Kitsap Bangor waterfront (Judd 2010). The north and south LWI and SPE project sites are within Drift Cells 18, 19, and 20, respectively. These drift cells have low disturbance rankings for longshore transport processes, attributable, in part, to the low density of armoring/bulkheads, groins, boat launches, and other shoreline structures that otherwise restrict sediment supply and transport (Judd 2010). The existing waterfront facilities on NAVBASE Kitsap Bangor are separated by expanses of uninterrupted shoreline and open water between them. Depending on the direction and intensity of the local winds, each facility offers varying amounts of fetch for the generation of wind waves, as well as protection from the effects of those waves. In most cases, the various pier facilities were constructed on a foundation of solid piles configured in a manner that serves to disrupt well-organized wave fields approaching the shoreline from open water. This reduces the amount of energy reaching the shallow subtidal and intertidal zones adjacent to each pier facility and the capacity of the waves to resuspend and transport unconsolidated seafloor sediments.

Evidence from bathymetric surveys and aerial photographs confirms the presence of sediment deposits along the shoreline near the pier facilities, resulting in localized changes in shoreline morphology (Morris et al. 2008). Some of these areas of increased sedimentation are co-located with the pier facilities, suggesting that the piles in the pier foundations promote a depositional environment and the accretion of unconsolidated material in the form of shallow subtidal shoals and broadening intertidal beaches. However, in other cases, the co-occurrence of shoreline structures and shoals may be coincidental. For example, an aerial photograph of Explosives Handling Wharf-1 (EHW-1) shortly after the structure was constructed shows the presence of a shoal inshore of the wharf, suggesting that the shoal was present at the time the wharf was constructed (Prinslow et al. 1979; Plate 1).

Conclusions regarding the cumulative effect of existing in-water infrastructure at NAVBASE Kitsap Bangor on longshore sediment supply, based on assessments of historical changes in the shoreline, are inconsistent. Golder Associates (2010) evaluated historical topographic sheets and photographs to assess the magnitude of shoreline change that has occurred in the project vicinity. These assessments show that relatively little shoreline change occurred over the last two decades and only moderate change has occurred since 1876, indicating that the shoreline in the region is fairly stable as a result of the relatively sheltered environment and low net erosion and longshore transport rates. In contrast, MacLennan and Johannessen (2014) concluded from assessments of historical shoreline information that apparent changes in the NAVBASE Kitsap Bangor shoreline have been substantial. These changes were attributable to several factors, including northward shifts in the positions of spits due to the natural effects of prevailing winds and waves, erosion in areas of feeder bluffs, sediment accumulation near Devil's Hole, and inaccuracies in the historical mapping. However, in some areas, such as north of EHW-1, MacLennan and Johannessen (2014) attributed the absence of shoreline recession to the wave dampening effects of in-water structures.

LONGSHORE SEDIMENT TRANSPORT AT THE LWI PROJECT SITES

Calculated wave fields in the vicinity of the south LWI project site that are associated with 100-year storm events based on southerly and northerly winds are shown in Figures 3.1–8 and 3.1–9, respectively. These figures illustrate the reduced wave heights in areas immediately adjacent to the shoreline compared with those immediately offshore of Devil's Hole (Golder Associates 2010). This study did not extend to the north LWI project site; therefore, comparable information is not available for this location.

Figures 3.1–10 and 3.1–11 provide examples of calculated sediment transport for representative flooding and ebbing tides, respectively. These figures show that the areas of the south LWI project site and the sediment delta off the mouth of Devil's Hole tend to have relatively little transport during average conditions. This may be primarily attributed to sheltering of the area by the configuration of the shoreline (e.g., the point at KB Docks) to the west and the Delta Pier facility to the north. The greatest transport rates occur immediately offshore of KB Point, which has a shallow shelf that protrudes into the primary Hood Canal current. Under severe storm wave forcing, offshore transport changes very little because of the relatively short period and low-amplitude waves that reach the local site. However, within the swash zone, breaking waves act as a mechanism to mobilize and mix sediment into the current for further transport.

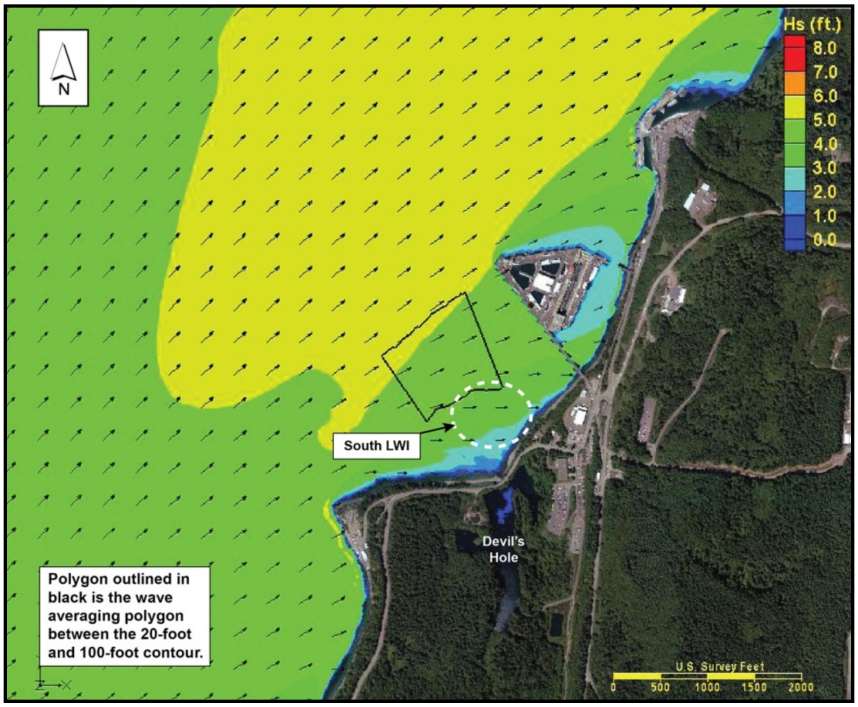
MacLennan and Johannessen (2014) identified the shorelines at the south and north LWI project sites as transport zones, in which littoral transport processes predominate over accretion and erosion processes. South of the south LWI project, the delta adjacent to Devil's Hole reflects the historical sediment supply from Devil's Hole and reduced wave energy in the down-drift side of Keyport Bangor Point. Golder Associates (2010) estimated that the net longshore transport rate over the delta adjacent to Devil's Hole was 150 cubic yards (115 cubic meters) per year to the northeast. While this value is only an estimate of annual littoral drift, the direction of net transport agrees with regional transport directions presented by Kitsap County Department of Community Development (2007) and geomorphologic indicators such as shoreline orientation and delta asymmetry.

Longshore sediment transport in the vicinity of the north and south LWI project sites was modeled by cbec (2013). This portion of the Hood Canal shoreline corresponds to Drift Cells DC-18 and DC-19, in the West Kitsap County Nearshore Assessment (Judd 2010). Changes to seabed levels, as measures of erosion and deposition, following typical (2-year recurrence event) storm conditions, in the absence of the proposed LWI structures, are shown in Figure 3.1–12. Changes in bed levels generally are less than 0.3 foot (0.1 meter). Relatively larger changes are predicted to occur following strong, infrequent (i.e., 50-year recurrence) storm events. Within the NAVBASE Kitsap Bangor waterfront region, areas with the greatest bed level changes largely coincide with the presence of aquatic vegetation.

LONGSHORE SEDIMENT TRANSPORT AT THE SPE PROJECT SITE

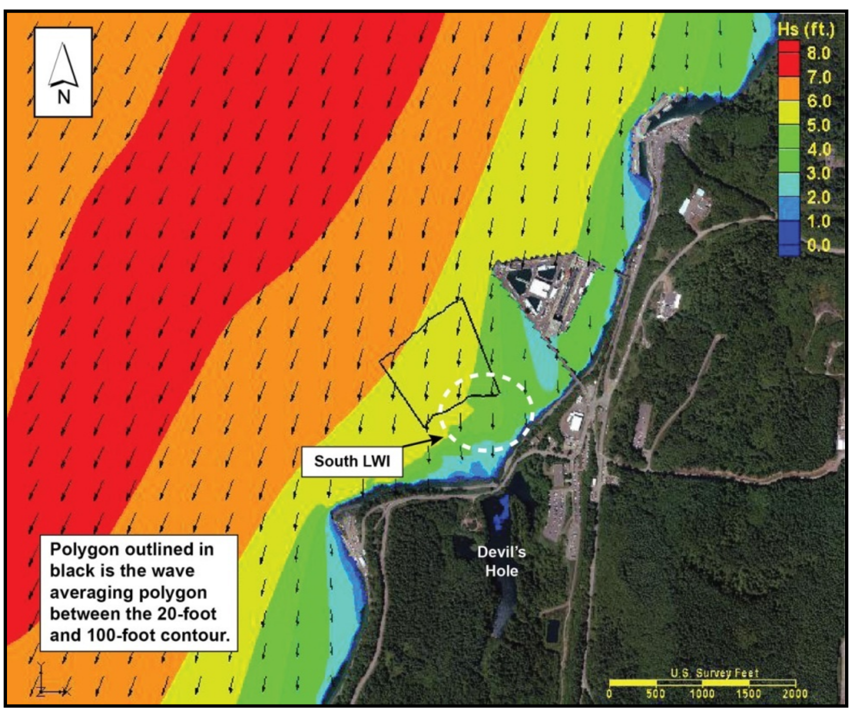
Longshore sediment transport in the vicinity of the SPE project site was modeled by cbec (2013). This portion of the Hood Canal shoreline corresponds to Drift Cell DC-20 in the West Kitsap County Nearshore Assessment (Judd 2010). MacLennan and Johannessen (2014) identified the shoreline adjacent to the existing Service Pier as feeder bluff shore type.

Changes to seabed levels following typical (2-year recurrence event) storm conditions near the Service Pier, in the absence of the proposed SPE structure, are shown in Figure 3.1–13. As noted for the LWI project sites, changes in bed levels in the vicinity of Service Pier generally are less than 0.3 foot (0.1 meter). Relatively larger changes are predicted to occur following 50-year recurrence storms. Regions with the greatest bed level changes largely coincide with the presence of aquatic vegetation.



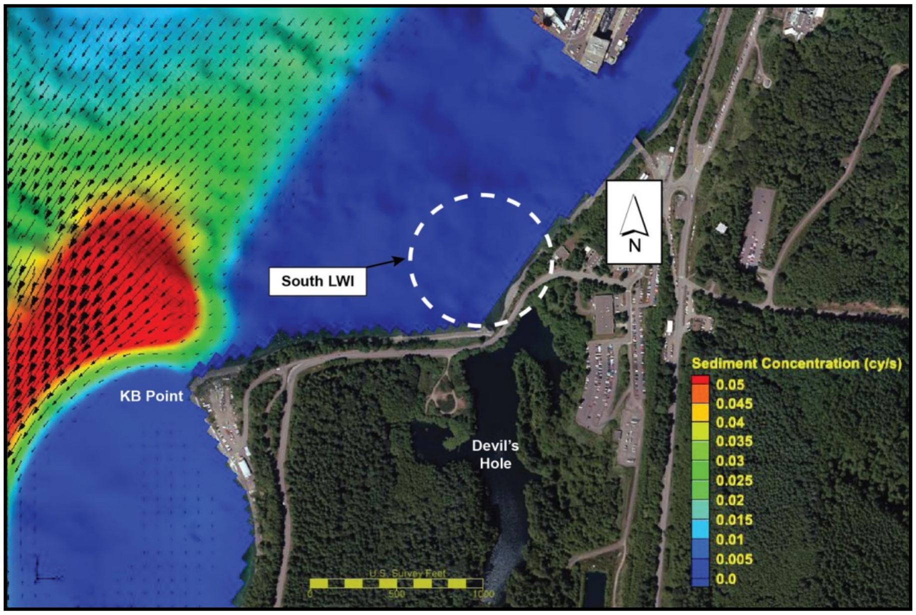
Source: Golder 2010

Figure 3.1–8. Calculated Wave Field in the Vicinity of the South LWI Project Site Associated with 100-Year Storm Event with Southerly Winds



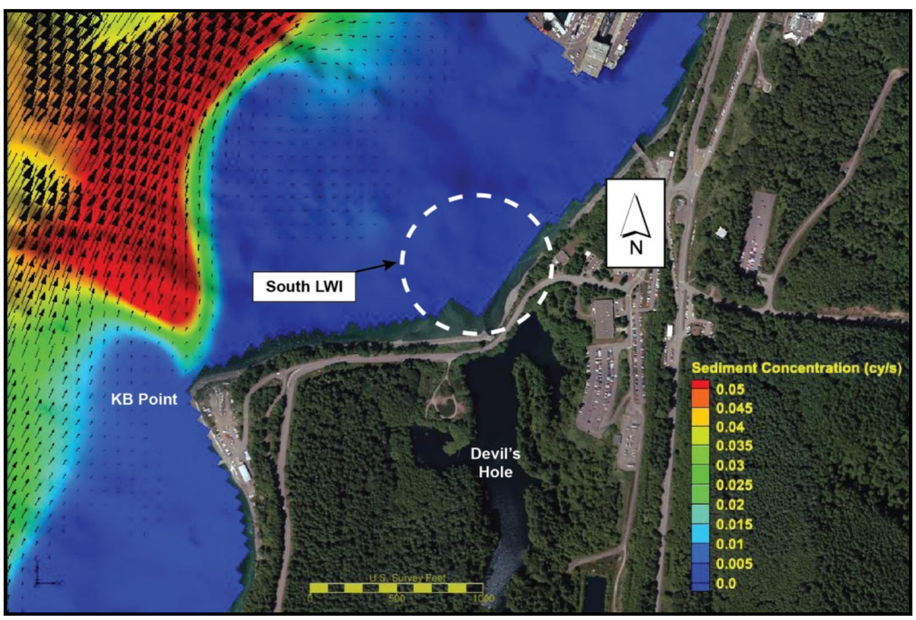
Source: Golder 2010

Figure 3.1–9. Calculated Wave Field in the Vicinity of the South LWI Project Site Associated with 100-Year Storm Event with Northerly Winds



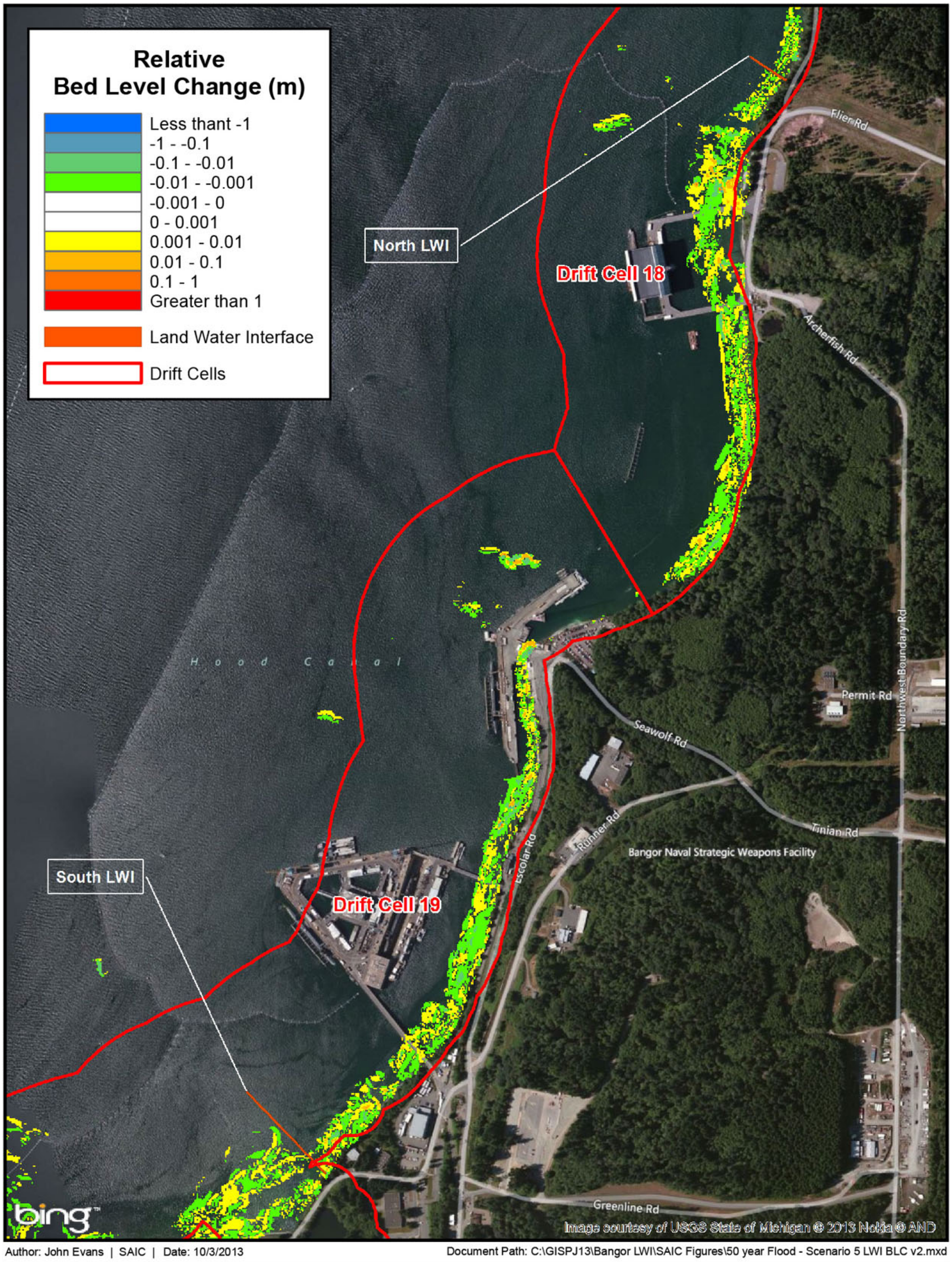
Source: Golder 2010

Figure 3.1–10. Calculated Sediment Concentration (contours) and Sediment Transport Rates (vectors) during Flood Tide for Hood Canal in the Vicinity of the South LWI Project Site



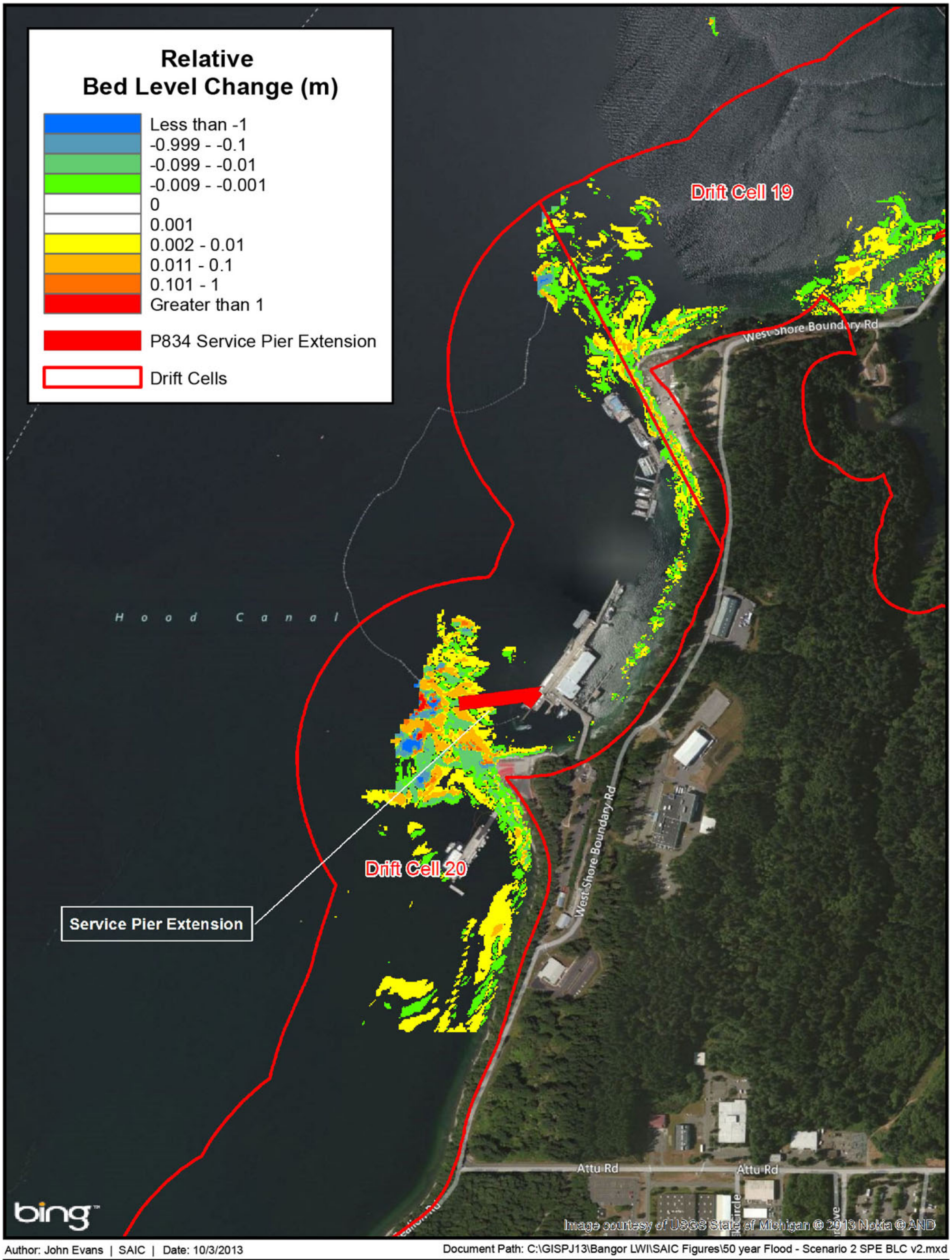
Source: Golder 2010

Figure 3.1–11. Calculated Sediment Concentration (contours) and Sediment Transport Rates (vectors) during Ebb Tide for Hood Canal in the Vicinity of the South LWI Project Site



Source: cbec 2013

Figure 3.1–12. Modeled Changes in Seabed Elevations Near the North and South LWI Project Sites Following a Peak 2-Year Storm Event, Existing Conditions



Source: cbec 2013

Figure 3.1–13. Modeled Changes in Seabed Elevations Near the SPE Project Site Following a Peak 2-Year Storm Event, Existing Conditions

3.1.1.1.2 Water Quality

Water quality parameters include temperature and salinity, which affect density layering and stratification, as well as chemical characteristics such as dissolved oxygen (DO), nutrients, pH, turbidity/water clarity, and contaminant levels that affect the suitability of the water body as habitat for marine organisms and other beneficial uses. Washington Administrative Code (WAC) 173-201A establishes four water body quality classifications as summarized in Table 3.1–1.

Table 3.1–1. Marine Water Quality Criteria

Water Quality Classification	Water Quality Criteria			
Aquatic Life	**Temperature[1]**	**Dissolved Oxygen[2]**	**Turbidity[3]**	**pH**
Extraordinary Quality	13°C (55°F)	7.0 mg/L	+5 NTU or +10%[4]	7.0 – 8.5[6]
Excellent Quality	16°C (61°F)	6.0 mg/L	+5 NTU or +10%[4]	7.0 – 8.5[7]
Good Quality	19°C (66°F)	5.0 mg/L	+10 NTU or +20%[5]	7.0 – 8.5[7]
Fair Quality	22°C (72°F)	4.0 mg/L	+10 NTU or +20%[5]	6.5 – 9.0[7]
	Coliform Bacteria			
Shellfish Harvesting	Geometric mean not to exceed 14 MPN/100 mL fecal coliforms[8]			
Recreation				
Primary Contact	Geometric mean not to exceed 14 MPN/100 mL fecal coliforms[8]			
Secondary Contact	Geometric mean not to exceed 70 MPN/100 mL enterococci [9]			

Source: WAC 173-201A-210, as amended in May 2011

°C = degrees Celsius; DO = dissolved oxygen; °F = degrees Fahrenheit; mg/L = milligrams per liter; mL = milliliter; MPN = most probable number; NTU = Nephelometric Turbidity Unit

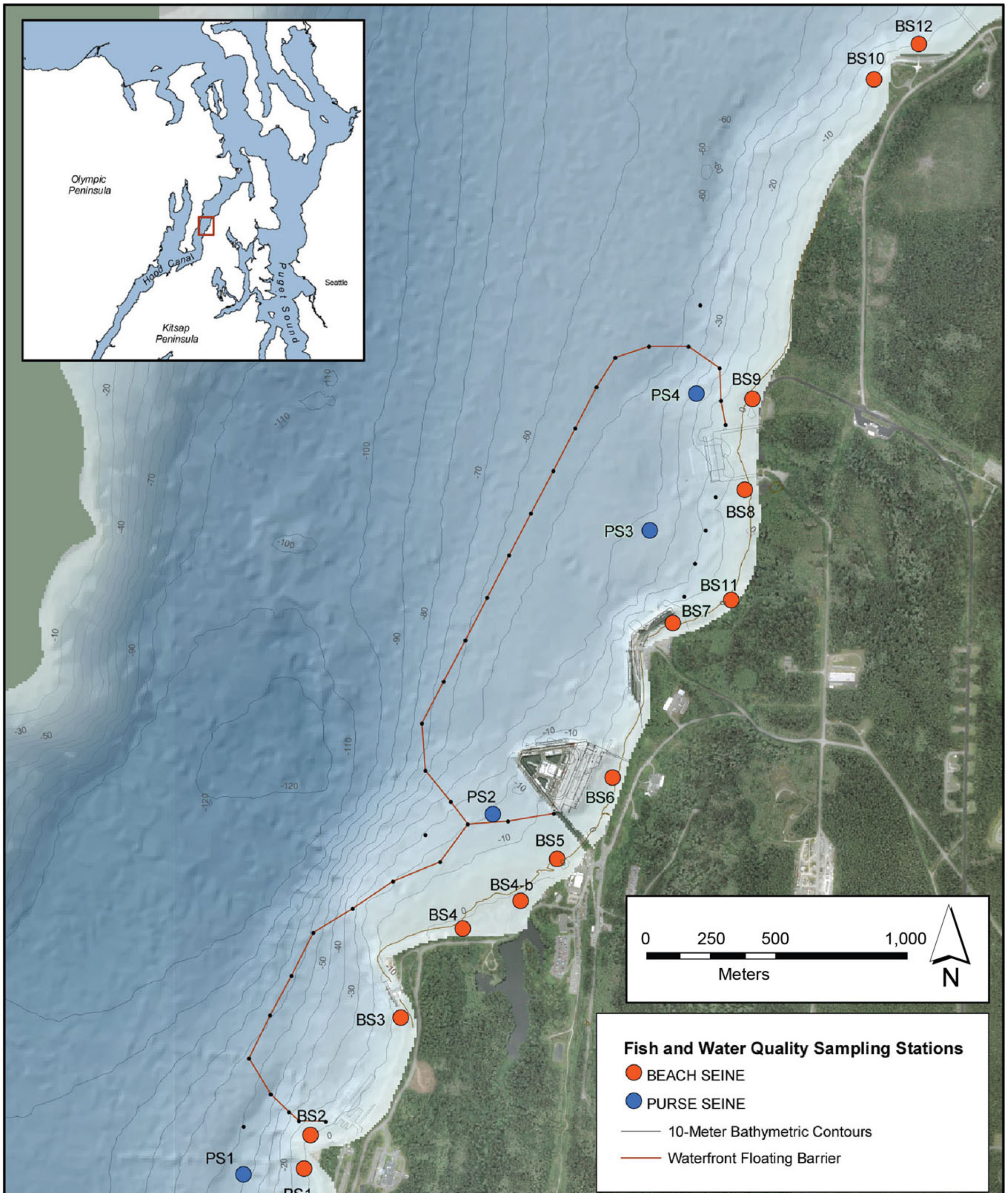
1. One-day maximum (°C [°F]). Temperature measurements should be taken to represent the dominant aquatic habitat of the monitoring site. Measurements should not be taken at the water's edge, the surface, or shallow stagnant backwater areas.
2. One-day minimum (mg/L). When DO is lower than the criteria or within 0.2 mg/L, then human actions considered cumulatively may not cause the DO to decrease more than 0.2 mg/L. DO measurements should be taken to represent the dominant aquatic habitat of the monitoring site. Measurements should not be taken at the water's edge, the surface, or shallow stagnant backwater areas.
3. Measured in NTU; point of compliance for non-flowing marine waters — turbidity not to exceed criteria at a radius of 150 feet (46 meters) from activity causing the exceedance.
4. 5 NTU over background when the background is 50 NTU or less; or 10 percent increase in turbidity when background turbidity is more than 50 NTU.
5. 10 NTU over background when the background is 50 NTU or less; or 20 percent increase in turbidity when the background turbidity is more than 50 NTU.
6. Human-caused variation within range must be less than 0.2 units.
7. Human-caused variation within range must be less than 0.5 units.
8. No more than 10 percent of all samples used to calculate geometric mean may exceed 43 MPN/100 mL; when averaging data, it is preferable to average by season and include five or more data collection events per period.
9. No more than 10 percent of all samples used to calculate geometric mean may exceed 208 MPN/100 mL; when averaging data, it is preferable to average by season and include five or more data collection events per period.

This section summarizes the existing marine water quality conditions of Hood Canal and the areas around the LWI and SPE project sites. The quality of surface waters in the upland portions of the project area, including stormwater runoff, is discussed in Section 3.7. The following discussion provides ranges in values for several of the water quality parameters (temperature, salinity, DO, and turbidity) that were measured at a series of shallow, nearshore, and deeper, offshore sampling locations along the Bangor waterfront in 2005 and 2006 (Phillips et al. 2009) and in 2007 and 2008 (Hafner and Dolan 2009). The sampling stations shown in Figure 3.1–14 include locations near the LWI and SPE project sites. Existing conditions for these parameters are also based on information collected as part of regional monitoring programs, such as the WDOE Marine Water Quality Monitoring Program (WDOE 2013a). In particular, the WDOE program monitors water quality at a series of core and rotating sites. The monitoring locations closest to NAVBASE Kitsap Bangor, HCB008 (King Spit Bangor) and HCB009 (Hazel Point), are rotating sites that were last sampled in 2005 and 2003, respectively. Monitoring site HCB010 (Hood Canal Sand Creek) is located off the southern tip of the Toandos Peninsula and is the closest core monitoring site that is sampled annually.

WAC 173-201A-612 designates Hood Canal as extraordinary for aquatic life uses (salmonid and other fish migration, rearing, and spawning; clam, oyster, and mussel rearing and spawning; and crustaceans and other shellfish rearing and spawning), with additional use designations for shellfish harvest, recreational use (primary contact), and miscellaneous (wildlife habitat, harvesting, commercial/navigation, boating, and aesthetics). Water quality along the Bangor waterfront is good by most measures and meets applicable standards. Although DO concentrations are low in much of Hood Canal, this problem is less pronounced in northern Hood Canal, the location of NAVBASE Kitsap Bangor, than elsewhere in Hood Canal. Based on measurements performed during 2005 through 2008 (Phillips et al. 2009; Hafner and Dolan 2009), DO concentrations in nearshore waters at the LWI and SPE project sites almost always meet water quality standards, as discussed below under the un-numbered subsection titled Dissolved Oxygen. WDOE (2013a) has not determined marine water conditions index values or assessed temporal trends in water quality for northern Hood Canal.

STRATIFICATION, SALINITY, AND TEMPERATURE

Temperature, salinity, and stratification conditions in Hood Canal are influenced by natural processes with seasonal and inter-annual cycles. Coastal upwelling and the California Current are the primary mechanisms producing the cool water mass that moves into Puget Sound with a relatively narrow range of temperatures throughout the year. Water temperatures in Puget Sound typically range from 44 to 46 degrees Fahrenheit (°F) (6.7 to 7.8 degrees Centigrade [°C]) throughout winter months (mid-December through mid-March). Surface waters slowly warm throughout the spring and summer due to increased solar heating, reaching temperatures of 50°F (10°C) in mid-May or early June to a maximum temperature of 54°F (12°C) during the month of August. Beginning in September, water temperatures begin to decrease by several degrees over the next three months due to decreasing levels of solar radiation. Variations in this pattern of heating and cooling occur, but they are often short in duration (one to two weeks) and likely driven by small variations in circulation patterns in the North Pacific Current and/or California Current.



Source: Phillips et al. 2009

NOTE:
Coordinate System: WA State Plane (North)
Horizontal Datum: NAD83
Vertical Datum: MHW
Units: feet
DEM provided by University of Washington

Figure 3.1–14. Water Quality Monitoring Stations for 2005 and 2006

Annual variability is related primarily to El Niño/La Niña cycles. El Niño conditions are influenced by atmospheric circulation within the Southern Oscillation in the equatorial Pacific that leads to a large-scale warming of the Pacific Ocean and is associated with a slackening, or even cessation, of the upwelling conditions that normally occur in proximity to the Strait of Juan de Fuca. The onset of El Niño conditions usually results in a warming trend in surface waters along the Washington and Oregon coasts, in addition to drier winters within the Pacific Northwest (Western Regional Climate Center 1998). In contrast, La Niña conditions lead to large-scale cooling of the Pacific Ocean, as well as colder air temperatures and an increase in precipitation in the late fall and early winter. Since the winter of 1999 to 2000, atmospheric and oceanic conditions associated with the Southern Oscillation have not exhibited strong El Niño or La Niña characteristics (Western Regional Climate Center 2008).

The waters of Hood Canal surrounding the LWI and SPE project sites are stratified with less saline, warmer surface water overlying colder, more saline bottom water. The salinity of the upper water layer reflects in part the amount of freshwater input and may become more diluted during heavy precipitation (URS 1994). Variances due to seasonal changes (such as freshwater input, wind-induced mixing, and solar heating) are common (URS 1994).

Freshwater input into Hood Canal comes from creeks, rivers, groundwater (including artesian wells), and stormwater outfalls. Artesian well contributions have estimated flows of 2,000 to 2,500 gallons (7,600 to 9,500 liters) per minute (WDOE 1981). Overland flow from much of the western portion of NAVBASE Kitsap Bangor is routed to Hood Canal through a series of stormwater outfalls. Saltwater and freshwater mixing zones exist at the mouths of each of these outflows and outfalls (URS 1994). Some locations along the Bangor waterfront are influenced to a greater extent by localized inputs from freshwater sources. For example, Phillips et al. (2008) noted that nearshore waters off Devil's Hole, near the south LWI project site, exhibited higher temperatures and lower salinities that were attributed in part to freshwater flows from Devil's Hole.

During the 2005 through 2008 water quality surveys, average surface water salinity values along the Bangor waterfront ranged from 24 to 34 practical salinity units (PSU) (Table 3.1–2). Based on vertical profile measurements, the transition between the lower salinity surface waters and higher salinity subsurface waters occurs at a depth of about 33 feet (10 meters) (Phillips et al. 2009). The lowest surface water salinity (18.4 PSU) was measured in February 2007 when fresh water (low salinity) input may have been high due to winter storms and runoff (Hafner and Dolan 2009). The range in salinity values along the Bangor waterfront measured during the 2005 through 2008 water quality surveys is typical for marine waters in Puget Sound (Newton et al. 1998, 2002).

Per the state's water quality classification, the temperature of marine surface waters designated as extraordinary quality should not exceed 13°C (55°F). When a water body's temperature is warmer than 13°C (55°F) and that condition is due to natural conditions, then human actions considered cumulatively may not cause the temperature of the water body to increase more than 0.3°C (0.5°F) (WAC 173-201A). Minimum, maximum, and mean surface water temperatures along the Bangor waterfront in 2005 through 2008 are summarized in Table 3.1–2. Average water temperatures along the Bangor waterfront ranged from 8.1 to 17.4 °C (46.6 to 63.3°F), and temperatures exceeded 13°C (55°F) during late spring through summer (May through September). Nearshore areas are susceptible to greater temperature variations due to seasonal differences in solar radiation. WDOE, through the Section 303(d) program (Water Quality Assessment for Washington), has not classified the water quality in the area of NAVBASE Kitsap Bangor as impaired (i.e., chronic or recurring monitored violations of the applicable numeric and/or narrative water quality criteria) for temperature (WDOE 2013b).

Table 3.1–2. Minimum, Maximum, and Mean Values of Water Quality Parameters at Nearshore Locations along the NAVBASE Kitsap Bangor Waterfront during the 2005–2008 Water Quality Surveys

Dates	Year	DO (mg/L)			Salinity (PSU)			Temperature (°C)			Turbidity (NTU)		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
1/22–1/28	2005	7.2	11.3	9.1	25.9	27.3	26.6	7.7	8.2	8.1	0.2	12.4	1.1
2/5–2/11	2005	7.1	10.6	8.8	26.5	29.8	28.3	7.4	8.4	8.0	0.3	26.4	1.3
2/26–3/4	2005	8.8	11.3	9.4	28.5	30.1	29.3	6.9	8.3	8.1	0.2	12.7	1.1
3/5–3/11	2005	8.9	10.3	9.3	26.4	28.7	28.1	7.4	8.4	8.3	0.0	12.0	1.0
3/12–3/18	2005	8.8	10.6	9.4	29.5	30.8	30.1	7.0	8.4	8.2	-0.1	41.8	2.6
3/19–3/25	2005	9.2	12.1	10.8	26.3	29.4	27.4	8.3	9.9	9.0	-0.3	42.9	1.3
3/26–4/1	2005	9.9	10.3	9.3	26.9	28.2	27.5	8.6	9.5	8.9	-0.1	15.7	1.2
4/2–4/8	2005	9.0	11.0	9.8	25.2	28.3	27.4	8.8	9.8	9.3	-0.2	8.0	0.7
4/9–4/15	2005	9.9	13.0	11.6	30.5	31.7	30.9	9.2	10.0	9.8	-0.1	3.8	0.5
4/16–4/22	2005	9.0	12.7	11.5	28.7	29.9	29.2	10.0	10.3	10.1	0.1	3.5	0.4
4/23–4/29	2005	9.5	10.8	9.5	33.7	34.9	34.5	9.6	10.9	10.1	-0.2	7.8	0.9
4/30–5/6	2005	10.2	10.8	9.8	25.8	27.6	26.7	9.6	11.4	10.6	0.1	12.5	1.3
5/7–5/13	2005	9.9	11.3	9.6	29.9	31.3	30.4	10.0	11.7	11.2	-0.7	29.4	1.5
5/14–5/20	2005	9.3	10.1	9.1	30.1	31.4	30.6	10.6	12.8	11.9	-2.6	6.5	-1.0
5/21–5/27	2005	7.6	10.0	8.8	29.3	31.7	30.2	11.1	13.9	12.4	†	†	†
5/28–6/3	2005	7.9	10.5	9.3	29.1	32.0	30.5	11.2	13.9	12.6	†	†	†
6/11–6/17	2005	8.1	10.5	10.0	29.6	31.1	30.0	11.9	13.9	13.3	†	†	†
6/29–7/1	2005	8.5	11.4	10.1	27.4	30.3	28.9	15.3	17.8	16.7	-2.4	6	-0.2
7/14–7/16	2005	8.3	11.2	9.2	27.3	32.5	31.7	13.2	16.9	14.5	-0.5	8.9	1
7/21–7/22	2005	6.9	11	8.3	26.8	28.1	27.6	11.9	16.4	13.7	-0.4	18	1
7/27–7/29	2005	7.2	9.4	8.2	34	35.1	34.5	13.3	15.8	14.5	0	11.8	0.7
8/3–8/4	2005	5.9	12.4	9	27.9	29.4	28.9	11.9	17.8	14.9	0	14.5	1.4
8/10–8/12	2005	7.8	9.2	8.6	29.9	31.6	30.6	15.1	19.1	17.4	0	15.7	1
8/15–8/16	2005	6.5	9.7	8.3	30.5	31.2	30.8	12.6	15.5	14.2	0.6	15.9	1.8
8/22–8/23	2005	5.3	8.7	6.9	30.3	31.3	30.9	12.4	15.5	13.8	0.1	4.8	0.5
8/29–8/30	2005	8.2	10.3	9.3	30.1	31.5	30.9	16.3	18.6	17.3	0.2	6	0.6
9/9–9/10	2005	7.9	9.2	8.7	28.1	29.5	28.9	13.5	15.6	14.8	0	12.6	0.7
9/12	2005	7	9.6	8.8	27.8	28.9	28.3	13.5	15.9	15.2	0.1	8.4	0.7
1/26–1/27	2006	7.2	11.3	9.1	25.9	27.3	26.6	7.7	8.2	8.1	0.2	12.4	1.1
2/7–2/8	2006	7.1	10.6	8.8	26.5	29.8	28.3	7.4	8.4	8	0.3	26.4	1.3
3/1–3/2	2006	8.8	11.3	9.4	28.5	30.1	29.3	6.9	8.3	8.1	0.2	12.7	1.1
3/7–3/8	2006	8.9	10.3	9.3	26.4	28.7	28.1	7.4	8.4	8.3	0	12	1
3/13–3/14	2006	8.8	10.6	9.4	29.5	30.8	30.1	7	8.4	8.2	-0.1	41.8	2.6

Table 3.1–2. Minimum, Maximum, and Mean Values of Water Quality Parameters at Nearshore Locations along the NAVBASE Kitsap Bangor Waterfront during the 2005–2008 Water Quality Surveys (continued)

Dates	Year	DO (mg/L)			Salinity (PSU)			Temperature (°C)			Turbidity (NTU)		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
3/23–3/24	2006	9.2	12.1	10.8	26.3	29.4	27.4	8.3	9.9	9	-0.3	42.9	1.3
3/27–3/28	2006	9.9	10.3	9.3	26.9	28.2	27.5	8.6	9.5	8.9	-0.1	15.7	1.2
4/4–4/5	2006	9	11	9.8	25.2	28.3	27.4	8.8	9.8	9.3	-0.2	8	0.7
4/11–4/12	2006	9.9	13	11.6	30.5	31.7	30.9	9.2	10	9.8	-0.1	3.8	0.5
4/20	2006	9	12.7	11.5	28.7	29.9	29.2	10	10.3	10.1	0.1	3.5	0.4
4/24–4/25	2006	9.5	10.8	9.5	33.7	34.9	34.5	9.6	10.9	10.1	-0.2	7.8	0.9
5/2–5/3	2006	10.2	10.8	9.8	25.8	27.6	26.7	9.6	11.4	10.6	0.1	12.5	1.3
5/11–5/12	2006	9.9	11.3	9.6	29.9	31.3	30.4	10	11.7	11.2	-0.7	29.4	1.5
5/15–5/16	2006	9.3	10.1	9.1	30.1	31.4	30.6	10.6	12.8	11.9	-2.6	6.5	-1
5/25–5/26	2006	7.6	10	8.8	29.3	31.7	30.2	11.1	13.9	12.4	†	†	†
5/30–5/31	2006	7.9	10.5	9.3	29.1	32	30.5	11.2	13.9	12.6	†	†	†
5/16	2006	8.1	10.5	10	29.6	31.1	30	11.9	13.9	13.3	†	†	†
1/25–1/26	2007	8.9	10.1	9.4	27.9	29.5	28.8	7.8	8.2	8.1	-0.2	0.6	0.0
2/8–2/9	2007	10.4	14.0	12.3	18.4	29.4	23.7	8.0	8.7	8.2	-1.0	8.3	0.0
3/1–3/2	2007	9.4	11.4	10.3	27.5	28.6	28.3	7.6	8.2	8.0	9.5	11.0	9.9
3/8–3/9	2007	3.9	8.0	6.5	23.9	25.7	24.9	8.3	9.0	8.7	-0.1	10.1	0.9
4/24–4/25	2007	9.1	10.6	10.0	25.4	27.0	26.5	10.8	11.5	11.2	-1.1	4.7	0.0
4/30–5/1	2007	8.8	12.3	10.0	27.5	28.8	28.3	9.3	12.1	10.3	-0.2	16.7	1.2
5/14–5/15	2007	8.3	12.3	10.2	28.3	29.4	28.9	9.9	12.1	10.8	-0.3	3.1	0.4
5/24–5/25	2007	8.8	11.7	10.2	30.4	31.9	31.1	11.4	14.1	12.6	-1.0	29.9	1.4
6/7–6/8	2007	9.2	12.0	11.3	30.2	31.1	30.8	12.6	13.5	13.1	0.0	11.7	1.3
2/2–2/3	2008	†	†	†	28.8	30.0	29.4	6.6	7.6	7.4	†	†	†
2/8–2/9	2008	†	†	†	29.3	29.7	29.6	7.4	7.7	7.6	†	†	†
3/12–3/13	2008	†	†	†	29.5	30.3	30.0	7.8	8.3	8.2	†	†	†
3/24–3/25	2008	†	†	†	30.0	30.4	30.3	7.8	8.5	8.1	†	†	†
4/1–4/2	2008	†	†	†	29.8	31.5	30.3	6.3	8.8	8.1	†	†	†
4/15–4/16	2008	†	†	†	31.8	32.4	32.2	8.5	9.1	8.8	0.1	0.8	0.4
4/29–4/30	2008	†	†	†	30.9	32.3	31.8	8.7	10.8	9.4	0.0	13.0	0.9
5/8–5/9	2008	†	†	†	31.2	32.8	32.2	8.4	10.3	9.3	0.1	9.4	1.3
5/21–5/22	2008	†	†	†	28.4	32.4	31.1	9.7	13.6	11.3	0.1	7.3	1.5
6/9–6/10	2008	†	†	†	26.7	28.0	27.3	10.4	12.8	11.6	-1.4	9.0	-0.2

Sources: Phillips et al. 2009; Hafner and Dolan 2009

† No data collected due to sensor malfunction.

°C = degrees Celsius; DO = dissolved oxygen; mg/L = milligrams per liter; NTU = Nephelometric Turbidity Units; PSU = practical salinity units

STRATIFICATION, SALINITY, AND TEMPERATURE AT THE LWI PROJECT SITES

Stratification, salinity, and temperature at the LWI project sites are consistent with conditions discussed above for the Bangor waterfront in general. Representative vertical profiles of water temperature, salinity, and density near the south LWI project site during summer (July 2007) are shown in Figure 3.1–15.

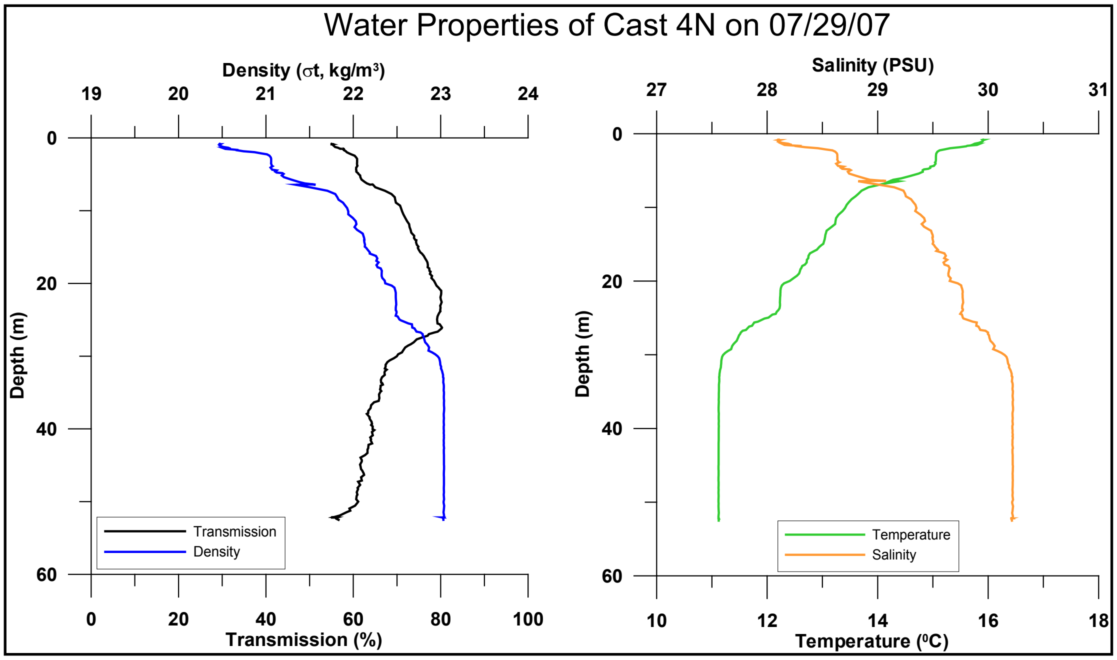
STRATIFICATION, SALINITY, AND TEMPERATURE AT THE SPE PROJECT SITE

Stratification, salinity, and temperature at the SPE project site are consistent with conditions discussed above for the Bangor waterfront in general. Representative vertical profiles of water temperature, salinity, and density near the Service Pier during summer (July 2007) are shown in Figure 3.1–16.

DISSOLVED OXYGEN

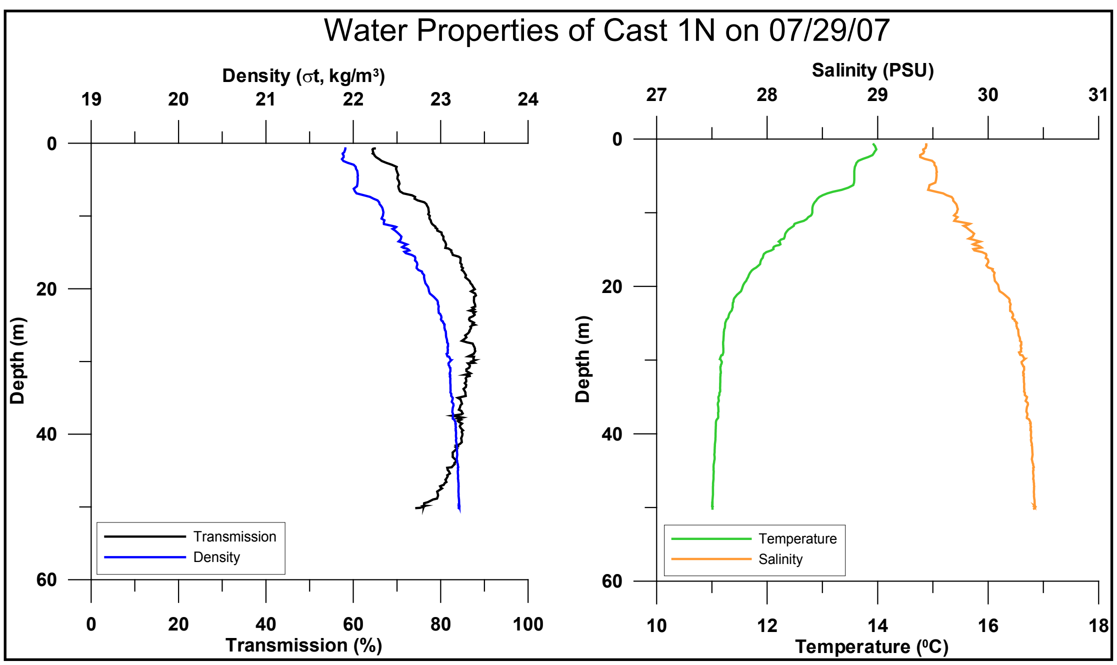
The DO concentrations in Hood Canal waters are affected by a number of physical and biological factors, some of which are influenced by human activities. Per the state's water quality classification, concentrations of DO in extraordinary quality marine surface waters, such as Hood Canal, should exceed 7.0 milligrams per liter (mg/L), allowing for only 0.2 mg/L reductions in the natural condition by human-caused activities (WAC 173-201A). However, physical and biological conditions contribute to DO concentrations below 7.0 mg/L within portions of Hood Canal. In these cases, state guidelines [WAC 173-201A-210(1)(d)] specify that "when a water body's DO is lower than the criteria in Table 210(1)(d) (or within 0.2 mg/L of the criteria) and that condition is due to natural conditions, the human action considered cumulatively may not cause the DO of that water body to decrease more than 0.2 mg/L."

Hood Canal is a deep, fjord-like basin with slow circulation, and these conditions are conducive to low DO conditions (Newton et al. 2011). Low DO concentrations in Hood Canal were reported as early as the 1930s and during the 1950s to 1960s (Collias et al. 1974), but at that time these conditions were largely confined to southern Hood Canal and lasted for three to six months. However, since the mid-1990s, the frequency, duration, and spatial extent of the hypoxia (low oxygen levels) have increased. Data from WDOE's Marine Water Quality Monitoring Program for 1998 to 2000 and the Hood Canal Dissolved Oxygen Program (HCDOP) for 2002 to 2004 show that seasonally low DO can also be found in the mainstem (northern and central reach) of Hood Canal (Newton et al. 2011). Scientists have proposed the following possible causes for the lower DO concentrations in Hood Canal: (1) changes in production or input of organic matter due to naturally better growth conditions, such as increased sunlight (or other climate factors), increased nutrient availability, or human loading of nutrients or organic material; (2) changes in ocean properties, such as seawater density that affects flushing of the canal's waters, oxygen concentration, or nutrients in the incoming ocean water; (3) changes in river input or timing from natural causes (e.g., drought) or from human actions (e.g., diversion) that affect both flushing and mixing in the canal; and (4) changes in weather conditions, such as wind direction and speed, which affect the flushing and/or oxygen concentration distribution. There is supporting evidence for all of these hypotheses (HCDOP 2009a).



Source: Morris et al. 2008

Figure 3.1–15. Water Quality (Temperature, Salinity, and Stratification/Density) Conditions Near the South LWI Project Site in Summer 2007



Source: Morris et al. 2008

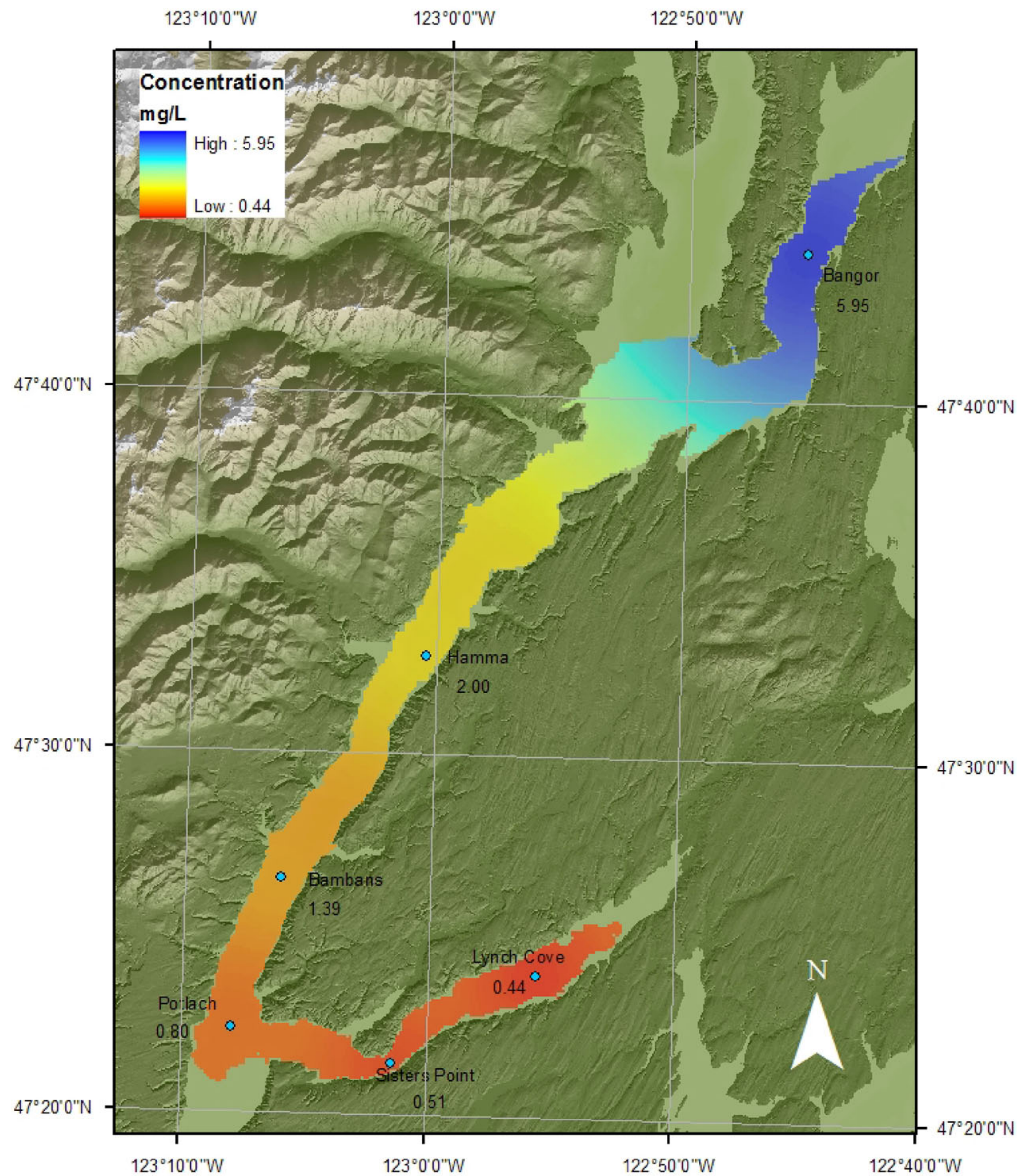
Figure 3.1–16. Water Quality (Temperature, Salinity, and Stratification/Density) Conditions Near the SPE Project Site in Summer 2007

The Bangor waterfront is located along the northern stretch of Hood Canal, which is less affected by these seasonal episodes of low DO (Figure 3.1–17) than other areas of the canal. From 2003 through 2008, DO concentrations in Hood Canal offshore from the southern boundary of NAVBASE Kitsap Bangor ranged from approximately 4 to 12 mg/L at depths of 33 feet (10 meters) (HCDOP 2009b). For this same time period, DO concentrations in surface waters ranged from approximately 5 to 14 mg/L. The concentrations fluctuated seasonally, with higher DO concentrations in the spring and early summer and lower DO concentrations in late summer and fall. Dissolved oxygen concentrations in Hood Canal between Dabob Bay and the Great Bend (south of the NAVBASE Kitsap Bangor area) ranged from approximately 3 to 5 mg/L at depths greater than 66 feet (20 meters) (Warner 2007). Monitoring data for core site HCB010 (off the southern tip of Toandos Peninsula) from 2012 (WDOE 2013a) indicated seasonal patterns in DO concentrations similar to those reported by HCDOP (2009b).

The 2012 303(d) list, the most recent list approved by the United States (U.S.) Environmental Protection Agency (USEPA), includes seven segments near NAVBASE Kitsap Bangor impaired by low DO levels (WDOE 2013b). Two of these (IDs 40984 and 10271) are located along the Bangor waterfront (Figure 3.1–18). Segment 10271 is just north of the south LWI project site. While the most recent (2009) data for segment 40984 showed no DO concentrations below the criterion (7.0 mg/L), both sites were determined to be category 5 (polluted sites requiring a total maximum daily load [TMDL]). The previously reported low DO concentrations at these locations were not attributable solely to natural conditions (WDOE 2013c).

Although some waters along the Bangor waterfront are on the 303(d) list, mean DO measurements during 2005 through 2008 indicated that nearshore stations at the waterfront consistently met extraordinary quality standards for DO (Table 3.1–2). Mean DO concentrations were above 7.0 mg/L during all but two surveys (August 22–23, 2005, and March 8–9, 2007), although it should be noted that water quality surveys during 2006 through 2008 did not extend into late summer and fall when the lowest seasonal DO concentrations are expected to occur (Hafner and Dolan 2009; Phillips et al. 2009). The 2005 to 2008 surveys of nearshore water quality off NAVBASE Kitsap Bangor did not detect any consistent spatial patterns in DO levels along the shoreline, as were noted for temperature and salinity.

At the offshore water quality sampling locations, water quality ratings based on DO concentrations ranged from fair to extraordinary quality during 2005 to 2006 (Phillips et al. 2009), whereas all DO concentrations measured at the offshore water quality sampling locations in 2007 were above 7.0 mg/L and met extraordinary quality standards (Hafner and Dolan 2009). The DO concentrations measured during the water quality surveys along the Bangor waterfront were on the upper range of DO conditions measured historically throughout Hood Canal during the late summer and fall periods (Warner 2007; WDOE 2013a).



Source: August 2006 Oxygen data provided by HCDOP Citizen Monitoring data, and image produced by University of Washington Spatial Analysis Lab.

Figure 3.1–17. Dissolved Oxygen Concentration in Hood Canal

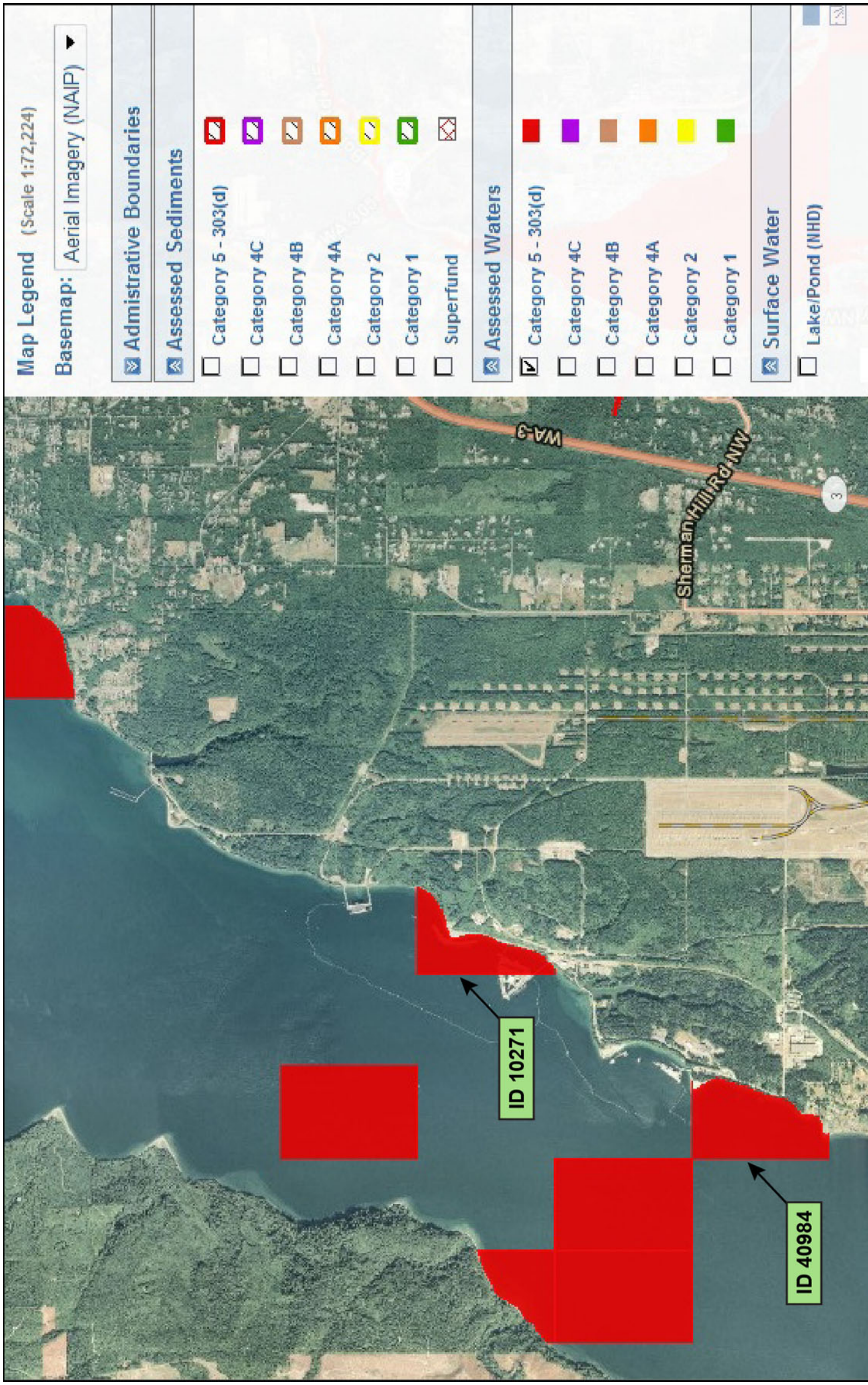


Figure 3.1–18. Washington State 2012 303(d) List Map for the NAVBASE Kitsap Bangor Area

DISSOLVED OXYGEN CONCENTRATIONS AT THE LWI PROJECT SITES

Dissolved oxygen concentrations measured near the LWI project sites during the 2005 to 2008 water quality surveys (Hafner and Dolan 2009; Phillips et al. 2009) were consistent with the patterns discussed above for the Bangor waterfront and ranged from fair to extraordinary conditions.

DISSOLVED OXYGEN CONCENTRATIONS AT THE SPE PROJECT SITE

Dissolved oxygen concentrations at the SPE project site measured during the 2005 to 2008 water quality surveys (Hafner and Dolan 2009; Phillips et al. 2009) were consistent with the patterns discussed above for the NAVBASE Kitsap Bangor shoreline and ranged from fair to extraordinary conditions.

TURBIDITY

Turbidity, measured in Nephelometric Turbidity Units (NTU), is a measure of the amount of light scatter related to total suspended solids (TSS) in the water column. Sources of turbidity in Hood Canal waters may include plankton, organic detritus from streams and other storm or wastewater sources, fine suspended sediments (silts and clays), and resuspended bottom sediments and organic particles. Suspended particles in the water have the ability to absorb heat in the sunlight, which then raises water temperature and reduces light available for photosynthesis.

Washington State-designated extraordinary quality marine surface waters have an average turbidity reading of less than 5 NTU (WAC 173-201A). Turbidity measurements conducted along the Bangor waterfront, including the vicinity of the LWI and SPE project sites during the 2005 through 2008 water quality surveys (Hafner and Dolan 2009; Phillips et al. 2009), are summarized in Table 3.1–2. The mean monthly turbidity measurements for nearshore waters ranged from 0.0 to 9.9 NTU and, for all but one survey (March 1–2, 2007), were within the Washington State standards for extraordinary water quality. The 2005 to 2008 surveys of nearshore water quality off the Bangor waterfront did not detect any consistent spatial patterns in turbidity levels along the waterfront, as were noted for temperature and salinity.

TURBIDITY AT THE LWI PROJECT SITES

Turbidity levels at the LWI project sites measured during the 2005 to 2008 water quality surveys (Hafner and Dolan 2009; Phillips et al. 2009) were consistent with the patterns discussed above for the NAVBASE Kitsap Bangor shoreline and typically reflected extraordinary water quality conditions.

TURBIDITY AT THE SPE PROJECT SITE

Turbidity levels at the SPE project site measured during the 2005 to 2008 water quality surveys (Hafner and Dolan 2009; Phillips et al. 2009) were consistent with the patterns discussed above for the NAVBASE Kitsap Bangor shoreline and typically reflected extraordinary water quality conditions.

NUTRIENTS

Nutrients (particularly nitrogen-based compounds), sunlight, and a stratified water column play important roles in algae productivity in Hood Canal. Nitrogen enters Hood Canal from the ocean, rivers, and the atmosphere. However, as more nitrogen enters the system through uncontrolled sources (e.g., runoff, fertilizer use, leaking septic systems), algae growth is stimulated, which can then reduce oxygen levels when the algae die and decompose in the late summer and early fall (HCDOP 2005).

WDOE's Marine Water Monitoring Program periodically monitors nutrients in the vicinity of the Bangor waterfront (WDOE 2013a). Concentrations of nitrate and phosphate during the 2005 monitoring year ranged from 0.02 to 2 mg/L and from 0.04 to 0.4 mg/L, respectively. Specific water quality standards for nutrients are not established, but the ranges observed near the LWI/SPE project sites are typical for marine waters in Puget Sound (Newton et al. 1998, 2002).

Nutrients at the LWI Project Sites

Nutrient concentrations in waters near the LWI project sites were not measured during the 2005 to 2008 water quality surveys of the Bangor waterfront; however, levels are expected to be similar to those reported by WDOE's Marine Water Monitoring Program (WDOE 2013a) for marine waters in the vicinity of the Bangor waterfront, as discussed above.

Nutrients at the SPE Project Site

Nutrient concentrations in waters near the SPE project site were not measured during the 2005 to 2008 water quality surveys of the Bangor waterfront; however, levels are expected to be similar to those reported by WDOE's Marine Water Monitoring Program (WDOE 2013a) for marine waters, as discussed above.

FECAL COLIFORM BACTERIA

Fecal coliform covers two bacteria groups (coliforms and fecal streptococci) that are commonly found in animal and human feces and are used as indicators of possible sewage contamination in marine waters (USEPA 1997). Although fecal indicator bacteria typically are not harmful to humans, they indicate the possible presence of pathogenic bacteria, viruses, and protozoa that also live in animal and human digestive systems. Therefore, their presence in marine waters at elevated levels may indicate the presence of pathogenic microorganisms that pose a health risk.

The Washington Department of Health (WDOH) Office of Food Safety and Shellfish Programs conducts annual fecal coliform bacteria monitoring in Hood Canal including stations near the Bangor waterfront. The standard for approved shellfish growing waters is a fecal coliform geometric mean not greater than 14 most probable number (MPN)/100 milliliters (mL) and an estimate of the 90^{th} percentile not greater than 43 MPN/100 mL (Table 3.1–1). When this standard is met, the water is considered safe for shellfish harvesting and for water contact use by humans (also referred to as primary human contact).

WDOH summarized the annual fecal coliform bacteria monitoring results in Hood Canal and the rest of Puget Sound in the form of an index rating system ranging from bad to good, where lower index values indicate lower fecal coliform. Most of the NAVBASE Kitsap Bangor shellfish areas are classified by WDOH as Approved for harvest (WDOH 2012); however, one area just south of Cattail Lake is classified as Prohibited.

FECAL COLIFORM BACTERIA AT THE LWI PROJECT SITES

The most recent WDOH data fecal coliform data for the closest sampling stations to the LWI project sites (85 and 87) indicate that these stations meet the WDOE water quality standard (WDOH 2012). A waterbody segment (Listing ID 40015) of Hood Canal off Devil's Hole (Hood Canal #2 87 and 88) is a category 2 listing (waters of concern, no TMDL required) on the current 303(d) list for elevated bacterial levels. The category determination was based on one exceedance in 2007. More recent data, which met the standard, are not sufficient to demonstrate that this waterbody currently is meeting water quality standards for bacteria because the determination is based on multiple measurements, specifically a rolling average of about 30 samples for classification of shellfish growing areas.

FECAL COLIFORM BACTERIA AT THE SPE PROJECT SITE

Similar to the LWI project sites, the most recent WDOH fecal coliform data for the area near the SPE project site (Station 88), indicates that this sampling station meets the WDOE water quality standard (WDOH 2012).

PH

The term *pH* is a measure of alkalinity or acidity and affects many chemical and biological processes in water. For example, low pH can affect the mobility (solubility) of toxic elements and their availability for uptake by aquatic plants and animals, which can produce conditions toxic to aquatic life, particularly to juvenile organisms. Washington State-designated extraordinary quality marine surface waters should have a pH reading between 7.0 and 8.5 (WAC 173-201A). WDOE's Marine Water Monitoring Program monitors pH in the vicinity of the Bangor waterfront. The pH levels at the rotating site HCB008 ranged from 7.6 to 8.1 during 2005, and all values were within extraordinary quality standards (WDOE 2013a).

PH LEVELS AT THE LWI PROJECT SITES

The pH of waters near the LWI project sites was not measured during the 2005 to 2008 water quality surveys of the Bangor waterfront. However, values are expected to be consistent with those discussed above for the WDOE Marine Water Monitoring Program and meet extraordinary water quality standards.

PH LEVELS AT THE SPE PROJECT SITE

The pH of waters near the SPE project site was not measured during the 2005 to 2008 water quality surveys of the Bangor waterfront. However, values are expected to be consistent with those discussed above for the WDOE Marine Water Monitoring Program and meet extraordinary water quality standards.

3.1.1.1.3 SEDIMENT QUALITY

Sediment quality focuses on the physical and chemical properties of bottom sediments. Physical parameters include grain size, which is a quantitative description of the proportions of gravel, sand, silt, and clay-size particles and the dominant size classes for the sediment matrix. Sediment quality also considers concentrations of total organic carbon (TOC), as well as the concentrations of trace constituents, including metals, petroleum-derived hydrocarbons, and chlorinated organic compounds, which may reflect a combination of natural and human-derived sources. The combination of sediment texture (grain size), organic content, and contaminant levels affect the suitability of the sediments as habitat for marine organisms and other beneficial uses.

PHYSICAL AND CHEMICAL PROPERTIES OF SEDIMENTS

Existing information on the physical and chemical properties of sediments in the vicinity of the LWI and SPE project sites is based on results from sampling during 2007 (Hammermeister and Hafner 2009). Sampling locations at the north and south LWI project sites are shown in Figures 3.1–19 and 3.1–20, respectively, and sampling locations in the vicinity of Service Pier are shown in Figure 3.1–21.

Marine sediments in the general project area are composed of gravelly sands with some cobbles in the intertidal zone, transitioning to silty sands in the subtidal zone (Hammermeister and Hafner 2009). Subsurface coring studies conducted in 1994 encountered glacial till approximately 6 feet (2 meters) below the mud line in the intertidal zone, increasing to over 10 feet (3 meters) in the subtidal zone (URS 1994).

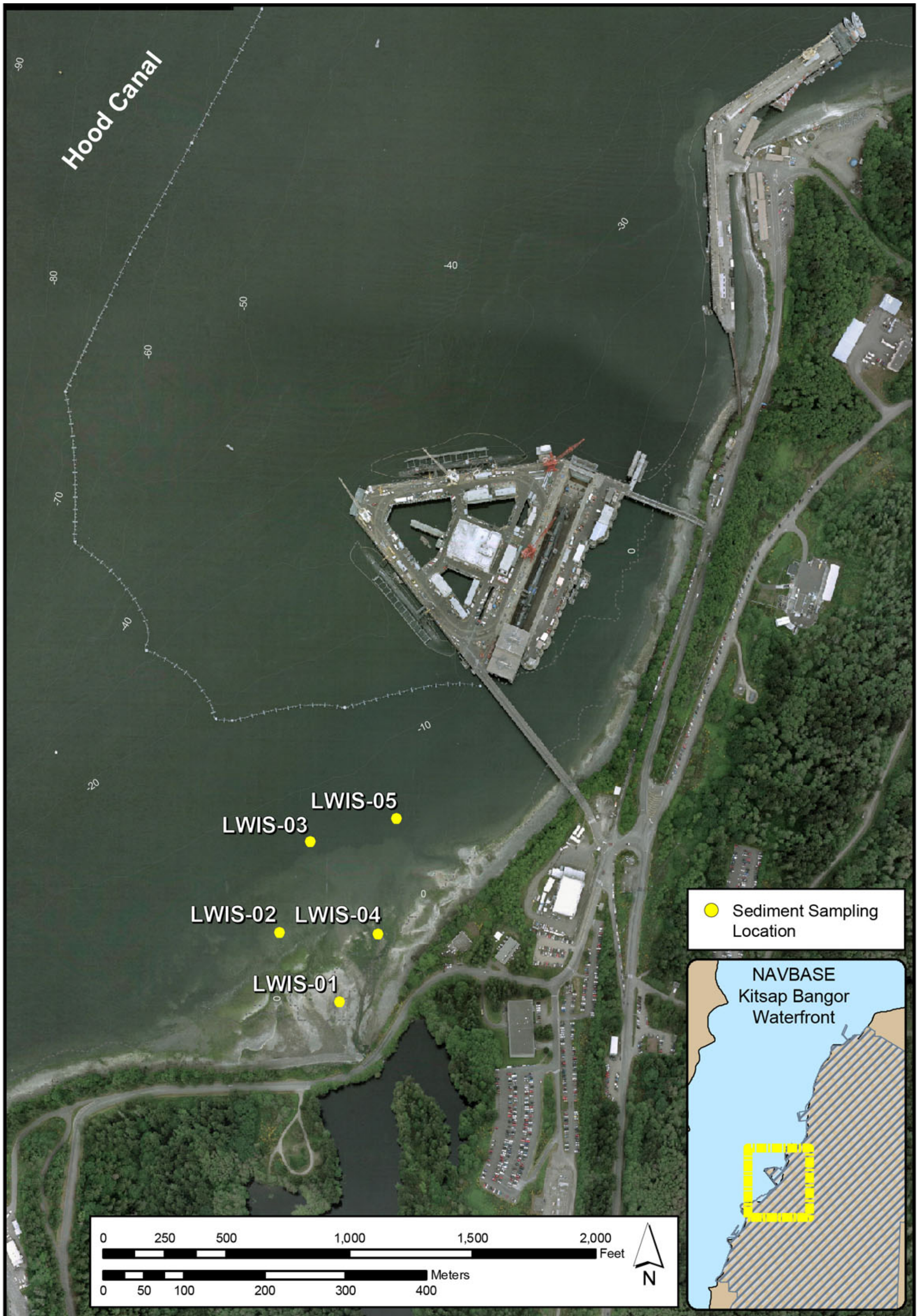
PHYSICAL AND CHEMICAL PROPERTIES OF SEDIMENTS AT THE LWI PROJECT SITES

Sediments from the north and south LWI project sites consist primarily of sand-sized particles (83 to 99 percent and 30 to 97 percent, respectively) with variable gravel fractions (1 to 4 percent and 1 to 70 percent, respectively) and small silt plus clay fractions (4 to 17 percent and 2 to 7 percent, respectively) (Table 3.1–3). Other than the comparatively higher gravel fraction in the south LWI sediments, the texture of bottom sediments at both locations is similar.

Sediment parameters (such as TOC, metals, and organic contaminants) were used to characterize sediment quality. TOC, which provides a measure of how much organic matter occurs in the sediments, is less than 1 percent at the north LWI and south LWI project sites (Table 3.1–3). A range of 0.5 to 3 percent is typical for Puget Sound marine sediments, particularly those in the main basin and in the central portions of urban bays (Puget Sound Water Quality Action Team and Puget Sound Estuary Program 1997). Total sulfide concentrations range from not detected (ND) (i.e., below the detection limit of 0.4 milligrams per kilogram [mg/kg]) to 259 mg/kg, and ammonia concentrations range from 4.8 to 14.5 mg/kg across both the north LWI and south LWI project sites. Table 3.1–3 lists marine sediment quality standards for selected parameters (marine sediment quality standards are discussed in Section 3.1.1.2.1). No marine sediment quality standards have been established for TOC, sulfides, or ammonia concentrations. In general, the TOC, sulfides, and ammonia concentrations in the north LWI and south LWI sediments are similar.

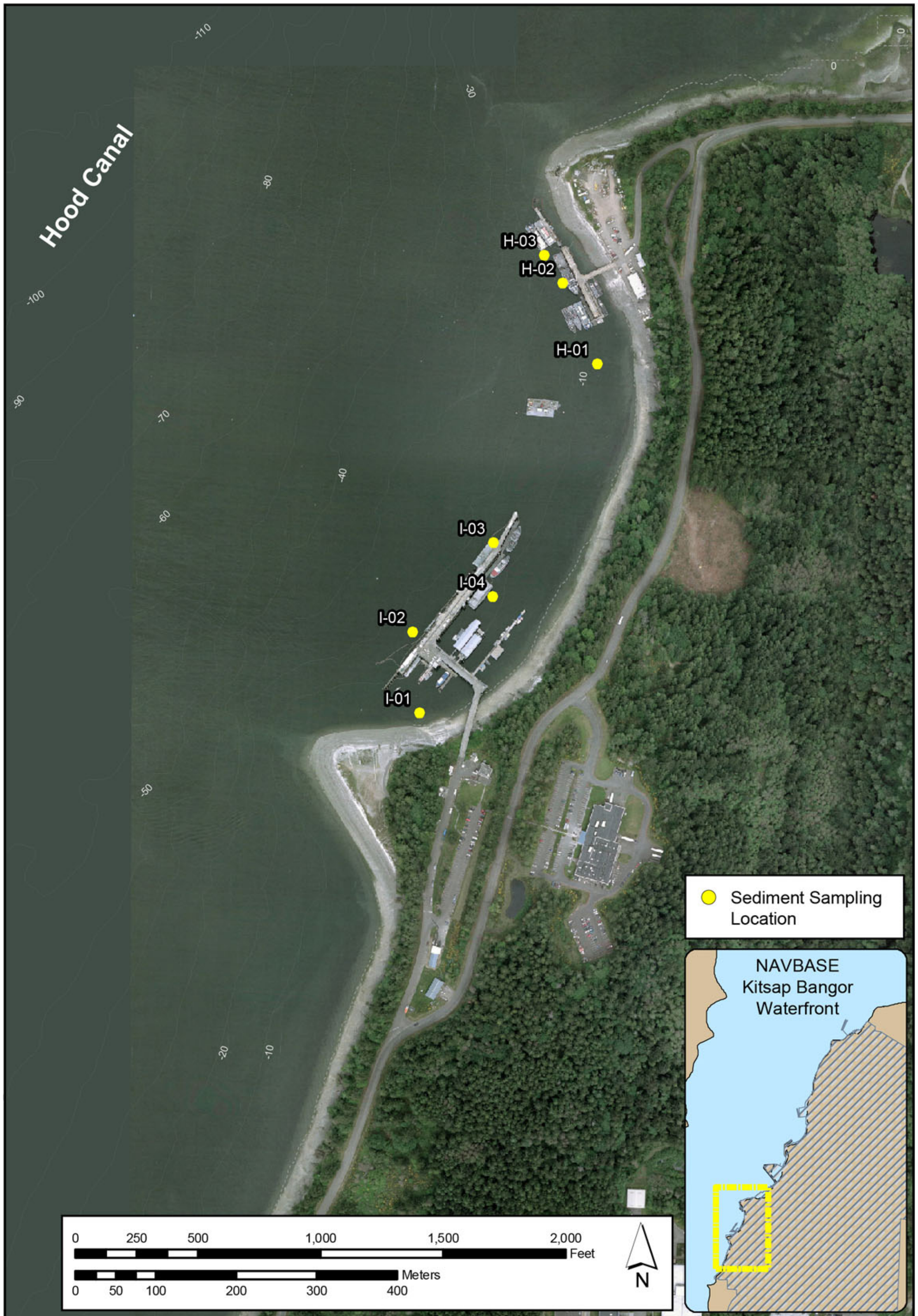
Source: Hammermeister and Hafner 2009

Figure 3.1–19. Sediment Sampling Locations at the North LWI Project Site



Source: Hammermeister and Hafner 2009

Figure 3.1–20. Sediment Sampling Locations at the South LWI Project Site



Source: Hammermeister and Hafner 2009

Figure 3.1–21. Sediment Sampling Locations at the SPE Project Site

Table 3.1–3. Physical and Chemical Characteristics of Surface Sediments at the North and South LWI Project Sites

Parameter	Marine Sediment Quality Standards	North LWI Site[1] (Minimum – Maximum Values)	South LWI Site[1] (Minimum – Maximum Values)
Conventionals			
Total Organic Carbon (TOC) (%)	—	0.19 – 0.56	0.16 – 0.54
Total Volatile Solids (%)	—	1.6 – 2.4	1.36 – 2.94
Total Solids (%)	—	67 – 75	73 – 86
Ammonia (mg-N/kg)	—	6.9 – 11	4.8 – 14
Total Sulfides (mg/kg)	—	3.7 – 210	ND – 259
Grain Size			
Percent Gravel (>2.0 mm)	—	0.91 – 3.99	1.18 – 69.9
Percent Sand (<2.0 mm – 0.06 mm)	—	82.6 – 99.3	30.5 – 96.8
Percent Silt (0.06 mm – 0.004 mm)	—	2.14 – 13.0	0.79 – 3.36
Percent Fines (<0.06 mm)	—	3.81 – 17.1	2.44 – 6.83
Percent Clay (<0.004 mm)	—	1.67 – 4.14	1.39 – 3.48
Metals (mg/kg)			
Antimony	—	0.05	0.03 – 0.10
Arsenic	57	2.29 – 3.37	1.42 – 2.55
Cadmium	5.1	0.18 – 0.37	0.04 – 0.35
Chromium	260	18.5 – 22.2	17.9 – 33.5
Copper	390	10.3 – 12.7	7.20 – 19.0
Lead	450	2.30 – 3.23	2.33 – 3.26
Mercury	0.41	0.01 – 0.03	0.01
Nickel	—	20.5 – 26.2	20.1 – 35.3
Selenium	—	0.40 – 0.60	0.40 – 0.50
Silver	6.1	0.02 – 0.04	0.02 – 0.03
Zinc	410	32.4 – 35.5	27.3 – 40.4
Butyltins (µg/kg)			
Di-n-butyltin	—	ND – 0.26	ND – 0.39
Tri-n-butyltin	—	ND	ND – 0.97
Tetra-n-butyltin	—	ND	ND
n-butyltin	—	ND	ND
LPAH (mg/kg TOC)			
Naphthalene	99	ND	ND
Acenaphthylene	66	ND	ND – 1.05
Acenaphthene	16	ND	ND
Fluorene	23	ND	ND – 0.74
Phenanthrene	100	1.59 – 2.58	1.39 – 9.52
Anthracene	220	ND – 0.48	ND – 2.19
2-Methylnaphthalene	38	ND	ND
Total LPAH[2]	370	1.59 – 2.80	1.39 – 13.5

Table 3.1–3. Physical and Chemical Characteristics of Surface Sediments at the North and South LWI Project Sites (continued)

Parameter	Marine Sediment Quality Standards	North LWI Site[1] (Minimum – Maximum Values)	South LWI Site[1] (Minimum – Maximum Values)
HPAH (mg/kg TOC)			
Fluoranthene	160	2.16 – 4.29	4.29 – 12.4
Pyrene	1,000	1.95 – 3.75	3.36 – 12.4
Benz(a)anthracene	110	ND – 1.55	ND – 5.00
Chrysene	110	ND – 2.32	1.93 – 5.71
Benzofluoranthenes[3]	230	ND – 2.80	4.00 – 7.38
Benzo(a)pyrene	99	ND – 1.66	1.18 – 5.24
Indeno(1,2,3-cd)pyrene	34	ND – 1.07	0.86 – 3.10
Dibenz(a,h)anthracene	12	ND	ND – 0.69
Benzo(g,h,i)perylene	31	ND – 0.91	0.71 – 2.62
Total HPAH[4]	960	4.11 – 21.2	21.8 – 61.9
Chlorinated Aromatics (mg/kg TOC)			
1,3-Dichlorobenzene	—	ND	ND
1,2-Dichlorobenzene	2.3	ND	ND
1,4-Dichlorobenzene	3.1	ND	ND
1,2,4-Trichlorobenzene	0.81	ND	ND
Hexachlorobenzene	0.38	ND	ND
Phthalate Esters (mg/kg TOC)			
Dimethylphthalate	53	ND	ND
Diethylphthalate	61	1.39 – 5.59	ND – 1.00
Di-n-Butylphthalate	220	4.82 – 10.0	4.29 – 11.9
Butylbenzylphthalate	4.9	ND	ND – 1.82
bis(2-Ethylhexyl)phthalate	47	ND – 3.39	ND – 4.17
Di-n-Octylphthalate	58	ND	ND
Phenols (µg/kg dw)			
Phenol	420	30.0 – 47.0	16.0 – 84.0
2-Methylphenol	63	ND	ND
4-Methylphenol	670	20.0 – 37.0	ND – 160
2,4-Dimethylphenol	29	ND	ND
Pentachlorophenol	360	ND	ND
Misc. Extractables (mg/kg TOC)			
Benzyl Alcohol	57	ND	ND – 1.07
Benzoic Acid	650	ND	ND
Dibenzofuran	15	ND	ND
Hexachloroethane	—	ND	ND
Hexachlorobutadiene	3.9	ND	ND
N-Nitrosodiphenylamine	28	ND	ND

Table 3.1–3. Physical and Chemical Characteristics of Surface Sediments at the North and South LWI Project Sites (continued)

Parameter	Marine Sediment Quality Standards	North LWI Site[1] (Minimum – Maximum Values)	South LWI Site[1] (Minimum – Maximum Values)
Pesticides and PCBs (mg/kg TOC)			
Total DDT[5]	—	ND	ND – 0.02
Aldrin	—	ND	ND
alpha-Chlordane	—	ND	ND
Dieldrin	—	ND	ND
Heptachlor	—	ND	ND
gamma-BHC (Lindane)	—	ND	ND
Total PCBs[6]	12	ND	ND

Source: Marine sediment quality standards from WAC 173-204-320; LWI data are from Hammermeister and Hafner (2009).

— = No sediment quality standard or screening levels exist; dw = dry weight; HPAH = high molecular weight polycyclic aromatic hydrocarbon; LPAH = low molecular weight polycyclic aromatic hydrocarbon; mg/kg = milligrams per kilogram; µg/kg = micrograms per kilogram; mm = millimeter; ND = not detected; PCB = polychlorinated biphenyl; TOC = total organic carbon

1. Samples taken at depths from 0–10 cm. Values represent the ranges for samples from three locations near the north LWI project site and four locations from the south LWI project site as shown in Figures 3.1–19 and 3.1–20.
2. Sum of detected LPAH results for naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. LPAH does not include 2-methylnaphthalene.
3. Sum of benzo(b)fluoranthene and benzo(k)fluoranthene.
4. Sum of detected HPAH results for fluoranthene, pyrene, benz(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
5. Sum of 4,4'-DDD, 4-4'-DDE, and 4-4'-DDT.
6. Sum of Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260.

Physical and Chemical Properties of Sediments at the SPE Project Site

Sediments at the SPE project site are primarily sand and gravel, and sediment quality is generally good based on contaminant levels that are below marine sediment quality standards (Table 3.1–4).

Table 3.1–4. Physical and Chemical Characteristics of Surface Sediments at the SPE Project Site

Parameter	Marine Sediment Quality Standards	SPE (Minimum – Maximum Values)[1]
Conventionals		
Total Organic Carbon (TOC) (%)	—	0.44 – 1.96
Total Volatile Solids (%)	—	1.4 – 6.8
Total Solids (%)	—	52 – 73
Ammonia (mg-N/kg)	—	7.6 – 29
Total Sulfides (mg/kg)	—	5.7 – 1330
Grain Size		
Percent Gravel (>2.0 mm)	—	1.4 – 36.5
Percent Sand (<2.0 mm – 0.06 mm)	—	37 – 96
Percent Silt (0.06 mm – 0.004 mm)	—	4.4 – 20

Table 3.1–4. Physical and Chemical Characteristics of Surface Sediments at the SPE Project Site (continued)

Parameter	Marine Sediment Quality Standards	SPE (Minimum – Maximum Values)[1]
Percent Fines (<0.06 mm)	—	6.9 – 28
Percent Clay (<0.004 mm)	—	2.6 – 8.3
Metals (mg/kg)		
Antimony	—	0.06 – 0.09
Arsenic	57	2.01 – 4.15
Cadmium	5.1	0.19 – 0.71
Chromium	260	18.3 – 22.1
Copper	390	8.6 – 23.9
Lead	450	3.29 – 9.32
Mercury	0.41	0.02 – 0.04
Nickel	—	18.7 – 25.4
Selenium	—	0.40 – 1.20
Silver	6.1	0.03 – 0.08
Zinc	410	31.6 – 77.5
Butyltins (µg/kg)		
Di-n-butyltin	—	ND – 0.65
Tri-n-butyltin	—	ND
Tetra-n-butyltin	—	ND
n-butyltin	—	ND – 0.24
LPAH (mg/kg TOC)		
Naphthalene	99	0.34 – 7.0
Acenaphthylene	66	1.5 – 5.0
Acenaphthene	16	0.22 – 3.6
Fluorene	23	0.31 – 5.4
Phenanthrene	100	3.3 - 30
Anthracene	220	1.0 - 14
2-Methylnaphthalene	38	0.29 – 2.9
Total LPAH[2]	370	5.4 – 62
HPAH (mg/kg TOC)		
Fluoranthene	160	12 – 61
Pyrene	1,000	10 – 54
Benz(a)anthracene	110	2.9 – 21
Chrysene	110	6.3 – 41
Benzofluoranthenes[3]	230	7.9 – 102
Benzo(a)pyrene	99	2.9 – 50
Indeno(1,2,3-cd)pyrene	34	2.0 – 21
Dibenz(a,h)anthracene	12	0.46 – 5.4
Benzo(g,h,i)perylene	31	1.7 – 15
Total HPAH[4]	960	57 – 372
Chlorinated Aromatics (mg/kg TOC)		
1,3-Dichlorobenzene	—	ND
1,2-Dichlorobenzene	2.3	ND
1,4-Dichlorobenzene	3.1	ND

Table 3.1–4. Physical and Chemical Characteristics of Surface Sediments at the SPE Project Site (continued)

Parameter	Marine Sediment Quality Standards	SPE (Minimum – Maximum Values)[1]
1,2,4-Trichlorobenzene	0.81	ND
Hexachlorobenzene	0.38	ND
Phthalate Esters (mg/kg TOC)		
Dimethylphthalate	53	ND – 0.30
Diethylphthalate	61	ND – 0.45
Di-n-Butylphthalate	220	2.8 – 4.4
Butylbenzylphthalate	4.9	ND – 1.0
bis(2-Ethylhexyl)phthalate	47	1.9 – 6.1
Di-n-Octylphthalate	58	ND
Phenols (µg/kg dw)		
Phenol	420	28 – 54
2-Methylphenol	63	ND
4-Methylphenol	670	2.7 – 260
2,4-Dimethylphenol	29	ND
Pentachlorophenol	360	ND
Misc. Extractables (mg/kg TOC)		
Benzyl Alcohol	57	ND – 0.73
Benzoic Acid	650	ND
Dibenzofuran	15	ND – 3.9
Hexachloroethane	—	ND
Hexachlorobutadiene	3.9	ND
N-Nitrosodiphenylamine	28	ND
Pesticides and PCBs (mg/kg TOC)		
Total DDT[5]	—	ND
Aldrin	—	ND
alpha-Chlordane	—	ND
Dieldrin	—	ND
Heptachlor	—	ND
gamma-BHC (Lindane)	—	ND
Total PCBs[6]	12	ND

Source: Marine sediment quality standards from WAC 173-204-320;
SPE data are from Hammermeister and Hafner (2009).

— = No sediment quality standard or screening levels exist; dw = dry weight; HPAH = high molecular weight polycyclic aromatic hydrocarbon; LPAH = low molecular weight polycyclic aromatic hydrocarbon; mg/kg = milligrams per kilogram; µg/kg = micrograms per kilogram; mm = millimeter; ND = not detected; PCB = polychlorinated biphenyl; TOC = total organic carbon

1. Samples taken at depths from 0–10 cm. Values represent the ranges for samples from four locations near the SPE project site as shown in Figure 3.1–21.
2. Sum of detected LPAH results for naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. LPAH does not include 2-methylnaphthalene.
3. Sum of benzo(b)fluoranthene and benzo(k)fluoranthene.
4. Sum of detected HPAH results for fluoranthene, pyrene, benz(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene.
5. Sum of 4,4'-DDD, 4-4'-DDE, and 4-4'-DDT.
6. Sum of Aroclors 1016, 1221, 1232, 1242, 1248, 1254, 1260.

METALS

METALS IN SEDIMENTS AT THE LWI PROJECT SITES

Table 3.1–3 shows the concentrations of metals in sediments at the north LWI and south LWI project sites based on sampling conducted by Hammermeister and Hafner (2009). These concentrations are comparable to background levels for Puget Sound and are well below marine sediment quality standards. For example, maximum cadmium concentrations are 0.37 and 0.35 mg/kg, respectively, which are below the marine sediment quality standard of 5.1 mg/kg. In general, the metal concentrations in the north LWI and south LWI sediments are similar.

METALS IN SEDIMENTS AT THE SPE PROJECT SITE

Table 3.1–4 shows the concentrations of metals in sediments at the SPE project site based on sampling conducted by Hammermeister and Hafner (2009). These concentrations are comparable to background levels for Puget Sound and are well below marine sediment quality standards.

ORGANIC CONTAMINANTS

The primary source of organotin (butyltin) compounds in marine sediments is residues from anti-fouling paints applied to vessel hulls (Danish EPA 1999). Use of organotins in anti-fouling paints for ships less than 82 feet (25 meters) in length and for ships with non-aluminum hulls was banned in 1988 by the Organotin Anti-Fouling Paint Control Act (33 United States Code [USC] 2401-2410).

ORGANIC CONTAMINANTS IN SEDIMENTS AT THE LWI PROJECT SITES

Sediments at the LWI project sites contain trace concentrations (less than 1 microgram per kilogram [µg/kg] or approximately 200 µg/kg TOC) of di-n-butyltin and tri-n-butyltin (Table 3.1–3). There is no existing marine sediment quality standard for organotins; however, Meador et al. (2002) proposed a threshold value of 6,000 µg/kg TOC for tributyltin in sediments as being protective of juvenile salmonids. Concentrations in sediments near the project sites are well below this threshold.

Concentrations of individual polycyclic aromatic hydrocarbon (PAH) compounds in sediments near the project sites vary from not detected (ND) to 12.4 mg/kg TOC (Table 3.1–3). Concentrations of individual PAH compounds, as well as the summed concentrations (i.e., total low molecular weight polycyclic aromatic hydrocarbons [LPAHs] and total high molecular weight polycyclic aromatic hydrocarbons [HPAHs]) are below the corresponding marine sediment quality standards.

Concentrations of other classes of organic contaminants, such as chlorinated aromatics, phthalate esters, phenols, and other miscellaneous extractable compounds, typically are at or below the analytical detection limits and consistently below the marine sediment quality standards. Concentrations of organic contaminants in the north LWI and south LWI sediments are similar.

ORGANIC CONTAMINANTS IN SEDIMENTS AT THE SPE PROJECT SITE

Sediments at the SPE project site contain trace concentrations (less than 1 microgram per kilogram [µg/kg] or approximately 200 µg/kg TOC) of di-n-butyltin and tri-n-butyltin (Table 3.1–4) that are well below the threshold value (6,000 µg/kg TOC for tributyltin) considered protective of juvenile salmonids (Meador et al. 2002).

Concentrations of individual PAH compounds, as well as the summed concentrations (i.e., total LPAHs and total HPAHs), in sediments at the SPE project site are below the corresponding marine sediment quality standards.

Concentrations of other classes of organic contaminants, such as chlorinated aromatics, phthalate esters, phenols, and other miscellaneous extractable compounds, typically are at or below the analytical detection limits and consistently below the marine sediment quality standards.

3.1.1.2 CURRENT REQUIREMENTS AND PRACTICES

3.1.1.2.1 REGULATORY COMPLIANCE

HYDROGRAPHY

Section 10 of the Rivers and Harbors Act (33 USC 401 et seq.) requires authorization from U.S. Army Corps of Engineers (USACE) for development of any structure in or over navigable water of the United States, as well as the excavation/dredging or deposition of material in these waters, or alteration of navigable waters. Navigable waters of the U.S. are those subject to the ebb and flow of the tide shoreward to the mean high water mark and/or which have been used, are currently used, or may be used in the future for transporting interstate or foreign commerce. The term includes navigable coastal and inland waters, lakes, rivers, streams, and the territorial seas.

The Coastal Zone Management Act (CZMA) created a partnership of federal and state governments to reduce conflicts over land and water uses in the coastal zone, protect fragile coastal resources, and provide for economic development (15 Code of Federal Regulations [CFR], Chapter IX, Section 930.30 et seq.). To this end, the CZMA seeks a balance between preservation and economic development and promotes the sustainable use of the valuable resources of the nation's shoreline. The CZMA requires that federal actions that have reasonably foreseeable effects on coastal users or resources must be consistent to the maximum extent practicable with the enforceable policies of approved state coastal management programs. Activities and development impacting coastal resources that involve the federal government are evaluated through a process called federal consistency, in which the proponent agency is required to prepare a Coastal Consistency Determination (CCD) for concurrence from the affected state, in this case Washington.

WATER QUALITY

The Federal Water Pollution Control Act Amendments of 1972, as amended in 1977 and 2002, and commonly known as the Clean Water Act (CWA) (33 USC 1251), established the basic structure for regulating discharges of pollutants into waters of the U.S. The CWA contains the requirements to set water quality standards for all contaminants in surface waters. The USEPA is the designated regulatory authority to implement pollution control programs and other requirements of the CWA.

For Washington State, the responsibility for reviewing, establishing, and revising water quality standards has been delegated by the USEPA to WDOE. State water quality standards must be at least as stringent as the federal standards. As long as state standards meet this criterion, WDOE may modify the water quality standards to reflect site-specific conditions or adopt standards based on other scientifically defensible methods. WDOE also has responsibility for identifying impaired waters that do not meet applicable surface water quality standards. This list of impaired water bodies is referred to as the 303(d) list, referring to the section of the CWA that requires the development of a cleanup plan for those waters not meeting the standards. The current 303(d) list includes two segments impaired by low DO levels along the Bangor waterfront. Waters of Hood Canal immediately north of the NAVBASE Kitsap Bangor boundary are on the current 303(d) list for low DO concentrations (WDOE 2013b,c). No TMDL has been developed by WDOE for this area.

The state water quality standards are defined in the Washington State Water Pollution Control Act (Revised Code of Washington [RCW] 90.48) and implemented in WAC 173-201A.

With respect to water quality, CWA Section 401 (water quality certification) and Section 402 (National Pollutant Discharge Elimination System [NPDES] permits) are applicable to these projects, and Section 404 (discharge of dredged or fill material into waters of the U.S.) is applicable to the LWI project. The project proponent applies for permits under CWA sections 401 and 404, as well as Section 10 of the Rivers and Harbors Act, through the Joint Aquatic Resources Permit Application (JARPA) process. The proponent submits the JARPA to USACE who coordinates the overall approval process. WDOE is responsible for administering Section 401, while USACE is responsible for Section 404 and Section 10. The Section 401 Certification documents the WDOE determination that the action is consistent with state water quality standards and other water quality goals. WDOE sets water quality standards to maintain the overall desired water quality in Hood Canal (in this case extraordinary water quality).

The USEPA administers Section 402 at federal facilities such as NAVBASE Kitsap Bangor. Section 402 establishes the NPDES permit program to regulate point source discharges of pollutants into waters of the U.S. An NPDES permit sets specific discharge limits and conditions for point sources discharging pollutants into waters of the U.S. and establishes monitoring and reporting requirements.

The USEPA issued the NPDES General Permit for Storm Water Associated with Construction Activities (Construction General Permit) that provides permit coverage for federal construction site operators engaged in clearing, grading, and excavating activities that disturb one acre or more. Ecology's *Stormwater Management Manual for Western Washington* (WDOE 2014) provides technical guidance on measures to control the quantity and quality of stormwater runoff from development projects for compliance with CWA permit conditions.

NAVBASE Kitsap Bangor currently holds an USEPA-issued NPDES permit for stormwater discharges associated with industrial activity. The permit, titled *Multi-Sector General Permit for*

Stormwater Discharges Associated with Industrial Activity (MSGP), requires stormwater monitoring, inspections, training/awareness, documentation, reporting, and implementation of control measures (including Best Management Practices [BMPs]) to reduce and/or eliminate stormwater pollutant discharges. NAVBASE Kitsap Bangor staff regularly review changes in facility infrastructure and operations related to MSGP coverage. If a new facility conducts an industrial activity, it would be incorporated under existing MSGP coverage.

Section 438 of the Energy Independence and Security Act of 2007 (Public Law 110-140) requires federal development projects with a footprint exceeding 5,000 square feet (460 square meters) to "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to temperature, rate, volume, and duration of flow." According to USEPA guidance on implementing Section 438 of the Act (USEPA 2009a), the intent of Section 438 is to "require federal agencies to develop and redevelop applicable facilities in a manner that maintains or restores stormwater runoff to the maximum extent technically feasible" and to "replicate the pre-development hydrology to protect and preserve both the water resources onsite and those downstream."

The USEPA and Department of Defense (DoD) jointly promulgated Phase I of Uniform National Discharge Standard program, 40 CFR Part 1700, on May 10, 1999 (64 Federal Register [FR] 25126). Phase I of the program concluded that 25 out of 39 liquid discharges from vessels of the Armed Forces would require pollution control. The USEPA and DoD have developed discharge marine pollution control device performance standards for 11 of the 25 discharges that were identified as requiring control, including Seawater Cooling Overboard Discharges. Discharges of non-contact cooling water are covered by the Uniform National Discharge Standard program, but discharge-specific requirements have not been promulgated to date. Once promulgated, these standards are expected to apply to cooling water discharges from submarines berthed at NAVBASE Kitsap Bangor. The performance discharge standards will closely mirror the USEPA's Vessel General Permit 2013 requirements.

The CZMA requires that federal permit activities having reasonably foreseeable effects on coastal water quality must be fully consistent with the enforceable policies of state coastal management programs. Section 3.1.2 addresses the potential for construction and operation of the proposed projects to significantly degrade water quality.

SEDIMENT QUALITY

The Washington State Sediment Management Standards (SMS) (WAC 173-204) provide the framework for long-term management of marine sediment quality in Washington State. The purpose of the SMS is to reduce and ultimately eliminate adverse biological impacts and threats to human health from sediment contamination. The SMS establishes standards for sediment quality as the basis for management and reduction of pollutant discharges by providing a management and decision-making process for contaminated sediments.

WAC 173-204-320 defines chemical concentration criteria for marine sediments. These chemical concentrations establish the marine sediment quality standards chemical criteria for designation of sediments. Per WAC 173-204-310, "sediments with chemical concentrations equal to or less than all the applicable chemical and human health criteria are designated as having no adverse effects on biological resources or posing a significant health threat to humans, and pass the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, pending confirmatory designation."

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also commonly known as Superfund, was enacted to address hazardous waste sites. The law has subsequently been amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and is implemented by the National Oil and Hazardous Substances Contingency Plan. CERCLA is administered by the USEPA and provides for site identification and listing on the National Priorities List (NPL). CERCLA provides for state participation, and WDOE is the lead regulatory agency for contaminated sites on NAVBASE Kitsap Bangor. The Model Toxics Control Act (MTCA) is the state regulation (WAC 173-340) that addresses the identification, investigation, and cleanup of hazardous waste sites in Washington.

Sites on NAVBASE Kitsap Bangor have been listed on the NPL because of contamination associated with a number of hazardous waste sites at the base. Under Executive Order (EO) 12580, the U.S. Department of the Navy (Navy) is the lead agency for investigation and cleanup of contaminated sites on NAVBASE Kitsap Bangor. Investigations were conducted from 1988 to 1994 in Site 26, Hood Canal Sediments, which was part of Operable Unit (OU) 7. In January 1990, the Navy, USEPA, and WDOE entered into a Federal Facilities Agreement for the study and cleanup of possible contamination on NAVBASE Kitsap Bangor. As of 2005, all required actions have been completed for Site 26, and WDOE concurred that there was no increasing trend of contaminants of concern or evidence of groundwater transport of contaminants of concern from the Floral Point landfill to the marine environment, and additional sampling was not needed (Madakor 2005).

The CZMA requires that federal permit activities having reasonably foreseeable effects on coastal sediment quality must be fully consistent with the enforceable policies of state coastal management programs. Section 3.1.2 addresses the potential for the proposed projects to significantly degrade sediment quality, such as from stormwater discharges, spills, or physical perturbations that could affect the chemical or physical composition of bottom sediments in the project vicinity.

3.1.1.2.2 CONSULTATION AND PERMIT COMPLIANCE STATUS

Because the proposed LWI project would involve in-water construction work, the Navy submitted a JARPA to USACE and other regulatory agencies, requesting permits under Rivers and Harbors Act Section 10 and CWA Sections 401, 402, and 404. In accordance with the CZMA, the Navy submitted a CCD to WDOE for the LWI project. When the SPE project is programmed and scheduled, the Navy will submit a CCD to WDOE and an application for permits under the CWA and Rivers and Harbors Act for the SPE project to USACE and WDOE.

3.1.1.2.3 BEST MANAGEMENT PRACTICES AND CURRENT PRACTICES

BMPs and current practices that would apply to the proposed projects include the following:

- The construction contractor will be required to prepare and implement a spill response plan (e.g., Spill Prevention, Control, and Countermeasure [SPCC] plan).

- The Navy will require the construction contractor to deploy debris barriers and oil absorbent booms around in-water and above-water construction sites as required by the Section 401 Water Quality Certification for protection of water quality.
- Debris will be prevented from entering the water during all demolition or new construction work. During in-water construction activities, floating booms will be deployed and maintained to collect and contain floatable materials. Any accidental release of equipment or materials will be immediately retrieved and removed from the water. Following completion of in-water construction activities, an underwater survey will be conducted to remove any remaining construction materials that may have been missed previously. Retrieved debris will be disposed of at an upland disposal site.
- Removed creosote-treated piles and associated sediments (if any) will be contained on a barge or, if a barge is not utilized, stored in a containment area near the construction site. All creosote-treated material and associated sediments will be disposed of in a landfill that meets the liner and leachate standards of the WAC.
- Piles would be removed by using a clam shell or similar methods and will be cut at the mudline if splitting or breakage occurs.
- Tugboat operations will be managed to avoid anchor drag and minimize suspension of bottom sediments from propeller wash.
- To prevent impacts to the seafloor and benthic community, barges and other construction vessels will not be allowed to run aground.
- BMPs will be implemented to control runoff and siltation and minimize impacts to surface water, per the *Stormwater Management Manual for Western Washington* (WDOE 2014).
- To reduce the likelihood of any petroleum products, chemicals, or other toxic or deleterious materials from entering the water, fuel hoses, oil or fuel transfer valves and fittings will be checked regularly for drips or leaks and maintained and stored properly to prevent spills from construction and pile driving equipment into state waters.
- The existing NAVBASE Kitsap Bangor fuel spill prevention and response plans (the *Commander Navy Region Northwest Oil and Hazardous Substance Integrated Contingency Plan* and the *NAVBASE Kitsap Bangor Spill Prevention, Control, and Countermeasure Plan* [COMNAVREGNWINST 5090.1, Integrated Contingency Plan, Annex G]) will apply to construction and operation of the proposed projects.

Stormwater discharges during project construction would be in accordance with the USEPA general construction stormwater discharge permit. Operation of the LWI and SPE would be in compliance with state water quality standards, including the MSGP. Construction and operation of the LWI and SPE projects would be in compliance with the Energy Independence and Security Act of 2007 with respect to maintenance of existing marine water quality.

3.1.2 Environmental Consequences

3.1.2.1 APPROACH TO ANALYSIS

The evaluations of environmental consequences to hydrography, water quality, and sediment quality assume that project construction and operation are in accordance with applicable regulations (Section 3.1.1.2.1) as well as permit conditions, BMPs, and current practices (Section 3.1.1.2.3).

3.1.2.1.1 HYDROGRAPHY

The evaluation of impacts on marine water resources and the natural hydrographic setting considers whether substantial changes would occur to the bathymetric setting (seafloor topography), tides, circulation and current patterns, or longshore sediment transport, either directly or indirectly, due to construction and operation of alternative configurations for the LWI and the SPE projects. A substantial change is defined as a degradation of the characteristics of Hood Canal in a manner that reduces or negates its overall value to the resources that naturally occur in the marine environment. Construction activities that physically alter the bathymetric profile of the area, substantially increase or decrease current velocities, or modify the tidal regime in the immediate area would be considered a direct impact on the hydrographic setting. Direct impacts are assessed by identifying the types and locations of construction activities and evaluating the extent of the disturbance. Indirect impacts could result from project-induced changes to the water column, seafloor, or shoreline following construction, from long-term planned uses or the physical presence of the LWI and/or SPE projects in the waterway. Results from modeling longshore sediment transport processes near NAVBASE Kitsap Bangor (cbec 2013) are used to evaluate the potential impacts on hydrographic processes from the project alternatives.

3.1.2.1.2 WATER QUALITY

The evaluation of impacts on marine water quality considers whether and to what extent project-related construction and operation activities would create conditions that violate state water quality standards or interfere with beneficial uses of the water body.

During construction of the in-water barriers, stormwater discharges would be in accordance with a NPDES Construction General Permit. A *Stormwater Pollution Prevention Plan* (SWPPP) would be developed, following USEPA's NPDES General Permit for Discharges from Construction Activities and guidance in WDOE's *Stormwater Management Manual for Western Washington* (WDOE 2014). The SWPPP would specify what BMPs would be implemented during construction to limit contaminant discharges to Hood Canal. The effects of construction and operation of the upland portions of the LWI structures on stormwater discharges are addressed in Section 3.7. During operation of the LWI and SPE facilities, stormwater discharges would be controlled by NAVBASE Kitsap Bangor's NPDES MSGP for industrial stormwater discharges and the NAVBASE Kitsap Bangor industrial activity SWPPP (Navy 2009a; USEPA 2015).

3.1.2.1.3 SEDIMENT QUALITY

The evaluation of impacts on marine sediments considers whether project-related construction and operation activities would create conditions, such as sediment contaminant concentrations or physical changes, which exceed marine sediment quality standards or interfere with beneficial uses of the water body. Measures to minimize potential impacts on sediment quality would be the same as those to minimize impacts on water quality and include BMPs and current practices identified in Section 3.1.1.2.3.

3.1.2.2 LWI PROJECT ALTERNATIVES

3.1.2.2.1 LWI ALTERNATIVE 1: NO ACTION

The LWI would not be built under the No Action Alternative and overall operations would not change from current levels. Therefore, existing hydrography, water quality, and sediment quality would not be impacted under the LWI No Action Alternative.

3.1.2.2.2 LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

HYDROGRAPHY FOR LWI ALTERNATIVE 2

CONSTRUCTION OF LWI ALTERNATIVE 2

Construction of LWI Alternative 2 would involve installing the LWI pier and temporary trestle structures, including piles and the underwater portion of a mesh and steel plate anchor, construction of a temporary pile-supported trestle, relocation of existing PSB sections and associated mooring anchors, and construction of shoreline abutments within intertidal and subtidal areas of the project sites. Construction is expected to require one barge with a crane, one supply barge, a tugboat, and work skiffs. Pier piles and vessel hulls can alter current flow and wave patterns in a manner that reduces turbulence, and work vessels can generate wakes and propeller wash that induce or increase turbulence in localized portions of the water column and at the seafloor. Pile driving, PSB mooring anchor removal and placement, propeller wash and vessel movement, anchor and spud deployment, and abutment construction could disturb bottom sediments. Measures would be implemented to prevent underwater anchor drag and line drag, and barges and workboats would be prohibited from grounding to minimize the potential for sediment disturbances (Section 3.1.1.2.3). Using the design footprints of the piers, along with an approximately 100-foot (30-meter) wide construction corridor (Section 2.3.2.1), the area of seafloor potentially disturbed by LWI construction activities is 13.1 acres (5.3 hectares); the actual area disturbed is expected to be considerably less.

Bathymetric Setting

Construction of the LWI shoreline abutments would require excavation below the mean higher high water (MHHW) of approximately 15,600 square feet [1,449 square meters] and up to 2,889 cubic yards [2,209 cubic meters] for the abutment and stairs at both LWI locations. Abutment work would be conducted at low tide and therefore “in the dry.” Following installation, the beach in front of the abutments would be re-contoured to pre-construction conditions. However, the abutment stair landings and a portion of the riprap would lie below the MHHW line. With the exception of the footprints for the stair landings (12 square feet [2 square meters]) for each north and south LWI, construction of the abutments would not alter bathymetric conditions in the long term.

LWI construction would also require placement of steel plate anchors for the mesh, removal and placement of PSB mooring anchors, as well as temporary anchors and spuds for work vessels on the seafloor. Localized mounding or trenching would occur within the 100-foot (30-meter) wide construction corridors as a result of anchor and spud placement, mooring ground tackle, and vessel propeller wash. Barge grounding would be prohibited and, therefore, would not contribute to changes in bathymetry. Some localized mounding and depressions would result from installation and removal of piles for the temporary trestle. These small-scale bathymetric features would not be expected to exceed 3 feet (1 meter) in displacement and would likely be temporary because natural processes that occur at the sediment-water interface (bedload transport, bioturbation [mixing of surface sediment by benthic infaunal organisms], etc.), particularly during storm events, would reshape the seabed to the surrounding environment. The seafloor topography would return to near the original profile over a period of approximately 6 to 12 months without intervention or mitigation. Although some displacement and redistribution of in-place sediments is anticipated, no substantial changes to bathymetry would occur.

Circulation and Currents

Circulation patterns in the surface layer (upper 10 to 15 feet [3 to 5 meters] of water) over the project area would be subject to minor, short-term changes in the direction and intensity of flow over periods of hours due to the presence of construction equipment and barges. However, overall circulation patterns, current velocities, and water levels along the Bangor waterfront would be relatively unaffected because currents and water circulation patterns are driven by tides, which would not be impacted by the presence of construction equipment or barges. Similarly, because the LWI piers and temporary trestle structure would be constructed on foundations of piles, water flow would not be impeded at the project sites. Thus, in-water construction activities would cause only minor, localized, and temporary (i.e., for the duration of in-water construction activities) changes to circulation and currents.

Longshore Sediment Transport

The presence of in-water construction equipment would have a negligible effect on the frequency or magnitude of conditions responsible for longshore sediment transport. This is because the spatial scale of wave dampening from vessels and barges would be small relative to the size of the drift cell.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 2

The submerged portions of the LWI piers (i.e., support piles, mesh, and mesh anchor) constructed for LWI Alternative 2 would alter current and wave patterns in the immediate vicinity of the structures. The metal plates that would be used to anchor the mesh to the seafloor would have a minimal vertical profile (i.e., thickness of the metal plates) and, therefore, would not be expected to alter current or wave patterns. Minor restrictions in water flow, due to the presence of fouling materials on the mesh, would not affect tides and circulation patterns in the project area because the LWI structures would allow water exchange with adjacent areas of Hood Canal. The LWI abutment stair landings and a portion of the riprap would lie below the MHHW line. However, the base of these structures would be submerged infrequently, and they would not restrict water flow or otherwise affect hydrological conditions at the project site except on a very localized basis (i.e., within meters of the structures).

Bathymetric Setting

Support piles installed for the LWI piers would alter current flows and wave propagation locally, which would cause localized erosion of fine-grained sediments near the base of some piles and settling and accumulation of fine-grained sediments at the base of others (Chiew and Melville

1987). Such bathymetric changes would not exceed 3 feet (1 meter). The metal plates that would be used to anchor the mesh to the seafloor would not be expected to alter the bathymetry because they would have a minimal vertical profile and, therefore, would not promote sediment deposition and accumulation. The operational effects of these structures on longshore sediment transport are discussed below. The lower portion of the abutment stair landings and a portion of the riprap would lie just below MHHW and consequently would be inundated infrequently and for brief periods. The resulting potential for erosion or mounding would be highly localized (within meters of the structures) and minor, not exceeding 1 foot (0.3 meter) vertically. These potential impacts would be minimized further by placing native beach material over the riprap to grade, and, if needed, large woody debris would be placed to prevent sediment scour at the new structures.

Circulation and Currents

The overall flow volume of water adjacent to the project site would not be affected by the presence of the LWI structures. However, it is anticipated that flow patterns in the immediate vicinity of the LWI piles would become turbulent locally as the water mass driven by tidal currents moves between and around the piles, especially during periods of peak flow. Turbulence in the water column would be a function of small-scale increases in the instantaneous velocity of water flow between the individual pile structures relative to the remainder of the water column. This occurs when the pressure exerted by a moving water body forces the flow around obstructions or into channels between the piles (Potter and Wiggert 1991). The result would be a decrease in water column current velocities downcurrent of the barriers, but an overall increase in turbulence and mixing in the water mass passing directly under the structures. Turbulence in the water column can be beneficial to water quality through the deflection of linear flow downward and laterally, promoting increased mixing between water layers. Along the seafloor, turbulent flow at the pier piles could cause some erosion of fine-grained material, resulting in a coarsening of surficial sediments and thin scouring around each pile (Chiew and Melville 1987; Sumer et al. 2001).

The underwater portion of the mesh could retain drift algae and/or floating debris that would partially restrict water flow through the structure and result in some small-scale changes in flow. Similarly, biofouling of the mesh also would partially restrict water flow at the structure. Routine inspections and maintenance would reduce the magnitude of any long-term effects associated with fouling on water flow through the structure. Minor restrictions in water flow, due to the presence of fouling materials on the mesh structure, would not affect circulation patterns in the project area because the structures would allow water exchange with adjacent areas of Hood Canal. Maintenance of the LWI structures, consisting of routine inspections, repair, and replacement of facility components as required, would not affect hydrographic conditions.

The LWI structures would not affect the tidal range along the NAVBASE Kitsap Bangor shoreline or immediate project area because the LWI piers would be constructed on a foundation of piles that would allow water exchange between the inside and outside of the barriers. The flow of water as driven by tidal currents could be slightly impeded in the immediate vicinity of the structures due to the presence of the piles, riprap, and mesh structure, but this would not affect tidal processes or tidal elevations in the project area.

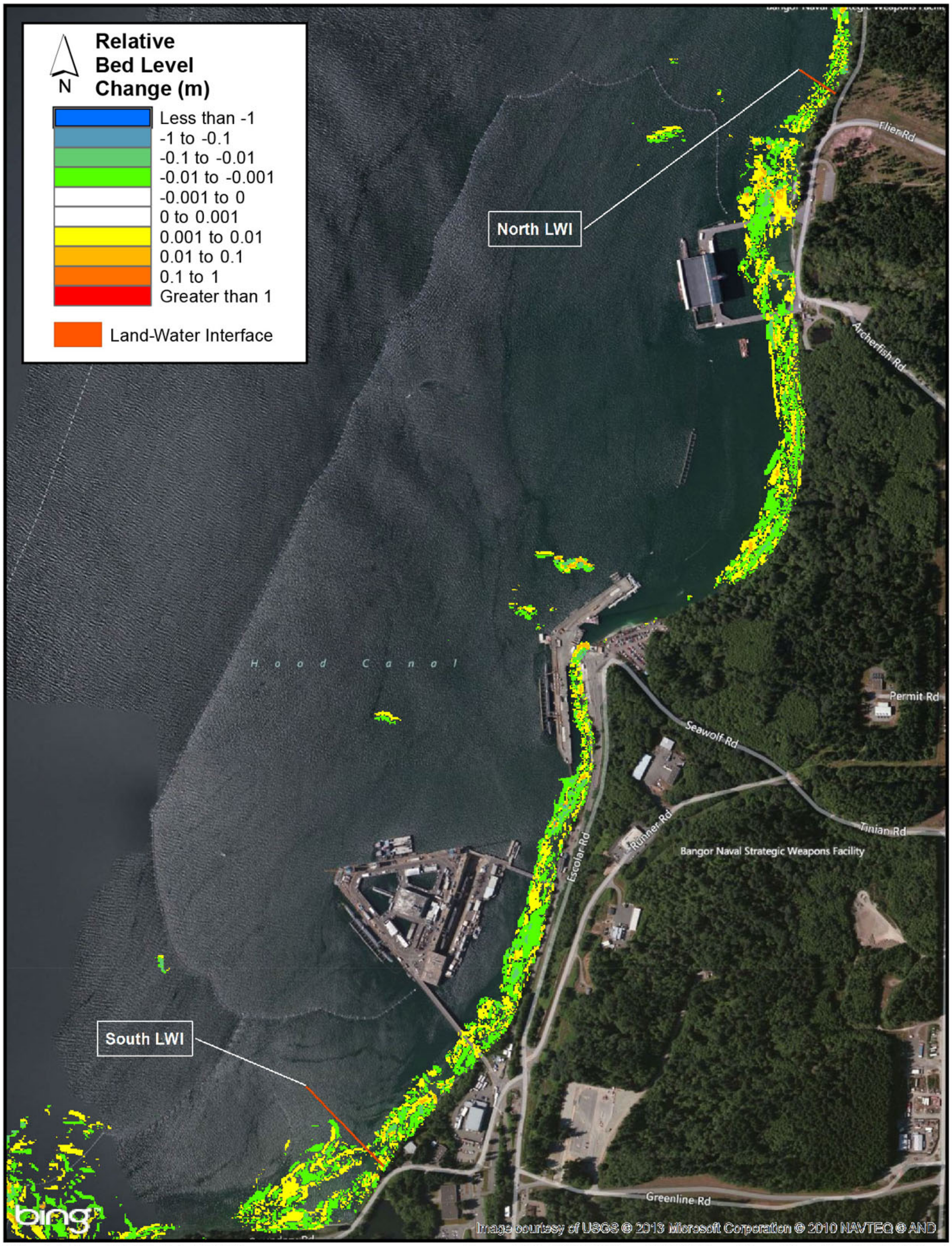
Longshore Sediment Transport

The piles and mesh associated with the LWI structures would attenuate some of the energy of surface waves and currents associated with storm events approaching the project sites from the north and south. This reduction in wave energy in areas shoreward of the barriers would reduce the frequency and magnitude of sediment resuspension events and promote conditions more conducive to long-term deposition of sediments and accumulation of fine-grained sediment in the form of a shoal area or comparatively broader intertidal area (Kelty and Bliven 2003).

As discussed in Section 3.1.1.1, Hood Canal is characterized as a low-energy environment, and longshore sediment transport rates are low. The pile-supported LWI structures could have a minor effect on the magnitude of storm-related wave events that have sufficient energy to resuspend bottom sediments in the immediate, nearshore areas of the project site. However, the structures are not expected to result in substantial, long-term reductions in the longshore sediment transport rates for the drift cell that includes the Bangor waterfront.

The effects of the LWI pile-supported pier structures on sediment transport along the Bangor waterfront were evaluated by cbec (2013). Results from hydrodynamic modeling indicated that the presence of the proposed north and south LWI structures would cause only marginal changes in current velocities. For both 2-year and 50-year storm event scenarios, average changes in seabed elevations from the LWI pile-supported pier structures would range from -0.28 to -0.16 inch (-7 to -4 millimeters), which is similar to the average change in the seabed elevation of -0.24 inch (-6 millimeters) under existing conditions (i.e., without LWI structures). Relative changes in sedimentation patterns between existing conditions (no LWI structures) and project conditions (with the north and south LWI structures) for the 50-year storm event are shown on Figure 3.1–22. Net changes in the sedimentation patterns under less severe, 2-year storm events would be relatively smaller. Based on these results, operation of the LWI would not be expected to cause appreciable erosion or deposition of sediments within the project area.

The bathymetry at the location of the south LWI site reflects sediment inputs from Devil's Hole, the influence of Carlson Spit and KB Point on wave and current energy, and sediment accumulation in the adjacent nearshore area of Hood Canal between KB Point and Delta Pier. During periods with low storm activity, reductions in wave and current energy near the south LWI structure could promote comparatively greater deposition of sediments within the delta area that occurs north of KB Point and offshore from Devil's Hole. Over time, the area of the deltaic formation may expand and increase the overall area of the intertidal zone. The south LWI structure would not prevent the longshore sediment transport from this location, but it could reduce the annual sediment load slightly until equilibrium conditions are achieved. Once equilibrium is reached, there would be no long-term impediment to littoral transport along the shoreline and no significant reduction in sediment supplies to adjacent areas of the Bangor shoreline.



Author: John Evans | SAIC | Date: 7/10/2013 Document Path: C:\GISPJ13\Bangor LWI\SAIC Figures\50 year Flood - Scenario 5 LWI BLC.mxd

Source: cbec 2013

Figure 3.1–22. Model-Predicted Changes in Relative Seabed Elevations with Installation of the North and South LWI Structures under a 50-Year Storm Scenario

The abutment and stairs constructed at the south LWI project site would armor a small (approximately 72 feet [22 meters]) section of the shoreline. The total length of riprap placed below the south LWI abutment wall and stairs would be 230 feet (70 meters) and the width would be approximately 10 feet (3 meters). The abutment would be exposed to wave run-up only during extreme high tides. This impact on sediment supplies to the drift cells associated with the south LWI project site or drift cells to the north of the site would be inconsequential because infrequent, short, and highly localized interactions would not interfere with alongshore currents or sediment transport processes.

While the project would replace the natural shoreline with a cement structure, the size of this structure would be small in comparison to the overall length of unarmored shoreline in the area, and the effect on the shoreline would be minimal. This conclusion is consistent with results from previous studies (Golder Associates 2010) indicating that the shoreline in the vicinity of the south LWI project site is fairly stable as a result of the relatively sheltered environment and relatively low net longshore transport rates.

The north LWI site is located near the middle of the drift cell (Drift Cell DC-18 in Judd 2010), which probably functions as the sediment transport region of the drift cell. The presence of piles and underwater mesh structures at the north LWI would likely promote deposition and accretion of finer-grained sediments transported by the alongshore currents. Some of the sediment accumulation would be seasonal, as storm waves would resuspend and redistribute sediments that were deposited initially near the structures. Because the north LWI structure would be shorter than the south LWI, sediment accumulation at the north LWI would be comparatively smaller, and it is not expected to appreciably reduce the alongshore sediment supply or result in erosion of the shoreline in areas north of the boundary.

Similar to the south LWI site, the abutment and stairs constructed at the north LWI project site would armor a 72-foot (22-meter) section of the existing shoreline. The total length of riprap placed below the north LWI abutment wall and stairs would be 180 feet (55 meters) and the width would be approximately 10 feet (3 meters). Construction and operation of the north LWI abutment would not substantially affect sediment supplies to the drift cells associated with the north LWI project site or drift cells to the north of the site because the amount of shoreline armoring associated with the abutment would be minimal. Because the abutment and observation post piles would not substantially alter sediment supply rates within the drift cell, they would have minimal effects on nearshore sediment supply and transport processes. These potential impacts would be minimized further by placing native beach material over the riprap to grade, and, if needed, large woody debris would be placed to prevent sediment scour at the new structures.

Therefore, while operation of the pile-supported pier structures for LWI Alternative 2 may retain some sediments, it is not expected to significantly interrupt longshore sediment transport processes or result in erosion of the shoreline within or adjacent to NAVBASE Kitsap Bangor. This conclusion is supported by the Golder Associates (2010) study findings that the presence of other Navy structures along the NAVBASE Kitsap Bangor shoreline has not caused appreciable changes in the morphology of the shoreline.

WATER QUALITY FOR LWI ALTERNATIVE 2

CONSTRUCTION OF LWI ALTERNATIVE 2

Construction of LWI Alternative 2 would involve installing the LWI pier and temporary trestle structures, including permanent piles and the underwater portion of a mesh and steel plate anchor, requiring use of barges, work vessels, and cranes; construction of a temporary pile-supported trestle; and construction of shoreline abutment stair landings within intertidal and subtidal areas of the project sites.

Direct discharges of waste, other than stormwater runoff, to the marine environment would not occur during construction. BMPs and current practices (Section 3.1.1.2.3) applicable to construction of LWI Alternative 2 would include preparation and implementation of debris management procedures for retrieving and cleaning up any accidental spills. The contractor would also prepare and implement a spill response plan (e.g., SPCC) to clean up any fuel or fluid spills. Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups.

Construction-related impacts on water quality would be limited to short-term and localized changes associated with resuspension of bottom sediments from pile installation, other in-water construction activities, barge and tug operations such as anchoring and propeller wash, as well as accidental losses or spills of construction debris into Hood Canal. These changes would be spatially limited to the construction corridor, including areas potentially impacted by anchor drag and areas immediately adjacent to the corridor (i.e., up to approximately 50 feet [15 meters] from the edge of the LWI and temporary trestle structures) that could be impacted by plumes of resuspended bottom sediments.

Stratification, Salinity, and Temperature

Construction of LWI Alternative 2 would not impact water temperature or salinity because construction activities would not discharge wastewaters other than stormwater runoff, in accordance with the SWPPP. Since no project-related discharges are anticipated, construction of the LWI would not alter stratification, salinity, or temperature in Hood Canal.

Dissolved Oxygen

Construction of LWI Alternative 2 would not discharge any wastes containing materials with an oxygen demand into Hood Canal. However, pile installation would temporarily resuspend bottom sediments, which may contain small amounts of chemically-reduced organic materials. Subsequent oxidation of sulfides, reduced iron, and organic matter associated with the suspended sediments would consume some DO in the water column. The amount of oxygen consumed would depend on the magnitude of the oxygen demand associated with suspended sediments (Jabusch et al. 2008). The organic carbon content of sediments at the LWI project sites is low (0.16 to 0.56 percent), and total sulfides concentrations are non-detectable to 259 mg/kg (Table 3.1–3). Thus, the oxygen demand of sediments resuspended during LWI construction activities also would be low, and resulting changes to DO concentrations in the water column would be minimal due to rapid mixing and dispersion of particles and low oxygen demand.

A bubble curtain would be used to reduce in-water noise levels generated during pile driving (Section 2.3.3), although the exact type of bubble curtain that would be used has not yet been specified by the Navy. Type I (unconfined) bubble curtains use pressurized air injected from small holes in aluminum or PVC (polyvinyl chloride) pipe from an air compressor located on the pile driving barge. Type II (confined) bubble curtains keep the bubbles "inside" a jacket (usually rigid or fabric). While the primary purpose of employing a bubble curtain would be to reduce in-water noise levels, a Type I bubble curtain would also increase DO concentrations in marine waters at the project site by (1) increasing the rate of vertical mixing of site waters and (2) promoting dissolution of air bubbles, thereby increasing oxygen saturation levels. The effect on DO concentrations from use of a Type I bubble curtain would be greater than that associated with sediment resuspension, and a net increase in DO levels would be expected. Use of a Type II confined bubble curtain would not aerate the water column and thus would not increase DO concentrations in project site waters.

Stormwater discharges would be addressed by a construction stormwater discharge permit and SWPPP. Consequently, stormwater discharges are not expected to alter DO concentrations at the project site. Construction activities would not result in decreases in DO concentrations, cause changes that would violate water quality standards, or exacerbate low DO concentrations that occur seasonally within portions of Hood Canal.

Turbidity

Installation of pier piles and mesh anchors, and other in-water construction activities for LWI Alternative 2, would resuspend bottom sediments within the immediate construction area, resulting in short-term and localized increases in suspended sediment concentrations that in turn would cause increases in turbidity levels. Suspended sediment/turbidity plumes associated with in-water construction activities would be generated intermittently during construction.

The amount of bottom sediments that would be resuspended into the water column, and the duration and spatial extent of the resulting suspended sediment/turbidity plume, would reflect the composition of the sediments and the source of the disturbance. Surface sediments at the project site are primarily coarse-grained, ranging from 88 to 97 percent sand and gravel (Hammermeister and Hafner 2009; see Table 3.1–3). In general, the coarse-grained sediments that occur in most areas of the project site are more resistant to resuspension and have a faster settling speed than fine-grained sediments. Higher settling rates would result in a shorter water column residence time and a smaller horizontal displacement by local currents (Herbich and Brahme 1991; LaSalle et al. 1991; Herbich 2000).

As noted for DO, a bubble curtain would be used to reduce in-water noise levels generated during pile driving, although the type of bubble curtain that could be used has not been specified by the Navy. With a Type I (unconfined) bubble curtain, the bottom ring is located on the soil/substrate/overburden, and it is likely that bubbling action would increase turbidity in the vicinity. Because the Type II (confined) bubble curtain keeps the bubbles "inside" a jacket (usually rigid or fabric), the majority of suspended sediments would be likewise confined within the curtain. After the pile is driven and the curtain removed, there would still be some residual plume, although less than with an unconfined bubble curtain.

Construction activities associated with LWI Alternative 2 would primarily occur in water depths up to approximately 15 feet (5 meters) MLLW, with some PSB reconfiguration occurring in deeper waters. Assuming conservative conditions that bottom sediments are disturbed during construction and resuspended to the surface (15 feet [5 meters] above the seafloor), the maximum water column residence time for sand-size particles would be approximately 50 seconds, assuming a particle settling rate of approximately 0.3 foot/second (9 centimeters per second). The water column residence time for suspended particles would be proportionately shorter in shallower portions of the construction area and/or instances where the turbidity plumes do not extend to the water surface. With a current velocity of 1 foot/second (30 centimeters per second), the maximum dispersion distance would be approximately 50 feet (15 meters). That is, it would take 50 seconds for a sand particle to settle 15 feet (5 meters) through the water column, at which time the horizontal transport rate of the particle would be 1 foot/second (30 centimeters per second]) with a resulting horizontal displacement of 50 feet (15 meters). Silt and clay particles resuspended during construction activities could have relatively longer water column residence times because they have slower settling speeds. However, fine-grained particles typically contribute less than 20 percent of bottom sediments within the project area. Also, resuspended, fine-grained sediments would be subject to rapid dilution by currents and eventual flushing during subsequent tidal exchanges (Morris et al. 2008). Therefore, the duration and spatial extent of turbidity plumes generated by in-water construction activities would be minimal.

Per WAC 173-201A-210, "[t]he turbidity criteria established under WAC 173-201A-210 (1)(e) shall be modified, without specific written authorization from the department, to allow a temporary area of mixing during and immediately after necessary in-water construction activities that result in the disturbance of in-place sediments. This temporary area of mixing is subject to the constraints of WAC 173-201A-400 (4) and (6) and can occur only after the activity has received all other necessary local and state permits and approvals, and after the implementation of appropriate best management practices to avoid or minimize disturbance of in-place sediments and exceedances of the turbidity criteria. A temporary area of mixing shall be as follows:

> "D. For projects working within or along lakes, ponds, wetlands, estuaries, marine waters or other nonflowing waters, the point of compliance shall be at a radius of one hundred fifty feet from the activity causing the turbidity exceedance."

Per the discussion above regarding the settling time for resuspended particles, turbidity conditions are not expected to increase by more than 5 NTU above background at the point of compliance, 150 feet (45 meters) from the disturbance. Within the intertidal portions of the LWI alignments, in-water construction activities with the potential for generating turbidity conditions would be discontinuous and intermittent. Any turbidity resulting from sediment resuspension would be minimal due to rapid mixing and dispersion of particles.

Empirical information demonstrating compliance with the water quality criterion for turbidity during in-water construction projects similar to those of LWI Alternative 2 is unavailable. However, turbidity measurements were performed as part of a water quality monitoring program conducted in association with a project at Jimmycomelately Creek that removed creosote-treated wood piles at a former log storage facility in Lower Sequim Bay (Weston Solutions 2006). Monitoring results indicated substantial sediment resuspension associated with prop wash from the tug, whereas activation of the vibratory hammer and removal of piles and dolphins resulted in only localized increases in turbidity levels that were less than 5 NTU above background. In comparison, turbidity levels associated with pile placement and temporary pile removal activities for LWI Alternative 2 would be lower because sediments at the LWI project site are coarser than those at the Jimmycomelately Creek site and pile placement would create less of a disturbance to bottom sediments than pile pulling. Thus, by extension, turbidity levels associated with in-water construction for LWI Alternative 2 would not be expected to exceed the water quality criterion.

Construction of the abutments at the north and south LWI sites would disturb sediments in the upper intertidal zone. However, construction work would only occur "in the dry" during low tides and would employ a coffer dam to prevent erosion and impacts to water quality. Thus, construction of the abutments would not contribute to increased turbidity levels. For other project-related construction activities, such as spud use and barge anchoring, fine-grained particles resuspended from the bottom would disperse rapidly as a result of particle settling and current mixing. Propeller wash impacts could occur in shallow waters, although current practices would be employed to prevent or minimize these effects.

Stormwater discharges would be in accordance with a stormwater discharge permit and SWPPP, which would minimize the potential for discharges to affect turbidity levels at the project site.

Consequently, construction activities would not result in persistent increases in turbidity levels or cause changes that would violate water quality standards because the proposed project would not result in wastewater discharges, other than stormwater that would be discharged in accordance with permit conditions, and processes that generate suspended sediments and increase turbidity levels 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.

Nutrients

Construction activities associated with LWI Alternative 2 would not result in the discharge of wastes containing nutrients. Because the proposed project would not result in wastewater discharges, other than stormwater that would be discharged in accordance with permit conditions, construction activities would not result in increases in nutrient levels or cause changes that would violate water quality standards. Because sediments at the project site do not contain high concentrations of nutrients, such as ammonia (Hammermeister and Hafner 2009), sediment resuspension during in-water construction activities would not release nutrients to site waters in amounts that would violate water quality standards.

Fecal Coliform Bacteria

Construction activities associated with LWI Alternative 2 would not impact bacteria (fecal indicator bacteria) levels because this alternative would not discharge untreated wastes or other materials containing bacteria. Stormwater discharges would be controlled in accordance with a stormwater discharge permit and SWPPP. Because the proposed project would not result in wastewater discharges, other than stormwater that would be discharged in accordance with permit conditions, construction activities would not result in increases in bacteria levels or cause changes that would violate water quality standards. Coliform bacteria levels in the Hood Canal waters near the project site generally are low and within the shellfish harvesting and recreation standard for fecal coliform. Consequently, bacterial levels in coarse-grained marine sediments at the project site also are expected to be low, and resuspension of sediments during construction activities would not release bacteria to site waters in amounts that would violate water quality standards.

pH

Construction activities associated with LWI Alternative 2 would not impact the pH levels of local waters because this alternative would not discharge pH-affecting wastes at the project site. There is a potential for cement spillage that could affect pH; however, measures to prevent losses and cleanup of spills would be addressed by debris management procedures. Also, seawater has a high buffering capacity that minimizes the potential for substantial changes in pH in well-mixed marine settings such as the project sites (Jabusch et al. 2008). Stormwater discharges would be controlled in accordance with a stormwater discharge permit and SWPPP. Because the proposed project would not result in wastewater discharges, other than stormwater that would be discharged in accordance with permit conditions, and spill-related releases would be controlled by debris management procedures (Section 3.1.1.2.3), construction activities would not result in changes in pH that would violate water quality standards.

Other Contaminants

Accidental spills of debris, fuel, or other contaminants from barges or construction platforms into Hood Canal represent a possible source of construction-related impacts on water quality. Some types of construction debris inadvertently lost into the water would be recovered, as specified in the debris management procedures, and would have no impact, while other materials such as hydraulic fluids or fuel (marine diesel) may impact turbidity, pH, DO, or other water quality parameters in a localized area. Typically, spills are prevented by a number of measures, including containing and cleaning up materials leaked on the deck of work vessels, prohibiting washdown of materials into the water, and prohibiting refueling in non-authorized areas. Generally, these types of spills are not anticipated to have a large impact on water quality because the spills would likely be small and the impact would be highly localized. The size of the area affected would depend on a number of factors, such as the volume spilled, wind, wave, and current conditions at the time of the spill, and the timing and effectiveness of the response effort. The existing facility response and prevention plans for the Bangor waterfront (the *Commander Navy Region Northwest Oil and Hazardous Substance Integrated Contingency Plan* and the *NAVBASE Kitsap Bangor Spill Prevention, Control, and Countermeasure Plan* [COMNAVREGNWINST 5090.1, Integrated Contingency Plan, Annex G]) provide guidance that would be used in a spill response, such as a response procedures, notification, and communication plan; roles and responsibilities; and response equipment inventories. In the event of an accidental spill, response measures would be implemented immediately to minimize potential impacts on the surrounding environment.

The Navy would require the construction contractor to prepare and implement debris management procedures for preventing discharge of debris to marine water and retrieving and cleaning up any debris spilled into Hood Canal (Section 3.1.1.2.3). Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups. With implementation of the existing facility response and prevention plans for the Bangor waterfront and the debris management procedures, construction activities associated with LWI Alternative 2 would not be expected to release contaminants or otherwise cause any water quality standards to be violated.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 2

Operation of LWI Alternative 2 would not result in discharges of wastes to Hood Canal. The project would be operated in accordance with the NPDES permit and implement stormwater BMPs. Stormwater runoff from the LWI structures would not require treatment and could discharge directly into Hood Canal since the structure surfaces are expected to consist largely of inert materials and would not represent a source of substantial pollutant loadings to Hood Canal. Similarly, because there would be no vehicular traffic associated with the LWIs there would be no requirement to collect and treat runoff from the LWI structures, and drainage would be to Hood Canal. Some of the materials used for the LWI pier structures would be galvanized metal, which could leach zinc, and thereby contribute to zinc loading to Hood Canal (WDOE 2008a). However, this is not expected to affect water quality at the project site because most surfaces would consist of inert materials, so the magnitude of the zinc input from galvanized metals used in the LWI structure would be minimal. The in-water mesh would not be composed of materials that would have the potential to degrade water quality at the project sites.

Stratification, Salinity, and Temperature

Operation of the LWI Alternative 2 would not result in any discharges into local waters. Also, the LWI structures would not interfere with tides, currents, or other natural processes that are responsible for mixing Hood Canal waters. Therefore, operations would not result in impacts on stratification, salinity, or temperature conditions or cause changes that would violate water quality standards.

Dissolved Oxygen

Periodic cleaning of the in-water mesh and PSB guard panels would release organic material into the water and subsequent decomposition of this material would result in localized increases in oxygen demand. However, these materials would be dispersed by waves and currents so effects on DO would be transient and inconsequential. Therefore, no general or widespread effects on DO levels at the Bangor waterfront are expected. Otherwise, operation of the LWI would not result in discharges with the potential for altering DO concentrations in waters near the project site. Also, these structures would not interfere with tides, currents, or other natural processes that are responsible for mixing Hood Canal waters. Because the proposed project would not result in wastewater discharges, other than stormwater that would be discharged in accordance with permit conditions, operations would not result in impacts on DO conditions or cause changes that would violate water quality standards.

Turbidity

Because the LWI Alternative 2 would not result in any discharges, other than stormwater that would be discharged in accordance with permit conditions, or resuspend bottom sediments, operations would not result in changes to turbidity levels that would violate water quality standards. Periodic cleaning of the submerged portions of the in-water mesh and PSB guard panels would release particulate material into the water that would increase turbidity levels locally. However, these materials would be dispersed by waves and currents so effects on water clarity would be transient and inconsequential.

Nutrients

Operation of the LWI Alternative 2 would not result in any discharges, other than stormwater that would be discharged in accordance with permit conditions, or alter site conditions. The LWI pier structures would provide roosting sites for marine birds, which would produce droppings (bacterial input) and associated nutrient loading to Hood Canal. However, nutrients would be rapidly mixed and dispersed by currents, and the magnitude of this input source would not cause eutrophication. Therefore, operations would not result in impacts on nutrient levels or cause changes that would violate water quality standards.

Fecal Coliform Bacteria

Operation of the LWI Alternative 2 would not affect fecal coliform bacteria levels in marine waters at the project site because the project would not result in any discharges or alter site conditions in a manner that would release bacteria to local waters. Birds roosting on the LWI pier structures would contribute to bacterial input, but this would be rapidly mixed and dispersed by currents. Because the existing PSBs and other in-water structures provide similar roosting sites, this alternative would not represent a new or substantial source for bacterial input from wildlife. Therefore, operations would not result in impacts on bacteria levels or cause changes that would violate water quality standards.

pH

Operation of the LWI Alternative 2 would not create discharges that have the potential to impact the pH of marine waters. Therefore, operations would not result in impacts on pH levels or cause changes that would violate water quality standards.

Other Contaminants

Spills of fuel, explosives, cleaning solvents, and other contaminants could impact water quality in Hood Canal. However, operation of LWI Alternative 2 would not increase the risk of accidental spills because, other than minor, small boat operations, project operations would not require use of explosives, solvents, or other contaminants. The existing NAVBASE Kitsap Bangor fuel spill prevention and response plans (the *Commander Navy Region Northwest Oil and Hazardous Substance Integrated Contingency Plan* and the *NAVBASE Kitsap Bangor Spill Prevention, Control, and Countermeasure Plan* [COMNAVREGNWINST 5090.1, Integrated Contingency Plan, Annex G]) would help minimize the risk of fuel spills from small boat operations. In the event of an accidental spill, emergency cleanup measures would be implemented immediately in accordance with state and federal regulations. The cleanup would minimize impacts on the surrounding environment.

Placement of aluminum anodes (for cathodic protection) on pier piles would represent a source for inputs of aluminum to Hood Canal waters. Aluminum anodes typically contain approximately 95 percent aluminum, 5 percent zinc, up to 0.001 percent mercury, and small amounts of silicon and iridium (USEPA 1999). As the anode is consumed (oxidized), aluminum and other trace constituents are released to surrounding waters. Based on modeling performed by USEPA (1999), the estimated flux of aluminum from an anode is 2.2×10^{-6} pounds (1 milligram) of aluminum per pound of anode per hour. USEPA (1999) concluded that the resulting concentrations in seawater would be well below the Federal and the most stringent state water quality criteria. Consequently, metal leaching from aluminum anodes placed on the LWI piles is not expected to impact water quality in the project area.

With implementation of the existing facility response and prevention plans for the Bangor waterfront, LWI Alternative 2 operations would not be expected to release other contaminants or otherwise cause any water quality standards to be violated.

SEDIMENT QUALITY FOR LWI ALTERNATIVE 2

CONSTRUCTION OF LWI ALTERNATIVE 2

Construction of LWI Alternative 2 would entail pile installation for the pier structure and temporary trestle structure, as well as excavation of shoreline sediments for abutment construction, but no dredging, trenching, or dredged material disposal would be required. There would be no direct discharges of wastes, other than stormwater runoff, to the marine environment during construction that would affect sediment quality. Setting spuds and anchors for the barges, and propeller wash from tugs used to construct the facilities would represent other, construction-related sources for disturbance of bottom sediments. Current practices (Section 3.1.1.2.3) would be implemented to prevent underwater anchor drag and line drag. Therefore, construction-related impacts on sediment quality would be limited to localized changes associated with physical disturbances of bottom sediments and from accidental losses or spills of construction debris into Hood Canal.

Another possible source for construction-related impacts on sediments would be from accidental debris spills from barges or construction platforms into Hood Canal or releases of cement from construction of underwater footings. Debris spills and/or cement releases could impact bottom sediments and create nuisance conditions by adding materials that could represent obstructions. The construction contractor would be required to retrieve and clean up any accidental spills in accordance with the existing NAVBASE Kitsap Bangor fuel spill prevention and response plans and as a current practice in accordance with the debris management procedures that would be developed and implemented (Section 3.1.1.2.3). Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups.

Construction-related changes to sediment quality would be spatially limited to the construction corridor including areas potentially impacted by anchor drag.

Physical Properties of Sediments

Some degree of localized changes in sediment composition would occur as a result of in-water construction activities. Sediments that are resuspended by pile installation and anchoring activities would be dispersed by currents and eventually redeposited on the bottom (Barnard

1978; Hitchcock et al. 1999). Depending on the distance suspended sediments are transported before settling, this process could result in minor changes to sediment texture (i.e., grain-size characteristics), particularly if coarse-grained sediments are transported from shallow to deeper portions of the project site or fine-grained sediments are transported from deeper to shallower areas. The distance over which suspended sediments are dispersed would depend on a number of factors, such as the sediment characteristics, particle settling rates, and current speeds.

Surface sediments at the LWI project sites are primarily coarse-grained, ranging from 88 to 97 percent sand and gravel (Hammermeister and Hafner 2009) (Section 3.1.1.1.3). In general, the coarse-grained sediments are more resistant to resuspension and have a faster settling speed than fine-grained sediments. Higher settling rates would result in a shorter water column residence time and a smaller horizontal displacement by local currents (Herbich and Brahme 1991; LaSalle et al. 1991; Herbich 2000).

In-water construction activities associated with LWI Alternative 2 would occur in water depths up to about 15 feet (5 meters) MLLW. Assuming that bottom sediments are disturbed during construction and resuspended to the surface (15 feet [5 meters] above the seafloor), the maximum estimated horizontal displacement of 50 feet (15 meters), as discussed in Section 3.1.2.2.2 (under Turbidity). Silt and clay particles would be dispersed over relatively larger distances (greater than 150 feet [46 meters]) because they have slower settling speeds. Also, resuspended, fine grained sediments would be subject to rapid dilution by currents and eventual flushing during subsequent tidal exchanges (Morris et al. 2008). Because fines represent a small proportion of sediments, they would probably not result in appreciable changes in the physical composition of bottom sediments as they settle. Also, rapid dilution and dispersion would minimize the potential for fine-grained sediments to settle and accumulate within sensitive habitat areas near the project site, such as nearshore eelgrass beds.

Metals

Construction activities for LWI Alternative 2 would not result in the discharge of wastes containing metals or otherwise alter the concentrations of trace metals in bottom sediments. Because the magnitude of metal concentrations in sediment can vary as a function of grain size (higher concentrations typically are associated with fine-grained sediments) (Schiff and Weisberg 1999), small changes to grain size associated with construction-related disturbances to bottom sediments could result in minor changes in bulk metal concentrations. However, the magnitude of the project-related changes is expected to be minimal. Because the proposed project would not result in wastewater discharges, other than stormwater that would be discharged in accordance with permit conditions, and spill-related releases would be controlled by the debris management procedures (Section 3.1.1.2.3), construction activities would not cause chemical constituents to exceed marine sediment quality standards.

Organic Contaminants

Construction activities for LWI Alternative 2 would not result in the discharge of contaminants or otherwise alter the concentrations of organic contaminants in bottom sediments. Similar to metal concentrations (discussed above), construction would not impact sediment quality with the possible exception of minor changes in the bulk concentrations of organic compounds that would result from changes in grain size. These changes would be minimal.

Accidental fuel spills or releases of other materials (e.g., hydraulic fluids) to Hood Canal could add contaminants (petroleum hydrocarbons) that could also impact sediment quality. However, as noted in Section 3.1.2.2.2, under Water Quality, the spill cleanup response would minimize impacts on the surrounding environment.

Because the proposed project would not result in wastewater discharges, other than stormwater that would be discharged in accordance with permit conditions, and spill-related releases would be controlled by a spill cleanup response (Section 3.1.1.2.3), construction activities would not cause chemical constituents to exceed marine sediment quality standards.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 2

Operation of LWI Alternative 2 would not discharge wastes other than untreated stormwater, increase contaminant inputs from vessels, or increase the frequency or size of possible spills into Hood Canal that would affect marine sediment quality. Maintenance of the LWI would include routine inspections, repair, and replacement of facility components as required. Periodic cleaning of the in-water mesh and PSB guard panels would release organic material into the water and decomposition of this material would result in localized increases in oxygen demand. If these conditions persisted, they could lead to locally reduced DO levels in the sediments. However, these materials would be dispersed by waves and currents, so that effects on DO would be transient. Therefore, no general or widespread effects on sediment DO at the LWI project sites are expected. BMPs and current practices (Section 3.1.1.2.3) would be employed to prevent discharges of chemical contaminants to the marine environment. Operation of LWI Alternative 2 would not affect sediment quality.

Physical Properties of Sediments

Anchor plates used to secure the mesh would represent a permanent change in substrate covering a seafloor area of 0.13 acre (0.052 hectare). The LWI Alternative 2 pier structures would alter current speeds, particularly near the piles, which would cause both erosion of fine-grained sediments near some piles impacted by turbulent flows and settling and accumulation of fine-grained sediments at the base of other piles (Section 3.1.2.2.2, under Hydrography). Shells and decaying organic matter from animals would slough from the piles and accumulate on the bottom, contributing to localized changes in sediment grain size immediately adjacent to the piles (Hanson et al. 2003). Similarly, fouling of the mesh from drift materials, floating debris, or attached organisms could reduce water flow sufficiently to promote settling of suspended particles and accumulation on the seafloor (snow-fence effect). Because fine-grained sediments have a greater affinity for some metal and organic contaminants from both local and regional sources, the spatial distribution of contaminants in bottom sediments may change slightly relative to existing conditions. Specifically, based on typical sediment-contaminant relationships, fine-grained sediments trapped by the piles could have higher contaminant concentrations compared to the coarse-grained sediments that presently occur at the site. However, these changes would only be expected immediately adjacent to the LWI and would not extend beyond the footprint of the LWI structures. The abutments would be exposed to waves only during extreme high tides and would not be expected to alter sediment properties. Additionally, with the placement of riprap at the base of the abutments scour is not expected to occur. The total area of riprap placed at the LWI abutments would be 4,100 square feet (381 square meters). The total length of riprap would be 410 feet (125 meters) and the width would be approximately 10 feet (3 meters). The riprap would extend from the MHHW elevation to approximately 10 feet above MLLW at the north LWI and 9 feet (2.7 meters) above MHHW at the south LWI.

Metals

Operation of LWI Alternative 2 would not result in the discharge of contaminants or otherwise alter the concentrations of trace metal in bottom sediments. Therefore, no chemical constituents would exceed marine sediment quality standards.

Organic Contaminants

Operation of LWI Alternative 2 would not result in the discharge of organic contaminants or otherwise alter the concentrations of organic contaminants in bottom sediments. Therefore, no chemical constituents would exceed marine sediment quality standards.

Operation of LWI Alternative 2 would not increase the risk of accidental spills of fuel, explosives, cleaning solvents, and other contaminants that, if spilled, would impact sediment quality in Hood Canal. In the event of an accidental spill, emergency cleanup measures would be implemented immediately, and the spill response would minimize impacts on the surrounding environment.

3.1.2.2.3 LWI Alternative 3: PSB Modifications (Preferred)

HYDROGRAPHY FOR LWI ALTERNATIVE 3

Construction

Construction of LWI Alternative 3 would involve relocating and installing new PSB sections. This construction would extend the existing PSB system across the intertidal zone and terminate at concrete abutments on the shoreline. The abutments would be the same as those described above for LWI Alternative 2 except that this alternative would include observation posts at each north and south abutment. Unlike the pile-supported LWI, the new PSB units would not deploy underwater mesh. The PSB units would have guard panels that extend into the water to an approximate depth of 1 foot (30 centimeters). However, these guard panels would not affect hydrographic conditions at the project sites during construction or operations.

Four of the existing mooring buoys would be relocated at the north LWI location. The mooring system for two of the four relocated buoys would be reduced from three anchor legs to two anchor legs. Three of the existing mooring buoys would be relocated at the south LWI location. The mooring system for one of the three relocated buoys would be reduced from three anchor legs to two anchor legs. In addition, one new buoy with two mooring anchor legs would be installed at the south LWI location (Section 2.1.1.3.3). The net effect of relocating and reconfiguring existing mooring anchors and adding new mooring anchors would be a decrease in the anchor footprint at the north LWI location by approximately 193 square feet (18 square meters), and an increase in the anchor footprint by approximately 42.5 square feet (4 square meters) at the south LWI location. The observation post structures at the north and south LWI locations would be supported by piles installed along the shoreline at elevations from 7 to 10 feet (2 to 3 meters) above MLLW and from 4 to 7 feet (1.2 to 2 meters) above MLLW, respectively. Each observation post would require a temporary construction trestle with the dimension of 20 by 50 feet (6 by 15 meters) at each LWI location along with 10 – 24-inch (60-centimeter) diameter steel pipe piles supporting the temporary trestle at each LWI location. With an approximately 100-foot (30-meter) wide construction corridor (Section 2.3.2.1), the estimated area of seafloor potentially disturbed by construction activities is 12.7 acres (5.2 hectares); the actual area that would be disturbed is expected to be considerably less.

Bathymetric Setting

Installation of new PSB segments would not alter bathymetric conditions other than minor disturbances associated with relocating and installing PSB moorings. Typical mooring installation consists of lowering the anchor with a floating crane using a slow, controlled descent to minimize disturbance to the seafloor. Installation of the abutments and piles for the observation posts in the upper part of the intertidal zone would cause some minor, localized mounding and depressions, which would not be expected to exceed 1 foot (0.3 meter) in displacement, representing a negligible change in the project bathymetry. These bathymetric features would likely be temporary because natural processes that occur at the sediment-water interface (bedload transport, bioturbation, etc.), particularly during storm events, would reshape the seabed to the surrounding environment. The seafloor topography would return to near its original profile over a period of approximately 6 to 12 months without intervention or mitigation.

Circulation and Currents

The presence of work vessels (estimated to be one barge with a crane plus one supply barge and work skiffs, based on previous NAVBASE Kitsap Bangor waterfront projects) associated with construction of LWI Alternative 3 would result in minor and localized effects on circulation patterns, which would not persist beyond the in-water construction phase, similar to those described for LWI Alternative 2. Additionally, with the placement of riprap at the base of the abutments scour is not expected to occur, but very localized effects to circulation may occur. The total area of riprap placed at the LWI abutments would be 4,100 square feet (381 square meters). The total length of riprap would be 410 feet (125 meters) and the width would be approximately 10 feet (3 meters). The riprap would extend from the MHHW elevation to approximately 10 feet above MLLW at the north LWI and 9 feet (2.7 meters) above MHHW at the south LWI.

Longshore Sediment Transport

The presence of two barges and work skiffs is expected to have a negligible effect on the conditions responsible for longshore sediment transport. This is because the spatial scale of wave dampening from barges would be small relative to the length of the shoreline.

OPERATION/LONG-TERM IMPACTS

The PSBs are a passive floating barrier system. Operation of the system would consist of opening and closing the barrier system to allow vessel passage by disconnecting the PSB gate units at the mooring locations and moving the barrier out of the way. The movable PSB units would not be anchored to the seafloor, so opening the barrier system would not require moving anchors or otherwise disturbing seafloor sediments. Also, opening and closing the PSB gate unit would not affect circulation patterns or other hydrographic processes. However, it is estimated that approximately 2,594 square feet (241 square meters) of the intertidal zone would be disturbed over the long term by the PSB units and buoys grounding out during low tide stages (Section 2.1.1.3.3).

Bathymetric Setting

The PSB sections and buoys would be moored so that there would be little slack, resulting in minimal lateral movement of the PSB sections and buoys during that portion of the tidal cycle when the PSB "feet" contact the seafloor. Regardless, considering that the PSBs and buoys would not always come to rest at the same point on the seafloor, it is estimated that the PSB feet and buoys would disturb a maximum area of 2,594 square feet (241 square meters). These footprints are small relative to the size of the project site, and the potential for the PSB to alter the seafloor bathymetry would be minimal. Similarly, small portions of the mooring anchor chain would be expected to move during each tidal cycle. Anchor chain associated with each mooring leg is expected to affect a 5-square foot area of the seafloor. Each mooring would have either two or three anchor legs, and eight moorings would be deployed for LWI Alternative 3, representing a total area of 100 square feet (9.3 square meters) of seafloor that would be affected by anchor chain movement. However, this alternative would also relocate seven existing moorings with a total of 21 anchor legs, so the net effect would be a slight decrease in seafloor area disturbed by anchor chain movement.

Grounding of the PSB feet and buoys and small movements of anchor chain are expected to result in small (less than 3 feet), localized changes in the sea bed elevations due to compression or displacement of surface layer sediments. The contact pressure associated with the pontoon feet is estimated at 4.5 pounds per square inch (psi), which is similar to that of a person walking on a beach. Minor changes in bathymetry associated with disturbances of the seafloor from the PSB pontoons and buoys would not alter circulation patterns or tidal elevations at the project sites.

Circulation and Currents

Operation of the PSB structures would not affect water circulation or tidal range within the project area, but the structures would result in some wave dampening as well as small-scale turbulence in the immediate vicinity of the individual PSB pontoons and abutment piles. However, the effects on circulation and currents from minor, localized turbulence would be negligible and less than for LWI Alternative 2.

Longshore Sediment Transport

Operation of the PSB segments for LWI Alternative 3 would not be expected to affect sediment transport processes along the NAVBASE Kitsap Bangor shoreline because the submerged portions of the PSB units and mooring/anchor systems would have small profiles that would not trap or promote accumulation of sediments. Thus, the overall effect would be minor and localized and would not affect longshore sediment transport processes.

Similar to LWI Alternative 2, the abutments constructed at the south and north LWI for LWI Alternative 3 would armor small sections of the existing shoreline. However, these areas are not expected to represent significant sources of sediments to the drift cell. As a result, the presence of the onshore abutments for LWI Alternative 3 would not substantially affect sediment supplies to the drift cells associated with the north and south LWI sites or drift cells to the north of these sites. Like LWI Alternative 2, the abutment stairways that extend over a small area below MHHW would be inundated infrequently and for short periods, and therefore are not expected to affect hydrodynamics or sediment transport processes. Because the piles for the observation posts would be at elevations between 6 and 12 feet (1.8 and 3.7 meters) above MLLW, and MHHW at the project site is 11 feet (3.4 meters) above MLLW, the base of the piles would be below the water surface during some high tide cycles. However, like the abutments, the piles would be inundated infrequently and for short periods and so would have a negligible effect on sediment transport. Therefore, the abutments and observation post piles would have minimal effects on nearshore processes and littoral drift.

WATER QUALITY FOR LWI ALTERNATIVE 3

CONSTRUCTION

Construction of LWI Alternative 3 would involve relocating and installing new PSB sections, relocating seven existing mooring buoys and adding one additional mooring buoy. These activities have the potential for resuspending bottom sediments, which could have minor, temporary effects on water quality at the project site. The PSB units would have guard panels that extend into the water to an approximate depth of 1 foot (0.3 meter). However, these guard panels would not affect water quality conditions at the project sites during construction or operations. This alternative would also construct observation posts at the north and south LWI locations. However, these structures would be constructed in the dry, so construction activities associated with these structures would have no effect on marine water quality. No part of the observation post to be installed on Marginal Wharf would extend into the water, and construction would not discharge any contaminants or other materials into the water. Therefore, water quality would not be affected.

Stratification, Salinity, and Temperature

Construction of LWI Alternative 3 would not impact water temperature or salinity because construction activities would not discharge wastewaters other than stormwater runoff, in accordance with the stormwater pollution prevention plan. In the absence of project-related discharges, construction of LWI Alternative 3 would not alter stratification, salinity, or temperature in Hood Canal.

Dissolved Oxygen

Construction of LWI Alternative 3 would not discharge any wastes containing materials with an oxygen demand into Hood Canal. Relocation of existing PSB mooring anchors and placement of the new PSB mooring anchors would not affect DO concentrations in site waters, other than minor, temporary and localized effects associated with resuspension of bottom sediments. Similar to LWI Alternative 2, resuspension of existing bottom sediments would not result in substantial oxygen depletion or reductions in DO levels. This is because the sediments have a low organic content and waves and currents provide rapid mixing and dispersion of suspended sediments.

Stormwater discharges would be controlled consistent with a construction stormwater discharge permit and stormwater pollution prevention plan. Consequently, stormwater discharges are not expected to alter DO concentrations at the project site. Construction activities would not result in decreases in DO concentrations, cause changes that would violate water quality standards, or exacerbate low DO concentrations that occur seasonally within portions of Hood Canal.

Turbidity

Construction of LWI Alternative 3 would temporarily increase suspended sediment concentrations and turbidity levels in Hood Canal as a result of resuspension of bottom sediments during placement of PSB mooring anchors. The PSB mooring anchors would be deployed with a barge-mounted crane using a controlled placement method that would minimize disturbances to bottom sediments. Regardless, resuspended sediment would contribute temporarily to elevated turbidity levels and reduced water clarity conditions. As particles settle and current and wave conditions mix and disperse the suspended particles, turbidity levels would decline. The time required to reach baseline conditions would depend on the composition of the resuspended particles, particle settling speeds, and dilution and dispersion rates related to current and wave conditions. Typically, these time periods are on the order of minutes to hours.

Similarly, for other project-related construction activities, such as anchoring work boats, fine-grained particles resuspended from the bottom would disperse rapidly as a result of particle settling and current mixing. Propeller wash impacts could occur in shallow waters, although the need for vessel operations in shallow waters and, thus, the extent of sediment resuspension is expected to be minimal.

Stormwater discharges would be in accordance with a stormwater discharge permit and stormwater pollution prevention plan, which would minimize the potential for discharges to affect turbidity levels at the project site.

Similar to LWI Alternative 2, construction of the abutments at the north and south LWI Alternative 3 sites would disturb sediments in the upper intertidal zone. These sediments would be subject to resuspension during high tide stages, which could contribute locally to increased turbidity levels. However, the magnitude of this effect would be minimal because construction would be conducted in the dry, sediments are mostly coarse-grained, the duration of inundation by high tides would be limited, and coffer dams would be used to prevent erosion and turbidity.

Consequently, construction activities would not result in persistent increases in turbidity levels or cause changes that would violate water quality standards. This is because processes that generate suspended sediments and increase turbidity levels 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.

Nutrients

Construction activities for LWI Alternative 3 would not result in the discharge of wastes containing nutrients. Because sediments at the project site do not contain high concentrations of nutrients, such as ammonia (Hammermeister and Hafner 2009), sediment resuspension during construction would not release nutrients to site waters in amounts that would violate water quality standards. Construction activities would not cause increases in nutrient levels or produce conditions that would violate water quality standards.

Fecal Coliform Bacteria

Construction activities for LWI Alternative 3 would not impact bacteria (fecal indicator bacteria) levels because this alternative would not discharge untreated wastes or other materials containing bacteria. Bacterial levels in coarse-grained marine sediments at the project site also are expected to be low, and resuspension of sediments during construction activities would not release bacteria to site waters in amounts that would violate water quality standards. Stormwater discharges would be controlled in accordance with a stormwater discharge permit and stormwater pollution prevention plan. Construction activities would not result in increases in bacteria levels or cause changes that would violate water quality standards.

pH

Construction activities for LWI Alternative 3 would not impact the pH levels of local waters because this alternative would not discharge pH-affecting wastes at the project site. Similar to Alternative 2, there is a potential for cement spillage during construction of the platforms. The chemical composition of cement can influence pH under some conditions, although this is unlikely to be a consideration for the project site and proposed construction methods. Further, measures to prevent losses and cleanup of spills would be addressed in the debris management procedures. Stormwater discharges would be controlled in accordance with a stormwater discharge permit and stormwater pollution prevention plan. Consequently, construction activities would not result in changes in pH that would violate water quality standards.

Other Contaminants

Another possible source of construction-related impacts on water quality for LWI Alternative 3 would be accidental spills into Hood Canal of debris, fuel, or other contaminants from barges or construction platforms. Typically, spills are prevented by a number of measures, including containing and cleaning up materials leaked on the deck of work vessels, prohibiting washdown of materials into the water, and prohibiting refueling in unauthorized areas. The existing facility response and prevention plans for the Bangor waterfront (the *Commander Navy Region Northwest Oil and Hazardous Substance Integrated Contingency Plan* and the *NAVBASE Kitsap Bangor Spill Prevention, Control, and Countermeasure Plan* [COMNAVREGNWINST 5090.1, Integrated Contingency Plan, Annex G]) provide guidance that would be used in a spill response, such as a response procedures, notification, and communication plan; roles and responsibilities; and response equipment inventories. In the event of an accidental spill, response measures would be implemented immediately to minimize potential impacts on the environment.

The Navy would require the construction contractor to prepare and implement debris management procedures for preventing discharge of debris to marine water and retrieving and cleaning up any debris spilled into Hood Canal. Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups. Overall, construction activities associated with Alternative 3 would not be expected to release contaminants or otherwise cause any water quality standards to be violated.

OPERATION/LONG-TERM IMPACTS

Operation of LWI Alternative 3 would not discharge wastes into Hood Canal. Wastewater from sinks and toilets in the observation posts would be transferred via transmission lines to the existing NAVBASE Kitsap Bangor wastewater infrastructure. The transmission lines would be double-piped to ensure no contamination of beach areas. Stormwater runoff from the PSB segments would not require treatment and could discharge directly into Hood Canal since the structure surfaces would consist largely of inert materials and would not represent a substantial source of pollutant loadings into Hood Canal. The PSB pontoons, which would provide the greatest surface area contact with seawater, would be constructed of HDPE (high density polyethylene), which is durable and inert. However, some of the materials used for the PSB and mooring units likely would be galvanized metal or steel, which can leach zinc and contribute to zinc loading in stormwater runoff (WDOE 2008a). However, this is not expected to affect water quality at the project site because the magnitude of the zinc input would be minimal, and the project would implement and operate stormwater BMPs in accordance with the NPDES permit.

Stratification, Salinity, and Temperature

Operation of the LWI Alternative 3 would not result in discharges into local waters. Also, these structures would not interfere with tides, currents, or other natural processes that are responsible for mixing Hood Canal waters. Therefore, operations would not result in impacts on stratification, salinity, or temperature conditions or cause changes that would violate water quality standards.

Dissolved Oxygen

Periodic cleaning of the PSB in-water guard panels would release organic material into the water and subsequent decomposition of this material would result in localized increases in oxygen demand. However, these materials would be dispersed by waves and currents so effects on DO would be transient and inconsequential. Also, these structures would not interfere with tides, currents, or other natural processes that are responsible for mixing Hood Canal waters. Therefore, operations of LWI Alternative 3 would not result in impacts on DO conditions or cause changes that would violate water quality standards.

Turbidity

Operation of the LWI Alternative 3 would not result in discharges or resuspend bottom sediments that have the potential for affecting turbidity levels at the project site. Some temporary and localized increases in turbidity could occur as a result of the PSB feet and buoy grounding during low tides. Small boat operations would be infrequent and boat operators would be required to use low power and speeds in shallow water, minimizing the potential for propeller wash to cause suspension of bottom sediments. Therefore, operations would not result in changes to turbidity levels that would violate water quality standards.

Nutrients

Operation of the LWI Alternative 3 would not result in discharges that would affect nutrient concentrations in marine waters at the project site. The PSB units would provide a roosting site for marine birds, which would produce feces and associated nutrient loading to Hood Canal. However, nutrients would be rapidly mixed and dispersed by currents, and the magnitude of this input source would not cause eutrophication. Further, since the existing PSBs provide similar roosting sites, this alternative would not represent a new source for nutrient loading. Therefore, operations would not violate water quality standards.

Fecal Coliform Bacteria

Operation of the LWI Alternative 3 would not affect fecal coliform bacteria levels in marine waters at the project site because the project would not result in any discharges or alter site conditions in a manner that would release bacteria to local waters. Birds roosting on the PSB sections would contribute to bacterial loading, but inputs would be rapidly mixed and dispersed by currents. Because the existing PSBs provide similar roosting sites, this alternative would not represent a new source for bacterial loading. Therefore, operations would not result in impacts on bacteria levels or cause changes that would violate water quality standards.

pH

Operation of the LWI Alternative 3 would not result in discharges with the potential for impacting the pH of marine waters. Therefore, operations would not result in impacts on pH levels or cause changes that would violate water quality standards.

Other Contaminants

Operation of the LWI Alternative 3 would not increase the risk of accidental spills of fuel, explosives, cleaning solvents, and other contaminants that, if spilled, would impact water quality in Hood Canal. This is because the existing NAVBASE Kitsap Bangor fuel spill prevention and response plans would help ensure the avoidance of fuel spills. In the event of an accidental spill, emergency cleanup measures would be implemented immediately in accordance with state and federal regulations. The cleanup would minimize impacts on the surrounding environment.

SEDIMENT QUALITY FOR LWI ALTERNATIVE 3

CONSTRUCTION

A possible source for construction-related impacts on sediments would be from accidental debris spills from barges or construction platforms into Hood Canal. Debris spills could impact bottom sediments and create nuisance conditions by adding materials that could represent obstructions. The construction contractor would be required to retrieve and clean up any accidental spills as a current practice in accordance with the debris management procedures that would be implemented per the Mitigation Action Plan (Appendix C). Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups. Construction-related changes to sediment quality would be spatially limited to the construction corridor, including areas potentially impacted by anchor drag.

Physical Properties of Sediments

Anchor placement during relocation of existing PSB units and installation of new PSB units would cause minor disturbances of bottom sediments. Sediments that are resuspended by anchoring activities would be dispersed by currents and eventually redeposited on the bottom (Barnard 1978; Hitchcock et al. 1999). Depending on the distance, suspended sediments would be transported before settling on the bottom. This process could result in minor changes to sediment texture (i.e., grain-size characteristics), particularly if coarse-grained sediments are transported from shallow to deeper portions of the project site or fine-grained sediments are transported from deeper to shallower areas. The distance over which suspended sediments are dispersed would depend on a number of factors, including sediment characteristics, current speeds, and distance above the bottom.

Metals

Construction activities for LWI Alternative 3 would not result in the discharge of wastes containing metals or otherwise alter the concentrations of trace metals in bottom sediments. Consequently, because construction-related disturbances to bottom sediments would be minor, any changes in bulk metal concentrations associated with localized effects on sediment grain size would be negligible. Changes would not cause chemical constituents to exceed marine sediment quality standards because the magnitude of the project-related changes would be minimal.

Organic Contaminants

Construction activities for LWI Alternative 3 would not result in the discharge of contaminants or otherwise alter concentrations of organic contaminants in bottom sediments. Similar to metals concentrations (discussed above), construction activities would not impact sediment quality except for minor changes in the concentrations of organic compounds that would result from changes in grain size. However, these changes would not cause chemical constituents to exceed marine sediment quality standards because the magnitude of project-related changes is expected to be minimal.

Accidental fuel spills or releases of other materials (e.g., hydraulic fluids) to Hood Canal could add contaminants (petroleum hydrocarbons) that could also impact sediment quality. However, the spill cleanup response (Section 2.3.2) would minimize impacts on the surrounding environment.

OPERATION/LONG-TERM IMPACTS

Other than untreated stormwater, operation of the LWI Alternative 3 would not discharge any wastes or increase contaminant inputs from vessels or the frequency or size of possible spills into Hood Canal that would affect marine sediment quality. Measures would be employed to prevent discharges of contaminants to the marine environment. These activities would not affect sediment quality.

Physical Properties of Sediments

Operation of the PSB segments could cause minor changes to sediment texture in the intertidal zone where the PSB "feet" and buoys contact the bottom during low tide stages. In particular, the periodic (tidal-dependent) but repeated disturbance of the seafloor would promote selective resuspension and dispersion of finer grained sediment particles, resulting in comparatively higher percentages of coarse-grained particles. However, the sediments of the intertidal areas of the LWI project sites consist primarily of coarse sand and gravel-sized particles. Thus, changes to sediment texture in areas subject to disturbances by the PSB feet and buoys would be minor, and the estimated maximum area of disturbance would be 2,594 square feet (241 square meters) of seafloor. Similarly, movement of portions of the anchor chain used on the PSB moorings would affect an estimated 100 square feet (9.3 square meters) of seafloor. However, this alternative would also relocate seven existing moorings, so the net effect would be a slight decrease in seafloor area disturbed by anchor chain movement. Additionally, with the placement of riprap at the base of the abutments scour is not expected to occur. The total area of riprap placed at the LWI abutments would be 4,100 square feet (381 square meters). The total length of riprap would be 410 feet long (125 meters) and the width would be approximately 10 feet (3 meters). The riprap would extend from the MHHW elevation to approximately 10 feet above MLLW at the north LWI and 9 feet (2.7 meters) above MHHW at the south LWI.

Metals

Operation of LWI Alternative 3 would not result in the discharge of contaminants or otherwise alter the concentrations of trace metal in bottom sediments. Leaching of metals from PSBs is not expected to affect sediment quality at the project site because the magnitude of the metal inputs would be minimal. Therefore, no chemical constituents for metals would exceed marine sediment quality standards.

Organic Contaminants

Operation of LWI Alternative 3 would not result in the discharge of organic contaminants or otherwise alter the concentrations of organic contaminants in bottom sediments. Therefore, no chemical constituents for organic contaminants would exceed marine sediment quality standards.

Spills of fuel, explosives, cleaning solvents, and other contaminants could impact sediment quality in Hood Canal. However, operation of the LWI Alternative 3 would not increase the risk of accidental spills because, other than minor, small boat operations, the project operations would not require use of explosives, solvents, or other contaminants. In the event of an accidental spill, emergency cleanup measures would be implemented immediately, and the spill response would minimize impacts on the surrounding environment. No changes are currently anticipated in the number or types of vessels on the Bangor waterfront as a result of construction of in-water barriers. In addition, operations would not increase the mass loading of contaminants, such as copper or zinc from anti-fouling hull paints and sacrificial anodes, to marine sediments at the project site. This is because there would be no increase in the number of vessels using the Bangor waterfront as a result of construction of the LWI.

3.1.2.2.4 SUMMARY OF IMPACTS FOR LWI PROJECT ALTERNATIVES

Impacts on marine water resources associated with the construction and operation phases of the LWI project alternatives, along with mitigation measures and consultation and permit status, are summarized in Table 3.1–5.

Table 3.1–5. Summary of LWI Impacts on Marine Water Resources

Alternative	Environmental Impacts on Marine Water Resources
LWI Alternative 1: No Action	The No Action Alternative would not result in any changes to existing hydrography, water quality, or sediment quality.
LWI Alternative 2: Pile-Supported Pier	*Construction*: Temporary and localized disturbances of bottom sediments (bathymetry) from anchor dragging, spud deployment, and propeller wash within the construction footprint (maximum 13.1 acres [5.3 hectares]), and small-scale changes in wave and current patterns. Project construction activities could result in temporary and localized changes in water quality associated with resuspension of bottom sediments (increased suspended sediment concentrations and turbidity levels), stormwater discharges (contaminant loading), and spills (contaminant releases), but conditions are not expected to exceed water quality standards. Project construction activities would result in disturbance of bottom sediments through pile installation and anchoring of barges and vessels, which would affect physical characteristics of the sediments such as grain size. Impacts on sediment contaminant levels are unlikely, and conditions are not expected to exceed marine sediment quality standards. Changes to marine water resources associated with project construction activities could occur throughout the in-water construction phase of the project. Changes to water quality conditions likely would persist for minutes to hours following disturbances, whereas changes to sediment conditions would persist for weeks to months. Construction-related changes would not be expected to occur beyond the immediate project site. *Operation/Long-term Impacts*: Small-scale changes in flow patterns could result in localized scouring or accumulation of sediments in the immediate vicinity of the support piles and underwater mesh. These changes likely would be seasonal, as storm waves would resuspend and redistribute sediments that were deposited initially near the structures. Release of organic matter from periodic cleaning of the in-water mesh could increase oxygen demand on a localized and temporary basis. Other project operations would not involve discharges of waste or other materials with the potential for impacting water quality. The presence of the LWI structures and abutments would not cause measurable changes in deposition or erosion patterns or average seabed elevations, and would not substantially affect local or regional sediment transport processes. The placement of riprap at the base of the abutments would prevent scour at the structure base effects to circulation and sediment dynamics would be minimized by covering the riprap with native beach material and placing large woody debris if needed.

Table 3.1–5. Summary of LWI Impacts on Marine Water Resources (continued)

Alternative	Environmental Impacts on Marine Water Resources
LWI Alternative 3: PSB Modifications (Preferred)	*Construction*: Temporary and localized disturbances of bottom sediments (bathymetry) from anchor placement within the construction footprint (maximum 12.7 acres [5.2 hectares]) and from construction of the shoreline abutments and observation posts.[1] Project construction activities could result in temporary and localized changes in water quality associated with resuspension of bottom sediments (increased suspended sediment concentrations and turbidity levels), stormwater discharges (contaminant loading), and spills (contaminant releases), but conditions are not expected to exceed water quality standards. Project construction activities would disturb bottom sediments through anchoring of barges and vessels, which would affect physical characteristics of the sediments such as grain size. However, impacts on sediment contaminant levels are unlikely, and conditions are not expected to exceed marine sediment quality standards. Construction impacts on the seafloor would be less under LWI Alternative 3 than for LWI Alternative 2 because of the slightly smaller construction corridor (12.7 acres vs. 13.1 acres (5.2 vs. 5.3 hectares) for LWI Alternative 2) and less intensive construction required to place PSB buoy anchors compared to the installation of plate anchors and more numerous piles for the piers. *Operation/Long-term Impacts*: PSBs would not result in changes in flow patterns. Project operations would not involve discharges of waste or other materials with the potential for impacting water quality. The presence of the PSB units, observation post piles, and abutments would not cause measurable changes in deposition or erosion patterns or average seabed elevations and would not substantially affect local or regional sediment transport processes. The placement of riprap at the base of the abutments would prevent scour at the structure base; effects to circulation and sediment dynamics would be minimized by covering the riprap with native beach material and placing large woody debris if needed.
Mitigation: BMPs and current practices to reduce and minimize impacts on marine water resources from the proposed LWI project are described in Section 3.1.1.2.3. No mitigation measures are necessary beyond BMPs and current practices.	
Consultation and Permit Status: The Navy submitted a JARPA to USACE and other regulatory agencies, requesting permits for this project under CWA Sections 401, 402, and 404 and Rivers and Harbors Act Section 10. In accordance with the CZMA, the Navy submitted a CCD to WDOE. Alternative 3 is the Least Environmentally Damaging Practicable Alternative according to the CWA Section 404(b)(1) guidelines.	

BMP = best management practices; CCD = Coastal Consistency Determination; CWA = Clean Water Act; CZMA = Coastal Zone Management Act; DO = dissolved oxygen; JARPA = Joint Aquatic Resources Permit Application; USACE = U.S. Army Corps of Engineers; WDOE = Washington Department of Ecology

1. Disturbance from observation post construction would be from those at the north and south LWI's only. The observation post at Marginal Wharf would be re-constructed on the existing wharf and would not result in sediment disturbance.

3.1.2.3 SPE PROJECT ALTERNATIVES

3.1.2.3.1 SPE ALTERNATIVE 1: NO ACTION

The SPE would not be constructed under the No Action Alternative and operations would not change from current levels. Therefore, existing hydrography, nearshore water quality, and sediment quality would not be impacted under the SPE No Action Alternative.

3.1.2.3.2 SPE Alternative 2: Short Pier (Preferred)

HYDROGRAPHY FOR SPE ALTERNATIVE 2

Construction of SPE Alternative 2

SPE Alternative 2 would extend the Service Pier to the southwest from the south end of the existing service pier (Section 2.2.1.3.2). Water depths in this area range from 30 to 75 feet (9 to 23 meters) below MLLW. The pier extension would demolish a portion of the existing pier and fender piles, install new, concrete-filled, steel pipe piles, and relocate the existing wave screen. Construction of the proposed SPE facilities is anticipated to take approximately 24 months. In-water construction, including pile driving, would take no more than 13 weeks and would occur within the allowable in-water work window (July 15 to January 15). The SPE Alternative 2 would not require construction activities in the intertidal zone.

Bathymetric Setting

Construction of SPE Alternative 2 would have some temporary impacts on the bathymetry (seafloor topography) within the immediate construction site. Given the deep-water setting of the SPE project site, there is no anticipated need for dredging within the construction corridor. However, removal of existing piles, anchor placement, and construction equipment mooring ground tackle, in addition to effects from pile driving, would result in some physical disturbance to the seafloor, such as mounding and displacement or movement of bottom sediments.

Changes to bathymetry, resulting from pile removal, pile driving, and anchor placement during construction activities, would be limited to highly localized areas within the 100-foot (30-meter) wide construction corridor. The magnitude of sediment displacement is estimated to be between 0.5 and 3 feet (0.2 to 1 meter), representing the potential displacement of sediment by a typical vessel or barge anchor (width of up to 3 feet [1 meter]). However, the majority of localized sediment disturbance from construction activities is expected to be much less than the maximum.

These impacts are anticipated to be temporary because natural processes that occur at the sediment-water interface (bedload transport, bioturbation [mixing of surface sediment by benthic infaunal organisms], etc.) following completion of construction activity would return the seafloor topography to near its original profile over time (6 to 12 months) without intervention or mitigation. A period of 6 to 12 months would allow for a full seasonal cycle of storm and wind events, tidal influence, and resumption of ambient sediment transport patterns that would degrade temporary boundary roughness and reshape the seabed to the surrounding environment. Although some movement and redistribution of in-place sediments is anticipated, no substantial changes to bathymetry would occur.

Circulation and Currents

Circulation patterns in the surface water layer (upper 10 to 15 feet [3 to 5 meters] of water) in the immediate vicinity of the SPE Alternative 2 site would be affected by short-term and temporary changes due to the presence of construction equipment and barges, which would partially obstruct flows. However, these effects would be localized and would not alter the overall circulation pattern and velocities in the nearshore and deeper water areas along the Bangor waterfront.

Construction of SPE Alternative 2 would have no impact on the tidal range or water levels in Hood Canal or the immediate project area because the pier would be constructed on a foundation of piles that would not interfere with tidal cycles. Thus, water levels at the project site would be similar to other, adjacent areas of northern Hood Canal.

Longshore Sediment Transport

Construction activities for the SPE Alternative 2 structure would not affect longshore sediment transport processes along the NAVBASE Kitsap Bangor shoreline because the influence of construction equipment on wave and current energy that are responsible for resuspending and transporting sediments along the shoreline would be negligible.

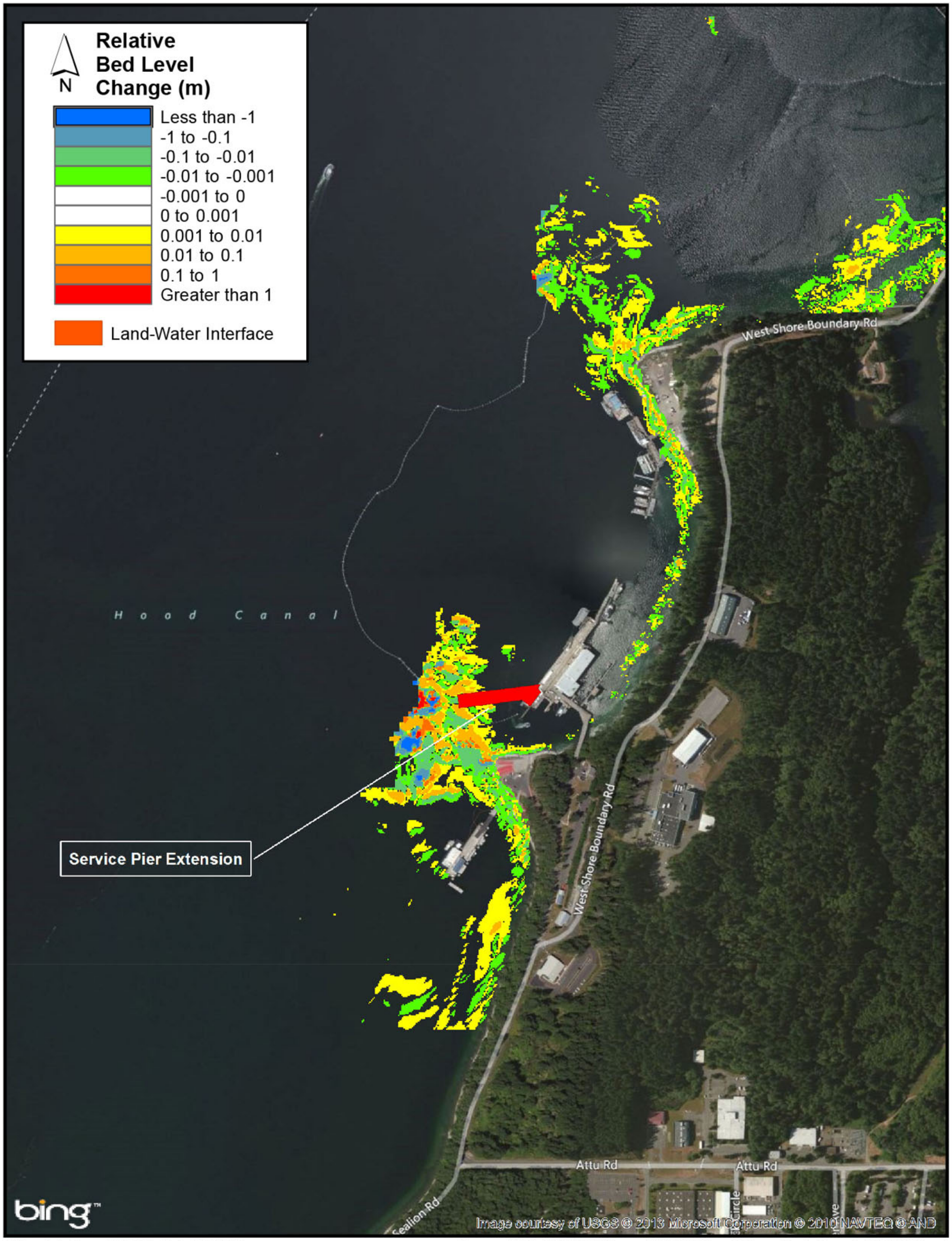
OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 2

The in-water portion of the SPE Alternative 2 structure (piles and wave screen) would dampen wave energy within the immediate vicinity of the pier, resulting in long-term but localized effects on water circulation and currents. Water levels and tidal exchange volumes in the basin would be unaffected by the continued presence and use of the SPE because the pier piles and wave screen would not prevent water flow. Maintenance of the SPE would include routine inspections, repair, and replacement of facility components as required. These activities would not affect hydrographic conditions. Transient berthing of submarines at the extended Service Pier would not affect bathymetry, tides, circulation patterns, or sediment transport processes at NAVBASE Kitsap Bangor, other than very minor, localized effects of submarine hulls dampening surface flows and waves in the immediate vicinity of the SPE project site.

Bathymetric Setting

The support piles installed for the SPE would alter current speeds beneath the pier, which would cause erosion of fine-grained sediments near some piles impacted by turbulent flows, as well as settling and accumulation of fine-grained sediments at the base of other piles (Chiew and Melville 1987). Over the lifetime of the SPE, tidal currents would result in thin scouring around the perimeter of the pier piles (Sumer et al. 2001). However, shells and barnacles that accumulate on the pier piles would also slough off over time and contribute to the sediment content below the piles. The loss of fine-grained sediment would be offset by the accumulation of shell and barnacle particles. These two processes would result in no net impact to seafloor bathymetry below the pier support piles.

Over the long term, small changes to the bathymetry inshore of the SPE structure could occur due to attenuation (reduction in energy) by the pier piles of surface waves approaching from the west. The effects of the SPE structure on bathymetry were evaluated by cbec (2013). Results from hydrodynamic modeling indicated that the presence of the SPE structure would have a negligible effect on the average seabed elevations in the project area. The net change in seabed elevations at the SPE project site for a 50-year storm event scenario is shown in Figure 3.1–23. For the 50-year recurrence event scenarios, average changes in seabed elevations with the SPE in



Author: John Evans | SAIC | Date: 7/10/2013   Document Path: C:\GISPJ13\Bangor LWI\SAIC Figures\50 year Flood - Scenario 2 SPE BLC.mxd

Source: cbec 2013

Figure 3.1–23. Model-Predicted Changes in Relative Seabed Elevations with Installation of the SPE Structure under a 50-Year Storm Scenario

place would range from -0.28 to -0.16 inch (-7 to -4 millimeters), which is similar to the average change in the seabed elevation (-0.24 inch [-6 millimeters]) under existing conditions (i.e., no SPE). Net changes in the sedimentation patterns under less severe, 2-year storm events would be relatively smaller. Based on these results, operation of the SPE is not predicted to cause appreciable changes to bathymetry within the project area. Effects of the proposed SPE on sediment transport processes are discussed below.

Circulation and Currents

Since the SPE Alternative 2 pier would be constructed on a foundation of piles, the overall volume of water flowing into the nearshore and deeper water areas adjacent to the project site would not be affected by the structures. It is anticipated that the flow pattern immediately under the SPE would become more disturbed (turbulent) as the water mass driven by tidal currents moves between and around the piles, especially during periods of peak flow. The presence of up to two additional submarines berthed at the SPE would be expected to reflect surface waves. Similarly, the presence of the wave screen relocated beneath the inboard portion of the SPE would also continue to reflect and dampen surface waves and currents. The resulting impact would be a small decrease in water column current velocities downcurrent of the SPE, but an overall increase in the turbulence and mixing in the water mass passing directly under the structure.

Turbulence in the water column would be a function of small-scale increases in the instantaneous velocity of water flow between the individual pile structures relative to the remainder of the water column. The impact of turbulence in the water column is beneficial to water quality through the deflection of linear flow downward and laterally, promoting increased mixing of the water column.

Modeling of hydrodynamic conditions with and without the SPE structure indicated only marginal changes in current velocities for 2-year storm and 50-year storm conditions (cbec 2013). This may be due in part to the location of the proposed SPE structure in the lee (down current) side of Carlson Spit, where current speeds are already lower than in the deeper open-water region offshore from the Service Pier.

Operation of the SPE Alternative 2 would not affect the tidal range along the shoreline or the immediate project area. This is because the pier extension would be constructed on a foundation of piles that allows water exchange with portions of Hood Canal immediately offshore, and operation of the SPE would not alter bathymetry within the project region (discussed above).

Longshore Sediment Transport

The SPE Alternative 2 would increase the combined footprint of pile-supported structures along the Bangor shoreline. However, based on data presented in Section 3.1.1.1, as well as results from longshore sediment transport modeling (cbec 2013), the proposed extension of the existing structure is not expected to reduce the local sediment budget or result in significant changes to the NAVBASE Kitsap Bangor shoreline. Piles installed to support the SPE are expected to attenuate the energy of surface waves associated with storm events approaching the project site from the north and south. This reduction in wave energy in areas shoreward of the structure would reduce the frequency and magnitude of sediment resuspension events and promote conditions more conducive to long-term deposition of sediments and accumulation of fine-grained sediment in the form of a shoal area or comparatively broader intertidal area. Regardless, results from modeling sediment transport processes in the vicinity of the SPE project area (cbec 2013) predict that the presence of the SPE structure would not cause measurable changes in average seabed elevation within the project area under 50-year storm or 2-year storm scenarios (Figure 3.1–23). Thus, the project would not affect the sediment budget and rates of erosion/accretion outside of the project footprint. This conclusion is supported by a Golder Associates (2010) study, which concluded that the presence of other Navy structures along the NAVBASE Kitsap Bangor shoreline has not caused appreciable changes in the morphology of the shoreline. Similarly, operation of the SPE is not expected to interrupt longshore sediment transport processes or result in changes to the NAVBASE Kitsap Bangor or West Kitsap County shoreline.

WATER QUALITY FOR SPE ALTERNATIVE 2

CONSTRUCTION OF SPE ALTERNATIVE 2

In-water construction of SPE Alternative 2 facilities and supporting components would not require dredging or placement of fill. Direct discharges of waste to the marine environment would not occur, other than stormwater runoff during construction. Construction-related impacts to water quality would be limited to short-term and localized changes associated with resuspension of bottom sediments from pile removal, pile installation, and barge and tug operations, such as anchoring, as well as accidental losses or spills of construction debris into Hood Canal. These changes would be spatially limited to the construction corridor, including areas potentially impacted by anchor drag and areas immediately adjacent to the corridor (i.e., up to approximately 130 feet [40 meters] from the offshore edge of the construction corridor) that could be impacted by plumes of resuspended bottom sediments. Construction-related impacts would not violate applicable state or federal water quality standards.

Stratification, Salinity, and Temperature

Construction of SPE Alternative 2 would not impact water temperature or salinity because construction activities would not discharge wastewaters other than stormwater runoff, in accordance with the SWPPP. In the absence of project-related discharges, construction of SPE Alternative 2 would not alter stratification, salinity, or temperature in Hood Canal.

Dissolved Oxygen

Construction of SPE Alternative 2 would not discharge any waste-containing materials with an oxygen demand into Hood Canal. However, pile removal and pile installation would resuspend bottom sediments, which may contain chemically reduced organic materials. Subsequent oxidation of sulfides, reduced iron, and organic matter associated with the suspended sediments would consume some DO in the water column. The amount of oxygen consumed would depend on the magnitude of the oxygen demand associated with suspended sediments (Jabusch et al. 2008). As discussed in Section 3.1.1.1.3, the organic carbon content of sediments at the SPE project site is low (0.4 to 2 percent), although total sulfides concentrations vary from 6 to 1,330 mg/kg. Therefore, the impacts of sediment resuspension from pile installation to DO concentrations would be minimal. Additionally, a bubble curtain would be used to reduce in-water noise levels during some construction activities (see discussion of impacts from underwater noise in Appendix D). Use of a Type I bubble curtain would increase DO concentrations in marine waters at the SPE project site by increasing the rate of vertical mixing of site waters and promoting dissolution of air bubbles, thereby increasing oxygen saturation levels. The effect on DO concentrations from use of a bubble curtain would be greater than that associated with sediment resuspension, and a net increase in DO levels would be expected. Use of a Type II confined bubble curtain would not increase DO concentrations in marine waters. Stormwater discharges would be addressed by a construction stormwater discharge permit and SWPPP. Consequently, stormwater discharges would not alter DO concentrations at the project site. Because the project would not discharge wastewaters, other than stormwater that would be discharged in accordance with a permit and SWPPP, construction activities would not result in decreases in DO concentrations, cause changes that would violate water quality standards, or exacerbate low DO concentrations that occur seasonally in Hood Canal waters.

Turbidity

Removal of existing piles and installation of new piles for the SPE Alternative 2 pier extension would resuspend bottom sediments within the immediate construction area, resulting in short-term and localized increases in suspended sediment concentrations that, in turn, would cause increases in turbidity levels. The suspended sediment/turbidity plumes would be generated periodically, in relation to the level of in-water construction activities, during the in-water work window. The amount of bottom sediments that would be resuspended into the water column during pile removal and pile placement, and the duration and spatial extent of the resulting suspended sediment/turbidity plume, would reflect the composition of the sediments. Surface sediments at the SPE project site are mostly coarse-grained, ranging from 72 to 93 percent sand and gravel (Hammermeister and Hafner 2009). In general, the coarse-grained sediments that occur in most areas of the SPE project site are more resistant to resuspension and have a faster settling speed than fine-grained sediments. Higher settling rates would result in a shorter water column residence time and a smaller horizontal displacement by local currents (Herbich and Brahme 1991; LaSalle et al. 1991; Herbich 2000).

Assuming that bottom sediments are disturbed during construction, and resuspended into the water column (a conservative assumption of 40 feet (13 meters), the maximum water column residence of sand sized particles would be approximately 130 seconds. A sand particle settles through the water column at a velocity of approximately 0.3 foot/second (9 centimeters/second). With a current velocity of 1 foot/second (30 centimeters/second) (Section 3.1.1.1.1), the maximum dispersion distance would be approximately 130 feet (40 meters), (i.e., it would take 130 seconds for a sand particle to settle 40 feet (13 meters) through the water column, at which time the particle is being transported horizontally at a rate of 1 foot/second (30 centimeters/second), resulting in horizontal displacement of 130 feet (40 meters). Silt and clay particles that are resuspended during construction activities could have relatively longer water column residence times because they have slower settling speeds. Based on the size of sediment particles typical of the project site, the settling period for individual particles could be up to several hours depending on the water depth and initial distance above the bottom. Suspended silt- and clay-sized particles would form weak (low particle density) plumes, which would be subject to rapid dilution by currents and eventual flushing during subsequent tidal exchanges (Morris et al. 2008). Therefore, relatively greater dispersion of these fine-grained suspended sediments would occur.

For other project-related construction activities, such as barge anchoring, fine-grained particles resuspended from the bottom would be confined to the near-bottom depth layers by natural density stratification of the water column. The subsurface suspended sediment plume would disperse rapidly as a result of particle settling and current mixing. In most cases, suspended sediment/turbidity plumes would not be visible at the surface. Propeller wash impacts would not be expected at depths where the SPE would be constructed. Stormwater discharges would be in accordance with a stormwater discharge permit and SWPPP, which would minimize the potential for discharges to affect turbidity levels at the SPE project site.

As mentioned above in the discussion of DO, a bubble curtain could be used to reduce in-water noise during some construction activities (Section 2.3.3), although the type of bubble curtain that could be used has not yet been specified by the Navy. The type of bubble curtain used will affect the suspended sediment concentrations and turbidity levels. After a pile is driven and the curtain is removed; there would still be some residual plume, although less than with an unconfined bubble curtain. Nevertheless, 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.

Per WAC 173-201a-210, "[t]he turbidity criteria established under WAC 173-201A-210 (1)(e) shall be modified, without specific written authorization from the department, to allow a temporary area of mixing during and immediately after necessary in-water construction activities that result in the disturbance of in-place sediments. This temporary area of mixing is subject to the constraints of WAC 173-201A-400 (4) and (6) and can occur only after the activity has received all other necessary local and state permits and approvals, and after the implementation of appropriate best management practices to avoid or minimize disturbance of in-place sediments and exceedances of the turbidity criteria. A temporary area of mixing shall be as follows:

D. For projects working within or along lakes, ponds, wetlands, estuaries, marine waters or other nonflowing waters, the point of compliance shall be at a radius of one hundred fifty feet from the activity causing the turbidity exceedance."

Per the discussion above regarding the settling time for resuspended particles, turbidity conditions are not expected to increase by more than 5 NTU above background at the point of compliance, 150 feet (45 meters) from the disturbance.

Nutrients

Construction activities associated with SPE Alternative 2 would not result in the discharge of wastes containing nutrients. Because sediments at the SPE project site do not contain high concentrations of nutrients, such as ammonia (Hammermeister and Hafner 2009), sediment resuspension during construction would not release nutrients to site waters in amounts that would violate water quality standards. Construction activities would not result in increases in nutrient levels or cause changes that would violate water quality standards.

Fecal Coliform Bacteria

Construction activities associated with SPE Alternative 2 would not impact bacteria (fecal indicator bacteria) levels because this alternative would not discharge untreated wastes or other materials containing bacteria. Stormwater discharges would be controlled in accordance with a stormwater discharge permit and SWPPP. Because the proposed project would not result in wastewater discharges, other than stormwater that would be discharged in accordance with permit conditions, construction activities would not result in increases in bacteria levels or cause changes that would violate water quality standards. Levels of coliform bacteria in the Hood Canal waters near the SPE project site generally are low and within the shellfish harvesting and recreation standard for fecal coliform (Section 3.1.1.1.2). Consequently, bacterial levels in coarse-grained marine sediments at the SPE project site also are expected to be low, and resuspension of sediments during construction activities would not release bacteria to site waters in amounts that would violate water quality standards.

pH

Construction activities associated with SPE Alternative 2 would not impact the pH levels of local waters because this alternative would not discharge wastes at the SPE project site. During construction, there is a potential for concrete to spill into Hood Canal, which could cause small, localized changes in pH levels. Debris management procedures (Section 3.1.1.2.3) would be implemented to prevent concrete spillage and to clean up any spilled material before or after it contacts site waters. Also, seawater has a high buffering capacity that minimizes the potential for substantial changes to pH in well-mixed marine settings (Jabusch et al. 2008). Stormwater discharges would be controlled in accordance with a stormwater discharge permit and SWPPP. Because the proposed project would not result in wastewater discharges, other than stormwater that would be discharged in accordance with permit conditions, and debris management procedures would be implemented as a current practice (Section 3.1.1.2.3), construction activities would not result in changes in pH that would violate water quality standards.

Other Contaminants

Another possible source of construction-related impacts to water quality would be accidental spills of debris, fuel, or other contaminants from barges or construction platforms into Hood Canal. Some types of construction debris such as wood scraps spilled into the water would be recovered and would have no impact, while other materials such as hydraulic fluids or fuel (marine diesel) may impact turbidity, pH, DO, or other water quality parameters in a localized area. Typically, risks of spills are managed by BMPs and current practices (Section 3.1.1.2.3), including containing and cleaning up materials leaked on the deck of work vessels, prohibiting washdown of materials into the water, and prohibiting refueling in non-authorized areas. Generally, these types of spills are not anticipated to have a large impact to water quality because the spills would likely be small and the impact would be highly localized. The size of the area affected would depend on a number of factors, such as the volume spilled, wind, wave, and current conditions at the time of the spill, and the timing and effectiveness of the response effort.

The existing facility response and prevention plans for the Bangor waterfront (the *Commander Navy Region Northwest Oil and Hazardous Substance Integrated Contingency Plan* and the *NAVBASE Kitsap Bangor Spill Prevention, Control, and Countermeasure Plan* [COMNAVREGNWINST 5090.1, Integrated Contingency Plan, Annex G]) provide guidance that would be used in a spill response, such as a response procedures, notification, and communication plan; roles and responsibilities; and response equipment inventories. In the event of an accidental spill, response measures would be implemented immediately to minimize potential impacts to the surrounding environment.

The potential for releases of creosote from treated piles removed during construction of SPE Alternative 2 would be managed by BMPs and current practices (Section 3.1.1.2.3) that would minimize the potentials for formation of surface sheens or other changes in water quality. The Navy would require the construction contractor to prepare and implement debris management procedures for preventing discharge of debris to marine water and retrieving and cleaning up any debris spilled into Hood Canal. Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups. Overall, with implementation of the existing facility response and prevention plans for the Bangor waterfront and debris management procedures, construction activities associated with SPE Alternative 2 would not cause any water quality standards to be violated.

Operation/Long-term Impacts of SPE Alternative 2

Operation of SPE Alternative 2 would not discharge wastes to Hood Canal. Drainage water from the SPE project site would be collected in a trench drain on the pier, treated using an in-line canister system designed to meet the basic treatment requirements of the WDOE *Stormwater Management Manual for Western Washington* (WDOE 2014), and then discharged to Hood Canal in accordance with an NPDES permit. Collection and treatment of pier drainage would be required to remove contaminants resulting from routine vehicle access to the pier. Thus, operations would not intentionally release materials that would have a potential to impact marine water quality and WDOE stormwater standards would be maintained. Additionally, wastewater (sewage and grey water wastes) from the submarines that would be transiently berthed at the Service Pier as part of SPE Alternative 2 would be retained in holding tanks and eventually transferred via transmission lines on the pier to the existing NAVBASE Kitsap Bangor wastewater infrastructure. This would be similar to current practices at the existing Service Pier. Wastewater from new facilities on the pier also would be pumped ashore for treatment. Therefore, shipboard and pier wastes would not affect long-term water quality conditions near the SPE project site. The risk of an accidental spill, such as a fuel or oil spill, would be expected to increase slightly due to the addition of two submarines to the project site. Spill containment practices would be consistent with those for other Bangor waterfront structures, including the use of in-water containment booms, and the existing NAVBASE Kitsap Bangor fuel spill prevention and response plans would be implemented to minimize the risk of spills during operations.

Maintenance of the SPE would include routine inspections, repair, and replacement of facility components (no pile replacement) as required. BMPs and current practices (Section 3.1.1.2.3) would be employed to avoid discharge of contaminants to the marine environment. The project would implement stormwater BMPs and be operated in accordance with the NPDES permit.

With implementation of BMPs and current practices (Section 3.1.1.2.3), including the existing NAVBASE Kitsap Bangor fuel spill prevention and response plans, operation of SPE Alternative 2 would not affect water quality.

Stratification, Salinity, and Temperature

Operation of SPE Alternative 2 would not result in discharges, other than treated stormwater, into local waters. Therefore, operations would not result in impacts to stratification, salinity, or temperature conditions or cause changes that would violate water quality standards.

Dissolved Oxygen

Operation of SPE Alternative 2 would not result in discharges with the potential for altering DO concentrations in waters near the SPE project site. Therefore, operations would not result in impacts to DO conditions or cause changes that would violate water quality standards.

Turbidity

Vessel berthing activities associated with routine SPE operations would occur at the berthing areas in water depths of 80 to 90 feet (24 to 27 meters) MLLW. Episodic sediment resuspension would not likely occur because propeller wash-induced turbulence near the surface would not reach the seafloor at those water depths.

Nutrients

Operation of SPE Alternative 2 would not affect nutrient concentrations in marine waters at the project site because wastewater from vessels would be pumped ashore for treatment, similar to existing conditions. Therefore, because the project would not discharge wastewaters, other than stormwater that would be discharged in accordance with a stormwater permit, operations would not result in impacts to nutrient levels or cause changes that would violate water quality standards.

Fecal Coliform Bacteria

Operation of SPE Alternative 2 would not affect fecal coliform bacteria levels in marine waters at the proposed project site because wastewater from vessels would be pumped ashore for treatment, similar to existing conditions. Therefore, because the project would not discharge wastewaters, operations would not result in impacts to bacteria levels or cause changes that would violate water quality standards.

pH

Operation of SPE Alternative 2 would not result in discharges with the potential for impacting the pH of marine waters. Therefore, because the project would not discharge wastewaters, operations would not result in impacts to pH levels or cause changes that would violate water quality standards.

Other Contaminants

Operation of SPE Alternative 2 would not increase the risk of accidental spills of fuel, explosives, cleaning solvents, and other contaminants that, if spilled, would impact water quality in Hood Canal. This is because BMPs and current practices (Section 3.1.1.2.3), including the existing NAVBASE Kitsap Bangor spill prevention and response plans, would minimize the risk from fuel spills. In the event of an accidental spill, emergency cleanup measures would be implemented immediately in accordance with state and federal regulations. The cleanup would minimize impacts to the surrounding environment. Therefore, with implementation of BMPs and current practices, operation of SPE Alternative 2 would not violate water quality standards.

Placement of sacrificial aluminum anodes (for cathodic protection) on individual piles would represent a source for input of aluminum to Hood Canal waters. Aluminum anodes typically contain approximately 95 percent aluminum, 5 percent zinc, up to 0.001 percent mercury, and small amounts of silicon and iridium (USEPA 1999). As the anode is consumed (oxidized), aluminum and other trace constituents are released to surrounding waters. Based on modeling performed by USEPA (1999), the estimated flux of aluminum from an anode is 2.2×10^{-6} pounds of aluminum per pound of anode per hour. USEPA (1999) concluded that the resulting concentrations in seawater would be well below the federal and the most stringent state water quality criteria. Consequently, metal leaching from aluminum anodes placed on the wharf piles is not expected to impact water quality in the project area.

SEDIMENT QUALITY FOR SPE ALTERNATIVE 2

CONSTRUCTION OF SPE ALTERNATIVE 2

No in-water dredging or placement of fill would occur under SPE Alternative 2. There would be no direct discharges of wastes, other than stormwater runoff, to the marine environment during construction. Stormwater discharges would meet the requirements of a construction stormwater discharge permit. Therefore, construction-related impacts to sediment quality would be limited to localized changes associated with disturbances of bottom sediments from removal of existing piles and installation of up to 385 piles and/or from accidental losses or spills of construction debris into Hood Canal. Setting anchors for the barges represents other, potential construction-related sources for disturbance of bottom sediments. BMPs and current practices (Section 3.1.1.2.3) would be implemented to avoid underwater anchor drag and line drag.

Another possible source for construction-related impacts to sediments would be from accidental debris spills from barges or construction platforms into Hood Canal. Debris spills could impact bottom sediments and create nuisance conditions by adding materials that could represent obstructions. The construction contractor would be required to retrieve and clean up any accidental spills as a current practice in accordance with the debris management procedures that would be developed and implemented (Section 3.1.1.2.3). Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups.

Construction-related changes to sediment quality would be spatially limited to the construction corridor, including areas potentially impacted by anchor drag.

Physical Properties of Sediments

Some degree of localized changes in sediment composition would occur as a result of in-water construction activities. In particular, sediments that are resuspended by pile installation and anchoring activities would be dispersed by currents and eventually redeposited on the bottom (Barnard 1978; Hitchcock et al. 1999). The distance over which suspended sediments are dispersed would depend on a number of factors, such as the sediment characteristics, particle settling rates, current speeds, and distance above the bottom. Depending on the distance suspended sediments are transported before settling on the bottom, this process could result in minor changes to sediment texture (grain size characteristics).

Surface sediments at the SPE project site range from 72 to 93 percent sand and gravel (Hammermeister and Hafner 2009). The maximum dispersion distance for bottom sediments disturbed during construction would be approximately 130 feet (40 meters), assuming a horizontal current velocity of 1 foot/second (30 centimeters/second) (Section 3.1.1.1.1) and a particle settling velocity of 0.3 foot/second (settling speed for a sand particle). Silt and clay particles would be dispersed over relatively larger distances (greater than 130 feet [40 meters]) because they have slower settling speeds. Rapid dilution and dispersion would minimize the potential for fine-grained sediments to settle and accumulate within sensitive habitat areas near the project site. Also, because fines represent a small proportion of the existing sediments, they would probably not result in appreciable changes in the physical composition of bottom sediments as they settle.

During construction, there is a potential for concrete to spill into Hood Canal, which could cause small, localized changes in pH levels and physical properties of sediments such as grain size. Measures to prevent concrete spillage, and clean up of any spilled material before or after it contacts site waters, would be addressed in the debris management procedures (Section 3.1.1.2.3).

Metals

Construction activities associated with SPE Alternative 2 would not result in the discharge of wastes containing metals or otherwise alter the concentrations of trace metals in bottom sediments. However, because the magnitude of metal concentrations in sediment can vary as a function of grain size (higher concentrations typically are associated with fine-grained sediments) (Schiff and Weisberg 1999), small changes to grain size associated with construction-related disturbances to bottom sediments could result in minor changes in metal concentrations. However, these changes would not cause chemical constituents to exceed marine sediment quality standards because current sediment concentrations are below the standards and the project-related changes are expected to be minimal.

Organic Contaminants

Construction activities associated with SPE Alternative 2 would not result in the discharge of contaminants or otherwise alter the concentrations of organic contaminants in bottom sediments. Similar to metal concentrations (discussed above), construction would not impact sediment quality with the exception of minor changes in the concentrations of organic compounds that would result from changes in grain size. Accidental fuel spills or releases of other materials (e.g., hydraulic fluids) to Hood Canal could add contaminants (petroleum hydrocarbons) that could also impact sediment quality. However, the spill cleanup response would minimize impacts to the surrounding environment, including sediment quality.

Because the proposed project would not result in wastewater discharges, other than stormwater that would be discharged in accordance with permit conditions, and spill-related releases would be controlled by the debris management procedures and existing spill response plan (Section 3.1.1.2.3), construction activities would not cause chemical constituents to exceed marine sediment quality standards.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 2

Operation of SPE Alternative 2 would not discharge any wastes, other than treated stormwater, or increase contaminant loadings from vessels or the frequency or size of potential spills into Hood Canal that would affect marine sediment quality. Additionally, submarines that would be transiently berthed at the Service Pier as part of SPE Alternative 2 would not discharge wastes to Hood Canal and would not affect long-term sediment quality conditions near the SPE project site. Maintenance of the SPE would include routine inspections, repair, and replacement of facility components (no pile replacement) as required. BMPs and current practices (Section 3.1.1.2.3) would be employed to avoid discharges of contaminants to the marine environment. Operations associated with SPE Alternative 2 would not affect sediment quality.

Physical Properties of Sediments

Current flow around the support piles installed for the SPE would cause both erosion of fine-grained sediments near some piles impacted by turbulent flows and settling and accumulation of fine-grained sediments at the base of other piles. Shells and decaying organic matter from animals would slough from the pier piles and accumulate on the bottom, contributing to localized changes in sediment grain size immediately adjacent to the piles (Hanson et al. 2003). Fine-grained sediments trapped by the pier piles could have higher contaminant concentrations compared to the coarse-grained sediments that presently occur at the site. However, these changes would only be expected to occur immediately adjacent to the pile and would not extend beyond the footprint of the SPE.

Metals

Operation of SPE Alternative 2 would not result in the discharge of contaminants that would alter the concentrations of trace metal in bottom sediments. Therefore, no chemical constituents would exceed the marine sediment quality standards.

Organic Contaminants

Operation of SPE Alternative 2 would not result in the discharge of organic contaminants or otherwise alter the concentrations of organic contaminants in bottom sediments. Therefore, no chemical constituents would exceed the marine sediment quality standards.

Operation of SPE Alternative 2 would not increase the risk of accidental spills of fuel, explosives, cleaning solvents, and other contaminants that, if spilled, would impact sediment quality in Hood Canal. In the event of an accidental spill, measures specified in the existing NAVBASE Kitsap Bangor fuel spill prevention and response plans would be implemented immediately, and the spill response would minimize impacts to the surrounding environment.

3.1.2.3.3 SPE ALTERNATIVE 3: LONG PIER

HYDROGRAPHY FOR SPE ALTERNATIVE 3

CONSTRUCTION OF SPE ALTERNATIVE 3

The pier extension structure constructed under SPE Alternative 3 and the locations of the PSBs attached to the end of the longer pier extension would extend farther into Hood Canal compared with SPE Alternative 2. All other aspects of Alternative 3 would be the same as Alternative 2, including upland features and overall construction schedule.

Bathymetric Setting

Similar to SPE Alternative 2, construction of SPE Alternative 3 would have some temporary impacts to the bathymetry (seafloor topography) within the immediate construction site. Anchor placement and construction equipment mooring ground tackle, in addition to effects from pile removal and pile driving, would result in physical disturbance to the seafloor, such as mounding and displacement or movement of sediments that would result in small-scale changes to bathymetry.

Changes to bathymetry would be highly localized and less than 3 feet (1 meter) in displacement. These impacts are anticipated to be temporary because natural processes that occur at the sediment-water interface (bedload transport, bioturbation, etc.) following completion of the construction activity would return seafloor topography to near the original profile over time (6 to 12 months) without intervention or mitigation. Thus, no substantial changes to the bathymetric setting would occur.

Circulation and Currents

The circulation patterns in the surface water layer (upper 10 to 15 feet [3 to 5 meters] of water) in the immediate vicinity of the SPE Alternative 3 structure would be affected by short-term and temporary changes due to the presence of construction equipment and barges, which would partially obstruct flow. However, these effects would be localized and would not alter the overall circulation pattern and velocities in the nearshore and deeper water areas along the Bangor waterfront.

Similar to SPE Alternative 2, the presence of the SPE Alternative 3 structure would not interfere with tidal cycles and water levels at the project site would be similar to other, adjacent areas of northern Hood Canal.

Longshore Sediment Transport

Construction activities for the SPE Alternative 3 structure would not affect longshore sediment transport processes along the NAVBASE Kitsap Bangor shoreline because the influence of construction equipment on wave and current energy that are responsible for resuspending and transporting sediments along the shoreline would be negligible.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 3

Similarly to SPE Alternative 2, support piles for the SPE Alternative 3 structure would dampen wave energy within the immediate vicinity of the pier, resulting in a long-term but localized effect on water circulation and currents. Water levels and tidal exchange volumes in the basin would be unaffected by the continued presence and use of the Service Pier because the pier piles would not prevent water flow. Maintenance of the SPE Alternative 3 would include routine inspections, repair, and replacement of facility components as required. These activities would not affect hydrographic conditions. Additionally, the transient berthing of submarines at the SPE Alternative 3 structure at NAVBASE Kitsap Bangor would not affect long-term bathymetry, currents, tides, or sediment transport processes near the SPE project site.

Bathymetric Setting

Support piles installed for the SPE Alternative 3 structure would alter current speeds beneath the pier, which would cause minor erosion of fine-grained sediments near some piles impacted by turbulent flows, as well as settling and accumulation of fine-grained sediments at the base of other piles (Chiew and Melville 1987). The loss of fine-grained sediment would be offset by the accumulation of shell and barnacle particles. These two processes would result in no net impact to seafloor bathymetry.

As discussed for SPE Alternative 2, the presence of the SPE structure would not affect seabed elevations within the project area and, therefore, would have negligible impact on the bathymetric setting.

Circulation and Currents

Since the SPE Alternative 3 structure would be constructed on a foundation of piles, the overall flow volume of water into the nearshore and deeper water areas adjacent to the project site would not be affected. It is anticipated that a small decrease in water column current velocities would occur downcurrent of the SPE, but there would be an overall increase in the turbulence and mixing in the water mass passing directly under the structure. Overall, the presence of the SPE Alternative 3 structure would have a negligible effect on hydrodynamic processes within the project region.

The SPE Alternative 3 structure would not affect the tidal range along the NAVBASE Kitsap Bangor shoreline or the immediate project area because the pier extension would be constructed on a foundation of piles that allows water exchange with portions of Hood Canal immediately offshore from the SPE. Water depths would remain the same in the subtidal areas adjacent to the SPE project site, and the tidal range along the shoreline would not change as a result of the SPE structure.

Longshore Sediment Transport

Similar to SPE Alternative 2, the presence of the SPE Alternative 3 structure is not expected to result in net deposition or erosion of sediments within the project area. Thus, the SPE Alternative 3 project is not expected to affect the sediment budget and rates of erosion/accretion outside of the project footprint, significantly interrupt longshore sediment transport processes, or result in changes to the NAVBASE Kitsap Bangor or West Kitsap County shoreline.

WATER QUALITY FOR SPE ALTERNATIVE 3

CONSTRUCTION OF SPE ALTERNATIVE 3

Impacts on marine water quality from in-water construction of SPE Alternative 3 would be short-term, localized, and similar to those noted for SPE Alternative 2. Construction activities would not impact water salinity, temperature, DO, nutrients, and pH, and would not increase concentrations of fecal coliform bacteria or other contaminants in the water. These parameters would remain in compliance with applicable water quality standards. As discussed for SPE Alternative 2, BMPs and current practices (Section 3.1.1.2.3) would be implemented to avoid changes to water quality from releases of creosote during pile removal activities.

An estimated 660 piles are proposed for installation under SPE Alternative 3, compared to 385 piles under SPE Alternative 2. The in-water construction period for SPE Alternative 3 would be proportionately longer (up to 205 days of pile driving) compared to SPE Alternative 2 (up to 161 days of pile driving) due to the greater number of piles. Installation of additional piles would result in resuspension of bottom sediments (turbidity) within the immediate construction area for a longer duration compared to SPE Alternative 2. Thus, the potential for water quality impacts during pile driving under SPE Alternative 3 would be greater than for SPE Alternative 2.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 3

Impacts to water quality from operation of SPE Alternative 3 would be the same as noted for SPE Alternative 2. This alternative would not result in direct discharges into Hood Canal or in activities that would have direct or indirect impacts to water quality. Additionally, submarines that would be transiently berthed at the Service Pier as part of SPE Alternative 3 would not discharge wastes to Hood Canal and would not affect long-term water quality conditions near the SPE project site. Maintenance of the SPE under Alternative 3 would have the same water quality impacts as SPE Alternative 2.

SEDIMENT QUALITY FOR SPE ALTERNATIVE 3

CONSTRUCTION OF SPE ALTERNATIVE 3

Similar to SPE Alternative 2, no in-water dredging or placement of fill would occur under SPE Alternative 3. There would be no direct discharges of wastes, other than stormwater runoff, to the marine environment during construction. Stormwater discharges would meet the requirements of a construction stormwater discharge permit. Therefore, construction-related impacts to sediment quality would be limited to localized changes associated with disturbances of bottom sediments from installation of piles and from accidental losses or spills of construction debris into Hood Canal. Setting anchors for the barges represent other, construction-related sources for disturbances of bottom sediments. BMPs and current practices would be implemented (Section 3.1.1.2.3) to avoid underwater anchor drag and line drag.

The construction contractor would be required to retrieve and clean up any accidental spills, including concrete, in accordance with the debris management procedures that would be developed and implemented per the BMPs and current practices (Section 3.1.1.2.3). Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups.

Physical Properties of Sediments

Sediments that are resuspended by pile removal, pile installation, and anchoring activities would be dispersed by currents and eventually redeposited (Barnard 1978; Hitchcock et al. 1999). Depending on the distance suspended sediments are transported before settling on the bottom, this process could result in minor changes to sediment texture (grain size characteristics).

Sand sized particles disturbed during construction could be displaced horizontally by an estimated distance of 130 feet (40 meters). Silt and clay particles would be dispersed over relatively larger distances because they have slower settling speeds. However, because these resuspended fines represent a small proportion of sediments, they probably would not result in appreciable changes in the physical composition of bottom sediments as they settle. Rapid dilution and dispersion would minimize the potential for fine-grained sediments to settle and accumulate within sensitive habitat areas near the project site.

Metals

Construction activities associated with SPE Alternative 3 would not result in the discharge of wastes containing metals or otherwise alter the concentrations of trace metals in bottom sediments. However, small changes to grain size associated with construction-related disturbances to bottom sediments could result in minor changes in metal concentrations. However, these changes would not cause chemical constituents to exceed marine sediment quality standards because current sediment concentrations are below the standards and the project-related changes are expected to be minimal.

Organic Contaminants

Construction activities associated with SPE Alternative 3 would not result in the discharge of contaminants or otherwise alter the concentrations of organic contaminants in bottom sediments. Similar to metal concentrations (discussed above), construction would not impact sediment quality with the exception of minor changes in the concentrations of organic compounds that would result from changes in grain size. These changes would not cause chemical constituents to exceed marine sediment quality standards because current sediment concentrations are below the standards and the project-related changes are expected to be minimal.

Accidental fuel spills or releases of other materials (e.g., hydraulic fluids) to Hood Canal could add contaminants (petroleum hydrocarbons) that could also impact sediment quality. However, the existing NAVBASE Kitsap Bangor fuel spill prevention and response plans would minimize impacts to the surrounding environment.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 3

Operation of SPE Alternative 3 would not discharge any wastes, other than treated stormwater, or increase contaminant loadings from vessels or the frequency or size of potential spills into Hood Canal that would affect marine sediment quality. Submarines that would be transiently berthed at the Service Pier as part of SPE Alternative 3 would not discharge wastes to Hood Canal and would not affect long-term sediment quality conditions near the SPE project site. Maintenance of the SPE would include routine inspections, repair, and replacement of facility components (no pile replacement) as required. BMPs and current practices (Section 3.1.1.2.3) would be employed to avoid discharges of contaminants to the marine environment. Operation of SPE Alternative 3 would not affect sediment quality.

Physical Properties of Sediments

The support piles installed for the SPE would cause both erosion of fine-grained sediments near some piles impacted by turbulent flows and settling and accumulation of fine-grained sediments at the base of other piles. Shells and decaying organic matter from animals would slough from the pier piles and accumulate on the bottom, contributing to localized changes in sediment grain size immediately adjacent to the piles (Hanson et al. 2003). However, these changes would only be expected immediately adjacent to the pile and would not extend beyond the footprint of the SPE.

Metals

Operation of SPE Alternative 3 would not result in the discharge of contaminants that would alter the concentrations of trace metals in bottom sediments. Therefore, no chemical constituents for metals would exceed the marine sediment quality standards.

Organic Contaminants

Operation of SPE Alternative 3 would not result in the discharge of organic contaminants or otherwise alter the concentrations of organic contaminants in bottom sediments. Therefore, no chemical constituents for organic contaminants would exceed marine sediment quality standards.

Operation of SPE Alternative 3 would not increase the risk of accidental spills of fuel, explosives, cleaning solvents, and other contaminants that, if spilled, would impact sediment quality in Hood Canal. In the event of an accidental spill, emergency cleanup measures would be implemented immediately, and the spill response would minimize impacts to the surrounding environment.

3.1.2.3.4 SUMMARY OF IMPACTS FOR SPE PROJECT ALTERNATIVES

Impacts on marine water resources associated with the construction and operation phases of the SPE project alternatives, along with mitigation measures and consultation and permit status, are summarized in Table 3.1–6.

Table 3.1–6. Summary of SPE Impacts on Marine Water Resources

Alternative	Environmental Impacts on Marine Water Resources
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	*Construction*: Temporary and localized alterations of bottom bathymetry from pile removal and installation and anchor dragging, within the construction footprint (maximum 3.9 acres [1.6 hectares]), and small-scale changes in wave and current patterns. Project construction activities could result in temporary and localized changes in water quality associated with resuspension of bottom sediments (increased suspended sediment concentrations and turbidity levels), stormwater discharges (contaminant loading), and spills (contaminant releases), but conditions are not expected to exceed water quality standards. Project construction activities would result in disturbance of bottom sediments through pile removal and installation and anchoring of barges and vessels, which would affect physical characteristics of the sediments such as grain size. Impacts on sediment contaminant levels are unlikely, and conditions are not expected to exceed marine sediment quality standards. Changes to marine water resources associated with project construction activities could occur throughout the in-water construction phase of the project. Changes to water quality conditions likely would persist for minutes to hours following disturbances, whereas changes to sediment conditions would persist for weeks to months. Construction-related changes would not be expected to occur beyond the immediate project site. *Operation/Long-term Impacts*: Small-scale changes in flow patterns could result in localized scouring or accumulation of sediments in the immediate vicinity of the support piles. These changes likely would be seasonal, as storm waves would resuspend and redistribute sediments that were deposited initially near the structures. Project operations would not involve discharges of waste or other materials with the potential for impacting water or sediment quality. The presence of the SPE structure would result in marginal changes in current velocity, but would not substantially affect sediment deposition/erosion patterns or longshore sediment transport processes within the project area.

Table 3.1–6. Summary of SPE Impacts on Marine Water Resources (continued)

Alternative	Environmental Impacts on Marine Water Resources
SPE Alternative 3: Long Pier	*Construction:* Same as SPE Alternative 2 except larger potential construction footprint of 6.6 acres (2.7 hectares). Temporary and localized alterations of bottom bathymetry from pile removal and installation and anchor dragging, within the construction footprint, and small-scale changes in wave and current patterns. Project construction activities could result in temporary and localized changes in water quality associated with resuspension of bottom sediments (increased suspended sediment concentrations and turbidity levels), stormwater discharges (contaminant loading), and spills (contaminant releases), but conditions are not expected to exceed water quality standards. Project construction activities would result in disturbance of bottom sediments through pile removal and installation and anchoring of barges and vessels, which would affect physical characteristics of the sediments such as grain size. Impacts on sediment contaminant levels are unlikely, and conditions are not expected to exceed marine sediment quality standards. *Operation/Long-term Impacts: Same as SPE Alternative 2.* Small-scale changes in flow patterns could result in localized scouring or accumulation of sediments in the immediate vicinity of the support piles. These changes likely would be seasonal, as storm waves would resuspend and redistribute sediments that were deposited initially near the structures. Project operations would not involve discharges of waste or other materials with the potential for impacting water or sediment quality. The presence of the SPE structure would result in marginal changes in current velocity, but would not substantially affect sediment deposition/erosion patterns or longshore sediment transport processes within the project area.
Mitigation: BMPs and current practices to reduce and minimize impacts on marine water resources from the proposed SPE project are described in Section 3.1.1.2.3. No mitigation measures are necessary beyond BMPs and current practices.	
Consultation and Permit Status: The Navy will submit a JARPA to USACE and other regulatory agencies, requesting permits for this project under CWA Section 401 and 402, and Rivers and Harbors Act Section 10. In accordance with the CZMA, the Navy will submit a CCD to WDOE. Alternative 2 is the Least Environmentally Damaging Practicable Alternative according to the CWA Section 404(b)(1) guidelines.	

BMP = best management practices; CCD = Coastal Consistency Determination; CWA = Clean Water Act; CZMA = Coastal Zone Management Act; DO = dissolved oxygen; JARPA = Joint Aquatic Resources Permit Application; USACE = U.S. Army Corps of Engineers; WDOE = Washington Department of Ecology

3.1.2.4 COMBINED IMPACTS OF THE LWI AND SPE PROJECT ALTERNATIVES

3.1.2.4.1 HYDROGRAPHY

Results from hydrodynamic modeling indicated that the presence of the proposed LWI and SPE structures would cause only marginal changes in current velocities. LWI Alternative 3 has little potential to affect hydrographic conditions or sediment transport. LWI Alternative 2, the pile-supported pier, has greater potential to have combined impacts with the SPE and therefore is the focus of the following discussion. For both typical and infrequent conditions (2-year and 50-year storm event scenarios, respectively), average changes in seabed elevations with the proposed LWI and SPE pile-supported pier structures in place would be similar to the average changes in seabed elevations under existing conditions (i.e., without the proposed LWI and SPE pier structures). Based on these results, combined impacts from construction and operation of the LWI and SPE pier structures would not be expected to cause appreciable erosion or deposition of sediments within the project area or affect littoral transport processes with the Region of Influence (ROI).

LWI Alternative 2 and the SPE would construct in-water structures resulting in localized changes in flow patterns. Combined, these projects would not alter the larger circulation patterns in Hood Canal; result in current conditions that would prevent or restrict other uses of Hood Canal (for example, strong currents that would endanger recreational boaters or fishermen); alter the migration pathways for marine organisms; or create stagnant water conditions that adversely affect water quality. Differences between the LWI and SPE alternatives in their contribution to the cumulative affected area would be minor for marine water resources. Thus, the other project alternatives would not contribute to significant impacts on hydrology.

3.1.2.4.2 WATER QUALITY

The proposed LWI and SPE projects would not involve direct discharges of wastes with the potential for impacting marine water quality in Hood Canal. Stormwater would be discharged in accordance with discharge permits and stormwater pollution prevention plans. Construction activities associated with both projects would result in temporary and localized effects, including disturbances to bottom sediments and elevated suspended sediment concentrations and turbidity levels. However, because these effects would be temporary and localized, and project-related construction and operation activities would be conducted in accordance with permit conditions, BMPs, and current practices (Section 3.1.1.2.3), the proposed LWI and SPE projects combined would not create conditions that would violate state water quality standards or interfere with beneficial uses of the water body.

3.1.2.4.3 SEDIMENT QUALITY

The proposed LWI and SPE projects would not involve direct discharges of wastes to Hood Canal with the potential for impacting sediment quality, and stormwater discharges would be in accordance with discharge permits and stormwater pollution prevention plans. Construction activities associated with both projects would result in temporary and localized disturbances to bottom sediments. However, because these effects would be temporary and localized, and project-related construction and operation activities would be conducted in accordance with permit conditions, BMPs, and current practices (Section 3.1.1.2.3), the proposed LWI and SPE projects combined would not create conditions that would violate state sediment quality standards or interfere with beneficial uses of the water body. The LWI overwater area would impact 0.12 to 0.34 acre (0.047 to 0.14 hectare), depending on the alternative, and the overwater area for LWI. The SPE overwater area would impact 1.0 to 1.6 acres (0.41 to 0.65 hectare), depending on the alternative. The combined total for both projects would be up to 2 acres (0.8 hectare) of affected bottom sediments.

The combined impacts of the LWI and SPE projects on hydrography, water quality, and sediment quality are summarized below in Table 3.1–7.

Table 3.1–7. Summary of Combined LWI/SPE Impacts for Marine Water Resources

Resource	Combined LWI/SPE Impacts
Hydrography	The effects of the LWI and SPE projects on currents, circulation, and sediment transport would be minor and localized. Therefore, the combined effects of the two projects would not overlap in space and would not affect currents, circulation, and sediment transport along the NAVBASE Kitsap Bangor waterfront in general.
Marine Water Quality	Construction of the LWI and SPE projects would result in localized and temporary increases in turbidity; BMPs would prevent adverse impacts from spills. Operation of the LWI and SPE would not result in adverse discharges to water bodies (stormwater would be treated). Therefore, the combined effects of the two projects on marine water quality would be no greater than localized and temporary.
Marine Sediment Quality	Construction of the LWI and SPE could disturb sediments in a combined area of 2 acres (0.8 hectare); BMPs would prevent adverse impacts from spills. Operation of the LWI and SPE would not result in adverse discharges to water bodies (stormwater would be treated). Therefore, the combined effects of the two projects on marine sediment quality would be minimal.

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3.2. MARINE VEGETATION AND INVERTEBRATES

3.2.1. Affected Environment

Marine vegetation communities include species of aquatic plants such as eelgrass and macroalgae. Benthic communities inhabit the bottom of a body of water such as a lake or ocean and include sea snails and worms, sea stars, and shellfish such as oysters, clams, crabs, and shrimp. Plankton are single-celled algae and multi-cellular animals that reside in the water column and form the foundation of the marine food web.

3.2.1.1. EXISTING CONDITIONS

3.2.1.1.1. NEARSHORE HABITATS

The nearshore marine environment extends from the upper intertidal to subtidal nonphotic zone (below a level supporting plant growth). Nearshore habitats include bluffs, beaches, mudflats, kelp and eelgrass beds, salt marshes, gravel spits, and estuaries. Bottom types in the nearshore include consolidated (rock) and unconsolidated (cobble, gravel, sand, and mud) substrate. For evaluating habitat impacts and mitigation in a regulatory context, the 30 feet [9 meters] below MLLW line is used to define nearshore habitat. Nearshore habitats are critical to biological resources, including shellfish, salmon, groundfish, seabirds, and marine mammals.

3.2.1.1.2. MARINE VEGETATION COMMUNITIES

Marine vegetation includes macrophytes and macroalgae. Macrophytes are aquatic rooted, flowering plants. Macrophyte genera that occur in the Pacific Northwest include *Salicornia* (sea asparagus), *Zostera* (eelgrasses), and *Phyllospadix* (surfgrasses). Algae are a diverse group of simple plants that are mainly aquatic. These organisms are capable of photosynthesis and range in size from single-celled organisms (i.e., phytoplankton, discussed in Section 3.2.1.1.4) to large plants often referred to as seaweeds. Macroalgae lack true roots, stems, and leaves. They are divided into three taxonomic groups based upon their dominant photosynthetic pigmentation: green, red, and brown (Lamb and Hanby 2005).

Aquatic marine vegetation of the NAVBASE Kitsap Bangor shoreline is composed of intertidal and subtidal species, as well as floating and attached species. Distribution maps of key species are presented below under Marine Vegetation Types. Eelgrass is high-quality habitat and is most abundant in low-energy areas in the lower intertidal and shallow subtidal photic zone where organic matter and nutrients are abundant (Johnson and O'Neil 2001). Dense to patchy bands of eelgrass are located in the vicinity of the north and south LWI project sites (Science Applications International Corporation [SAIC] 2009). Green algae grow mainly in the lower intertidal and subtidal zones and include common species, such as sea lettuce (*Ulva* spp.). Red algae are located in the cobble and gravel upper intertidal zone but also occur subtidally. Brown algae, which include understory kelps (*Saccharina* sp.[1]) and the non-native Sargasso weed, or wireweed (*Sargassum muticum*), are found in nearshore environments of the Bangor shoreline from lower intertidal to subtidal zones (SAIC 2009). Additionally, algae that become detached can form

[1] *Laminaria* in the Pacific Northwest have recently been reclassified as *Saccharina* sp. except for *L. yezoensis*, which does not occur in Washington waters.

floating mats that drift with the currents and support a variety of marine life including juvenile fish and zooplankton.

MARINE VEGETATION TYPES

Marine vegetation within the NAVBASE Kitsap Bangor shoreline includes eelgrass; kelp; *Sargassum*; and green, red, and brown algae (Table 3.2–1). Marine vegetation in the vicinity of the north and south LWI project sites includes primarily eelgrass, green and red algae, and kelp (a type of brown algae that includes *Saccharina* sp.). Most forms of macroalgae were documented in the shallow subtidal zone between 0 and 10 feet (0 and 3 meters) below MLLW, often growing with eelgrass (SAIC 2009; Leidos and Grette Associates 2013a).

A survey of the Bangor shoreline was conducted in 2007 to characterize and document the presence and relative abundance of marine vegetation (SAIC 2009). The 2007 survey area extended to a depth of approximately 50 feet (15 meters) below MLLW. Eelgrass beds and macroalgae communities were mapped and relative densities were determined along the entire shoreline. In 2012, a focused survey was conducted of the SPE project area (Anchor QEA 2012). This survey documented the distribution of eelgrass and eelgrass shoot density, and reported general observations of macroflora and macrofauna in the project area, but did not map the extent of macroalgae or determine macroalgae densities. In 2013, a focused survey was conducted of the areas within 25 feet (8 meters) on each side of the centerlines of the proposed north and south LWI structures (Leidos and Grette Associates 2013a). This survey documented the distribution of eelgrass and macroalgae, eelgrass shoot density, and relative abundance of macroalgae in the project areas.

Table 3.2–1. Abundance of Marine Vegetation Classified as Percent of Linear Shoreline, NAVBASE Kitsap Bangor

Vegetation Type	Percent Linear Shoreline[1]	Acreage (hectares)[2,3]
Eelgrass (*Zostera* sp.)	81.9	37.7 (15.3)
Green Algae (e.g., *Ulva* spp.)	97.4	202.1 (82)
Red Algae (e.g., *Gracilaria* spp.)	76.8	73.8 (30)
Brown Algae		
(*Fucus*-Barnacle Assemblage)[2]	60.4	Not determined
Kelp (*Saccharina* sp.)	75.8	58.4 (23.6)
Sargassum muticum	15.9	11.8 (4.8)

Sources: Washington Department of Natural Resources (WDNR) 2006; SAIC 2009

1. Percent represented by proportionate amount in sampled area.
2. Macroalgae coverage data collected by Science Applications International Corporation (SAIC) in 2007 were concentrated in the lower intertidal and shallow (less than 70 feet [21 meters]) zones along the Bangor shoreline. *Fucus* occurrence in the upper intertidal of the Bangor shoreline is based on the Washington State Shorezone Inventory (WDNR 2006). These data are not included in algal distribution figures.
3. Eelgrass and macroalgae overlap in their occurrence along the Bangor shoreline; therefore, the total shoreline length or acreage of marine vegetation cannot be calculated by simply summing the values for each vegetation type.

EELGRASS

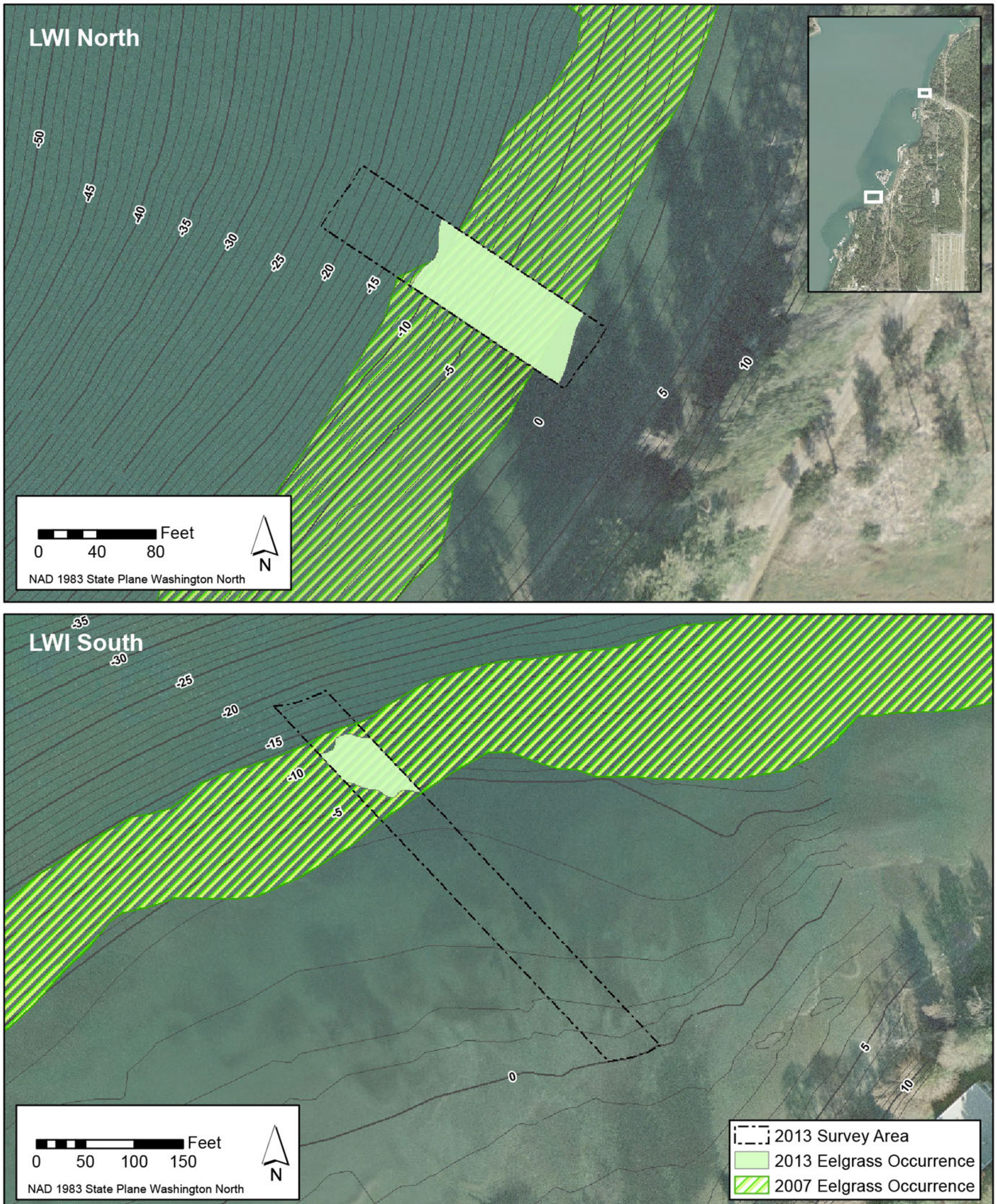
Eelgrass is one of the most important vegetation types in the marine ecosystem because eelgrass beds produce large amounts of carbon that fuel nearshore food webs and offer habitat to many marine species (Mumford 2007). Eelgrass beds build up in the spring and summer and decay in the fall and winter (Puget Sound Water Quality Action Team 2001). Shellfish, such as crabs and bivalves, use eelgrass beds for habitat and nursery areas. Eelgrass is an important habitat for juvenile salmonids, which use eelgrass beds as migratory corridors, for protection from predators, and for foraging (review in Mumford 2007). Kitsap County has one of the state's highest percentages of estuary and nearshore marine habitats occupied by eelgrass (WDNR 2006). Eelgrass depth distributions are related to water clarity, and in Hood Canal eelgrass can be found at maximum depths of about 24 feet (7 meters) (review in Mumford 2007). Well-established eelgrass beds were documented in 2007 in all survey areas along the Bangor shoreline in shallow water depths ranging from 0 to 20 feet (0 to 6 meters) below MLLW (SAIC 2009).

Eelgrass at the LWI Project Sites

North LWI Project Site. Based on the results of the 2007 surveys, an eelgrass bed of just over 12 acres (4.9 hectares) occurs in a continuous, narrow band along the shoreline north of EHW-1, ending at the Magnetic Silencing Facility (MSF) (SAIC 2009). The upper limits of this eelgrass bed corresponded to the MLLW line and extended out to water depths of about 14 feet (4 meters) below MLLW (Figure 3.2-1). In 2013 this bed was approximately 120 feet (37 meters) wide and extended to just over 12 feet (4 meters) below MLLW at the north LWI location (Leidos and Grette Associates 2013a). Average shoot density of the eelgrass in 2013 was 9.8 shoots per square foot (105.5 shoots per square meter). In 2013 a narrow band (approximately 15 feet [4.5 meters wide]) of *Z. japonica* was present along the shallow edge of the eelgrass bed at depths between 0 and 5 feet (1.5 meters) below MLLW.

Given that viable eelgrass habitat is limited to the zone between the MLLW line and the photocompensation depth (the depth where photosynthesis is unable to meet the metabolic demands of the plant to sustain net growth), the narrow width of this eelgrass bed is a result of the steep profile of the coastline in this area (SAIC 2009) as well as wave action in this exposed location (Leidos and Grette Associates 2013a). The continuous bed extends south from Floral Point and then broadens within the suitable substrate into a large area of dense coverage where the physical conditions (light, substrate type, etc.) can support many large-bladed plants. As the eelgrass bed continues south toward EHW-1, it narrows again to a swath of moderate to dense coverage, more consistent with the beds typical of Hood Canal.

South LWI Project Site. Based on the results of the 2007 surveys, a large eelgrass bed covering 7.6 acres (3.1 hectares) occurs in the shallow waters south of Delta Pier (SAIC 2009). This bed is restricted to water depths between 0 and 20 feet (0 to 6 meters) below MLLW. Bathymetry data indicated the presence of a large subtidal flat (0 to 5 feet [0 to 1.5 meters] below MLLW) occupying much of that area, which likely represents an outwash plain associated with sediment discharged from Devil's Hole. In addition to sediment, this inland pond and wetland also discharges fresh water into the shallow area between Delta Pier and the point at KB Dock.



Source: SAIC 2009; Leidos and Grette Associates 2013a

Figure 3.2–1. Eelgrass Distribution within the LWI Alignments

This freshwater discharge gradually mixes with the saline Hood Canal water, creating a mixing zone of brackish water along the immediate coast that likely decreases the salinity over the subtidal flat to a concentration too low to support eelgrass growth. As a result, the direct input of fresh water may have a role in preventing the eelgrass bed from expanding inshore and exploiting most of the shallow, subtidal seabed. At the location of the proposed south LWI, the bed is narrow, approximately 40 to 80 feet (12 to 24 meters) wide, and extends from 5 to 17 feet (1.5 to 5.2 meters) below MLLW (Leidos and Grette Associates 2013a). Average shoot density of the eelgrass in 2013 was 8.4 shoots per square foot (90.7 shoots per square meter). No *Z. japonica* was observed in this area during the 2013 survey.

Eelgrass at the SPE Project Site

Two small eelgrass beds were documented to the south and southwest of the existing Service Pier in a September 2012 survey (Figure 3.2–2; Anchor QEA 2012). The beds covered 0.25 and 0.14 acre (0.10 and 0.057 hectare), respectively. The 2012 survey did not extend beyond the area delineated for the southwest bed and so the total extent of that bed is unknown. Based on the 2007 survey (SAIC 2009), these two beds were one continuous band that continued to the southwest and ended just beyond Carlson Spit, covering a total of 0.69 acre (0.28 hectare). The apparent gap between the two areas of eelgrass shown in Figure 3.2–2 indicates that the more extensive eelgrass bed observed in 2007 fragmented during the years between surveys. It is unknown if the fragmentation is an artifact of inter-annual or inter-survey variability or an actual loss of eelgrass coverage at this location. In 2012, eelgrass bed elevations varied from approximately 3 to 15 feet (1 to 5 meters) below MLLW. Eelgrass shoot densities were high, ranging from 7.1 to 12.6 shoots per square foot (76 to 136 shoots per square meter) with an average density of 9.5 shoots per square foot (102 shoots per square meter) and a median density of 9.7 shoots per square foot (104 shoots per square meter). There was a slight trend of increasing shoot density in the deeper water.

MACROALGAE

Green Macroalgae

Sea lettuce (*Ulva* spp.) is the most common green algae at the Bangor shoreline. It grows from the lower-intertidal subzone to depths of more than 50 feet (15 meters) below MLLW in protected areas. However, the *Ulva* community is concentrated at depths less than about 30 feet (9 meters) below MLLW and occurs only sparsely (less than 10 percent coverage) at greater depths (Pentec 2003; SAIC 2009). Boulders in the nearshore marine habitats are typically encrusted with sea lettuce (Pentec 2003). Sea lettuce has a high nutrient content (Kirby 2001) which, when it dies and decomposes, provides an important source of nitrogen, as detritus, that supports eelgrass growth. Another green macroalga, *Ulvaria,* tends to occur in more subtidal waters in Puget Sound than does *Ulva* (Nelson et al. 2003). This macroalga was observed in only one survey quadrat in 2013, within deeper waters of the south LWI project site.

Red Macroalgae

Red algae of the genera *Endocladia*, *Mastocarpus*, *Ceramium, Porphyra*, *Gracilaria*, *Chondracanthus*, *Gracilariopsis*, *Smithora*, *Polyneura*, and *Sparlingia* are present on NAVBASE Kitsap Bangor in the intertidal zones (Pentec 2003; SAIC 2009; Leidos and Grette Associates 2013a). *Smithora naidum* is a thin, short, epiphytic red macroalgae that was observed

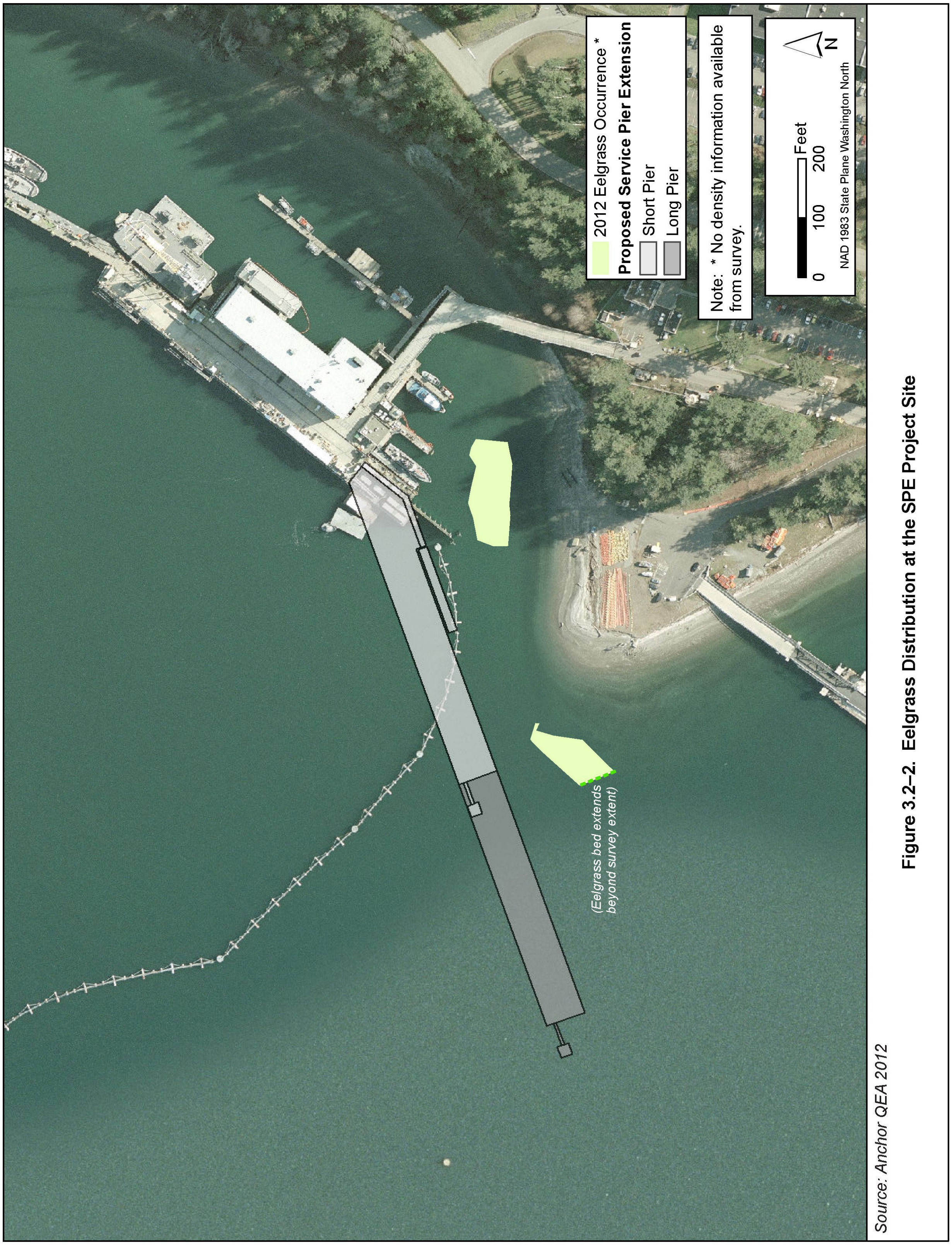


Figure 3.2–2. Eelgrass Distribution at the SPE Project Site

Figure 3.2–2. Eelgrass Distribution at the SPE Project Site

on eelgrass in 2013 (Leidos and Grette Associates 2013a). Red algae such as those found on NAVBASE Kitsap Bangor are ecologically important as primary producers and for providing habitat for other marine organisms.

Brown Macroalgae

Brown algae occur in a variety of forms, including encrusting, filamentous, and leafy varieties, on rocks and boulders. A key brown alga, the understory kelp *Saccharina* sp., is discussed below under Kelp. Several leafy brown algae species (e.g., *Egregia* and *Desmarestia*) are present on NAVBASE Kitsap Bangor (Pentec 2003; Leidos and Grette Associates 2013a). Rock weed (*Fucus* spp.) attached to rocks and cobble in the intertidal barnacle zone is common in the project areas (Pentec 2003) (Table 3.2–1).

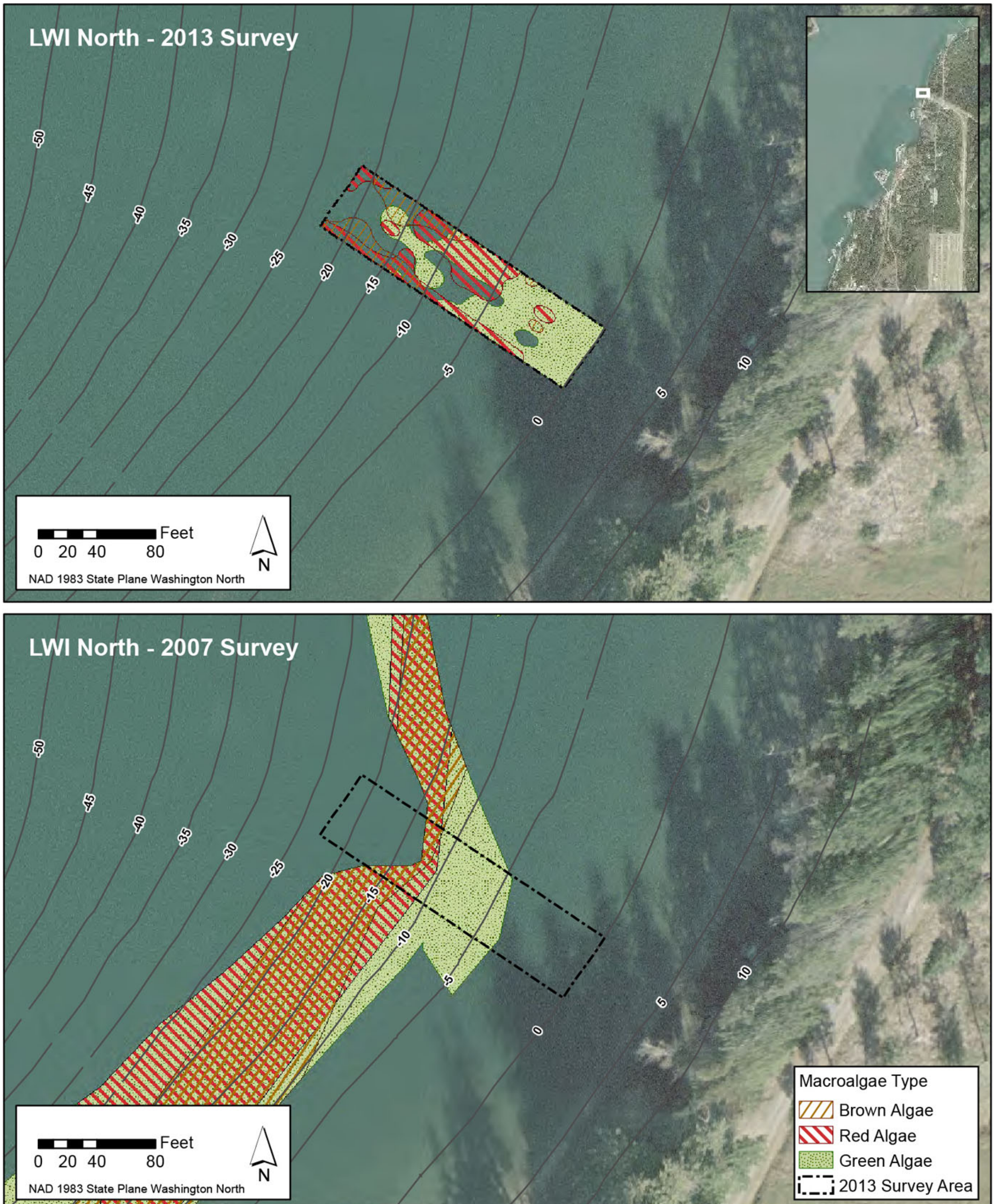
Kelp. Understory kelp (*Saccharina* sp.) provide an important source of nutrients to the seafloor (from fragmentation and decomposition) and multi-species vertical habitat in deeper marine waters (Mumford 2007). The kelp beds on NAVBASE Kitsap Bangor occur to depths of about 25 feet (8 meters) below MLLW. Most kelp in the lower-intertidal subzone and the nearshore marine habitats of NAVBASE Kitsap Bangor are *Saccharina* sp., but traces of the genera *Desmarestia* and *Pilayella* also have been documented (Pentec 2003; SAIC 2009). No attached, canopy-forming kelp beds (e.g., bull kelp) occur at the Bangor shoreline (SAIC 2009).

Sargassum muticum. Sargassum muticum is a brown macroalga native to the Sea of Japan, but it now occurs in most areas of the Pacific Coast of North America. It was first documented in Washington State waters in the 1950s and was likely introduced when Pacific oysters were planted in the early 1900s. The complex branching of *Sargassum* plants provides habitat for amphipods and other invertebrates and their predators; however, where *Sargassum* overlaps with native marine vegetation (such as eelgrass, kelp, and other macroalgae), it outcompetes those species by shading (Whatcom County Marine Resources Committee 2005). Further, *Sargassum* "may negatively affect water movement, light penetration, sediment accumulation, and [DO concentrations] at night" (Williams et al. 2001). Two large beds of *Sargassum* occur along the Bangor shoreline between the outlet of Devil's Hole and Carlson Spit. Other pockets of *Sargassum* on the base are small and isolated.

Macroalgae at the LWI Project Sites

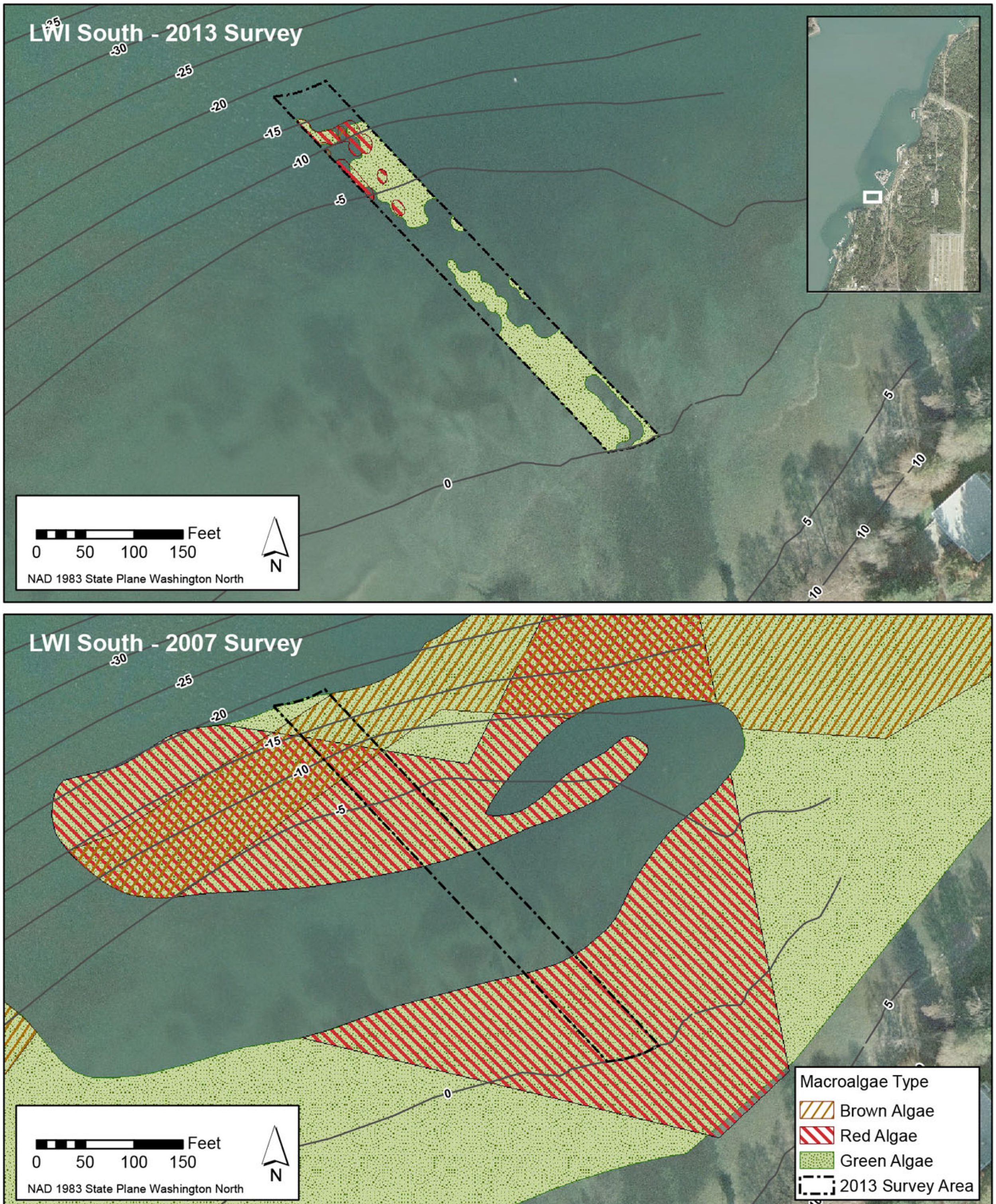
North LWI Project Site. Based on the 2007 surveys, the predominant algae type documented in this area is *Ulva*, often accompanied by *Saccharina* and *Gracilaria* (SAIC 2009) (Figure 3.2–3). In 2013, *Ulva* spp. and *Saccharina latissima* were the dominant macroalgae species where eelgrass was absent (Leidos and Grette Associates 2013a). No *Sargassum* was detected in the vicinity of the north LWI project site in 2007 or 2013. Rockweed was attached to rocks and cobble in this area during the 2008 shellfish survey (Delwiche et al. 2008). The full extent of macroalgae coverage may not have been surveyed during 2007 since many transects did not extend to the MLLW line due to insufficient water depth for the survey vessel.

South LWI Project Site. Based on the 2007 and 2013 surveys, the predominant algae in this area are *Ulva*, *Saccharina*, and *Gracilaria* (SAIC 2009; Leidos and Grette Associates 2013a), although no *Saccharina* was observed in 2013 (Figure 3.2–4). There were mats of *Ulva* on the



Source: SAIC 2009; Leidos and Grette Associates 2013a

Figure 3.2–3. Macroalgae Distribution within the North LWI Alignment



Source: SAIC 2009; Leidos and Grette Associates 2013a

Figure 3.2–4. Macroalgae Distribution within the South LWI Alignment

flats and oyster beds in this area during the 2008 shellfish survey (Delwiche et al. 2008). In 2007, *Sargassum* was detected only on the southwest side of the Devil's Hole outflow, more than 1,000 feet (300 meters) from this project area (SAIC 2009). In 2013, *Sargassum* was observed in four of the 130 survey quadrats in the south LWI project area (Leidos and Grette Associates 2013a). This species generally occurred as an individual plant, with percent coverage ranging from 1 to 5 percent in each of the four quadrats in which it was detected.

Macroalgae at the SPE Project Site

In the 2007 survey, green macroalgae (primarily *Ulva*) and kelp (*Saccharina*) were documented to the north and south and shoreward of the Service Pier (SAIC 2009) (Figure 3.2–5). Red macroalgae (primarily *Gracilaria*) were only observed to the south of the Service Pier. A long *Sargassum* bed was observed from just south of the KB Dock, running parallel to the shoreline and shoreward of the Service Pier and terminating north of the trestle, and a small pocket was observed west of the Service Pier trestle. High-percentage macroalgae coverage was limited to small areas behind the western portion of the Service Pier and at the tip of the point to the west (SAIC 2009). Species observed during the 2012 eelgrass survey included *Ulva*, *Saccharina*, *Desmarestia*, *Gracilaria*, *Sarcodiotheca*, and *Palmaria* (Anchor QEA 2012). No *Sargassum* was observed west of the Service Pier trestle within the construction area during the 2012 eelgrass survey.

3.2.1.1.3. BENTHIC COMMUNITIES

Benthic organisms, including both infaunal and epifaunal species, are abundant and diverse along the NAVBASE Kitsap Bangor waterfront (Pentec 2003; Weston 2006; Delwiche et al. 2008; Leidos and Grette Associates 2013b). Oyster beds occur along approximately 72 percent of the Bangor shoreline and occasionally co-occur with beds of mussels (Delwiche et al. 2008). Five beaches on NAVBASE Kitsap Bangor were open to shellfish harvest by residents until 2002 when increased security measures closed the beaches to shellfish gathering. The exception is that American Indian tribes continue to harvest oysters and clams on NAVBASE Kitsap Bangor at the shellfish bed at the proposed south LWI project site, off the Devil's Hole outlet (Section 3.14).

BENTHIC ABUNDANCE AND DIVERSITY

Local patterns of benthic community structure are influenced by physical and chemical characteristics; therefore, benthic organisms are useful indicators of habitat differences and quality. Hood Canal has been divided into nine biotic subregions based on soft-bottom benthic community structure, dominant taxa, sediment fines (i.e., the percent of silt and clay material), TOC content of bottom sediments, and depth (WDOE 2007). NAVBASE Kitsap Bangor and the LWI and SPE project sites are within the north Hood Canal biotic subregion, which is characterized by coarser sediment, lower TOC, and higher DO values than the other biotic subregions of Hood Canal. These conditions support a relatively more abundant and diverse benthic community, including stress-sensitive species such as the seed-shrimp, a small ostracod crustacean (WDOE 2007). Table 3.2–2 provides a list of some of the benthic invertebrates and shellfish occurring on NAVBASE Kitsap Bangor. In a 2005 survey of four locations along the Bangor shoreline, abundance and diversity of benthic organisms increased from intertidal to subtidal depths (Weston 2006).

Source: SAIC 2009

Figure 3.2–5. Macroalgae Distribution at the SPE Project Site

Table 3.2–2. Benthic Invertebrates along the NAVBASE Kitsap Bangor Shoreline

Phylum	Major Taxa	Genus or Species	Typical Location	Common Name or Description
Mollusca	**Gastropods**	*Alvania compacta*	Sand, silt, clay or mixed substrate, vegetated shallow subtidal	Snail
		Lirularia acuticostata	Mixed substrate, intertidal-subtidal	Sharp-keeled lirularia
	Bivalves	*Macoma* sp.	Mixed substrate, intertidal-subtidal	Macoma clam
		Nutricola spp.	Sandy subtidal	Clam
		Saxidomus gigantea	Sandy subtidal	Butter clam
		Panopea generosa	Sandy intertidal-subtidal	Geoduck clam
		Venerupis philippinarum	Gravel, sand, mud above half-tide	Manila clam
		Rochefortia tumida	Sandy intertidal-subtidal	Robust mysella
		Axinopsida serricata	Sandy or mixed substrate with organic enrichment subtidal	Silky axinopsid
		Leukoma staminea	Sandy intertidal-subtidal	Native littleneck clam
		Tellina carpenteri	Sandy or mixed sand/silt intertidal-subtidal	Clam
		Mytilus spp. [prob. *M. trossulus*]	Intertidal-subtidal, hard substrates	Blue mussel
		Pododesmus macroschisma	Hard substrates	Jingle shell
		Crassidoma gigantea	Rocky substrates subtidal, rarely intertidal under boulders	Giant rock scallop
		Crassostrea gigas	Rocky substrates	Pacific oyster
Crustaceans	**Ostracods**	*Euphilomedes carcharodonta*	All soft substrates	Seed-shrimp
	Tanaids	*Leptochelia dubia*	Mixed substrate, vegetated habitat, manmade structures	Tanaid
	Barnacles	*Balanus* sp. could also include *Semibalanus* spp.	Rocky, manmade structures	Barnacle
	Amphipods	*Protomedeia* sp.	All soft substrates	Gammarid
		Aoroides spp.	Detritus, sand, vegetated habitats	Corophiid
		Rhepoxynius boreovariatus	Sandy subtidal	Gammarid
		Corophium and *Monocorophium* spp.	Sandy subtidal, manmade structures	Corophiid

Table 3.2–2. Benthic Invertebrates at the Bangor Shoreline (continued)

Phylum	Major Taxa	Genus or Species	Typical Location	Common Name or Description
Crustaceans (continued)	**Crabs**	*Hemigrapsus oregonensis*	Quiet water, rocky habitats, gravel	Yellow shore crab
		Pagurus granosimanus	Mixed substrate, eelgrass, subtidal	Hermit crab
		Pugettia spp.	Sand/silt/clay subtidal, eelgrass	Kelp crab
		Cancer gracilis	Intertidal and subtidal, eelgrass	Graceful crab
		Cancer magister	Intertidal and subtidal, eelgrass	Dungeness crab
		Cancer oregonensis	Rocky and manmade structures, intertidal-subtidal	Oregon Cancer crab
		Cancer productus	Sandy, protected rocky areas, eelgrass, intertidal-subtidal	Red rock crab
	Shrimp	*Crangon* sp.	Shallow waters, sandy substrates	True shrimp
		Pandalus sp.	Mixed sand substrate intertidal and shallow subtidal	Spot shrimp
		Neotrypaea sp.	Mixed sand substrate intertidal and shallow subtidal	Ghost shrimp
Annelida	***Polychaetes***	*Platynereis bicanaliculata*	Mixed substrates, manmade structures, eelgrass	Nereidae
		Pectinaria californiensis	Sandy, low intertidal and subtidal	Cone worm
		Owenia collaris	Sandy, intertidal-subtidal	Oweniidae
Echino-dermata	***Echinoderms***	*Pisaster brevispinus*	Subtidal eelgrass	Pink sea star
		Pisaster ochraceus	Lower intertidal, hard structures	Purple star
		Amphiodia urtica/periercta	Subtidal silty mud	Burrowing brittle star
		Pycnopodia helianthoides	Lower intertidal to subtidal soft substrates	Sunflower star
		Dendraster excentricus	Flat, sandy subtidal	Sand dollar
Chordata	***Tunicates***	*Corella willmeriana*	Subtidal to deep water	Transparent tunicate
		Distaplia occidentalis	Intertidal to subtidal	Mushroom compound tunicate

Sources: Abbott and Reish 1980; Barnard et al. 1980; Lee and Miller 1980; Kozloff 1983; URS 1994; WDOE 1998; Pentec 2003; Weston 2006; Leidos and Grette Associates 2013b

BENTHIC ABUNDANCE AND DIVERSITY AT THE LWI AND SPE PROJECT SITES

Surveys indicate the intertidal benthic community at the north LWI project site is dominated by the clam *Rochefortia tumida*, oligochaetes, the tanaid *Leptochelia dubia*, nematodes, and the polychaete *Owenia collaris* (Weston 2006). The subtidal benthic community at the north LWI project site is dominated by the gastropod *Alvania compacta*, the polychaete *Platynereis bicanaliculata*, the clam *Axinopsida serricata*, and nematodes. The intertidal benthic community at the south LWI project site is dominated by the nemertean *Anopla*, the clam *R. tumida*, the tanaid *L. dubia*, nematodes, and the snail *Haminoae vesicula*. The subtidal benthic community at the south LWI project site is dominated by the gastropod *A. compacta*, the ostracod *Euphilomedes carcharodonta*, the polychaete *P. bicanaliculata*, *Nutricola* clams, the clam *A.*

serricata, and nematodes. Substrates behind the Service Pier on the north side in the intertidal are cobble and large gravel in sand and did not contain any evidence of clams in the 2008 shellfish survey (Delwiche et al. 2008). In the 2007 eelgrass survey, no bivalve siphons were seen extending from sediments shoreward of this pier (SAIC 2009).

Several factors likely contribute to local variability in benthic communities, including proportions of relatively coarser to finer sediment fractions associated with mixed sand and gravel substrates. Organic content of sediments is low along the shoreline but may range higher in depositional areas near wharves (Section 3.1.1.1.3) and would be expected to be greater in areas with submerged aquatic vegetation. In addition, proximity to freshwater tributaries influences the composition of the benthic community along the shoreline (Weston 2006).

MOLLUSCS

Molluscs are invertebrates that have soft, unsegmented bodies and are usually protected by a shell. Those occurring at NAVBASE Kitsap Bangor include two major classes: gastropods (slugs and snails) and bivalves (having two-part shells, such as clams, oysters, and mussels). In contrast to mussels and oysters, which attach to hard substrate, clams live fully buried in the substrate and gastropods live on the substrate surface. Oysters and many species of clams are filter feeders on plankton. Some clams also feed on organic matter at the sediment surface. Gastropods feed on vegetation and organic matter at the sediment surface and/or prey on other invertebrates.

The gastropod snail *Alvania compacta* was a numerical dominant of shallow subtidal waters at both LWI project sites (Weston 2006); it is commonly found in mixed sediments including fine gravels (Kozloff 1983). Other snails (e.g., sharp-keeled lirularia) are associated with eelgrass beds, and limpets occur intertidally on hard substrates (e.g., docks, cobble, and rocks). Common species on hard substrates (manmade structures and rocks) include blue mussels, jingle shell, rock scallop, and Pacific oyster (Navy 1988; Washington Department of Fish and Wildlife [WDFW] 2013a).

Bivalves are ecologically important because, as filter feeders, they uptake and recycle organic matter, help control phytoplankton levels, and improve water clarity, thereby allowing greater light penetration for the growth of seagrass and other marine vegetation. Molluscs are an important food source for some fish species (WDOE 2007).

MOLLUSCS AT THE LWI PROJECT SITES

A variety of bivalves occur within the proposed LWI project sites, ranging from intertidal to subtidal depths (Table 3.2–2). Common intertidal species include Macoma clams, robust mysella, butter clams, littleneck clams, horse clams, and soft-shelled clams (Pentec 2003; Weston 2006; Delwiche 2008). In 2005, the most abundant species in subtidal waters include silky axinopsid, various dwarf venus clams, fine-lined lucine, and robust mysella (Weston 2006). Robust mysella live in semi-permanent burrows and can be an indicator of a more stable habitat (Ockelmann and Muus 1978). Based on the 2013 shellfish survey of the north LWI site (Leidos and Grette Associates 2013b), bent nose clams were the most abundant clams in the intertidal region, followed by butter clams and native little necks (Table 3.2–3). At the south LWI project site, bent nose clams were the most abundant clams in the intertidal region, followed by Manila clams and native little necks. Other species were present in lesser numbers. In the 2013 subtidal survey, only 9 percent of the north LWI survey locations contained clam siphons. All were identified as horse clams. Similarly, in the 2013 subtidal survey of the south LWI project site, only 9 of 130 sample locations (7 percent) contained infaunal shellfish. These included geoduck, false geoduck (*Zirfaea pilsbryii*), horse clam, and cockle (*Clinocardium nuttallii*).

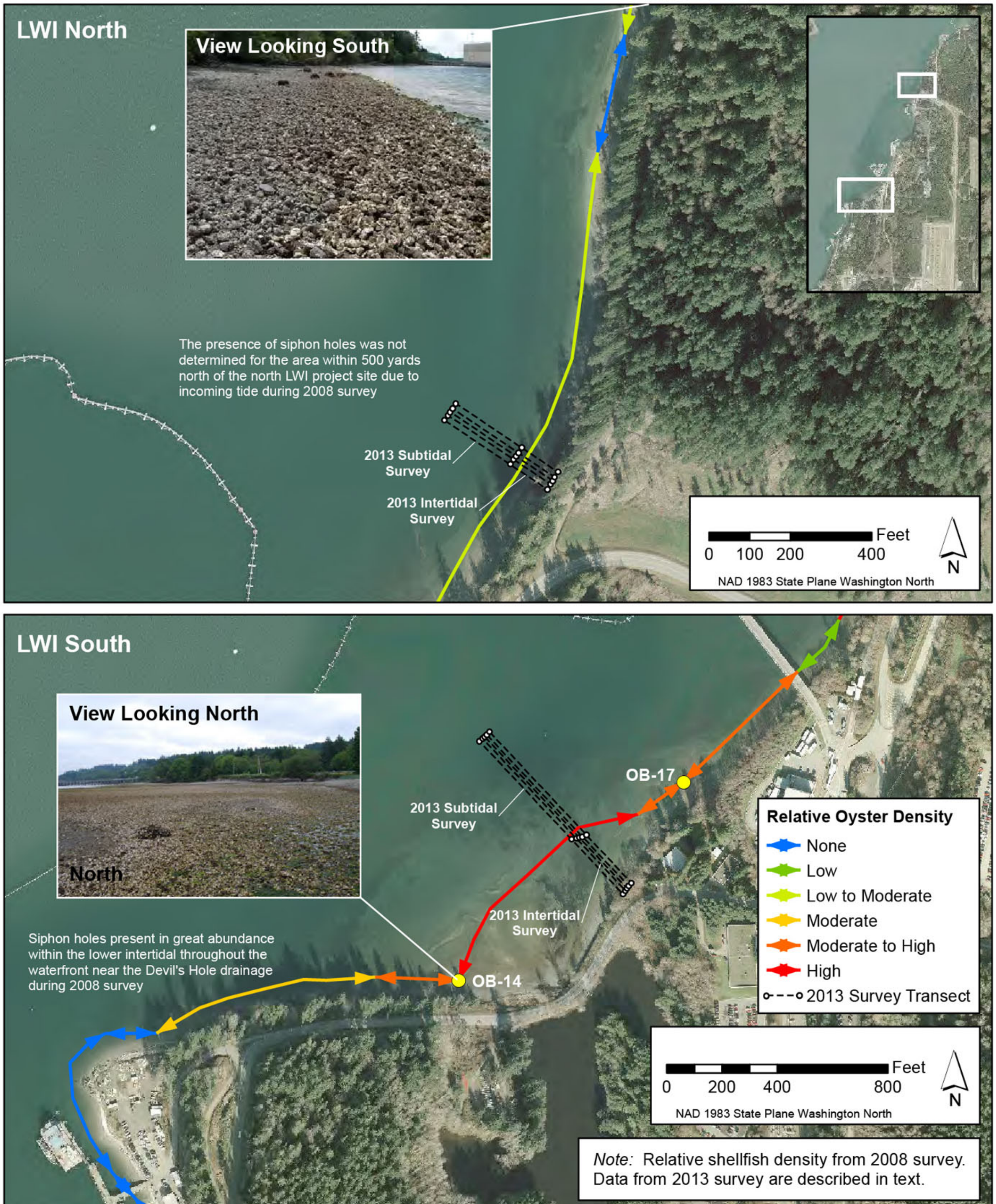
Table 3.2–3. Average Intertidal Shellfish Densities (number per square feet) at the North and South LWI Project Sites

Location	Oyster	Bent Nose Macoma	Manila Clam	Butter Clam	Horse Clam	Native Little Neck	Eastern Softshell Clam	Purple Varnish Clam	Cockle
North LWI	1.7	6.6	0.14	2.2	1.1	1.7	NA	NA	NA
South LWI	2.3	4.0	1.2	0.26	0.06	0.95	0.03	0.76	0.14

Source: Leidos and Grette Associates 2013b
NA = species not observed at location.

During the 2007 comprehensive eelgrass survey, bivalve siphons were generally detected at the north LWI project site at depths greater than 15 feet (5 meters) below MLLW and at the south LWI project site at depths greater than 20 feet (6 meters) below MLLW (SAIC 2009). In general, the siphons associated with geoduck clams occurred in both sand and silt substrate within each survey area, but the occurrence of bivalve siphons was higher in both deeper water and siltier sediment than in the sand and gravel material in the shallow depths. The north LWI project site contained a higher concentration of geoduck clams than the south LWI project site, possibly due to the siltier nature of the sediments at the north site compared to the sandier sediments at the south site (SAIC 2009). Based on the 2013 subtidal surveys (Leidos and Grette Associates 2013b), no geoducks were observed at the north LWI project site and three geoducks were observed at the south LWI project site. However, these surveys only extended to depths of approximately 22 feet (6.7 meters) and 20 feet (6 meters) below MLLW at the north and south LWI sites, respectively – depths where geoducks would not be expected to be abundant based on data obtained from the 2007 survey (SAIC 2009). Figure 3.2–6 presents the distribution of oysters and clams from a 2008 survey of the shoreline at the north and south LWI project sites and shows the 2013 survey locations (Delwiche et al. 2008; Leidos and Grette Associates 2013b).

A 1971 WDFW survey for the commercial tract (#21150), on which both LWI project sites would be located, reported geoduck densities of 0.09 per square foot (0.9 per square meter) (Sizemore et al. 2003). This tract is inactive and no recent survey information is available. Surveys conducted at NAVBASE Kitsap Bangor in support of the 1974 TRIDENT Fleet Ballistic Missile (TRIDENT) Final Environmental Impact Statement (FEIS) found geoduck densities of 0.15 per square foot (1.5 per square meter) near the outlet from Hunter's Marsh, which is approximately 1,300 feet (400 meters) south of the north LWI project site (Navy 1974). No other geoduck survey data are available for the Bangor waterfront. More recent WDFW geoduck studies conducted in Hood Canal from 2004 to 2007 found densities ranging from 0.0029 per square foot at Quatsap (approximately 10 miles [16 kilometers] southwest of the south LWI project site) to 0.676 per square foot at Lofall/Vinland (1.5 to 5.5 miles [2.4 to 8.9 kilometers] north of the north LWI project site) (Sizemore et al. 2007).



Source: Delwiche et al. 2008

Figure 3.2–6. Shellfish Resources near the LWI Project Sites

Oysters have a limited elevational distribution at the north LWI project site, representing a band across the intertidal habitat (Delwiche et al. 2008; Leidos and Grette Associates 2013b). Tidal heights over which this band occurred ranged from 2.5 to 7 feet (0.8 to 2.1 meters) above MLLW, with no oysters detected in the subtidal region. Though not a dense band, the average width of the oyster bed at this location is approximately 40 feet (12 meters). This bed runs from the EHW-1 north trestle to the north for a distance of about 1,700 feet (518 meters). A total of 102 oysters were detected at the north LWI project site in the 2013 survey, equating to an average density of 1.7 oysters per square foot (18.3 per square meter).

Oysters at the south LWI project site occur as a dense band across the intertidal and shallow subtidal habitat (Delwiche et al. 2008; Leidos and Grette Associates 2013b). Tidal heights over which this band occurs range from 0.5 feet (0.12 meter) below to 4 feet (1.2 meters) above MLLW. This bed runs approximately 440 feet (134 meters) across the Devil's Hole outfall delta. The average width of the oyster bed at this location is approximately 140 feet (43 meters). A total of 291 oysters were detected at the south LWI site in the 2013 survey, equating to an average density of 2.35 oysters per square foot (25.3 per square meter).

MOLLUSCS AT THE SPE PROJECT SITE

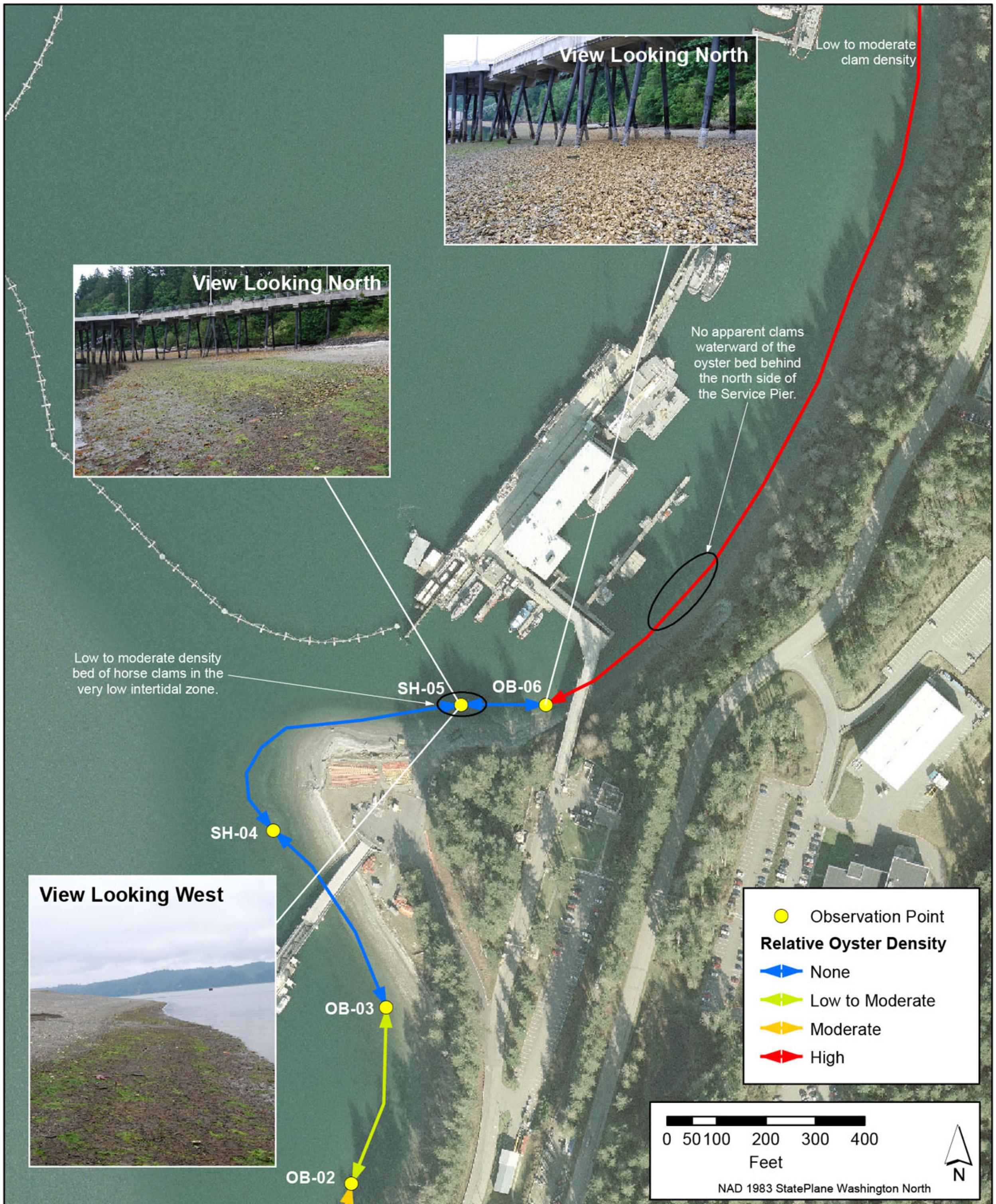
An approximately 63-foot wide (19-meter) dense oyster bed runs from just south of the Service Pier trestle to the north approximately 1,800 feet (550 meters), ending just south of KB Dock (Figure 3.2–7; Delwiche et al. 2008). There is a moderate to low-density bed of horse clams in the very low intertidal zone just south of the Service Pier. The 2007 eelgrass survey did not detect bivalve siphons behind the Service Pier (SAIC 2009). Opalescent nudibranchs (*Hermissenda crassicornis*, a gastropod mollusc) were observed at this site during the 2012 eelgrass survey (Anchor QEA 2012).

There are no recent geoduck survey data for the SPE project site. The 1971 WDFW survey for the commercial tract (#21150), on which the SPE project site would be located, reported geoduck densities of 0.09 per square foot (0.9 per square meter) (Sizemore et al. 2003). The 1974 survey for TRIDENT near the mouth of Hunters Marsh (approximately 1.8 miles [2.9 kilometers] north of the SPE project site) found geoduck densities of 0.15 per square foot (Navy 1974).

The Quatsop survey site, which found geoduck densities of 0.0029 per square foot, is approximately 8 miles (13 kilometers) southwest of the SPE site (Sizemore et al. 2007). Similarly, the Lofall/Vinland survey site, which found geoduck densities of 0.676 per square foot, is approximately 4 to 8 miles (6.4 to 13 kilometers) north of the SPE project site.

CRUSTACEANS

Crustaceans are aquatic arthropods with an exoskeleton or shell, a pair of appendages on each segment, and two pairs of antennae. Examples are shrimps, crabs, barnacles, and amphipods. Crustaceans are associated with all soft-bottom and hard substrate habitats (rocky outcrops, manmade structures) and also occur in the water column. Crustaceans, particularly small epibenthic species, provide a primary ecological value as an important food source for fish, birds, marine mammals, and other animals. For example, gammarid amphipods (small,



Source: Delwiche et al. 2008; SAIC 2009

Figure 3.2–7. Shellfish Resources near the SPE Project Site

shrimp-like crustaceans) are the primary food source for chum salmon along the Bangor shoreline (Simenstad and Kinney 1978). Dungeness crabs and spot prawns are WDFW-regulated species that are subject to commercial and sport harvest in Hood Canal.

Small epibenthic crustaceans (such as amphipods, copepods, cumaceans, isopods, ostracods, and tanaids) are associated with soft-bottom habitat. Benthic ostracods are minute crustaceans that are protected by a bivalve-like shell and typically feed on detritus in the subtidal nearshore marine habitats. Based on 2005 benthic sediment sampling along the Bangor shoreline the seed-shrimp, an ostracod, is the most abundant species (Weston 2006). Seed-shrimp comprised almost 30 percent of the individual benthic organisms in the sandy deltaic subtidal zones along the shoreline (Weston 2006). In previous studies (WDOE 1998), this species was numerically dominant in other areas of the north Hood Canal biotic subregion. Other common species in soft-bottom habitats include amphipods and tanaids (Weston 2006). Most amphipods are detritus-feeders or scavengers, and tanaids are associated with vegetated habitats and/or organic detritus (Barnard et al. 1980; Lee and Miller 1980).

Barnacles, amphipods, copepods, cumaceans, and isopods are common members of marine fouling communities (organisms that attach to and live on manmade structures such as docks). Amphipods often account for the greatest variety of crustaceans on manmade structures. Several of these fouling species are non-native in Puget Sound (e.g., *Ampithoe valida*, *Corophium acherusicum*, and *Parapleustes derzhavini*) (Cohen et al. 1998). During the 2008 survey, barnacles were frequently seen attached to cobble, oyster shells, and pier structures throughout the intertidal areas of the Bangor shoreline (Delwiche et al. 2008).

CRUSTACEANS AT THE LWI AND SPE PROJECT SITES

Larger crabs and shrimps, which are mobile and evasive during sampling, are not well quantified near the proposed LWI or SPE project sites. Several species have been commonly observed (Pentec 2003; Weston 2006). Dungeness crabs range from intertidal to subtidal depths in sandy habitats and may use eelgrass beds as nursery areas (LFR 2004). Hermit crabs, *Cancer* crabs, kelp crabs, and shore crabs occur in rocky and/or vegetated habitats (Table 3.2–2). Red rock crabs, kelp crabs, graceful crabs, and Dungeness crabs were observed during the 2013 LWI shellfish surveys (Leidos and Grette Associates 2013b). Red rock crabs, hermit crabs, kelp crabs, and ghost shrimp were observed during the 2012 SPE eelgrass survey (Anchor QEA 2012).

ANNELIDS

Annelids are segmented worms that occur in soils (e.g., earthworms) and freshwater and marine environments (e.g., leeches and polychaetes). Polychaetes are a major component of the benthic community and occupy intertidal and subtidal soft- and hard-bottom habitats (Weston 2006). Sessile polychaetes are often tube-building while other species may be active burrowers (Kozloff 1983). Polychaetes are typically more abundant in the nearshore subtidal zone than in the intertidal zone (Weston 2006; WDOE 2007). Several species of polychaetes live among fouling organisms on manmade structures. Suspension-deposit spionids, herbivorous nereids, predatory syllids, and scale worms were found during rapid assessment of several marinas in Puget Sound (Cohen et al. 1998).

ANNELIDS AT THE LWI AND SPE PROJECT SITES

The polychaete *Platynereis bicanaliculata* was abundant in subtidal samples at all three stations at the north LWI project site and at one of three stations at the south LWI project site (Weston 2006). No benthic invertebrate surveys have been conducted in the vicinity of Service Pier. However, annelids in this area would likely include those typical of Puget Sound hard and soft-bottom habitats, as noted for the LWI project sites.

ECHINODERMS

Echinoderms are a group of marine invertebrates that usually have a symmetry of five and skin typically covered in spines. Examples include sea stars (starfish), sea urchins, and sea cucumbers.

ECHINODERMS AT THE LWI AND SPE PROJECT SITES

Echinoderms contributed up to 6 percent of benthic organisms in sediment sampling conducted in 2005 along the shoreline, but they represented less than 1 percent of the abundance of benthic organisms at the LWI project sites (Weston 2006). Echinoderms at the LWI project sites include brittle stars and green sea urchins (Navy 1988; Weston 2006). However, sea stars have also been observed at many locations along the shoreline (Navy 1988; Delwiche et al. 2008). Purple stars are found primarily in the lower-intertidal zone on piles where they feed on mussels. Pink sea stars are often found in subtidal eelgrass beds (Pentec 2003). Sunflower, pink, and false ochre sea stars were observed at the SPE project site during the 2012 eelgrass survey (Anchor QEA 2012).

The red sea urchin has not been documented near the LWI or SPE project sites but typically lives in rocky areas, which have not been extensively surveyed at the shoreline. Red sea urchin habitat ranges from protected shallow subtidal zones to marine deeper water and nearshore marine habitats.

OTHER MINOR PHYLA

Other minor phyla at the Bangor shoreline include Nemertea (ribbon worms), Nematoda (round worms), Platyhelminthes (flat worms, which are mostly oyster leaches), Chordata (e.g., transparent tunicate and mushroom compound tunicate), Cnidaria (jellyfish, polyps, the frilled anemone *Metridium senile*), and Sipuncula (unsegmented worms) (Navy 1988, 1992; Weston 2006).

OTHER MINOR PHYLA AT THE LWI AND SPE PROJECT SITES

During the 2007 comprehensive eelgrass survey, frilled anemones were less prevalent at the proposed LWI and SPE project sites than at the more central area of the shoreline (SAIC 2009).

3.2.1.1.4. PLANKTON

Plankton are often divided into two groups: photosynthetic species that transform light energy from the sun into chemical energy (phytoplankton) and heterotrophic species that derive nutrition by consuming other organisms (zooplankton). Zooplankton are an important part of the food chain for other marine organisms, such as threatened and endangered salmon species.

The plankton community in Hood Canal includes phytoplankton (e.g., diatoms and dinoflagellates), zooplankton such as calanoid copepods, hyperiid amphipods, and euphausiids (krill), larval life stages of some invertebrate species, and fish larvae and eggs (called ichthyoplankton) (Schreiner 1977; Simenstad and Kinney 1978; Salo et al. 1980; Llansó 1998; WDOE 1998). Crustacean larvae are the most common type of zooplankton in Hood Canal. Phytoplankton and zooplankton are critical components of the Hood Canal food web, but their abundance and distribution are not well known or characterized (Puget Sound Action Team [PSAT] 2007a).

PHYTOPLANKTON

In Hood Canal, phytoplankton are composed mainly of diatoms (unicellular algae with silica shells) and dinoflagellates (microscopic organisms with self-propulsion) (Strickland 1983). Diatoms account for most of the phytoplankton biomass in Hood Canal (PSAT 2007a).

Phytoplankton abundance in the Puget Sound region follows a seasonal pattern. In the summer, increased abundance is influenced by weak tidal mixing, reduced circulation, and increased heat from the sun, which contributes to strong stratification in the upper water column. In the fall, local wind events or strong tidal exchange can mix the stratified water and upwell nutrients from lower in the water column, causing a phytoplankton bloom. Phytoplankton abundance then decreases as winter approaches due to decreased sunlight and increased mixing and outflow from heavy rains (Newton and Mote 2005). Between 2001 and 2005, blooms were recorded in the waters adjacent to NAVBASE Kitsap Bangor from February through June (PSAT 2007a).

Phytoplankton populations may become problematic during bloom periods because, once they die off, DO levels can decrease dramatically as bacteria consume the organic materials. Only a few dozen species are associated with harmful algal blooms (Boesch et al. 1997; Horner 1998; PSAT 2007a). Examples of toxic species that occur in Hood Canal include diatoms in the genus *Pseudo-nitzschia*, which produce domoic acid that causes shellfish poisoning in humans (domoic acid acts as a neurotoxin, causing permanent short-term memory loss, brain damage, and death in severe cases), and dinoflagellates in the genus *Alexandrium* that can produce a toxin (saxitoxin, a neurotoxin) that causes paralytic shellfish poisoning (Boesch et al. 1997; Newton 2006). Poisoning of humans and wildlife can occur when filter-feeding shellfish concentrate these toxins to dangerous levels. There are usually periods each year when clam and/or oyster harvest at the Devil's Hole shellfish beach is curtailed due to saxitoxin or *Vibrio* (a bacterium) contamination (Kalina 2012, personal communication). In addition, several diatom species of the genus *Chaetoceros* have barbed spines that can damage fish gills and can cause fish kills during bloom conditions (Boesch et al. 1997).

ZOOPLANKTON

The most abundant types of zooplankton in Hood Canal are crustaceans (including various types of copepods, amphipods, ostracods, isopods, shrimp, and cumaceans) and crustacean larvae (Simenstad and Kinney 1978; Strickland 1983). Some zooplankton spend their entire life as planktonic organisms (resident plankton) while some spend only a portion of their life cycle as plankton (meroplankton) such as in egg or larval stages of development. The larvae of many fish are planktonic. Zooplankton do not occur in blooms, but their populations increase with phytoplankton abundance (PSAT 2007a).

Zooplankton depend on the availability of phytoplankton as a food source, which fluctuates seasonally, annually, and geographically. An increase in the abundance of zooplankton occurs locally near fish and invertebrate spawning sites, with the emergence of large clouds of meroplankton (planktonic larvae) during the winter and spring months. Other species contribute to the meroplankton population during other times of the year, such as bivalves and sand dollars that spawn in the summer (Strickland 1983; WDFW 2000; Snow et al. 2005). Zooplankton may remain in the meroplankton stage for up to 7 weeks.

3.2.1.2. CURRENT REQUIREMENTS AND PRACTICES

3.2.1.2.1. EELGRASS POLICIES

The Washington Department of Natural Resources (WDNR) monitors the status and trends of eelgrass abundance and depth throughout Puget Sound, including in Hood Canal. The policy of WDNR and the other agencies is to prevent loss and promote expansion of eelgrass in Hood Canal and Puget Sound. Specific regulatory protections for eelgrass are discussed in the following section.

3.2.1.2.2. REGULATORY COMPLIANCE

VEGETATION COMMUNITIES

Eelgrass is protected under several federal laws. The Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 USC 1801-1881 et seq.) established procedures designed to identify, conserve, and enhance Essential Fish Habitat (EFH) including eelgrass for those species regulated under a federal Fisheries Management Plan (FMP). The MSA requires federal agencies to consult with National Marine Fisheries Service (NMFS) on all actions, or proposed actions, authorized, funded, or undertaken by the agency, that may adversely affect EFH (MSA 305(b)(2)). EFH protects waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity for federally managed (commercially harvested) fisheries. In addition to EFH designations, Habitat Areas of Particular Concern (HAPCs) are also designated by the regional Fishery Management Councils (FMCs). Designated HAPCs are discrete subsets of EFH that provide important ecological functions or are especially vulnerable to degradation (50 Code of Federal Regulations [CFR] 600.805-600.815). The seagrasses HAPC for Pacific coast groundfish includes eelgrass beds in estuaries (Pacific Fishery Management Council [PFMC] 2008). EFH existing conditions and impacts are evaluated in the Marine Fish resource (Section 3.3).

Under the provisions of CWA Section 404 implemented by USACE and USEPA, eelgrass beds are also considered Special Aquatic Sites that receive special protection. Section 404 pertains to discharges of dredged or fill material in waters of the U.S., which include areas suitable for supporting eelgrass. The jurisdictional limit for Section 404 in tidal waters is the high tide line. Construction of the LWI abutments would require excavation below MHHW and the abutment stair landings and portions of the riprap below the abutment walls would be below MHHW, thus requiring a CWA Section 404 permit from USACE. In accordance with USEPA Section

404(b)(1) guidelines, permits for discharges of dredged or fill material in eelgrass beds may not be issued if practicable alternatives would avoid such impacts. Loss of eelgrass habitat due to construction of the LWI project would require compensatory mitigation as described in the Mitigation Action Plan (Appendix C).

Section 404 activities permitted by USACE require that a Section 401 water quality certification be issued or waived by WDOE. Thus, separate Section 401 water quality certification would be required for the in-water work for both the proposed LWI and SPE project. The Navy has applied for a Section 404 permit (LWI project only) and Section 401 certifications (LWI and SPE projects) by submitting a JARPA for review by USACE and state agencies. The WDFW regulates non-federal, in-water construction actions through the State Hydraulic Code (RCW 77.55) and specifically protects eelgrass and kelp (*Saccharina* sp.) resources through WAC 220-660-080, which requires no-net-loss of habitat that supports fish life. Eelgrass and kelp are also considered saltwater habitats of special concern (WAC 220-660-320(3)). However, NAVBASE Kitsap Bangor is exempt from these requirements because it is a federal installation.

WDFW and WDNR may comment and provide recommendations on federal construction projects through the JARPA and National Environmental Policy Act (NEPA) processes. Permitting agencies (USACE and WDOE) may incorporate these comments and recommendations into permits and authorizations.

Section 10 of the Rivers and Harbors Act (33 USC 401 et seq.) requires authorization from USACE for the development of any structure in or over any navigable water of the United States. The Navy requested separate Section 10 permits for construction of the overwater portions of the LWI and for the SPE. The permit process for Section 10 of the Rivers and Harbors Act of 1899 results in an evaluation of project impacts on eelgrass beds. While not subject to specifications of the CWA 404(b)(1) guidelines, USACE considers impacts on eelgrass (as part of the public interest review) in their evaluation of permit applications for structures or work in navigable waters pursuant to Section 10. This applies to non-fill activities such as pile-supported structures, moorings, floats, excavation, and other structures or work conducted beyond mean high water in tidal waters.

Under Kitsap County's Shoreline Management Plan (SMP), Section 22.28.030, General Policies (which is applicable under the CZMA), development activities are directed to avoid eelgrass, kelp, and estuarine ecosystems because of their high ecological value. As a federal agency, the Navy prepares a CCD in compliance with the CZMA explaining how their action would be "consistent to the maximum extent practicable" with the state's Coastal Zone Management Plan (CZMP), which in Washington invokes the applicable local shorelines management program (i.e., Kitsap County's program). WDOE reviews the CCD and make a federal consistency determination in the form of concurrence, conditional concurrence, or objection.

BENTHIC COMMUNITIES

No federally listed benthic species within the vicinity of the LWI and SPE project sites are subject to regulation under the Endangered Species Act (ESA). However, benthic invertebrates that constitute food for salmon listed under the ESA are indirectly protected. Activities that alter or eliminate benthic invertebrates or their habitats are evaluated for their significance to federally listed species during ESA consultations with NMFS. The MSA, through the EFH provision, protects substrate necessary for federally managed fisheries. In this context, "substrate" includes the associated benthic communities that make these areas suitable fish habitats. USACE also considers protection of shellfish under Section 404 of the CWA (e.g., Nationwide Permit regional conditions prohibit construction in special aquatic sites, which include oyster beds).

At the state level, WDFW is tasked with providing protection to benthic organisms, including shellfish, as required under the Washington State Hydraulic Code (RCW 77.55). The code is implemented through WAC 220-660, which states that there should be no net-loss of fish life (which includes shellfish) and habitat that supports fish life. Settlement areas for native shellfish (i.e., Olympia oysters) are considered saltwater habitats of special concern (WAC 220-660-320). However, NAVBASE Kitsap Bangor is exempt from these requirements because it is a federal installation.

WDOH monitors beaches in Hood Canal, including those at the Bangor shoreline, for shellfish contamination to protect consumers from illness caused by eating shellfish contaminated by fecal pathogens, biotoxins, or other pollutants. The shellfish bed at the south LWI project site off the Devil's Hole outfall is harvested for oysters and clams by tribes (Kalina 2012, personal communication). The beach areas at the north LWI and SPE project sites (Figures 3.2–6 and 3.2–7) are closed to any shellfish harvest due to security restrictions.

PLANKTON

There are no federal or state regulations pertaining directly to plankton or requirements for regulatory consultation. Regulations indirectly affecting plankton include water quality criteria for parameters related to excessive nutrient loading, which can cause algal blooms (larger accumulations of phytoplankton) that can adversely affect water quality (Section 3.1.1.1.2).

3.2.1.2.3. CONSULTATION AND PERMIT COMPLIANCE STATUS

The Navy included impacts on marine vegetation and benthic communities as part of its consultation with the NMFS West Coast Region office under the ESA and MSA. A biological assessment and EFH assessment were submitted to the NMFS West Coast Region Office and the USFWS Washington Fish and Wildlife Office on March 10, 2015. A revised biological assessment was submitted to NMFS and USFWS on June 10, 2015. NMFS issued a Letter of Concurrence on November 13, 2015, concurring with the Navy's ESA effect determination for fish (*not likely to adversely affect*) and MSA effect determination (*may adversely affect*) for the LWI preferred alternative, and indicating formal ESA consultation will be needed for the SPE project. In a concurrence letter dated March 4, 2016, USFWS stated that for both the LWI and SPE projects impacts to bull trout are not measurable and therefore insignificant, and impacts to marbled murrelets are discountable. In addition, the Navy submitted a JARPA to USACE and other regulatory agencies, requesting permits under CWA Section 401 and Section 404, and Rivers and Harbors Act Section 10 for the LWI project. In accordance with the CZMA, the Navy submitted a CCD to WDOE for the LWI project. When the SPE project is programmed and scheduled, the Navy will submit an application for permits under the CWA and Rivers and Harbors Act for the SPE project to USACE and WDOE and a CCD to WDOE.

3.2.1.2.4. BEST MANAGEMENT PRACTICES AND CURRENT PRACTICES

BMPs and current practices that would avoid or minimize impacts of the proposed projects on marine vegetation and invertebrates would include those described in Section 3.1.1.2.3 for protection of marine water resources including hydrography, water quality, and sediments. Specifically, prevention of vessel and barge grounding, minimization of propeller wash, prevention of line and anchor drag, and protection of water quality all would minimize impacts to marine vegetation and invertebrates. BMPs and current practices to minimize and avoid impacts on marine vegetation and invertebrates include the following:

- Construction of the LWI will be conducted from barges in deep waters during high tides, from land, from a temporary trestle (south LWI only), and/or from already constructed parts of the LWI itself. Construction of the SPE will be conducted from barges in deep water.
- Spuds will be used to prevent barges from grounding in shallow areas including eelgrass beds.
- Vessel traffic will be excluded from the shallow areas outside of the 100-foot (30-meter) construction zones, which will be demarcated with clearly visible markers.
- Vessel operators will be provided maps of the project sites with eelgrass beds clearly marked so that the beds can be avoided.
- The Navy will require the construction contractor to prepare and implement debris management procedures for preventing discharge of debris to marine water and retrieving and cleaning up any accidentally discharged spills.
- The existing NAVBASE Kitsap Bangor fuel spill prevention and response plans (the *Commander Navy Region Northwest Oil and Hazardous Substance Integrated Contingency Plan* and the *NAVBASE Kitsap Bangor Spill Prevention, Control, and Countermeasure Plan* [COMNAVREGNWINST 5090.1, Integrated Contingency Plan, Annex G]) will apply to construction and operation of the proposed projects.
- The Navy will require the construction contractor to comply with RCW 77.15.290 (*Unlawful transportation of fish or wildlife — Unlawful transport of aquatic plants — Penalty*) and U.S. Coast Guard regulations to ensure vessels do not transport invasive aquatic plants.

In addition, the vessels used during construction would comply with U.S. Coast Guard regulations designed to minimize the spread of exotic species such as *Sargassum*. Mitigation measures are described in Appendix C, Mitigation Action Plan.

3.2.2. Environmental Consequences

3.2.2.1. APPROACH TO ANALYSIS

3.2.2.1.1. VEGETATION COMMUNITIES

The evaluation of impacts on marine vegetation considers whether there would be loss or degradation of marine vegetation including eelgrass or kelp, which are protected under federal or state law, or if there would be introduction of an exotic species, such as *Sargassum*, that would impact the growth of protected or native species. Construction activities that significantly degrade or eliminate marine vegetation habitat would be considered a direct impact on marine vegetation communities. Construction impacts include a 100-foot (30-meter) area of potential disturbance; actual impacts would likely be less. Operational changes to marine vegetation habitat, such as the introduction of shading over these habitats, would also be considered direct impacts on marine vegetation communities. The evaluation assumes that project construction and operation are in accordance with applicable regulations (Section 3.2.1.2.2) as well as permit conditions, BMPs, and current practices (Section 3.2.1.2.4).

3.2.2.1.2. BENTHIC COMMUNITIES

The evaluation of impacts on benthic communities and shellfish considered whether the conditions resulting from project construction and operation would cause significant loss of benthic habitat or decreases in habitat value for benthic invertebrates or decreases in benthic invertebrate populations over the life of the project. The analysis considered the habitat displaced by new structures, potentially disturbed by construction vessels and activities, shaded by new structures, or otherwise altered. The evaluation assumes that project construction and operation are in accordance with applicable regulations (Section 3.2.1.2.2) as well as permit conditions, BMPs, and current practices (Section 3.2.1.2.4).

3.2.2.1.3. PLANKTON

The evaluation of impacts on plankton considers whether an increase of phytoplankton blooms or a decrease in plankton abundance would impact the aquatic organisms dependent on this food supply. The evaluation assumes that project construction and operation are in accordance with applicable regulations (Section 3.2.1.2.2) as well as permit conditions, BMPs, and current practices (Section 3.2.1.2.4).

3.2.2.2. LWI PROJECT ALTERNATIVES

3.2.2.2.1. LWI ALTERNATIVE 1: NO ACTION

Under the No Action Alternative, the LWI would not be built and operations in the area would not change from current levels. Therefore, there would be no impacts on marine vegetation, benthic communities, or plankton.

3.2.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

VEGETATION COMMUNITIES FOR LWI ALTERNATIVE 2

The total area of habitat potentially disturbed during construction of LWI Alternative 2 would be 6.2 acres (2.5 hectares) in the nearshore (shallower than 30 feet [9 meters] below MLLW) and 6.9 acres (2.8 hectares) in deep water (deeper than 30 feet below MLLW) (Figure 3.2–8). Of those 13.1 acres (5.3 hectares), approximately 3 acres (1.2 hectares) support marine vegetation communities. Construction activities for Alternative 2 would result in impacts on approximately 1.1 acres (0.43 hectare) of eelgrass beds (approximately 3 percent of the eelgrass at the NAVBASE Kitsap shoreline), 2.6 acres (1.1 hectares) of green macroalgae community, 2 acres

(0.81 hectare) of red macroalgae community, and 0.57 acre (0.23 hectare) of kelp beds (Table 3.2–4; Figures 3.2–8, 3.2–9, and 3.2–10). Areas with less than 10 percent coverage of a particular vegetation type were not considered beds or communities of that type. The various types of macroalgae are expected to return to the area following construction. The hard substrate associated with the pier piles and steel plate anchors would provide habitat for marine vegetation species such as *Ulva*. The Mitigation Action Plan (Appendix C) describes the compensatory aquatic habitat mitigation action that the Navy would undertake as part of the Proposed Action. This habitat mitigation action, including mitigation for eelgrass, would compensate for the impacts of the Proposed Action to marine habitat and species.

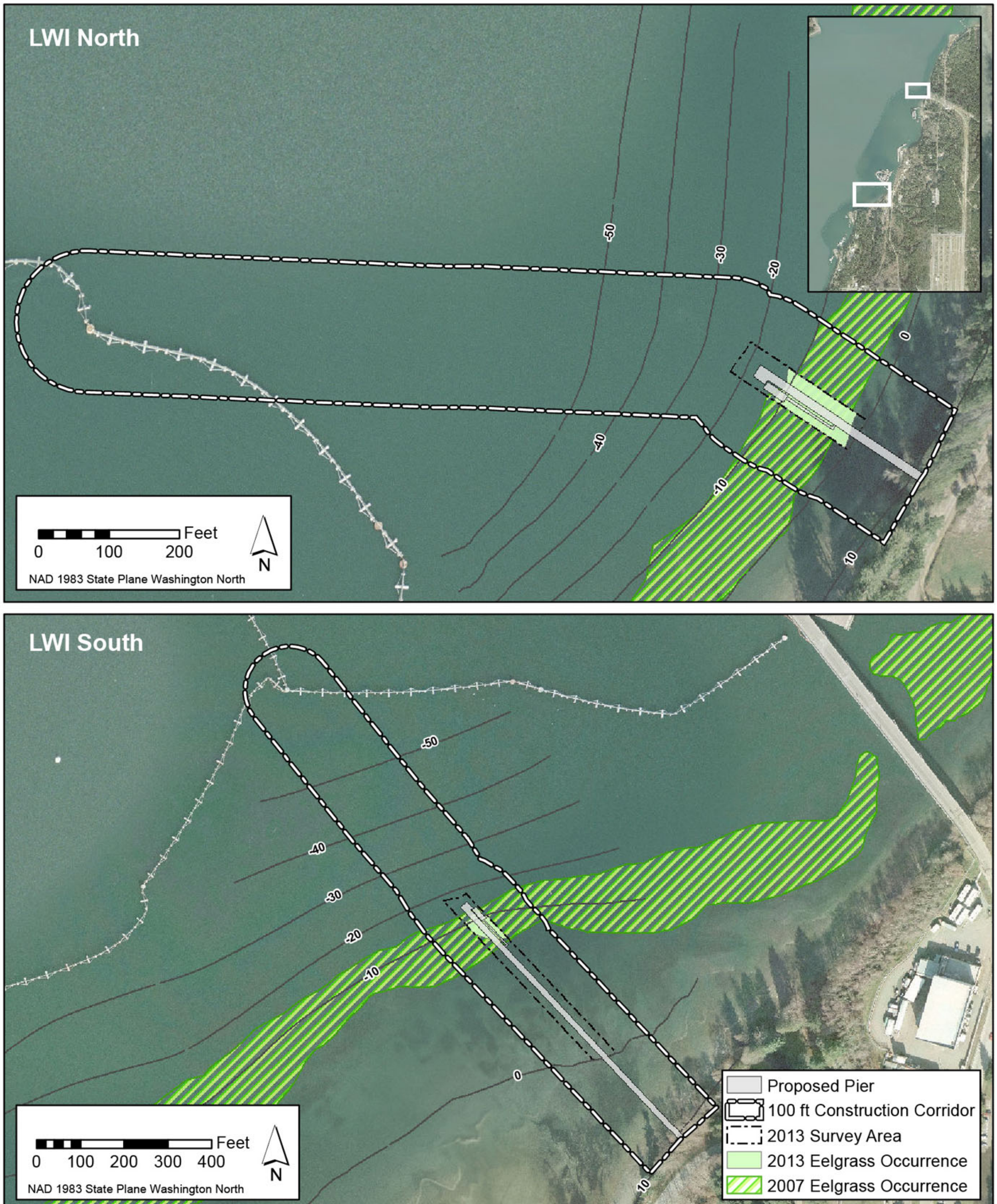
Table 3.2–4. Marine Habitat Impacted by LWI Alternative 2

Habitat Type	Potential Temporary Construction Disturbance Area in Acres (Hectares)[1]	Area Permanently Displaced by Structures[2] in Acres (Hectares)[3]	Operational Full Shading Area in Acres (Hectares)[3]	Operational Partial Shading Area in Acres (Hectares)[3]
Nearshore[4]	6.2 (2.5)	0.14 (0.056)	0.0029 (0.0012)	0.34 (0.14)
Deep Water[5]	6.9 (2.8)	0	0	0
Vegetation Type[6]				
Eelgrass[7]	1.1 (0.43)	0.024 (0.01)	0	0.076 (0.031)
Green Macroalgae	2.6 (1.1)	0.069 (0.028)	0	0.14 (0.058)
Red Macroalgae	2.0 (0.81)	0.016 (0.0066)	0	0.038 (0.015)
Brown Macroalgae (Kelp)	0.57 (0.23)	0.0025 (0.0010)	0	0.0072 (0.0029)

1. The potential construction disturbance area includes the LWI structure footprints and the areas within 100 feet (30 meters) of the proposed LWI structures. Areas actually disturbed by construction are likely to be substantially less. Calculated based on 2007 survey, which covered the entire 100-foot corridor.
2. Structures include piles, steel plate anchors, and the concrete pads supporting the abutment stairs.
3. Operational impacts on marine vegetation were calculated based on results of the 2013 survey, which covered the area 25 feet (7.6 meters) to either side of the centerline of the proposed LWI structures. Partially shaded areas would be the areas under the piers, gangways, and floating docks, which would be built with grating. Fully shaded areas would be those under the dolphin platforms, which are not vegetated.
4. Nearshore = the area shallower than 30 feet (9 meters) below mean lower low water (MLLW).
5. Deep water = the area deeper than 30 feet below MLLW.
6. Eelgrass and macroalgae overlap in their occurrence along the Bangor shoreline (e.g., Figure 3.2–3). Therefore, the total acreage of marine vegetation potentially impacted cannot be calculated by summing the values for each vegetation type.
7. Barges would avoid placing spuds or anchors in eelgrass beds wherever possible.

CONSTRUCTION OF LWI ALTERNATIVE 2

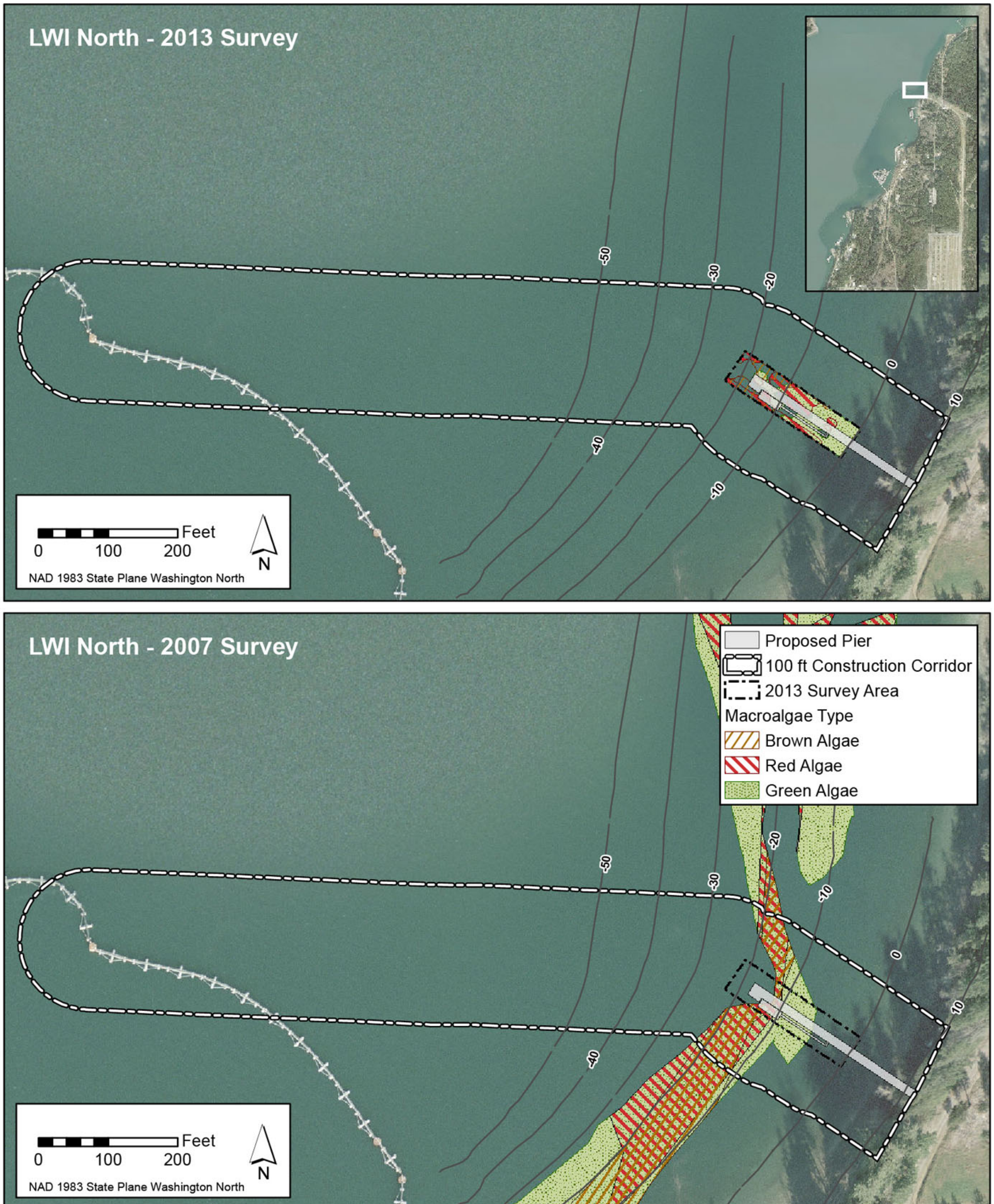
Barges, tugboats, and other vessels (e.g., skiffs) would be stationed at the LWI project sites during construction. Tugboats would bring in and position barges and then leave the sites. While the vessels would be directed to avoid grounding and damaging marine vegetation on the seafloor, the vegetation would be directly impacted by seafloor disturbance from anchor, spud, and steel plate anchor placement, pile installation, and vessel shading. Measures would be implemented to avoid underwater line drag and anchor drag (Appendix C). The impact area



Source: SAIC 2009; Leidos and Grette Associates 2013a

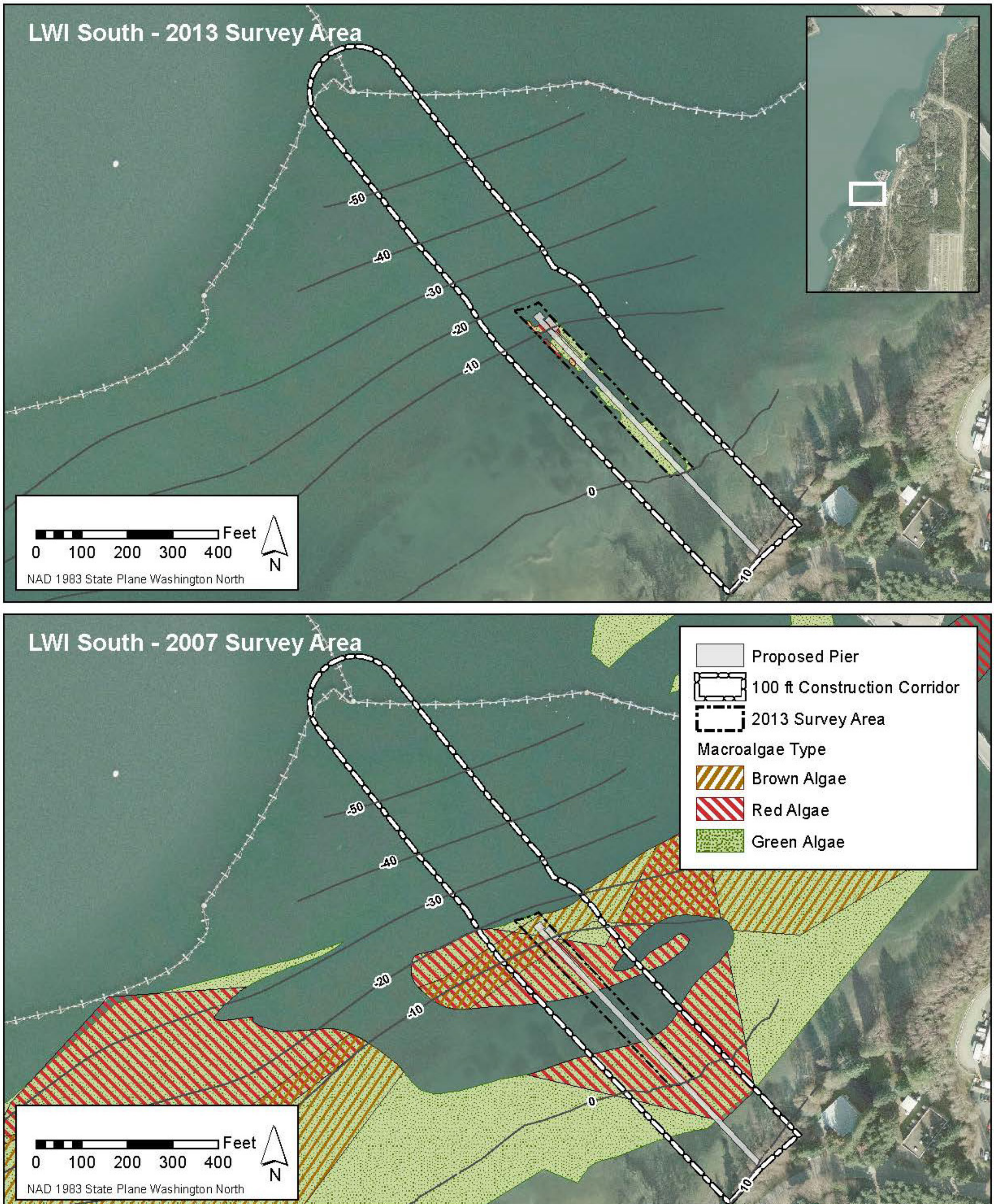
Figure 3.2–8. Disturbance Areas for Eelgrass near the LWI Alignments, Alternative 2

Figure 3.2–8. Disturbance Areas for Eelgrass near the LWI Alignments, Alternative 2



Source: SAIC 2009; Leidos and Grette Associates 2013a

Figure 3.2–9. Disturbance Area for Macroalgae near the North LWI Alignment, Alternative 2



Source: SAIC, 2009; Leidos and Grette Associates, 2013a

Figure 3.2-10. Disturbance Area for Macroalgae near the South LWI Alignment, Alternative 2

would consist of the LWI footprints where piles would be driven and pier construction would occur, as well as a 100-foot (30-meter) wide corridor where barges would be stationed and tugboats would maneuver the barges during pile installation and steel plate anchor placement. A possible source for construction-related impacts on marine vegetation would be from accidental debris spills from barges or construction platforms into Hood Canal. Debris spills could smother bottom vegetation. The Navy would require the construction contractor to prepare and implement debris management procedures for preventing discharge of debris to marine water and retrieving and cleaning up any accidental spills. Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups.

As shown in Table 3.2–4, the potential construction disturbance area for Alternative 2 would include 1.1 acres (0.43 hectare) of eelgrass beds, 2.6 acres (1.1 hectares) of green macroalgae community, 2 acres (0.81 hectare) of red macroalgae community, and 0.57 acre (0.23 hectare) of brown macroalgae (primarily kelp). Potential impacts for north and south LWI sites are given under each vegetation type. Because vegetated communities comprise a mixture of vegetation types, the acreages are not additive. The total marine vegetation area potentially impacted by in-water construction activities would be 3 acres (1.2 hectares) (0.74 and 2.2 acres [0.3 and 0.91 hectare] for the north and south LWI project sites, respectively). Reconfiguration of the PSBs would require removing some existing PSB segments and their associated anchors and repositioning them to connect with the new LWI piers. As described in Chapter 2, there would be a net reduction of two PSB buoys and their associated mooring anchors.

While construction activities would be limited to the LWI piers and 100-foot (30-meter) surrounding area, not all of the seafloor within the 100-foot corridor would be disturbed. The areas likely to be highly disturbed during construction of Alternative 2 would be where the steel plate anchors are placed under the piers (approximately 0.035 acre [0.014 hectare] at the north LWI and 0.092 acre [0.037 hectare] at the south LWI) and where the permanent and temporary piles are placed (approximately 0.0039 acre [0.0016 hectare] at the north LWI and 0.0087 acre [0.0035 hectare] at the south LWI). (Pile disturbance contributes less than 10 percent of the total permanent seafloor displacement shown in Table 3.2–4.). The area of riprap placed at the base of the LWI abutments would be 4,100 square feet (381 square meters). The total length of riprap would be 410 feet (125 meters) and the width would be approximately 10 feet (3 meters). The riprap would extend from the MHHW elevation to approximately 10 feet above MLLW at the north LWI and 9 feet (2.7 meters) above MLLW at the south LWI. In addition, the riprap would be covered with native beach material. Therefore, construction impacts to marine vegetation communities that would occur within the 100-foot corridor identified in this section are conservative; the actual impact is expected to be substantially less.

Eelgrass

The north LWI would cross the southern portion of the eelgrass bed located immediately north of EHW-1 (Figure 3.2–8). A maximum of 0.51 acre (0.21 hectare) of the 12-acre (4.9-hectare) north LWI eelgrass bed would be impacted during construction. The south LWI would cross the northeastern portion of the eelgrass bed located immediately south of Delta Pier. A maximum of 0.54 acre (0.22 hectare) of the 7.6-acre (3.1-hectare) south LWI bed would be impacted during construction. These areas include eelgrass directly under the proposed piers, as well as within

100 feet (30 meters) of the structures. None of the temporary trestle piles would be installed within the south LWI eelgrass bed. The PSB anchoring systems installed at the end of the LWI piers would not be installed within eelgrass beds. The total eelgrass potentially disturbed during construction would be 1.1 acres (0.43 hectare).

Approximately 0.014 and 0.0075 acre (0.0057 and 0.003 hectare) of the north and south LWI eelgrass habitat, respectively, would be permanently eliminated when the steel plate anchors are installed. An additional 0.0017 and 0.00073 acre (0.00067 and 0.00029 hectare) would be permanently eliminated by the piles. Eelgrass is a rooted aquatic plant that depends on biogeochemical processes in sediment to maintain growth (Hart Crowser 1997; Thom et al. 1998; review in Mumford 2007). Sediments also protect the roots from drying out and being eaten by herbivores. Repeated disturbance around individual plants, such as would occur from pile driving, can result in death or shifting of the bed location (Hart Crowser 1997). Over time, events causing erosion would remove sediments from the root system and expose below-ground plant parts to degradative processes. In addition, vessel propeller wash can scour and redistribute sediments and reduce the amount of light energy reaching the plants at the sea floor (Thom et al. 1998). Barges and boats involved in pile installation and steel plate anchor placement would be expected to impact existing eelgrass beds (e.g., by anchor and spud placement) in those areas where the proposed pier structures would cross existing beds, extending 100 feet laterally from the pier footprints to include areas where the vessels would be stationed and most boat movement activities would occur. Propeller wash impacts on marine vegetation would be limited to shallower waters.

Eelgrass is sensitive to low light levels (reviews in Nightingale and Simenstad 2001a and Mumford 2007), and marine plant communities in Washington, including eelgrass, can be limited by light availability (Thom and Albright 1990). Portions of the eelgrass beds at the north and south LWI project sites disturbed by the construction activities would be expected to lose individual plants and become less dense but would be expected to recover after construction is completed.

Eelgrass within the 100-foot (30-meter) wide construction corridor that is not directly impacted would potentially experience reduced growth due to increased turbidity and particle settlement on individual plant blades, as well as between the plants. In the shallow areas where eelgrass occurs, sediment resuspension would be associated with pile installation, steel plate anchor placement, and barge operations. Due to the sandy composition of the surficial sediments, the nature of the water column currents in those areas, and the shallow depths at the sites, the majority of the sediment particles would quickly fall out of suspension (see discussion of impacts on water quality in Section 3.1.2.2.2). Resuspended, fine-grained sediments would be subject to rapid dilution by currents and eventual flushing during subsequent tidal exchanges. Therefore, the duration and spatial extent of turbidity plumes generated by in-water construction activities would be minimal and there would be minimal settling of fines on eelgrass. In addition, eelgrass would experience lower irradiance during construction due to vessel shading. The eelgrass area subject to shading by construction vessels and barges during the construction period is assumed to be equal to that within the 100-foot construction area (0.51 and 0.55 acre [0.21 and 0.22 hectare] at the north and south LWI project sites, respectively); however, this is a highly conservative estimate because the vessels would not be stationary for the entire construction period and would be positioned to avoid eelgrass beds to the extent possible (Appendix C, Section 5.1.2).

Studies of seagrass recoveries in natural systems following clearing or declines due to turbidity plumes found full recoveries ranging from 2 to 6 years (Rasheed 1999; review in Erftemeijer and Lewis 2006). Factors that would influence the rate and success of eelgrass recovery include the extent of sediment disturbance and competition from macroalgae such as *Ulva*.

Oil spills could potentially occur during construction, which could result in the loss of eelgrass. As described in Section 3.1.2.2.2, under Water Quality, the existing facility response and prevention plans for the Bangor shoreline provide guidance that would be used in the event of a spill, including a response procedures, notification, and communication plan; roles and responsibilities; and response equipment availability. The contractor would also prepare and implement a spill response plan (e.g., an SPCC Plan) to clean up fuel or fluid spills. In the event of an accidental spill, response measures would be implemented immediately to reduce the potential for exposure to the environment.

In summary, placement of the steel plate anchors and piles would permanently eliminate an estimated 0.016 and 0.0083 acre (0.0064 and 0.0034 hectare) of eelgrass from the north and south LWI eelgrass beds, respectively. In addition, some disturbances to eelgrass beds would occur within the construction corridor, potentially affecting up to 0.51 acre (0.21 hectare) of the 12-acre (4.9-hectare) north LWI eelgrass bed and 0.55 acre (0.22 hectare) of the south LWI 7.6-acre (3.1-hectare) eelgrass bed. Eelgrass is expected to recover in disturbed areas within 2 to 6 years, depending on the extent of the disturbance. The permanent and temporary losses of eelgrass would be mitigated as described in the Mitigation Action Plan (Appendix C).

Macroalgae

Macroalgae, which occur at a greater range of depths than eelgrass at the LWI project sites (SAIC 2009), require lower light levels than eelgrass for growth (Frankenstein 2000; Nightingale and Simenstad 2001a), and would be expected to recruit back to the seafloor following construction. As described in above in Section 3.2.1.1.2, green macroalgae, such as sea lettuce, have rapid growth rates during summer and early fall months when light intensity is highest in the Pacific Northwest (Nelson et al. 2003). Macroalgae communities in the construction zones would be at their maximum biomass prior to the onset of pile driving activities in August, which would contribute to rapid recovery after construction is completed.

A maximum of 2.6 acres of seafloor supporting green macroalgae (0.40 and 2.2 acres [0.16 and 0.9 hectare] at the north and south LWI project sites, respectively), 2 acres (0.81 hectare) of red macroalgae (0.21 and 1.8 acres [0.086 and 0.72 hectare] at the north and south LWI project sites, respectively), and 0.57 acre (0.23 hectare) of seafloor supporting brown macroalgae (0.19 and 0.39 acre [0.075 and 0.16 hectare] at the north and south LWI project sites, respectively) would be impacted during construction (Table 3.2–4; Figures 3.2–9 and 3.2–10). The impact area would primarily occur within 100 feet (30 meters) of the LWI project sites where most direct (e.g., vessel shading), and indirect (e.g., turbidity, sedimentation) impacts would occur. Installation of the steel plate anchors on the seafloor would eliminate approximately 0.065, 0.015, and 0.0024 acre (0.026, 0.0062, and 0.001 hectare) of green, red, and brown macroalgae community, respectively. Installation of the temporary trestle piles at the south LWI would impact approximately 0.009 acre (0.0035 hectare) of green and red macroalgae.

Reconfiguration of the PSBs would result in the net reduction of two PSB buoys and their associated mooring anchors, one at each of the LWI project sites. This action would result in a minimal loss of macroalgae fouling community associated with anchors that are removed entirely, elimination of the community where anchors are relocated, and recolonization of areas where anchors are removed. Bottom-disturbing activities during construction could dislodge macroalgae, creating drifting algal mats. Drift algae are important sources of food and habitat for some fish and invertebrates. Drifting algal mats have the potential to shade and smother eelgrass. However, it is not anticipated that algae would be detached in sufficient quantities during construction to create large mats that would negatively affect eelgrass.

Propeller wash impacts on marine vegetation would be limited to shallower waters. No impacts on macroalgae would be expected beyond the 100-foot (30-meter) areas. Oil spills could also potentially occur during construction, which could result in the loss of macroalgae. In the event of an accidental spill, response measures as noted above would be implemented immediately to reduce potential exposure to the environment.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 2

The total area of marine habitat impacted by operation of LWI Alternative 2 would be 0.15 acre (0.061 hectare) in the nearshore (Table 3.2–4), which is the total area displaced by the piles, steel plates, and abutment stair landings (0.14 acre [0.055 hectare]), a total of 0.07 acre (0.028 hectare) of which is vegetated. Marine habitats in deep water (deeper than 30 feet [9 meters] below MLLW) would not be impacted by the LWI structures. Operational activities would primarily impact marine vegetation through the habitat fragmentation that would occur from the piles and steel plate anchors in eelgrass (total of 0.024 acre), although the piles and steel plates would serve as attachment sites for macroalgae species. Partially shaded areas would continue to support eelgrass and macroalgae. The relocated PSB systems at the end of the LWI piers would be located beyond the eelgrass beds.

Maintenance of the LWI piers would include routine inspections, repair, and replacement of facility components as required. These activities would not directly affect marine vegetation; however, fouling organisms, including macroalgae, would be periodically cleared from the below-pier mesh and PSB guard panels. Debris released by mesh and PSB guard panel cleaning would be small and dispersed by currents such that it would not smother underlying or nearby marine vegetation. Measures such as those documented under Section 3.1.2, would be employed to avoid discharges of contaminants to the marine environment during LWI operations. Propeller wash from small boat operations at the floating docks would have the potential to cause scour and suspension of bottom sediments, but these operations would be infrequent.

Eelgrass

The seafloor areas shaded by the piers would be minimized by the use of grating in the piers that allows 65 percent of light to pass through, restriction of pier widths to the minimum necessary to meet structural and program requirements, and the height of the piers over the water (approximately 17 feet [5 meters] above MLLW). The gangways and floating docks also would be constructed using grating. An increased structure height over the water diminishes the degree of shading by providing a greater distance for light to diffuse and refract around its surface as the sun arcs across the sky (review in Nightingale and Simenstad 2001a). The shading effect of the piers would be greatest at higher tides when the pier heights over water would range from 1 to 5 feet (0.3 to 1.5 meters). This daytime shadow effect would occur during less than 1 percent of all daylight hours throughout the year. During the rest of the time, the pier clearances would be 5 feet (1.5 meters) or more over the water. An overwater trestle at Indian Island, Washington, constructed with grating material allows approximately 50 percent of the light to pass through. Eelgrass and other marine vegetation continue to be present under this trestle, which is nearly four times as wide as the proposed LWI piers (approximately 45 feet [14 meters] wide) (Kalina 2011, personal communication). Therefore, it is expected that the areas under the piers, floating docks, and gangways outside of the steel plate and pile footprints would continue to support eelgrass growth.

As described in Section 3.1.2.2.2, support piles installed for the in-water barriers would alter current flows and wave propagation locally, which would cause localized erosion of fine-grained sediments near the base of some piles and settling and accumulation of fine-grained sediments at the base of other piles (Chiew and Melville 1987). Turbulence associated with tidal current flows around the piles would result in a gradual coarsening of surface sediments and thin scouring initially around the perimeter of each pile and groups of piles (Sumer et al. 2001). Where eelgrass occurs under the piers, the presence of the beds would retard erosion to some degree due to the eelgrass root systems and the slowing of water velocities over eelgrass beds (reviews in Davison and Hughes 1998 and Bos et al. 2007). Further, shells and barnacles that accumulate on the piles would also slough off over time and contribute to the sediment content below the piles. The loss of fine-grained sediment would be offset by the accumulation of shell and barnacle particles. Similar effects on the bathymetric setting would be expected from the mesh. The presence of these structures would promote temporary sediment accumulation on one side, which could vary depending on the direction of storm-related waves and strength of wave-induced turbulence. While these changes would occur gradually over time, the presence of the steel plates and mesh would result in some fragmentation of the eelgrass beds in which they are placed.

The PSBs and associated anchoring systems for the segments connected to the north and south LWI piers would lie outside of, and therefore would not impact, the existing eelgrass beds.

The floating dock would be located in shallow waters and there would be a potential for propeller wash from the security boats to disturb eelgrass due to periodic increases in turbidity associated with resuspended bottom sediments. However, small boat operations would be infrequent. No mitigation measures beyond current practices in place would be required.

Macroalgae

The north and south LWI structures would partially shade approximately 0.042 acre (0.017 hectare) and 0.1 acre (0.041 hectare) of green macroalgae, respectively. The north and south LWI structures would each partially shade approximately 0.019 acre (0.0078 hectare) of red macroalgae. The north LWI and south LWI structures would partially shade approximately 0.005 acre (0.002 hectare) and 0.0024 acre (0.001 hectare) of brown macroalgae, respectively. As with eelgrass, the extent of macroalgae shading by the overwater structures would be minimized by the design of the structures: the use of light transmitting materials, the height of the piers over water, and the narrow width of the piers. Because macroalgae have considerably lower light requirements than eelgrass (Frankenstein 2000; Nightingale and Simenstad 2001a), macroalgae under the piers, gangways, and floating docks also would not be expected to die off, and these areas would not be negatively impacted for this marine vegetation type.

The piles and other underwater structures such as anchors would support algae common to marine fouling communities, such as sea lettuce (*Ulva*) and acid weeds (*Desmarestia*) (Goyette and Brooks 2001) (Figure 3.2–11). Colonization would vary among piles and water depth associated with light availability and overwater shading (e.g., Navy 1988). Macroalgae would colonize the piles within months (Kozloff 1983) and should be well established within a year (Goyette and Brooks 2001). Drift algae may accumulate on the mesh, PSB guard panels, and piles. In the short term, the drift algae would provide food and habitat for invertebrate and fish species. Macroalgae colonizing the mesh and PSB guard panels and drift algae accumulated on these structures, however, would be periodically removed during maintenance.

Figure 3.2–11. Green Macroalgae (*Ulva*) Attached to a Shoreline Pier on NAVBASE Kitsap Bangor

The floating docks would be located in shallow waters and there would be a potential for propeller wash from the security boats to disturb macroalgae due to increased turbidity from resuspended sediments. However, small boat operations would be infrequent.

BENTHIC COMMUNITIES FOR LWI ALTERNATIVE 2

Construction of the pile-supported piers would result in several impacts on the benthic community, including loss of soft-bottom habitat from pile and steel plate anchor placement, disturbance to the soft-bottom habitat from propeller wash, increased turbidity and suspended solids, and increased noise and vibration during pile placement. Operational impacts would include overwater shading and permanent replacement of soft-bottom habitat with hard-bottom habitat due to the installation of piles, steel plate anchors, and riprap. These changes would adversely impact some species and benefit others, resulting in some localized changes in the number and composition of benthic species. The impacts of the riprap would be minimized by covering the riprap with native beach material.

CONSTRUCTION OF LWI ALTERNATIVE 2

The benthic and shellfish communities would be directly impacted by substrate disturbance by anchor, spud, and steel plate anchor placement, and pile installation. Benthic communities would also be impacted by turbidity and sediment redeposition resulting from these activities and vessel propeller wash, as well as by vessel shading. The impact area would consist of the north and south LWI footprints where piles would be driven, steel plate anchors placed, and new pier construction would occur, as well as a 100-foot (30-meter) wide area surrounding the sites where barges would be stationed, tugboats would maneuver the barges during pile installation and steel anchor placement, and other boat-based construction activity would occur. In addition, there would be additional pile installation and pile removal of a temporary trestle at the south LWI pier. There would also be some benthic community disturbance during the PSB reconfiguration where the anchors are removed and repositioned. Long-term conversion of these areas from soft to hard bottom is discussed below under Operation/Long-term Impacts.

It is expected that benthic and shellfish communities would be disturbed and partially eliminated in the direct construction areas and the 100-foot (30-meter) wide corridors around these areas. Total potential disturbance area for the benthic community would be approximately 13.1 acres (5.3 hectares) (Table 3.2–5), including 6.2 acres (2.5 hectares) at the north LWI project site and 6.9 acres (2.8 hectares) at the south LWI project site. Areas beyond the 100-foot wide corridors would be protected by limiting construction equipment and activities to the construction corridor. The only areas potentially highly disturbed during construction of Alternative 2 would be where the piles and steel plate anchors are placed under the piers, and where excavation for the abutments is conducted. The areas covered by the piles, steel plate anchors, and concrete pads for the north and south LWI piers, and abutment stairs would be approximately 0.039 and 0.1 acre (0.016 and 0.04 hectare), respectively. Therefore, the 100-foot wide corridor construction impacts identified in this section are conservative; the actual impact is expected to be substantially less. The abutment stair landings would be located above the elevations where shellfish have been observed (above 9 feet [2.7 meters] above MLLW versus maximum elevations of 7 feet [2.1 meters] above MLLW at the north LWI and 4 feet [1.2 meters) above MLLW at the south LWI).

Repositioning of the PSB anchors would be conducted using a barge-mounted crane and result in minor increases in turbidity at those sites. Installation of the cofferdams and excavation for the abutments would be conducted above the oyster beds at both locations and would not impact oysters or other shellfish below in the intertidal zones. Potential impacts on the benthic community from erosion and turbidity during abutment construction would be reduced by limiting construction activities to low tides (i.e., constructing in the dry only). The abutments themselves would be located above MHHW, which is above the benthic community habitats. Both the abutment stair landings (12 square feet [2 square meters] at each LWI) and a portion of the riprap at the base of the abutments would be placed below MHHW. The area of riprap placed at the LWI abutments would be 4,100 square feet (381 square meters). The length of

Table 3.2–5. Benthic Community Resources Impacted by LWI Alternative 2

Impact Type	Benthic Community Area in Acres (Hectares)	Oyster Bed Area in Acres (Hectares)
Potential Temporary Construction Disturbance[1]	13.1 (5.3)	0.88 (0.35)
Permanent loss under piles	0.01 (0.004)	0.00058 (0.00023)
Permanent loss under steel plates, and concrete pads[2]	0.13 (0.051)	0.023 (0.0092)
Operational Partial Shading[3]	0.34 (0.14)	0.054 (0.022)
Operational Full Shading[3]	0.0029 (0.0012)	0

1. The area within the 100-foot (30-meter) wide construction corridor.
2. The impact area for the benthic community would include the oyster beds and the areas in the pile footprints; thus, the oyster bed impact areas are subsets of the benthic community impact areas. The oyster bed area lost under steel plates was calculated using the width of the steel plates and average width of the north and south LWI oyster beds of 40 and 140 feet (12 and 43 meters), respectively.
3. Partially shaded areas would be the areas under the piers, floating docks, and gangways, which would be built with grating; fully shaded areas would be those areas under the dolphin platforms.

riprap would be 410 feet (125 meters) and the width would be approximately 10 feet (3 meters). The riprap would extend from the MHHW elevation to approximately 10 feet above MLLW at the north LWI and 9 feet (2.7 meters) above MLLW at the south LWI. Since no benthic communities occur in this zone, no impact would occur to benthic communities from the placement of riprap at base of abutment structures.

The increased potential for spills during construction, spill response, and debris cleanup would be as described above for marine vegetation under Vegetation Communities.

Disturbance from Placement of Piles, Anchors, and Steel Plate Anchors

Construction of LWI Alternative 2 would impact benthic communities through disruption of the sediment surface, which would result in at least partial loss of the community, including geoducks, in the affected areas. Barges used during construction typically have drafts (amount of barge below the water surface) up to 3 feet (1 meter) and would normally operate in water depths of 6 feet (2 meters) or more to prevent grounding. The barges would be at the construction site for up to 2 years and would cause shading under the barges, which could impact survival of the benthic community. An extensive oyster bed occurs at the south LWI Site (average width approximately 140 feet [43 meters]), and a more narrow, fringe oyster bed occurs north of EHW-1 at the north LWI site (average width approximately 40 feet [12 meters]) (Figure 3.2–5). Piles and steel plate anchors for the piers for Alternative 2 would be placed in these beds, and oysters and other benthic organisms in the footprints would be permanently lost. Assuming 100-foot (30-meter) wide construction corridors, up to 0.19 acre (0.079 hectare) of the north LWI oyster bed and 0.68 acre (0.28 hectare) of the south LWI oyster bed could be disturbed during construction. However, impacts on shellfish, including geoducks, due to sediment disturbance and increases in turbidity most likely would be within the narrower zone where the piles and steel plate anchors are installed; there would be fewer impacts on shellfish in the larger 100-foot wide corridor.

Some benthic organisms in the footprints of the barge anchors and spuds, as well as the temporary and permanent piles and steel plate anchors, would be physically crushed. Construction activities would also cause turbidity and sediment redeposition that would impact the benthic community. The areas within the 100-foot (30-meter) wide construction corridors would have higher levels of turbidity and disturbed sediments that would settle on top of the existing benthic community (see discussion of turbidity and suspended sediments in Section 3.1.2.2.2, under Water Quality). Suspension and surface deposit feeders would be the most susceptible to burial. Mobile infaunal deposit feeders would be more likely to survive burial due to their ability to burrow upward through the newly deposited material. Based on various studies of critical burial depths for different benthic organisms, critical burial depths appear to range from 2 inches (5 centimeters) for suspension and surface deposit feeders, to 12 inches (30 centimeters) for active burrowers (Maurer et al. 1978; Nichols et al. 1978). Turbidity plumes would be short lived and settling of resuspended fines on benthic communities would be minimal. Burial depths in the 100-foot wide construction corridor may exceed 2 inches (5 centimeters) in limited areas but would not approach 12 inches (30 centimeters) except in localized areas, such as where anchors and spuds would be placed and where temporary piles are installed and then pulled. The only areas potentially highly disturbed during construction of Alternative 2 would be the areas where the steel plate anchors for the mesh would be installed under the piers and where the temporary trestle piles would be installed at the south LWI project site.

Filter- and suspension-feeding invertebrates (e.g., bivalves, tunicates, crustaceans, and some polychaetes) may close their shells, suspend feeding, or increase feeding rates in response to turbidity increases (LaSalle et al. 1991; Cruz-Rodriguez and Chu 2002). Marine invertebrates have been shown to be tolerant of relatively high suspended solid concentrations over periods of hours to days, with adverse impacts limited to prolonged exposures (e.g., continuously up to 21 days) and/or to high concentrations (e.g., fluid mud) (reviews in LaSalle et al. 1991; O'Connor 1991; Clarke and Wilber 2000; and Wilber and Clarke 2001, 2010). However, the length of time for construction (5 to 6 days per week for up to 6 months for construction of the pier plus up to another 6 months for installation of the mesh) and the increased turbidity levels would likely result in short- to long-term loss of localized areas of the benthic community, including geoducks, within 100 feet of the project site.

Complete loss, however, would be limited to highly disturbed areas such as the small areas disturbed by anchor and spud placement, and the areas where the permanent and temporary piles and steel plate anchors are installed. Most affected areas would experience some reduction in diversity and abundance of benthic species. Opportunistic species, such as small tubiculous, surface-dwelling polychaetes, would be favored for recolonization where sediments accumulate.

Previous studies of dredged, sediment capped, and other disturbed sites show that many benthic and epibenthic invertebrates rapidly recolonize disturbed bottom areas within 2 years of disturbance (CH2M Hill 1995; Romberg et al. 1995; Parametrix 1994a, 1999; Anchor Environmental 2002; Vivan et al. 2009). Dredging and placement of clean sediment caps at contaminated sites provide extreme examples of benthic recovery from disturbance, demonstrating how benthic organisms have the capability to recover from habitat perturbations and recolonize disturbed areas over time. Many benthic organisms lost due to turbidity and bottom disturbances by barges, tugboats, anchors, and spuds would 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 sites have ceased. Less mobile, longer-lived benthic species such as clams can take 2 to 3 years to reach sexual maturity (Chew and Ma 1987; Goodwin and Pease 1989) and may require 5 years to recover from disturbance such as smothering by sediment (study discussed in Chew and Ma 1987). Therefore, shellfish beds impacted by LWI construction would be expected to recover within approximately 5 years after construction. Ecological productivity would be reduced during the 5-year recovery period.

Noise

Indirect impacts associated with increased underwater sound and vibration during pile driving would occur during construction. No studies have been identified that document invertebrate responses to pile driving sound. Although there are few studies of underwater sound impacts on invertebrates, available information suggests a variety of species (crabs, shrimp, clams, mussels, squid, sea cucumbers) tolerate temporary exposures to increased sound levels within the range expected with pile driving without long-term adverse impacts (Stocker 2001; Christian et al. 2003; Moriyasu et al. 2004; Kent and McCauley 2006).

Sound thresholds associated with sublethal physiological or behavioral responses are not well understood and apparently vary among invertebrate species. For example, egg development of snow crabs was delayed by exposure to seismic air gun peak sound decibel (dB) levels of 201 to 227 dB peak (Christian et al. 2003), but no impacts on Dungeness crab larvae were observed at mean sound pressures as high as 231 dB (Root Mean Square [RMS]) (Pearson et al. 1994). Continuous exposure of sand shrimp in aquaria to a high sound-level increase (30 dB in the 25 to 400 hertz [Hz] bandwidth) resulted in sublethal behavioral changes and reduced growth and reproduction (review in Moriyasu et al. 2004). Consequently, invertebrates may experience acoustic stress and disturbance as a result of impact hammer pile driving. Based on evidence from the limited scientific studies conducted to date, reproductive impairment of some invertebrate species, in the form of delayed egg maturity, could result from pile driving for Alternative 2. These impacts would not be expected to extend beyond the duration of pile driving (up to 80 days), and the peak sound levels with the potential to cause these impacts would occur only within the 33-foot (10-meter) radius around any pile being proofed with an impact hammer. As described in Chapter 2 and Appendix D (Noise Analysis), most of the piles would be driven using the vibratory method, which would result in much lower noise levels that are not expected to result in impacts on benthic species.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 2

The overwater structures of Alternative 2 would introduce limited shading in the immediate area of 0.34 acre (0.14 hectare) (Table 3.2–5), including 0.012 acre (0.0048 hectare) of the oyster bed at the north LWI and 0.042 acre (0.017 hectare) of the oyster bed at the south LWI. Regional studies have shown that light-blocking overwater structures can directly impact benthic productivity (Simenstad et al. 1999). For Alternative 2, the shaded area would be functionally minimized due to design elements incorporated into the structure, including the use of grating or other light-transmitting materials in the piers, floating docks, and gangways, the height of the piers over the water (approximately 17 feet [5 meters] above MLLW, which allows more sunlight to pass under the pier as the sun arcs across the sky), and the relatively narrow width.

Only the areas under the dolphin platforms would be fully shaded; however, these structures would not be located above the oyster beds. Therefore, there would be no shading impacts on oysters and very limited full shading impacts (0.0029 acre [0.0012 hectare]) on the rest of the benthic community.

Because there would be no vehicular traffic associated with the LWIs, there would be no requirement to collect and treat runoff from the LWI structures, and drainage would be to Hood Canal. Small boat operations at the floating docks would be infrequent (estimated two per day), minimizing the potential for propeller wash to cause suspension of bottom sediments. The risk of spills during operation would be minimized through adherence to COMNAVREGNWINST 5090.1, Integrated Contingency Plan, Annex G. Containment practices would be consistent with the existing Bangor shoreline structures, including the use of in-water containment booms and response plans (for more detail on impact reducing measures see Section 2.3.4 and Appendix C). Therefore, operation of the LWIs would not degrade water quality or impact benthic and shellfish communities.

Placement of piles and steel plate anchors would result in the long-term conversion of up to 0.038 acre (0.016 hectare) and 0.098 acre (0.04 hectare) of soft-bottom to hard-bottom habitat at the north and south LWIs, respectively. The abutment stair landings and riprap would be placed below MHHW, resulting in conversion of a total of 4,124 square feet (383 square meters) of soft-bottom habitat, but these would be located at elevations well above shellfish habitats. The impacts of the riprap would be minimized by covering the riprap with native beach material. Reconfiguration of the PSB anchors would result in the net gain of soft-bottom habitat where existing anchors are removed. The piles and anchors would become colonization sites for hard-bottom species such as mussels (*Mytilus* sp.), tunicates, and sea anemones that would attach to the piles and anchors (the fouling community). Fouling communities support other species such as amphipods, annelids, gastropods, and predatory sea stars that feed and take refuge in these habitats (Kozloff 1983; Cohen et al. 1998; Brooks 2004; Cordell 2006; PSAT 2006). The decrease in soft-bottom habitat and increase in hard substrate habitat would result in a localized change in species composition (Glasby 1999; Atilla et al. 2003), particularly in the areas where eelgrass abundance is reduced. Colonization of new hard surfaces would begin within months (Schoener and Schoener 1981; Kozloff 1983; Goyette and Brooks 2001; Brooks 2004). A study of wooden piles at a Pacific Northwest location found that the pile community had twice as many species and nearly eight times the density as is typically found in Pacific Northwest sediments (Brooks 2004). However, steel piles would not be expected to attain the same epifaunal diversity as wood piles because steel loses more heat than wood during cold winter conditions, resulting in possible unfavorable conditions for the animals (Brooks 2009, personal communication).

The habitat value of the LWI sites would be significantly reduced in the steel plate anchor areas for species that utilize eelgrass. For example, Dungeness and red rock crabs use eelgrass for larval settlement, as refuge from predators, and as feeding sites (review in Mumford 2007). Macroalgae such as kelp, which also provide some habitat value for benthic organisms, would be expected to recover and to colonize the surface of the anchors.

As discussed for hydrography and sediment impacts in Section 3.1.2.2.2, the presence of the mesh would promote settling of suspended particles and accumulation on the seafloor (snow-fence effect). These changes would occur gradually over time, would be localized at the piles and mesh, and would not adversely impact benthic communities. The placement of riprap at the base of the abutments would prevent scour at the structure base, but effects to circulation below MHHW may occur. However, because the base of the riprap would be submerged infrequently and covered with native beach material, water flow would not be restricted and hydrological conditions would not be affected at the project site except on a very localized basis (i.e., within meters of the structures). Further, because this riprap is located very high in the intertidal zone, no significant impacts to benthic communities would be expected.

Maintenance of the LWIs would include routine inspections, repair, and replacement of facility components (no pile replacement) as required. Measures would be employed to minimize the likelihood of discharging contaminants to the marine environment (Section 3.1.2.2.2, under Water Quality). Any benthic fouling community that established on the underwater mesh and PSB guard panels would be scraped free during annual maintenance and carried on currents until they sink to the bottom. Most of these organisms would not survive due to their need for attachment and/or for specific water depths for habitat (e.g., mussels). There would be periodic impacts on turbidity and DO when the pier mesh and PSB guard panels are cleaned during maintenance activities. Any reductions in DO as a result of mesh and guard panel cleaning activities would be localized and transient, and would not impact benthic communities. Debris released by mesh and guard panel cleaning would be small and dispersed by currents such that it would not smother underlying or nearby benthic organisms.

PLANKTON FOR LWI ALTERNATIVE 2

During construction and operation of Alternative 2, there would be minimal changes in plankton distribution and abundance.

CONSTRUCTION OF LWI ALTERNATIVE 2

No direct impacts on plankton would occur during construction because plankton are not sessile and subject to impacts associated with placement of the piles and other in-water structures for the LWI. However, as described for construction impacts on water quality in Section 3.1.2.2.2, pile installation and propeller wash from construction vessels would result in suspension of bottom sediments and formation of a turbidity plume. 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 (see discussion of impacts on water quality in Section 3.1.2.2.2). Increases in turbidity associated with dredging, backfilling, or other large-scale bottom disturbances, can temporarily alter phytoplankton communities (Hanson et al. 2003). However, sediment disturbances from pile installation and anchor movement would not create such high levels of turbidity. Pile driving would occur between August and mid-January, outside of the most productive period for phytoplankton in Puget Sound (May) (Strickland 1983). Further, because Alternative 2 would not increase nutrients in Hood Canal, construction of the LWI piers and PSB connections would not cause increases in toxin-associated species such as *Pseudo-nitzschia*, which could harm other aquatic organisms.

Potential impacts of increased water column turbidity on zooplankton include entrapment and sinking of plankton due to particle ingestion or adhesion, and decreased survival, growth rates, and body weight resulting from clogged and damaged feeding appendages (Pequegnat et al. 1978; O'Connor 1991; USACE 1993). However, the majority of zooplankton are filter-feeders and are well adapted to suspended materials in the water. Studies in freshwater and marine systems have found that some zooplankton actively migrate to areas of turbidity (review in O'Connor 1991). Some non-selective, filter-feeding zooplankton, including calanoid copepods commonly found in Puget Sound, may decrease their feeding rates in response to high TSS (O'Connor 1991).

The increased potential for spills during construction, spill response, and debris cleanup would be as described above for marine vegetation under Vegetation Communities. Sediments at the north and south LWI project sites have low organic carbon levels (Section 3.1.1.1.3), which correspond to low levels of organic nutrients. Therefore, releases of nutrients to the water column due to sediment resuspension during construction would not be of sufficient magnitude to cause an increase in phytoplankton blooms, including harmful algal blooms, along the Bangor shoreline. Construction of LWI Alternative 2 would not decrease the existing plankton abundance or alter the plankton community.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 2

Piles supporting the piers would become colonization sites for common marine fouling communities, including filter-feeders that prey on plankton. The effect would be to increase predation on plankton but the impact would be minimal. Hard surfaces are known to support a variety of planktonic organisms including protozoa, foraminiferans (Kozloff 1983), and benthic diatoms (Stark et al. 2000). Planktonic harpacticoid copepods, ostracods, amphipods, and isopods are often abundant around docks and piers that provide a habitat and food source of algae, diatoms, and hydroids (Kozloff 1983).

LWI Alternative 2 would increase overwater shading at the project site by approximately 0.34 acre (0.14 hectare). However, the use of grating in the pier decks, floating docks, and gangways would permit light transmission to the water. Other design elements of the structures (e.g., height of the piers over the water and narrow width) would also minimize the area shaded. The only areas fully shaded would be those under dolphin platforms (total of 0.0029 acre [0.0012 hectare]). In aquatic systems with static water, such as lakes, overwater shading can substantially reduce the productivity of plankton (review in Kahler et al. 2000). However, given surface currents of approximately 0.07 to 0.1 foot (2 to 3 centimeters) per second (Section 3.1.1.1.1) in the project vicinity, potential residence times for plankton under either of the LWI piers would be on the order of minutes, depending on local variations in flow direction. Therefore, although the LWI structures would create new overwater shading, no appreciable reduction in primary production of phytoplankton communities would occur due to the localized nature of the shading; the design of the structures, which would minimize shading (use of light transmitting materials in the piers, floating docks, and gangways, height of the piers over water, narrow width); and the short residence time of plankton under structures.

Observed effects of artificial nighttime lighting on plankton include increased feeding opportunities by predators, including salmonids (Nightingale and Simenstad 2001a). Studies of freshwater plankton in a lake setting found potential inhibition of grazing of zooplankton that migrate toward the water surface at night to feed (Moore et al. 2006). However, as described above, surface currents would quickly move planktonic organisms through the area. Further, the pier security lighting directed at the water would not operate constantly, but on an as-needed basis, such as during security responses. Therefore, artificial lighting of the LWIs would not significantly impact plankton resources.

Small boat operations at the floating docks would be infrequent, minimizing the potential for propeller wash to resuspend bottom sediments. Maintenance of the LWI piers would include routine inspections, repair, and replacement of facility components as required. Planktonic organisms residing amongst the fouling vegetation and other organisms on the underwater mesh and PSB guard panels would be periodically removed during maintenance when the mesh is cleaned. Measures would be employed to avoid discharge of contaminants to the marine environment (Section 3.1.2.2.2).

3.2.2.2.3. LWI Alternative 3: PSB Modifications (Preferred)

VEGETATION COMMUNITIES FOR LWI ALTERNATIVE 3

As described in Chapter 2, Alternative 3 differs from Alternative 2 in that pile-supported piers would not be installed and PSBs would be extended all the way to shore.

Construction of LWI Alternative 3

Construction impacts on marine vegetation would be much less under this alternative than Alternative 2, due to the less intensive nature of in-water construction required to place PSB buoy anchors compared to installing piles used to construct the piers in Alternative 2. Also, less substrate would be disturbed in this alternative compared to Alternative 2 and only one in-water construction season would be required.

As shown in Table 3.2–6, an estimated 0.46 acre (0.19 hectare) and 0.5 acres (0.2 hectare) of eelgrass potentially would be impacted within the 100-foot (30-meter) wide construction corridors of the north and south LWI, respectively (Figure 3.2–12). Similarly, an estimated 0.36 acre (0.15 hectare) and 2.1 acres (0.84 hectares) of green macroalgae, 0.18 acre (0.075 hectare) and 1.7 acres (0.68 hectare) of red macroalgae, and 0.16 acre (0.065 hectare) and 0.35 acre (0.14 hectare) of brown macroalgae potentially would be impacted within the 100-foot wide construction corridors of the north and south LWI, respectively (Figures 3.2–13 and 3.2–14). The observation posts would be located above the areas of marine vegetation. Construction of the observation posts would be done in the dry at low tides, and would not impact marine vegetation.

Because vegetated communities comprise a mixture of vegetation types, the acreages are not additive and the total marine vegetation area potentially impacted by in-water construction activities would be 2.8 acres (0.67 and 2.1 acres [0.27 and 0.85 hectare] for the north and south LWI project sites, respectively). As with Alternative 2, construction impacts in the 100-foot wide construction corridor identified in this section are conservative; the actual impact are expected to be substantially less. The eelgrass beds would be avoided when placing the PSB buoy mooring anchors.

As described in Section 3.1.2.2.3, installation of the LWI PSBs would temporarily increase suspended sediment concentrations and turbidity levels as a result of resuspension of bottom sediments during relocation and placement of PSB mooring anchors. Propeller wash impacts

Table 3.2–6. Marine Habitat Impacted by LWI Alternative 3

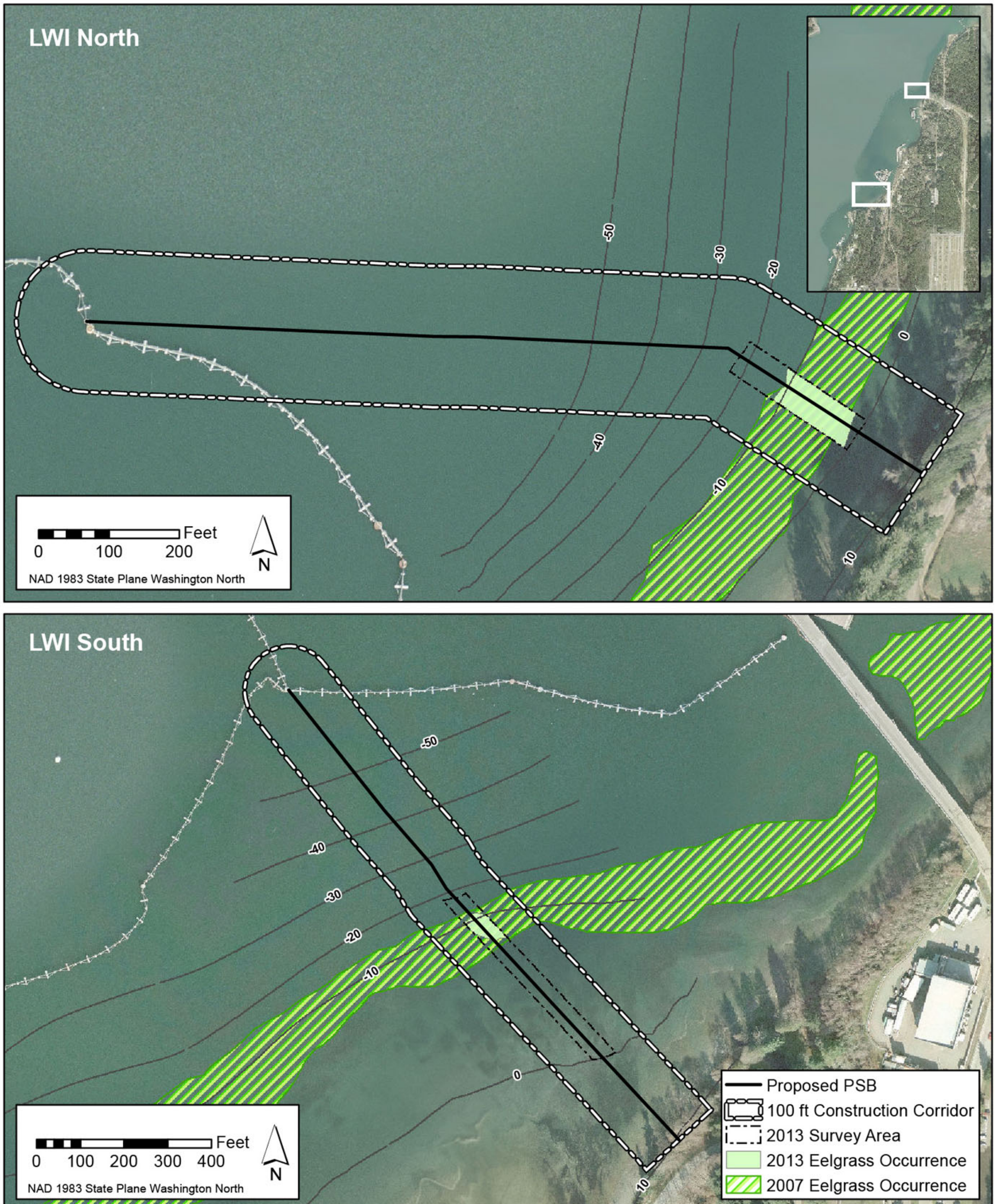
Habitat Type	Potential Temporary Construction Disturbance Area in Acres (Hectares)[1]	Operational Full Shading in Acres (Hectares)[2]	Operational Partial Shading in Acres (Hectares)[2]	Permanent Losses due to PSB & Buoy Grounding in Acres (Hectares)[3]
Nearshore	5.9 (2.4)	0.046 (0.019)	0.07 (0.029)	0.06 (0.024)
Deep Water	6.8 (2.8)	0	Reduction[4]	0
Vegetation Type[5]				
Eelgrass[6]	1.0 (0.39)	0	0.01 (0.0039)	0.013 (0.0054)
Green Macroalgae	2.4 (1.0)	0	0.027 (0.011)	0.043 (0.018)
Red Macroalgae	1.9 (0.75)	0	0.0072 (0.0029)	0.01 (0.0039)
Brown Macroalgae (Kelp)	0.51 (0.21)	0	Negligible	Negligible

1. The potential construction disturbance area includes the structure footprint and the area within 100 feet of the proposed LWI structures. Calculated based on results of the 2007 survey, which covered the entire 100-foot (30-meter) construction corridor.
2. Full shading would be from the observation posts. Partial shading includes contributions from nearshore PSB pontoons (estimated 8 modules at the north LWI project site and 18 modules at the south LWI project site; shade from each module is 105 square feet) and the observation post stairs. Operational impacts on marine vegetation were calculated based on results of the 2013 survey, which covered the area 25 feet (7.6 meters) to either side of the centerline of the proposed LWI structures.
3. There would be some overlap in the areas partially shaded by the PSB pontoons and the areas impacted by grounded PSBs. Impact calculations for vegetated habitats include relocated and/or new PSB mooring anchors; the nearshore habitat calculation does not include mooring anchors because there would be an overall net reduction in the area of mooring anchors.
4. There would be a net reduction in deep water PSB mooring anchors and shading due to relocation of some PSB segments to nearshore waters. The amount of reduction was not calculated due to the variability in deep-water pontoon positions as tides change.
5. Eelgrass and macroalgae overlap in their occurrence along the Bangor shoreline. Therefore, the total acreage of marine vegetation potentially impacted cannot be calculated by summing the values for each vegetation type.
6. Barges would avoid placing spuds or anchors in eelgrass beds wherever possible.

could occur in shallow waters, although current practices would be employed to prevent or minimize these effects. Construction activities would not result in persistent increases in turbidity levels, and increases in turbidity levels would be short-term and localized as suspended sediments would disperse and/or settle rapidly (within a period of minutes to hours) after construction activities cease. Therefore, turbidity impacts on marine vegetation would be localized and temporary.

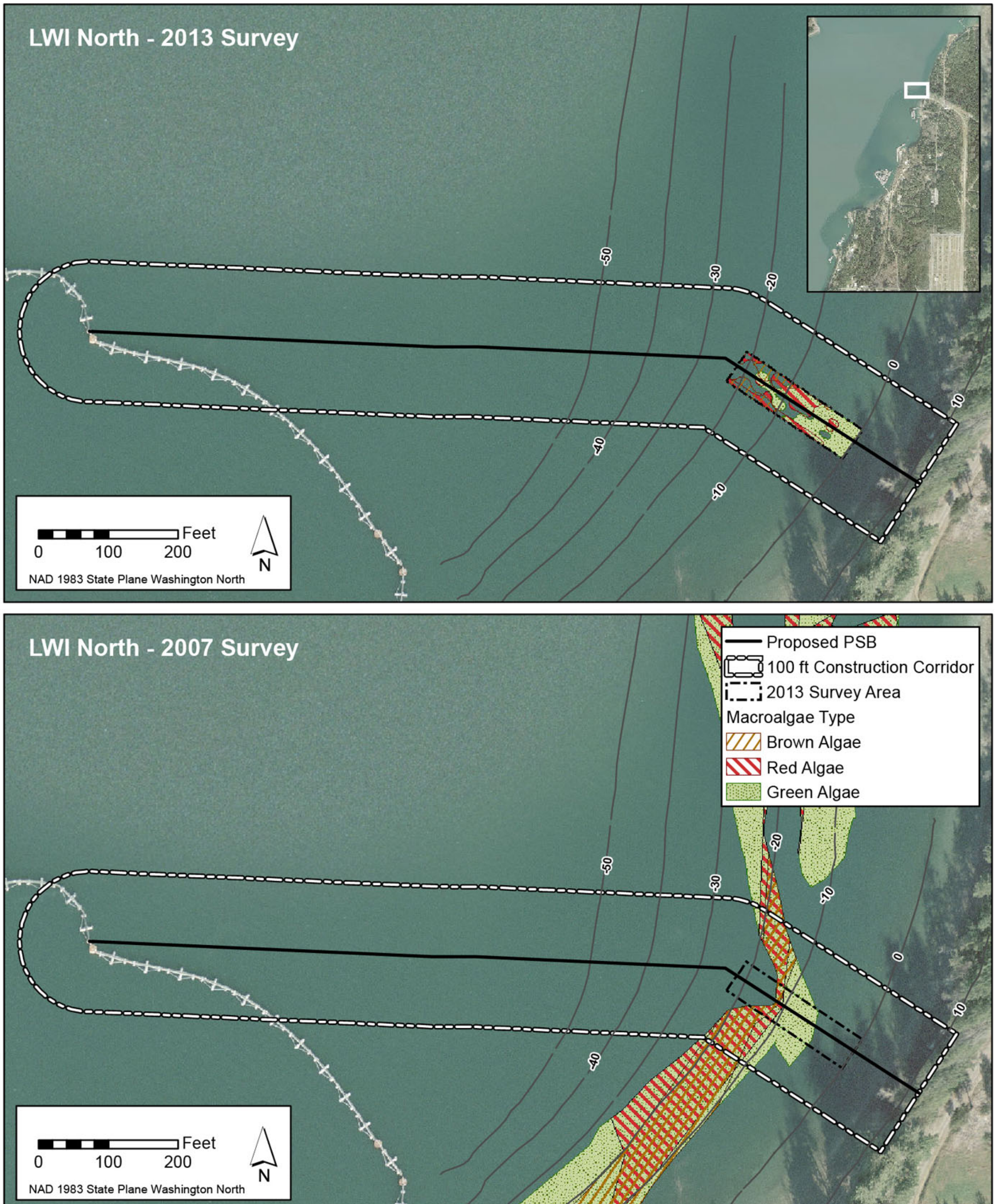
OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 3

It is anticipated that during lower low water conditions, no more than 5 PSB modules on the north LWI and 13 on the south LWI would “ground out” (i.e., touch the bottom). On average, however, between mean high and MLLW, approximately 11 PSB units including a total of 33 pontoons would ground out in the intertidal zone. To minimize the resulting disturbance of



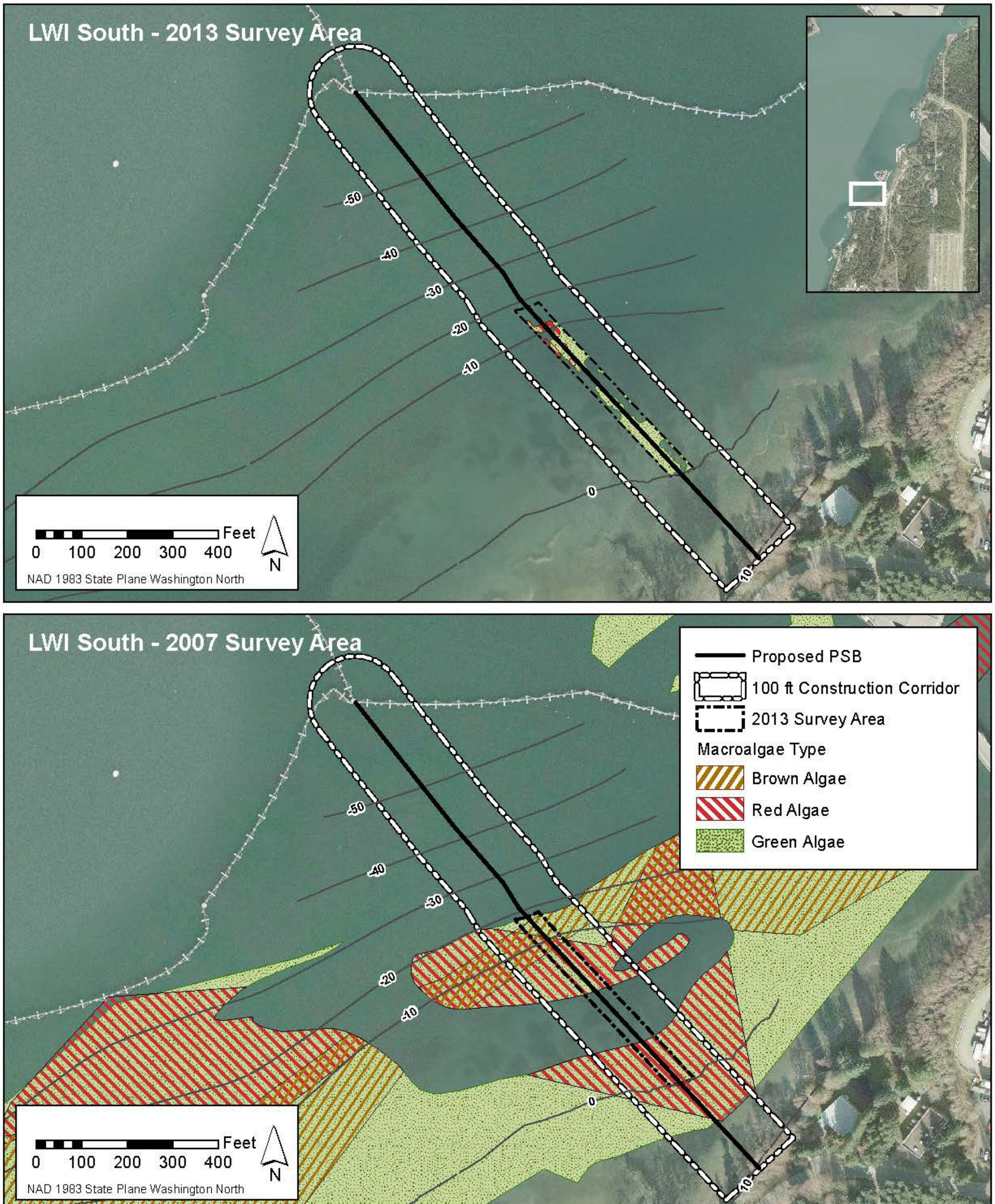
Source: SAIC 2009; Leidos and Grette Associates 2013a

Figure 3.2–12. Disturbance Areas for Eelgrass near the LWI Alignments, Alternative 3



Source: SAIC 2009; Leidos and Grette Associates 2013a

Figure 3.2–13. Disturbance Area for Macroalgae near the North LWI Alignment, Alternative 3



Source: SAIC, 2009; Leidos and Grette Associates, 2013a

Figure 3.2-14. Disturbance Area for Macroalgae near the South LWI Alignment, Alternative 3

the intertidal zone, each pontoon would be fitted with metal "feet" that would prevent the entire pontoon from contacting the surface. The PSB sections and buoys would be moored to minimize side to side movement. Combined with the local bathymetry and predictable flood and ebb influence on PSB pontoon position, this is expected to result in clean grounding with little to no scouring. Over the long term, it is estimated that PSB feet and buoys would disturb approximately 2,594 square feet (241 square meters) of the intertidal zone.

During very low tides, up to two PSB units and one buoy are anticipated to ground out in the north LWI eelgrass bed and one PSB unit would ground out in the south LWI eelgrass bed. Up to 0.013 acre (0.0054 hectare) of eelgrass habitat, 0.043 acre (0.018 hectare) of green macroalgae, and lesser amounts of red and brown macroalgae habitat would be eliminated under PSB buoy mooring anchors and over time due to PSB and buoy grounding. The anchors, however, would support macroalgae colonization. Drift algae may accumulate on the PSB guard panels. However, macroalgae colonizing the panels and drift algae accumulated on these structures would be periodically removed during maintenance.

Partial shading effects from Alternative 3 on marine vegetation would be from the nearshore PSB units. Each PSB unit would create 0.0024 acre (0.00098 hectare) of shading, for a total of approximately 0.063 acre (0.025 hectare) of shading in the nearshore area. However, the PSBs would move with the tides and currents and would not continually shade or limit marine vegetation growth at the depths where there is no grounding. There would be a net reduction in shading of deep water due to the relocation of PSB units from deep water to nearshore areas. The observation posts would be located above the areas of marine vegetation; the post on Marginal Wharf would not create new over-water coverage. Therefore, operation of these posts would not impact marine vegetation.

BENTHIC COMMUNITIES FOR LWI ALTERNATIVE 3

As described in Chapter 2, Alternative 3 would not construct piers, but would construct and install new floating PSB systems that would connect to new shoreline abutments and the existing but reconfigured floating PSB systems. The alignments and lengths of the LWIs would be the same as for Alternative 2, but substrate disturbance would be less in Alternative 3.

CONSTRUCTION OF LWI ALTERNATIVE 3

Construction impacts on benthic communities would be less under this alternative because of the slightly smaller construction corridor (12.7 acres for Alternative 3 vs. 13.1 acres for Alternative 2), and the less intensive construction required to place buoy anchors and a small number of piles in the upper intertidal that would be installed from land (Table 3.2–7). Further, LWI Alternative 3 would require only one in-water construction season versus two in-water seasons for Alternative 2. An estimated 6.1 acres (2.5 hectares) and 6.6 acres (2.7 hectares) of benthic habitat potentially would be impacted within the 100-foot (30-meter) wide construction corridors of the north and south LWI, respectively. The benthic communities in the footprints of the PSB anchors used to moor the eight buoys (total of 236 square feet [22 square meters] for each 3-anchor leg buoy and 139 square feet [13 square meters] for each 2-anchor leg buoy) would be eliminated when they are installed. Assuming 100-foot wide construction corridors, up to 0.18 acre (0.074 hectare) of the north LWI oyster bed and 0.64 acre

(0.26 hectare) of the south LWI oyster bed, for a total of 0.83 acre (0.33 hectare) could be disturbed during construction.

Table 3.2–7. Benthic Community Resources Impacted by LWI Alternative 3

Impact Type	Benthic Community Area[1] in Acres (Hectares)	Oyster Bed Area[2] in Acres (Hectares)
Potential Temporary Construction Disturbance	12.7 (5.2)	0.83 (0.33)
Permanent Loss under Piles and Concrete Pads[3]	0.0033 (0.0013)	0
Nearshore Operational Shading	0.12 (0.047)	0.0027 (0.0011)
Operational Substrate Disturbance (under pontoon feet and buoys)	0.06 (0.024)	0.013 (0.0052)

1. Benthic community area in the 100-foot (30-meter) wide construction corridor around the PSB system area.
2. The impact area for the benthic community includes the oyster bed; thus, the oyster bed is a subset of the benthic community.
3. The piles for the observation posts and the concrete pads for the abutment stairs would be located in the high intertidal above benthic habitats.

As described in Section 3.1.2.2.3, construction of LWI Alternative 3 would temporarily increase suspended sediment concentrations and turbidity levels as a result of resuspension of bottom sediments during relocation and placement of PSB mooring anchors. Propeller wash impacts could occur in shallow waters, although current practices would be employed to prevent or minimize these effects. There would be less potential for sedimentation impacts for Alternative 3 than for Alternative 2 because no piles would be driven in the water and only one in-water construction season would be required.

There would be little potential for noise impacts because there would be no in-water pile driving for this alternative. The observation post piles, with a total footprint of 0.0027 acre (0.0011 hectare), would be located in the upper intertidal zone above the oyster beds and driven in the dry. While construction equipment and boats would emit noise, this would be temporary and generally of the same magnitude as other industrial activities along the Bangor shoreline.

The area of riprap placed at the LWI abutments would be 4,100 square feet (381 square meters). The length of riprap would be 410 feet (125 meters) and the width would be approximately 10 feet (3 meters). The riprap would extend from MHHW to approximately 10 feet above MLLW at the north LWI and 9 feet (2.7 meters) above MLLW at the south LWI. Since no benthic communities occur in this zone no impact would occur to benthic communities from the placement of riprap at base of abutment structures.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 3

Under Alternative 3 there would be a small net decrease in the number of PSB anchors and in the amount of seafloor disturbed by anchor chains. The observation post piles and PSB anchors would be colonized by hard-bottom species and common fouling communities and would effectively result in soft-bottom benthos converted to hard-bottom benthos. These communities are known to support a variety of organisms including a number of green and red algae species, mussels (*Mytilus* spp.), copepods, and amphipods. This conversion from soft-bottom benthos to hard-bottom substrate would result in minor localized faunal and floral changes, but it would not result in any loss of biological productivity.

Up to 18 PSB pontoon units and 3 buoys would touch the intertidal substrates during lower low tides, 5 PSBs and 1 buoy at the north LWI and 13 PSBs and 2 buoys at the south LWI. Over time, each pontoon foot would disturb an area approximately 10 times its size, given shifts of the PSB systems during tidal cycles and buoys would disturb an area approximately five times their size. The total area disturbed is estimated at 0.06 acre (0.024 hectare), with 0.017 acre (0.0067 hectare) at the north LWI project site and 0.043 acre (0.0017 hectare) at the south LWI project site. Repeated disturbance to the sediment surface in these localized areas would substantially reduce the habitat value for benthic organisms.

The total area of nearshore benthic habitats shaded by the PSB pontoons in Alternative 3 would be considerably less than the shading from Alternative 2 (0.063 acre vs. 0.34 acre [0.025 vs. 0.14 hectare]), although nearly all of the LWI Alternative 2 shading would be by grated piers, floating docks, and gangways that would transmit some light. Observation posts would contribute a total of 0.046 acre (0.019 hectare) of full shading in the upper intertidal zone under LWI Alternative 3. Benthic habitat conversion (4,266 square feet [396 square meters]) due to placement of the abutment stair landings, observation post piles, and riprap below MHHW would occur from LWI Alternative 3 (impacts of the riprap would be minimized by covering it with native beach material). There would be no net gain in deep water shading due to relocation of existing PSB units from deep water to nearshore areas when the LWI is constructed.

PLANKTON FOR LWI ALTERNATIVE 3

As described in Chapter 2, LWI Alternative 3 would not construct piers, but would construct and install new floating PSB systems that would connect to new shoreline abutments and the existing but reconfigured floating PSB systems. The alignments and lengths of the LWIs would be the same as for LWI Alternative 2.

CONSTRUCTION OF LWI ALTERNATIVE 3

Potential impacts on plankton from construction of LWI Alternative 3 would be similar to those described for LWI Alternative 2. The construction disturbance area would be slightly smaller under LWI Alternative 3 due to the slightly smaller construction corridor (12.7 vs. 13.1 acres [5.2 vs. 5.3 hectares]) and less intensive construction, and only one in-water construction season would be required versus two for LWI Alternative 2.

As described in Section 3.1.2.2, construction of the PSBs would temporarily increase suspended sediment concentrations and turbidity levels as a result of resuspension of bottom sediments during relocation and placement of PSB mooring anchors. Propeller wash impacts could occur in shallow waters, although current practices would be employed to prevent or minimize these effects. Releases of nutrients to the water column due to sediment resuspension during construction would not be of sufficient magnitude to cause an increase in phytoplankton blooms, including harmful algal blooms, along the Bangor shoreline.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 3

Operational impacts on plankton from LWI Alternative 3would be primarily due to impacts from shading. Potential impacts on plankton from artificial lighting would be minimal and similar to those described for Alternative 2. Operational shading from this alternative would be limited to the observation posts, which would be located high in the intertidal zone, and the pontoons in the PSB units in the nearshore where horizontal movement is limited. Observation post shading would be minimized by the height of these structures over the water and the use of grating for the stairs and walkways. Planktonic organisms residing among the fouling vegetation and other organisms on the PSB guard panels would be periodically removed during maintenance when the guard panels are cleaned.

3.2.2.2.4. SUMMARY OF IMPACTS FOR LWI PROJECT ALTERNATIVES

Impacts on marine vegetation and invertebrates during the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.2–8.

Table 3.2–8. Summary of LWI Impacts on Marine Vegetation and Invertebrates

Alternative	Environmental Impacts on Marine Vegetation and Invertebrates
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Pier	**Marine Vegetation** *Construction:* Would temporarily disturb marine vegetation in a localized area. Potential disturbance of 6.2 acres (2.5 hectares) of shallow water habitat including 1.1 acres (0.43 hectare) of eelgrass, 2.6 acres (1.1 hectare) of green macroalgae, 2.0 acres (0.81 hectare) of red macroalgae, and 0.57 acre (0.23 hectare) of brown macroalgae (primarily kelp). Construction would be conducted over two in-water work seasons: one to build the piers and one to install the mesh. *Operation/Long-term Impacts:* Permanent loss of eelgrass (0.024 acre [0.01 hectare]) in steel plate anchor and pile footprints. This represents less than 0.13 percent of the existing eelgrass beds at those locations. No full shading in areas of marine vegetation; partial shading from grated structures not expected to impact marine vegetation. **Benthic Invertebrates** *Construction:* Temporary disturbance of community in maximum of 13.1 acres (5.3 hectares); loss of 0.14 acre (0.055 hectare) of benthic organisms in footprints (piles, steel plate anchors, and abutment stair landings); construction would be conducted over two in-water work seasons, with no more than 80 days of in-water pile driving in the first season and mesh installation in the second season. *Operation/Long-term Impacts:* Full overwater shading (0.0029 acre [0.0012 hectare]) may slightly affect sessile benthic organism productivity but would primarily be located high in the intertidal zone above oyster beds; steel piles, plate anchors, and abutment stair landings would result in permanent loss of 0.14 acre (0.055 hectare) of soft-bottom habitat and an increase in hard surface habitat. **Plankton** *Construction:* Indirect and localized effects from increased turbidity and settling of resuspended sediments from in-water construction and vessel activity. Construction would be conducted over two in-water work seasons. *Operation/Long-term Impacts:* No appreciable reduction in primary production of phytoplankton.

Table 3.2–8. Summary of LWI Impacts on Marine Vegetation and Invertebrates (continued)

<table>
<tr><th>Alternative</th><th>Environmental Impacts on Marine Vegetation and Invertebrates</th></tr>
<tr><td>LWI Alternative 3: PSB Modifications (Preferred)</td><td>Marine Vegetation
Construction: Slightly smaller area of potential construction disturbance in shallow water (5.9 acres [2.4 hectares]) including 1 acre (0.39 hectare) of eelgrass, 2.4 acres (1 hectare) of green macroalgae, 1.9 acres (0.75 hectare) of red macroalgae, and 0.51 acre (0.21 hectare) of brown macroalgae (primarily kelp). Construction would be conducted over one in-water work season.
Operation/Long-term Impacts: No full shading in areas with marine vegetation. PSB anchors, and PSB and buoy grounding would impact 0.013 acre (0.0054 hectare) of eelgrass, and less than 0.05 acre (0.02 hectare) of macroalgae habitat.
Benthic Invertebrates
Construction: Slightly smaller area of potential construction disturbance of 12.7 acres (5.2 hectares) (versus 13.1 acres [5.3 hectares]) of benthic habitat; loss of 0.0016 acre (0.00063 hectare) of benthic organisms in pile and abutment stair landing footprints; no in-water pile driving; construction would be conducted over one in-water work season.
Operation/Long-term Impacts: Smaller permanent loss of 0.0033 acre (0.0013 hectare) of soft-bottom habitat from piles and abutment stair landings; however, grounding of pontoon feet and buoys would scour small areas of intertidal habitat (estimated 0.06 acre [0.024 hectare]) over time. Full overwater shading from observation posts in the upper intertidal zone (0.046 acre [0.019 hectare]), more than Alternative 2.
Plankton
Construction: Lower potential for impacts than Alternative 2 due to less intensive construction required, less turbidity, and one less in-water work season.
Operation/Long-term Impacts: No appreciable reduction in primary production of phytoplankton.</td></tr>
<tr><td colspan="2">Mitigation: BMPs and current practices to reduce and minimize impacts on marine vegetation and invertebrates are described in Section 3.2.1.2.4 under Current Requirements and Practices. Under either alternative, proposed compensatory aquatic mitigation (Appendix C, Section 6.0) would compensate for the remaining impacts of the LWI.</td></tr>
<tr><td colspan="2">Consultation and Permit Status:
The Navy included impacts on marine vegetation and benthic communities as part of its consultation with the NMFS West Coast Region office under the ESA and MSA. A biological assessment and EFH assessment were submitted to the NMFS West Coast Region office and the USFWS Washington Fish and Wildlife Office on March 10, 2015. A revised biological assessment was submitted to NMFS and USFWS on June 10, 2015. NMFS issued a Letter of Concurrence on November 13, 2015, concurring with the Navy’s ESA and MSA effect determinations for the preferred alternative. In a concurrence letter dated March 4, 2016, USFWS stated that LWI project impacts to bull trout are not measurable and therefore insignificant, and impacts to marbled murrelets are discountable.
The Navy submitted a JARPA to USACE and other regulatory agencies, requesting permits under CWA Sections 401 and 404, and Rivers and Harbors Act Section 10. Alternative 3 is the Least Environmentally Damaging Practicable Alternative according to the CWA Section 404(b)(1) guidelines.
The Navy submitted a CCD to WDOE.</td></tr>
</table>

BMP = best management practice; CCD = Coastal Consistency Determination; CWA = Clean Water Act; EFH = Essential Fish Habitat; ESA = Endangered Species Act; JARPA = Joint Aquatic Resources Permit Application; MSA = Magnuson-Stevens Fishery Conservation and Management Act; NMFS = National Marine Fisheries Service; USACE = U.S. Army Corps of Engineers; WDOE = Washington Department of Ecology

3.2.2.3. SPE PROJECT ALTERNATIVES

3.2.2.3.1. SPE ALTERNATIVE 1: NO ACTION

Under the No Action Alternative, the SPE would not be built and operations in the area would not change from current levels. Therefore, there would be no impacts on marine vegetation, benthic communities, or plankton.

3.2.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

VEGETATION COMMUNITIES FOR SPE ALTERNATIVE 2

CONSTRUCTION OF SPE ALTERNATIVE 2

The total area of habitat in the potentially disturbed construction area for SPE Alternative 2 would be 1 acre (0.42 hectare) in the nearshore and 2.9 acres (1.2 hectares) in deep water (Table 3.2–9; Figures 3.2–15 and 3.2–16). Of those 3.9 acres (1.6 hectares), approximately 0.45 acre (0.18 hectare) (11 percent) supports marine vegetation communities, primarily green macroalgae. However, construction activities would largely be restricted to deep waters (30 feet [9 meters] below MLLW and deeper) beyond the depths where marine vegetation occurs. The impact area would consist of the SPE footprint where existing piles would be removed and new piles would be driven and a 100-foot (30-meter) wide corridor where barges would be stationed and tugboats would maneuver the barges during construction. The only seafloor areas that would be highly disturbed would be where the piles are removed or installed, which are located beyond the depths where marine vegetation occurs at the site. Most of the sediments at the SPE site are coarse grained and resuspended sediments would settle close to the disturbance area

Table 3.2–9. Marine Habitat Impacted by SPE Alternative 2

Habitat Type	Potential Temporary Construction Disturbance Area in Acres (Hectares)[1]	Area Permanently Displaced by Piles in Acres (Hectares)[2]	Operational Shading in Acres (Hectares)
Nearshore	1.0 (0.42)	0	0
Deep Water	2.9 (1.2)	0.045 (0.018)	1.0 (0.41)
Vegetation Type[3]			
Eelgrass[4]	Negligible	0	0
Green Macroalgae	0.27 (0.11)	0	0
Red Macroalgae	Negligible	0	0
Brown Macroalgae (Kelp)	Negligible	0	0

1. The potential temporary construction disturbance area includes the structure footprint and the area within 100 feet (30 meters) of the proposed SPE structure.
2. Includes the area displaced by the proposed pier extension piles minus the area of piles being removed from the existing Service Pier.
3. Eelgrass and macroalgae overlap in their occurrence along the Bangor shoreline. Therefore, the total acreage of marine vegetation potentially impacted cannot be calculated by summing the values for each vegetation type.
4. No piles would be installed in eelgrass and barges would avoid anchoring in eelgrass beds wherever possible.

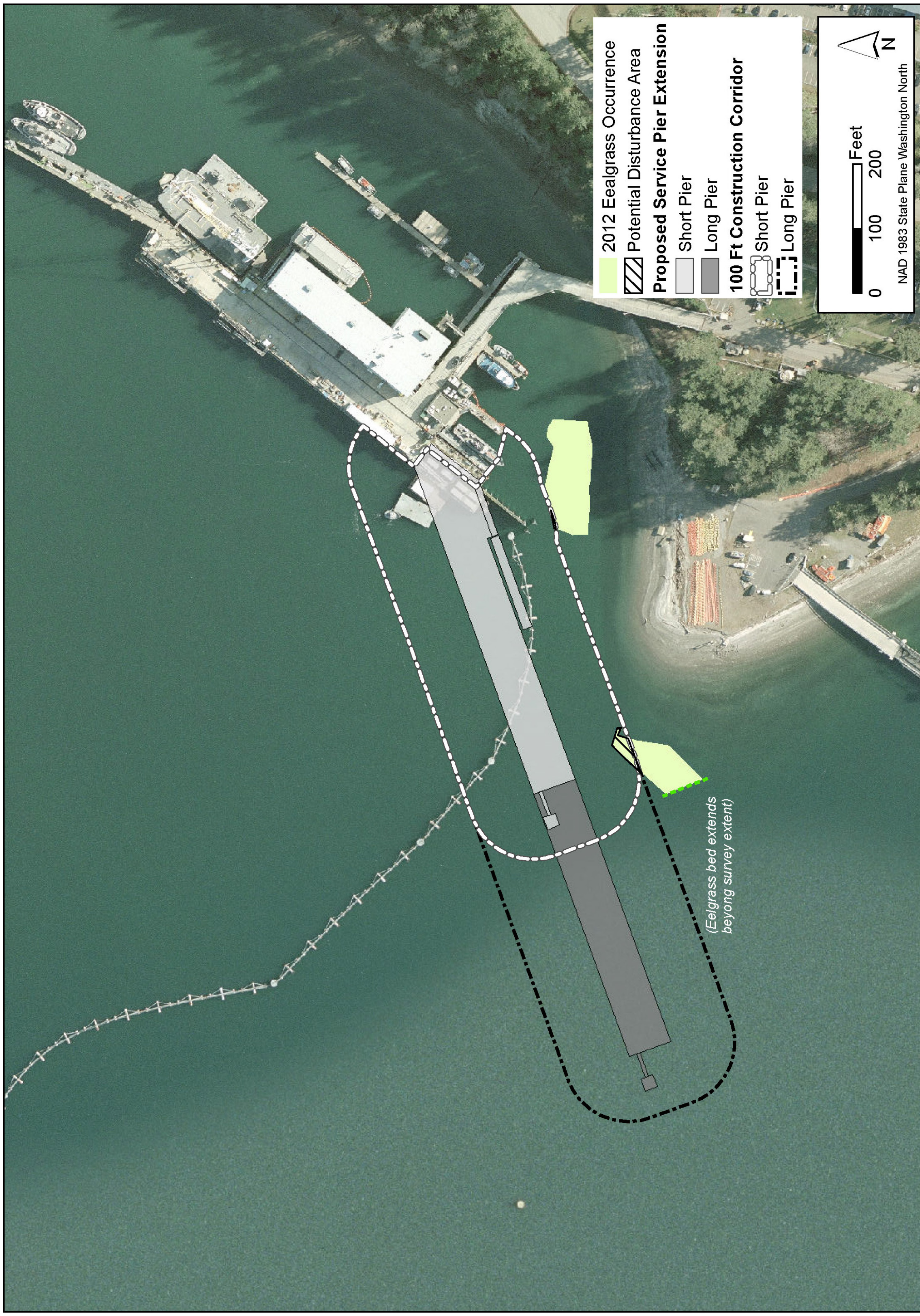
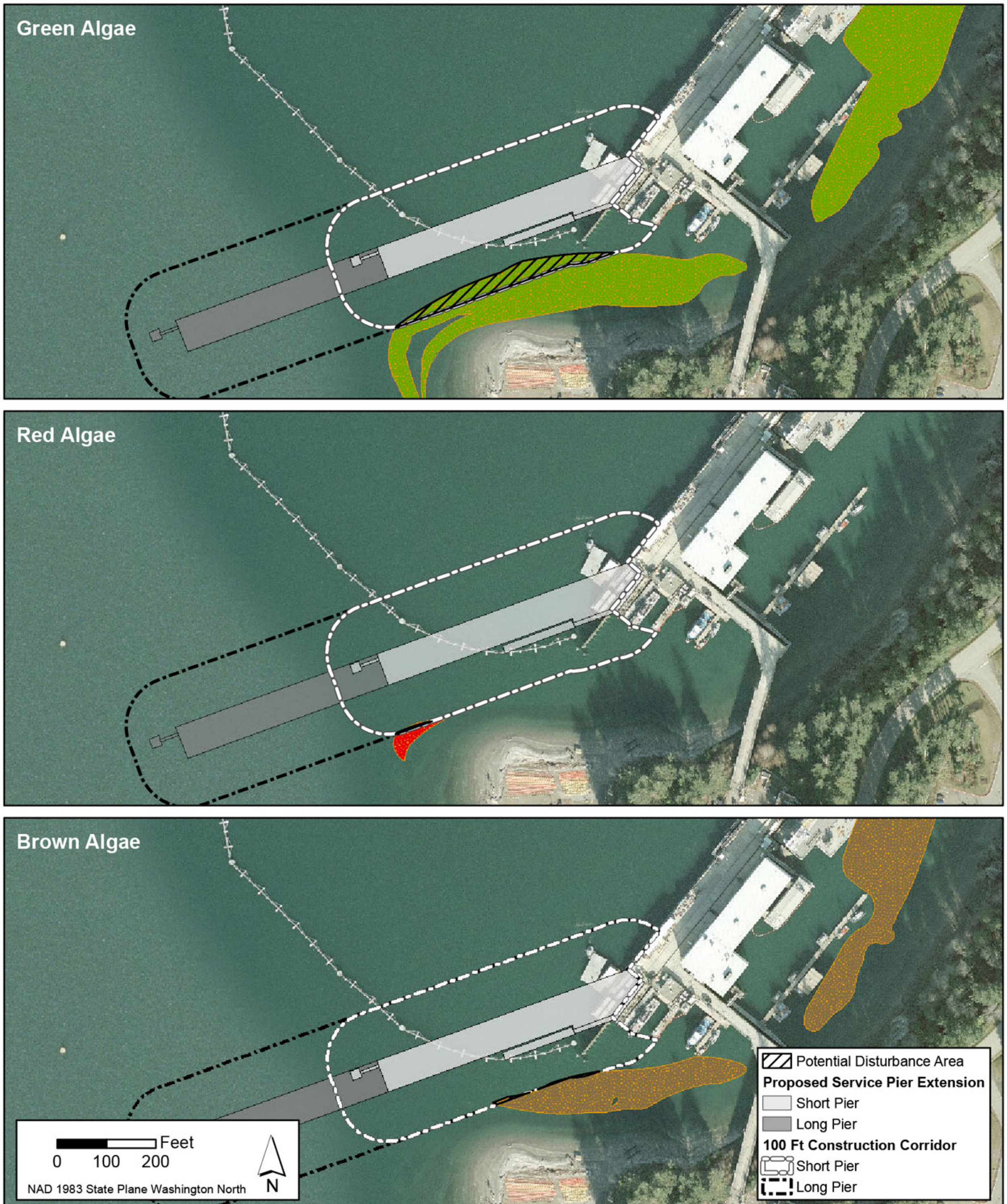


Figure 3.2–15. Disturbance Area for Eelgrass near SPE Alternatives 2 and 3

Source: Anchor QEA 2012



Source: SAIC 2009

Figure 3.2–16. Disturbance Area for Macroalgae near SPE Alternatives 2 and 3

(Section 3.1.2.2.2, under Water Quality). Given the distance of the site to marine vegetation and the low percentage of fines, turbidity plumes would be short-lived and settling of resuspended fines on submerged vegetation is expected to be minimal.

Sargassum is an invasive algal species that can be introduced to new areas by distribution on the hulls of barges, tugboats, and other boats, and on propellers or anchors (review in Josefsson and Jansson 2007). Given the existing *Sargassum* in the SPE construction area, contractors constructing the SPE would be required to comply with RCW 77.15.290 (*Unlawful transportation of fish or wildlife — Unlawful transport of aquatic plants — Penalty*), which imposes penalties for transporting invasive aquatic plants and requires recreational and commercial boats be decontaminated. The piles and other materials for the structures would be new and therefore would not be sources of attached exotic organisms. In addition, the vessels used during construction would also be required to comply with U.S. Coast Guard regulations designed to minimize the spread of exotic species. As a result, construction of the SPE would not introduce exotic species from foreign water bodies or increase the prevalence of existing exotic species in Hood Canal.

The potential for spills during construction is described for Other Contaminants in Section 3.1.2.3.2. The existing facility response and prevention plans for the Bangor shoreline provide guidance that would be used in a spill response, such as a response procedures, notification, and communication plan; roles and responsibilities; and response equipment inventories. In the event of an accidental spill, response measures would be implemented immediately to minimize potential impacts on the surrounding environment. Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups. Therefore, overall construction activities associated with SPE Alternative 2 would not cause long-term impacts on marine vegetation.

Given the water depths at the project site and restriction of construction vessels to the construction corridor and deep waters, there would be no significant impacts on marine vegetation from construction of SPE Alternative 2.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 2

While the SPE would shade 1.0 acre (0.41 hectare), this shading would be in deep waters that do not support marine vegetation as of the 2007 survey (Table 3.2–9). The piles would support colonization of algae common to marine fouling communities, such as *Ulva*.

Operation of SPE Alternative 2 would not increase the risk of accidental spills of fuel, explosives, cleaning solvents, and other contaminants that, if spilled, would impact marine vegetation. This is because the existing NAVBASE Kitsap Bangor spill prevention and response plans would help prevent fuel spills. In the event of an accidental spill, emergency cleanup measures would be implemented immediately in accordance with state and federal regulations. The cleanup would minimize impacts on the surrounding environment. Therefore, there would be no operational impacts on marine vegetation from SPE Alternative 2.

BENTHIC COMMUNITIES FOR SPE ALTERNATIVE 2

CONSTRUCTION OF SPE ALTERNATIVE 2

Construction impacts of SPE Alternative 2 on the benthic community would be due primarily to pile removal and installation activities, with disruption of the sediment and at least partial loss of the community in the affected area. There would be some minor loss of encrusting species (e.g., mussels) on the piles removed from the existing Service Pier.

Potential noise impacts (e.g., reproductive impairment of some invertebrate species, in the form of delayed egg maturity [Christian et al. 2003]) would be limited to the immediate area around piles being driven by impact hammer and to the period of construction. However, most of the piles would be driven using the vibratory method, which would result in noise levels that are not expected to result in impacts on benthic species.

An estimated 3.9 acres (1.6 hectares) of benthic habitat potentially would be impacted within the 100-foot (30-meter) wide construction corridor of SPE Alternative 2 (Table 3.2–10). The benthic communities in the footprints of the piles (0.046 acre [0.019 hectare]) would be eliminated when the piles are installed. A total of 0.0012 acre (0.00051 hectare) of piles would be removed, for a net conversion of 0.045 acre (0.018 hectare) of benthic habitat. There would be some disturbance to sediments and benthic community from pile removal and vessel anchors, but there would be little potential disturbance from propeller wash and no potential for barge grounding due to the water depths at the site. Intertidal habitats, including clam and oyster beds, would be outside the 100-foot wide construction zone and would not be impacted by construction of SPE Alternative 2. The potential for releases of creosote from treated piles removed during construction of SPE Alternative 2 would be managed by BMPs and current practices (Section 3.1.1.2.3) that would minimize the potential for releases of creosote to the water column, which could affect benthic organisms.

Table 3.2–10. Benthic Community Resources Impacted by SPE Alternative 2

Impact Type	Benthic Community Area in Acres (Hectares)
Potential Temporary Construction Disturbance	3.9 (1.6)
Permanent loss under piles[1]	0.045 (0.018)
Operational Shading	1.0 (0.41)

1. Includes the area displaced by the proposed pier extension piles minus the area of piles being removed from the existing Service Pier.

Previous studies of dredged, sediment capped, and other disturbed sites show that many benthic and epibenthic invertebrates rapidly recolonize disturbed bottom areas within 2 years of disturbance (CH2M Hill 1995; Romberg et al. 1995; Parametrix 1994a, 1999; Anchor Environmental 2002; Vivan et al. 2009). Dredging and placement of clean sediment caps at contaminated sites provide extreme examples of benthic recovery from disturbance, demonstrating how benthic organisms have the capability to recover from habitat perturbations and recolonize disturbed areas over time. Many benthic organisms lost due to turbidity and bottom disturbances by barges, tugboats, and anchors would 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 2 to 3 years to reach sexual maturity (Chew and Ma 1987; Goodwin and Pease 1989) and may require 5 years to recover from disturbance such as smothering by sediment (study discussed in Chew and Ma 1987). Therefore, shellfish communities under the SPE impacted by construction would be expected to recover within approximately 5 years after construction. Ecological productivity would be reduced during the 5-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. Effects would not likely be measurable due to the small amount of habitat affected compared to the amount of available habitat in this part of Hood Canal.

The increased potential for spills during construction, spill response, and debris cleanup would be as described above for marine vegetation, under Vegetation Communities.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 2

Operation impacts of the SPE on the benthic community would be due primarily to the conversion of soft-bottom habitat to hard-bottom habitat (0.045 acre [0.018 hectare]). The piles would be colonized by hard-bottom species such as mussels (*Mytilus* sp.) and sea anemones that would attach to the piles (the fouling community). The fouling community also would support other species such as amphipods, annelids, gastropods, and predatory sea stars (Kozloff 1983; Cohen et al. 1998; Brooks 2004; Cordell 2006; PSAT 2006). The decrease in soft-bottom habitat and increase in hard substrate habitat would result in a localized change in species composition (Glasby 1999; Atilla et al. 2003). Impacts due to shading of benthic habitat would be unlikely due to the depth of the water at the pier site.

Impacts on the physical properties of sediments are discussed in Section 3.1.2.3.2, under Sediment Quality; as noted in that section, the SPE would have a minor localized effect on sediment texture due to scouring and deposition related to flow patterns around the individual piles. However, these changes would occur gradually over time, would be localized at the piles, and would not adversely impact benthic communities.

As described for Marine Water Resources (Section 3.1), operation of the SPE would not impact water quality near the project site. The slight increase in potential for spills during operations would be as described in Section 3.1.2.3.2.

PLANKTON FOR SPE ALTERNATIVE 2

CONSTRUCTION OF SPE ALTERNATIVE 2

Construction impacts on plankton from SPE Alternative 2 would be related to localized and temporary increases in turbidity levels. Turbidity plumes would be short-lived (minutes to hours). Turbidity increases would occur during the in-water work season, which is outside of the period of greatest phytoplankton productivity in Puget Sound (May). Sediments at the SPE project site have low organic carbon levels (less than 2 percent) (Section 3.1.1.1.3, under Physical and Chemical Properties of Sediments). Therefore, releases of nutrients to the water column due to sediment resuspension during SPE construction would not be of sufficient magnitude to cause an increase in phytoplankton productivity, including harmful algal blooms, along the Bangor shoreline. The increased potential for spills during construction, spill response, and debris cleanup would be as described above for marine vegetation, under Vegetation Communities.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 2

Impacts on plankton from SPE Alternative 2 operations would be due primarily to artificial lighting and shading, and the creation of habitat for both planktonic species and predators that feed on plankton. Shading created by SPE Alternative 2 would be approximately 1.0 acre (0.41 hectare) (Table 3.2–10). Security lighting directed at the water would come on only when needed, and surface currents would quickly move planktonic organisms through the area. Therefore, shading and artificial lighting from the SPE pier would not significantly impact plankton resources. Due to water depth at the site, turbidity resulting from propeller wash would be minimal. The potential for spills during operations would be as described in Section 3.1.2.3.2. Therefore, there would be no operational impacts on plankton from SPE Alternative 2.

3.2.2.3.3. SPE ALTERNATIVE 3: LONG PIER

VEGETATION COMMUNITIES FOR SPE ALTERNATIVE 3

CONSTRUCTION OF SPE ALTERNATIVE 3

Potential construction impacts on marine vegetation from SPE Alternative 3 would be the same as described for Alternative 2 (Table 3.2–11; Figures 3.2–15 and 3.2–16) except that there would be slightly less substrate disturbance due to the smaller diameter of piles installed under this alternative. Although the area of potential impacts would be greater (6.6 acres vs. 3.9 acres [2.7 vs. 1.6 hectares] for SPE Alternative 2) due to the increased length of the pier extension, the only seafloor areas that would be highly disturbed would be where the existing piles would be removed and new piles would be installed, which are at depths beyond where marine vegetation occurs in this area.

Table 3.2–11. Marine Habitat Impacted by SPE Alternative 3

Habitat Type	Potential Temporary Construction Disturbance Area in Acres (Hectares)[1]	Area Permanently Displaced By Piles in Acres (Hectares)[2]	Operational Shading in Acres (Hectares)
Nearshore	1.0 (0.42)	0	0
Deep Water	5.5 (2.2)	0.043 (0.017)	1.6 (0.65)
Vegetation Type[3]			
Eelgrass[4]	Negligible	0	0
Green Macroalgae	0.27 (0.11)	0	0
Red Macroalgae	Negligible	0	0
Brown Macroalgae (Kelp)	Negligible	0	0

Table 3.2–11. Marine Habitat Impacted by SPE Alternative 3 (continued)

1. The potential temporary construction disturbance area includes the structure footprint and the area within 100 feet (30 meters) of the proposed SPE structures.
2. Includes the area displaced by the proposed pier extension piles minus the area of piles being removed from the existing Service Pier.
3. Eelgrass and macroalgae overlap in their occurrence along the Bangor shoreline. Therefore, the total acreage of marine vegetation potentially impacted cannot be calculated by summing the values for each vegetation type.
4. No piles would be installed in eelgrass and barges would avoid anchoring in eelgrass beds wherever possible.

There would be some minor loss of fouling vegetation on the piles removed from the existing Service Pier. As with SPE Alternative 2, contractors would be required to comply with RCW 77.15.290 (*Unlawful transportation of fish or wildlife — Unlawful transport of aquatic plants — Penalty*) and U.S. Coast Guard regulations designed to minimize the spread of exotic species including *Sargassum*, which has been documented in the area.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 3

The operation and long-term impacts of SPE Alternative 3 would be similar to those described for SPE Alternative 2, including shading and localized effects of the piles on the substrate. The piles and the shaded areas would be in depths of 30 to 100 feet (9 to 30 meters) below MLLW or deeper, which is beyond the depths where marine vegetation occurs in this area of the shoreline. Therefore, there would be no operational impacts on marine vegetation.

BENTHIC COMMUNITIES FOR SPE ALTERNATIVE 3

CONSTRUCTION OF SPE ALTERNATIVE 3

Benthic community impacts from construction of SPE Alternative 3 would be the same as described for SPE Alternative 2 except that the potential disturbance area would be larger (6.6 vs. 3.9 acres [1.6 vs. 2.7 hectares]), the benthic community lost in the pile footprints would be slightly less (0.043 vs. 0.045 acre [0.017 vs. 0.018 hectare]), and the duration of pile driving would be greater (up to 205 days vs. up to 161 days for Alternative 2) (Table 3.2–12).

Table 3.2–12. Benthic Community Resources Impacted by SPE Alternative 3

Impact Type	Benthic Community Area in Acres (Hectares)
Potential Temporary Construction Disturbance	6.6 (2.7)
Permanent loss under piles[1]	0.043 (0.017)
Operational Shading	1.6 (0.65)

1. Includes the area displaced by the proposed pier extension piles minus the area of piles being removed from the existing Service Pier.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 3

Benthic community impacts from operation of SPE Alternative 3 would be the same as described for SPE Alternative 2 except that the area of operational shading would be greater (1.6 vs. 1.0 acres [0.65 vs. 0.41 hectare]) and the amount of soft-bottom lost in the pile footprints would be greater (660 vs. 385 piles). As noted for SPE Alternative 2, shading would be limited to deeper waters and would not be expected to impact the benthic community. Sediment changes would be as described for SPE Alternative 2, would occur gradually over time, and would not adversely impact benthic communities.

PLANKTON FOR SPE ALTERNATIVE 3

CONSTRUCTION OF SPE ALTERNATIVE 3

Construction impacts on plankton for SPE Alternative 3 would be similar to those described for SPE Alternative 2, but the area of potential impacts would be greater (6.6 acres vs. 3.9 acres [2.7 vs. 1.6 hectares]) due to the larger structural footprint of this alternative.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 3

Operational impacts of SPE Alternative 3 (increased feeding opportunities for plankton predators due to pier lighting) would be similar to those described for SPE Alternative 2 but the area of potential impacts would be greater due to the larger structural footprint of this alternative (1.6 vs. 1.0 acres [0.65 vs. 0.41 hectare]).

3.2.2.3.4. SUMMARY OF IMPACTS FOR SPE PROJECT ALTERNATIVES

Impacts on marine vegetation and invertebrates during the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.2–13.

Table 3.2–13. Summary of SPE Impacts on Marine Vegetation and Invertebrates

Alternative	Environmental Impacts on Marine Vegetation and Invertebrates
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	**Marine Vegetation** *Construction:* Small areas of marine vegetation (primarily green macroalgae) potentially would be disturbed in the construction corridor, but construction would largely occur in water depths that are greater than macroalgae habitat. Construction would be conducted over two in-water work seasons. *Operation/Long-term Impacts:* No overwater shading of existing marine vegetation communities; increase in hard-surface habitat for encrusting species (e.g., *Ulva*). **Benthic Resources** *Construction:* Temporary disturbance of community in maximum of 3.9 acres (1.6 hectares); loss of 0.045 acre (0.018 hectare) of benthic habitat in pile footprints; construction would be conducted over two in-water work seasons, with no more than 161 days of in-water pile driving. *Operation/Long-term Impacts:* Overwater shading (1.0 acre [0.41 hectare]) unlikely to impact sessile benthic organism productivity; permanent loss of 0.045 acre (0.018 hectare) of soft-bottom habitat, increase in hard surface habitat on piles. **Plankton** *Construction:* Indirect and localized effects from increased turbidity and settling of resuspended sediments from in-water construction and vessel activity. *Operation/Long-term Impacts:* No appreciable reduction in primary production of phytoplankton; increased feeding opportunities for plankton predators due to pier lighting.

Table 3.2–13. Summary of SPE Impacts on Marine Vegetation and Invertebrates (continued)

Alternative	Environmental Impacts on Marine Vegetation and Invertebrates
SPE Alternative 3: Long Pier	**Marine Vegetation** *Construction:* Same areas of marine vegetation (primarily green macroalgae) potentially disturbed in the construction corridor as SPE Alternative 2. Construction would be conducted over two in-water work seasons. *Operation/Long-term Impacts:* Same as SPE Alternative 2, but larger increase in hard-surface habitat due to greater number of piles (660 vs. 385). **Benthic Resources** *Construction:* Greater temporary disturbance of community than SPE Alternative 2 in maximum of 6.6 acres (2.7 hectares); loss of 0.043 acre (0.017 hectare) of benthic organisms in pile footprints; construction would be conducted over two in-water work seasons, with no more than 205 days of in-water pile driving. *Operation/Long-term Impacts:* Overwater shading (1.6 acres [0.65 hectare]) unlikely to impact sessile benthic organism productivity; permanent loss of 0.043 acre (0.017 hectare) of soft-bottom habitat, increase in hard surface habitat on piles. **Plankton** *Construction:* Greater potential for impacts than SPE Alternative 2 due to 68 percent larger construction area. *Operation/Long-term Impacts:* No appreciable reduction in primary production of phytoplankton; increased feeding opportunities for plankton predators due to pier lighting.
Mitigation: BMPs and current practices to reduce and minimize impacts on marine vegetation and invertebrates are described in Section 3.2.1.2.4 under Current Requirements and Practices. Under either alternative, proposed compensatory aquatic mitigation (Appendix C, Section 6.0) would compensate for the remaining impacts of the SPE.	
Consultation and Permit Status: The Navy included impacts on marine vegetation and benthic communities as part of its consultation with the NMFS West Coast Region office under the ESA and MSA. A biological assessment and EFH assessment were submitted to the NMFS West Coast Region office and the USFWS Washington Fish and Wildlife Office on March 10, 2015. A revised biological assessment was submitted to NMFS and USFWS on June 10, 2015. ESA consultation with NMFS is ongoing. In a concurrence letter dated March 4, 2016, USFWS stated that SPE project impacts to bull trout are not measurable and therefore insignificant, and impacts to marbled murrelets are discountable. The Navy will submit a JARPA to USACE and other regulatory agencies, requesting permits under CWA Section 401 and Rivers and Harbors Act Section 10. Alternative 2 is the Least Environmentally Damaging Practicable Alternative according to the CWA Section 404(b)(1) guidelines. The Navy will submit a CCD to WDOE.	

BMP = best management practice; CCD = Coastal Consistency Determination; CWA = Clean Water Act; EFH = Essential Fish Habitat; ESA = Endangered Species Act; JARPA = Joint Aquatic Resources Permit Application; MSA = Magnuson-Stevens Fishery Conservation and Management Act; NMFS = National Marine Fisheries Service; USACE = U.S. Army Corps of Engineers; WDOE = Washington Department of Ecology

3.2.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

3.2.2.4.1. MARINE VEGETATION

The LWI would impact up to 3 acres (1.2 hectares) of marine vegetation during construction and would contribute up to 0.024 acre (0.01 hectare) loss of eelgrass in Hood Canal during operation. Macroalgae losses would total approximately 0.08 acre (0.032 hectare) for LWI (much less for LWI Alternative 3), but this amount would be functionally decreased by the hard surface attachment habitat of the steel plates, piles, and anchors. The introduction of hard surfaces is not considered to be mitigation for soft-bottom habitat loss. Both SPE alternatives would contribute only minor (0.28 acre [0.1 hectare]) impacts on marine vegetation (primarily green macroalgae), during construction only, due to the deep project bottom depths. There would be no operational contribution of the SPE to marine vegetation impacts.

3.2.2.4.2. BENTHIC COMMUNITIES

The LWI pier piles (Alternative 2) and observation post piles (Alternative 3), steel plate anchors (LWI Alternative 2), and abutment stair landings (either alternative) would contribute 0.0033 to 0.14 acre (0.0013 to 0.055 hectare) of soft-bottom habitat conversion in Hood Canal, and the SPE piles would contribute 0.043 to 0.045 acre (0.017 to 0.018 hectare), depending on the alternative, of soft-bottom habitat conversion, for a combined total of up to 0.18 acre (0.074 hectare). Both projects would increase hard surfaces that would support benthic species adapted to these surfaces, such as mussels and anemones. The introduction of hard surfaces is not considered to be mitigation for soft-bottom habitat loss.

3.2.2.4.3. PLANKTON

Individually and combined, the LWI and SPE projects would have minimal, localized impacts on plankton through shading, artificial lighting, and creation of habitat for filter feeders on plankton.

The combined impacts of the LWI and SPE projects on marine vegetation, benthic communities, and plankton are summarized below in Table 3.2–14.

Table 3.2–14. Summary of Combined LWI/SPE Impacts for Marine Vegetation, Benthic Communities, and Plankton

Resource	Combined LWI/SPE Impacts
Marine Vegetation	The combined effects of the LWI and SPE projects on marine vegetation would be minor and localized, except for eelgrass losses, which would be up to 0.024 acre (0.01 hectare) and require mitigation.
Benthic Communities	Construction and operation of the LWI and SPE projects combined would result in primarily localized and temporary impacts on benthic communities, with the exception of the permanent conversion of up to 0.18 acre (0.074 hectare) of soft-bottom benthic habitat to hard-bottom habitat for both projects combined.
Plankton	Construction of the LWI and SPE projects would result in temporary impacts on plankton that would be localized and immeasurable. Therefore, the combined effects of the two projects on plankton would be no greater than localized and temporary.

3.3. FISH

3.3.1. Affected Environment

3.3.1.1. EXISTING CONDITIONS

Hood Canal is known to support at least 250 species of marine fish, including anadromous species (salmonids) that live part of their life cycle in fresh water (Schreiner et al. 1977; Miller and Borton 1980; Prinslow et al. 1980; Bax 1983; Salo 1991; Bhuthimethee et al. 2009; Burke Museum 2010). Common fish species known or expected to occur in Hood Canal are listed in Appendix A. Seven threatened or endangered marine fish species have the potential to occur in the waters of northern Hood Canal, and are discussed separately under the Threatened and Endangered Species section below (Section 3.3.1.3). Non-ESA-listed marine fish have been categorized into three groups (salmonids, forage fish, and other marine fish) to facilitate a discussion of similar species, and are discussed in Section 3.3.1.4. Non-ESA-listed salmonids include both naturally spawning and hatchery-released salmon and trout species. Forage fish are those species that are considered a vital food resource to salmonids and other fish predators, as discussed in Section 3.3.1.5. Other marine fish include all other species ranging from benthic dwelling (demersal) to shallow-water species. Other marine fish are discussed in Section 3.3.1.6.

Seven salmonid species occur within the marine waters of Hood Canal: Chinook salmon, chum salmon, coho salmon, pink salmon, steelhead, bull trout, and cutthroat trout. Five hatcheries augment salmon populations by releasing four of these species (Chinook, chum, coho, and pink salmon) into Hood Canal. In 2006, approximately 34 million hatchery salmonids were released in Hood Canal to support the multi-million-dollar sport, commercial, and tribal salmon fisheries in the region (SAIC 2006; Appendix B). These releases included approximately 25.1 million chum, 6.7 million Chinook, 1.6 million coho, and 467,000 pink salmon. Release dates varied from April 1 to June 1, depending on species and release location (SAIC 2006; Regional Mark Processing Center 2009). Since hatcheries were not required to mark 100 percent of all salmonids released, unmarked hatchery fish captured along the Bangor shoreline are indistinguishable from naturally spawned fish (SAIC 2006; Bhuthimethee et al. 2009). This is particularly problematic when estimating the distinction between seasonal occurrence and abundance of naturally spawned summer-run chum, naturally spawned fall-run chum, and hatchery-released chum salmon (SAIC 2006; Bhuthimethee et al. 2009; Appendix B).

Forage fish species present along the Bangor shoreline primarily include Pacific herring, surf smelt, and Pacific sand lance. In addition, over 45 other non-salmonid finfish species occur in the vicinity of the proposed project area (SAIC 2006; Bhuthimethee et al. 2009).

Marine fish species that are more prevalent in deeper offshore habitats include a variety of rockfish species, Pacific hake, walleye pollock, wolfeel, skates, sharks, lanternfish, snailfish, and flatfish species. Recent fish surveys in nearshore habitats along the Bangor shoreline have documented the occurrence of juvenile salmonids and forage fish, as well as a variety of other species, including perches, gunnels, pricklebacks, sculpins, pipefish, threespine sticklebacks, tubesnouts, and juvenile flatfish species (Bhuthimethee et al. 2009).

Fish habitat along the Bangor waterfront has been characterized as diverse and healthy based on analyses of fish species richness, composition, abundance, and size distribution; fish habitat includes marine waters, estuaries, and streams (URS 1994). Of particular importance are the freshwater outlets from Hunter's Marsh, Devil's Hole, and Cattail Lake that provide warmer, nutrient-rich fresh water in these areas. This warmer water supports dense marine vegetation and benthic communities, which provide refuge and food sources for marine fish, including juvenile salmon.

3.3.1.2. ESSENTIAL FISH HABITAT

The MSA (16 USC 1801-1881 et seq.), through the Essential Fish Habitat (EFH) provision, protects waters and substrate necessary for federally managed (commercially harvested) fisheries in Washington waters. Federal agencies are required to consult with NMFS about activities that may adversely affect EFH for species protected under the MSA. The MSA is currently undergoing reauthorization and is expected to be reauthorized by the time of project construction. The analysis of EFH in this EIS is based on the provisions of the current MSA.

In addition to the federal agencies that regulate threatened and endangered fish species, the Point No Point Treaty Tribes (PNPTT) are co-managers with WDFW in regulating harvest management and supplementation programs for the Hood Canal summer-run chum evolutionarily significant unit (ESU) (71 Federal Register [FR] 47180). The PNPTT include the Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes, who have treaty rights to Usual and Accustomed (U&A) fishing across the summer-run chum geographic range (71 FR 47180). Additional groups that contribute to and oversee recovery planning include the Puget Sound Technical Recovery Team (PSTRT) and the Hood Canal Coordinating Council (HCCC), respectively (71 FR 47182).

The PFMC has designated EFH for Pacific groundfish, coastal pelagic species, and Pacific salmon species (PFMC 2011, 2014a,b). The federally managed species, life stages, and habitats, as indicated by PFMC FMPs, are summarized for Hood Canal and the project vicinity (Table 3.3–1). Pacific groundfish EFH is designated for species and life stages and includes five primary habitats: the epipelagic zone of the water column (including macrophyte canopies and drift algae); unconsolidated sediments of mud and sand; hard-bottom habitats of boulders, bedrock, and coarse deposits; mixed sediments of sand and rocks; and vegetated bottoms with algal beds, macrophytes, or rooted vascular plants (PFMC 2014a, Appendix B4). The PFMC (2014a) has also designated EFH for each individual groundfish species by life stage. For those species that were covered in 2005, these designations are contained within the 2005 Appendix B4 of the FMP. The life history for each of the 2005-covered groundfish species was included in the 2005 Appendix B2 of the Pacific Coast Groundfish FMP (PFMC 2014a, Appendix B2). However, in May 2014 the Pacific Coast Groundfish FMP was updated to include a total of 89 species. Using the Pacific Habitat Use Relational Database developed by the PFMC, it was determined which groundfish species and life stages have EFH designated within the vicinity of the LWI and SPE project sites. Of the groundfish species described in the FMP, 33 were identified through the analysis of the Habitat Use Relational Database as having EFH designated in the vicinity of NAVBASE Kitsap Bangor (Table 3.3–1).

Coastal pelagic EFH consists of all marine and estuarine waters between the shoreline and the exclusive economic zone, above the thermocline and falling between 50 and 79°F (10 and 26°C) in temperature. The PFMC manages coastal pelagic species, two of which (anchovy and market squid) occur in Hood Canal and the vicinity of the project site.

Pacific salmon EFH includes all estuarine waters and substrates, including the nearshore and tidal submerged environments, and freshwater bodies historically accessible to salmon. The PFMC manages three salmonids that occur in Hood Canal: coho, Chinook, and pink salmon.

Table 3.3–1. Fish Species with Designated EFH in Hood Canal

Species	Applicable Life Stages	Designated Habitats
Groundfish		
Big skate	A,J,E	Unconsolidated bottom
Black rockfish	A,J	Artificial structure, hard bottom, vegetated bottom, epipelagic zone, tide pool
Blue rockfish	A,J,L	Hard bottom, vegetated bottom, epipelagic zone
Bocaccio	J,L	Hard bottom, epipelagic zone
Brown rockfish	A,J	Artificial structure, hard bottom, mixed bottom, vegetated bottom, epipelagic zone
Butter sole	A,J,L,E	Unconsolidated bottom, epipelagic zone
Cabezon	A,J,L,E	Hard bottom, tide pool, unconsolidated bottom, vegetated bottom, epipelagic zone
China rockfish	A,J	Hard bottom, vegetated bottom, epipelagic zone
Copper rockfish	A,J	Artificial structure, hard bottom, mixed bottom, vegetated bottom, epipelagic zone
English sole	A,J,E	Unconsolidated bottom, epipelagic zone
Flathead sole	A,J	Unconsolidated bottom
Kelp greenling	A,J,L,E	Hard bottom, vegetated bottom, epipelagic zone
Lingcod	A,J,L,E	Hard bottom, vegetated bottom, unconsolidated bottom, epipelagic zone
Longnose skate	A	Unconsolidated bottom
Pacific sanddab	A,J,L,E	Mixed bottom, unconsolidated, epipelagic zone
Pacific whiting (hake)	A,J	Epipelagic zone
Petrale sole	A,J,L,E	Unconsolidated bottom
Quillback rockfish	A,J,L	Artificial structure, mixed bottom, vegetated bottom, hard bottom, biogenic, epipelagic zone
Redstripe rockfish	A,J,L	Hard bottom, mixed bottom, epipelagic zone
Rex sole	A,J	Unconsolidated bottom
Rock sole	A,J,L,E	Unconsolidated bottom, mixed bottom, epipelagic zone
Sablefish	A,J,L,E	Unconsolidated bottom, epipelagic zone

Table 3.3–1. Fish Species with Designated EFH in Puget Sound (continued)

Species	Applicable Life Stages	Designated Habitats
Sand sole	A,J,L	Unconsolidated bottom, epipelagic zone
Silvergray rockfish	A	Hard bottom
Soupfin shark	A,J	Unconsolidated bottom, epipelagic zone
Spiny dogfish	A,J	Unconsolidated bottom, epipelagic zone
Splitnose rockfish	J,L	Epipelagic zone
Spotted ratfish	A,J,E	Hard bottom, unconsolidated bottom
Starry flounder	A,J,L,E	Unconsolidated bottom, epipelagic zone
Tiger rockfish	A,J,L	Hard bottom, epipelagic zone
Widow rockfish	A,J,L	Hard bottom, mixed bottom, epipelagic zone, unconsolidated bottom, vegetated bottom
Yelloweye rockfish	A,J,L	Hard bottom, mixed bottom, epipelagic zone, biogenic
Yellowtail rockfish	A,J	Hard bottom, unconsolidated bottom, vegetated bottom, epipelagic zone
Coastal Pelagic Species		
Anchovy	A,L,E	All estuarine waters above the thermocline and falling between 10 and 26°C
Market squid	A,L,E	Same as above
Salmon		
Coho	A,J	All estuarine waters and substrates, including the nearshore and tidal submerged environments, and freshwater bodies historically accessible to salmon
Chinook	A,J	Same as above
Pink	A,J	Same as above

Sources: PFMC 2011, 2014a,b.

A = adult; E = eggs; J = juvenile; L = larvae.

3.3.1.3. THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN

This section summarizes species-specific life history and occurrence information, with additional details provided in Appendix B, on ESA-listed salmonids and rockfish. The summary of marine habitat conditions, described in Section 3.3.1.7, is applicable to both ESA-listed and non-listed species of marine fish. Table 3.3–2 provides the federal ESA listing for marine fish and whether critical habitat is designated near the Bangor waterfront.

3.3.1.3.1. PUGET SOUND CHINOOK

The Puget Sound Chinook salmon ESU was listed as federally threatened under the ESA in 1999 (64 FR 14308), with the threatened listing reaffirmed in 2005 (70 FR 37160). Critical habitat was designated for Puget Sound Chinook in 2005 (70 FR 52685) and the recovery plan and supplement to the recovery plan were published in 2007 (NMFS 2006; Shared Strategy for Puget Sound 2007). Chinook are the largest species of salmonid. In general, juveniles out-migrate as

Table 3.3–2. Federally Listed Threatened and Endangered Marine Fish in Hood Canal

Fish	Federal Listing	Critical Habitat	Critical Habitat Designated in Northern Hood Canal
Puget Sound Chinook	Threatened *70 FR 37160, June 28, 2005*	Designated Depth -33 feet (-30 meters) *70 FR 52630, September 2, 2005*	Designated along the shoreline to depth of -33 feet (-30 meters) except not along Bangor waterfront.
Hood Canal summer-run chum	Threatened *64 FR 14508, March 25, 1999*	Designated Depth -33 feet (-30 meters) *70 FR 52630, September 2, 2005*	Designated along the shoreline to depth of -33 feet (-30 meters) except not along Bangor waterfront.
Puget Sound steelhead	Threatened *72 FR 26722, May 11, 2007*	Designated *81 FR 9251, February 24, 2016*	Occupied riverine habitats in the Hood Canal Subbasin.
Bull trout	Threatened *64 FR 58910, November 1, 1999*	Designated Depth -33 feet (-10 meters) *75 FR 63898 October 18, 2010* Effective *November 17, 2010*	Designated along the shoreline to depth of -33 feet (-10 meters). The closest critical habitat occurs along the western and northern shores of Dabob Bay beyond Hazel Point, at the southern tip of Toandos Peninsula, which is outside of the area affected by the proposed action.
Bocaccio	Endangered *75 FR 22276, April 28, 2010*	Designated *79 FR 68041, Primary constituent elements (PCEs) November 13, 2014, Effective February 11, 2015*	Nearshore and deepwater habitats of Hood Canal, excluding DoD boundaries.
Canary rockfish	Threatened *75 FR 22276, April 28, 2010*	Designated *79 FR 68041, PCEs November 13, 2014, Effective February 11, 2015*	Nearshore and deepwater habitats of Hood Canal, excluding DoD boundaries.
Yelloweye rockfish	Threatened *75 FR 22276, April 28, 2010*	Designated *79 FR 68041, PCEs November 13, 2014, Effective February 11, 2015*	Nearshore and deepwater habitats of Hood Canal, excluding DoD boundaries.

DoD = Department of Defense; FR = Federal Register sub-yearlings or yearlings and return to spawn as adults, generally after 3 to 5 years. Chinook salmon are one of the least abundant salmonids occurring along the Bangor shoreline (Appendix B, Figure B–1). From 2005 to 2008 a total of 58,667 salmonids were captured in beach seine surveys along the NAVBASE Kitsap Bangor waterfront (SAIC 2006; Bhuthimethee et al. 2009). During that time period, only 224 of the total number of salmonids captured (approximately 0.4 percent) were juvenile Chinook salmon (Appendix B, Figure B–1). As suggested by findings of Chamberlin et al. (2011), juvenile Chinook salmon may have extended intra-basin residence times, and may not necessarily utilize nearshore habitats solely as a nearshore migratory corridor during out-migration. Additional details describing the life history of Puget Sound Chinook are also provided in Appendix B.

CRITICAL HABITAT DESCRIPTION

A final designation of Puget Sound Chinook salmon critical habitat was published on September 2, 2005, with an effective date of January 2, 2006 (70 FR 52685). Nearshore marine waters within Hood Canal were included as part of this designation. Although critical habitat occurs in northern Hood Canal waters adjacent to the base (Figure 3.3-1), NAVBASE Kitsap Bangor is excluded from critical habitat designation for ESA-listed Puget Sound Chinook salmon by federal law (70 FR 52630; 81 FR 7226). No Puget Sound Chinook salmon critical habitat is located in the immediate vicinity of the LWI or SPE project sites. The closest critical habitat is located immediately beyond the northern and southern base boundaries.

OCCURRENCE AT LWI PROJECT SITES

Appendix B provides detailed information regarding the in-migration and spawn timing of adult Puget Sound Chinook past NAVBASE Kitsap Bangor and within the greater Hood Canal region. In general, adult Chinook salmon enter Hood Canal waters from August to October and begin spawning in their natal streams in September, with peak spawning occurring in October. Juvenile Puget Sound Chinook peak out-migration along the Bangor shoreline, and within the greater Hood Canal region, generally occurs from May to early July. As described further in Appendix B, Chinook salmon are one of the least abundant salmonids occurring along the Bangor shoreline, with occurrence in survey data so low that determining a prevalence at one location over another was not possible (SAIC 2006; Bhuthimethee et al. 2009).

OCCURRENCE AT SPE PROJECT SITES

Due to the close proximity, adult and juvenile Chinook at the SPE site would be comparable to those occurrences at the LWI project sites.

3.3.1.3.2. HOOD CANAL SUMMER-RUN CHUM SALMON

The Hood Canal summer-run chum salmon ESU was federally listed as threatened under the ESA in 1999, and the threatened listing was reaffirmed in 2005 (70 FR 37160) (Table 3.3–2). Critical habitat was also designated for Hood Canal summer-run chum ESU in 2005, and the NMFS recovery plan for this species was adopted on May 24, 2007 (72 FR 29121). The Hood Canal summer-run chum ESU includes all naturally spawned populations and supplemented stocks of summer-run chum salmon in Hood Canal and its tributaries. Reduced viability, lower survival, and listing of extant stocks of summer-run chum and recent stock extinctions in Hood Canal are

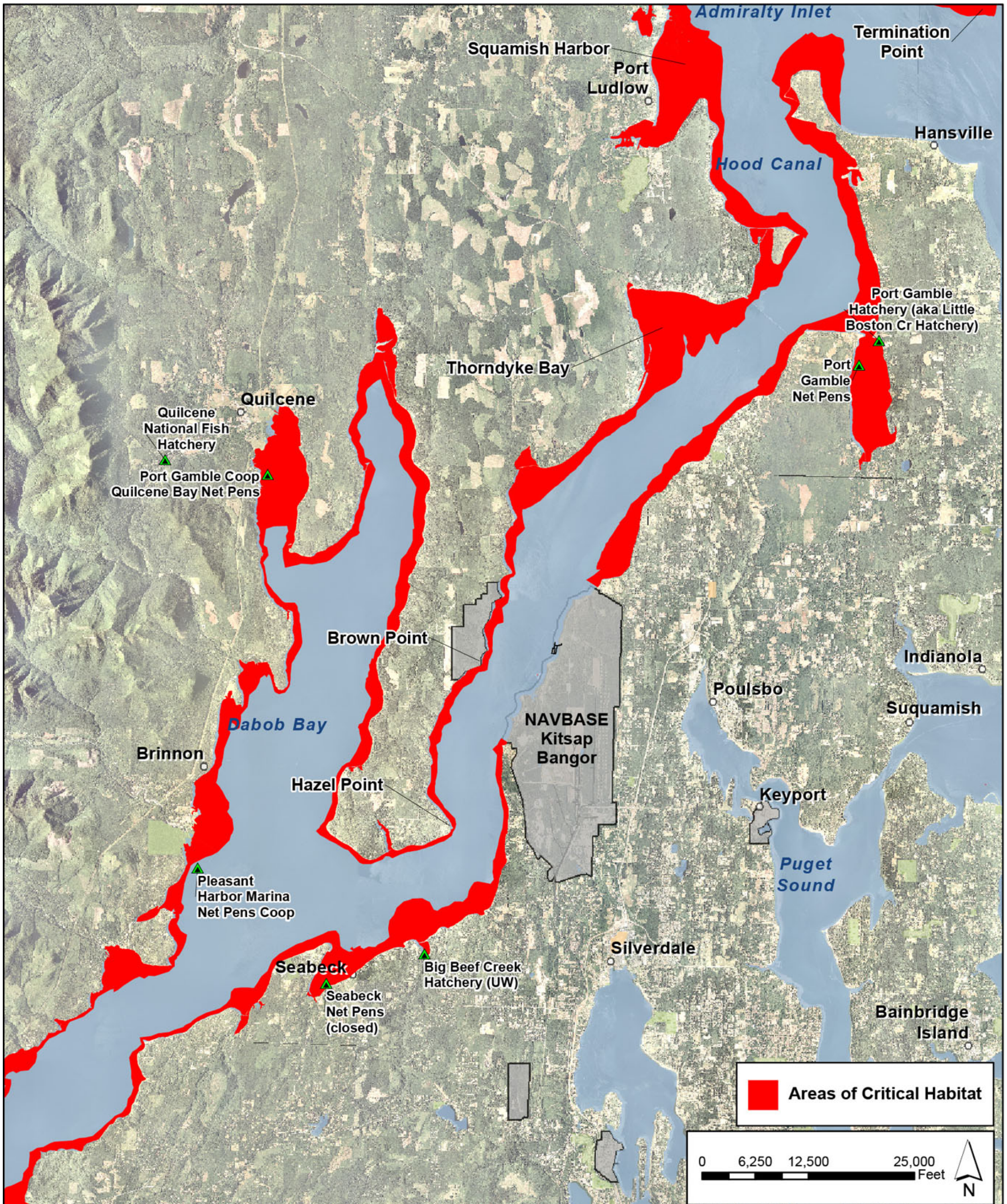


Figure 3.3–1. Puget Sound Chinook and Hood Canal Summer-Run Chum Salmon Critical Habitat for Hood Canal Nearshore Marine Areas

attributed to the combined impacts of three primary factors: (1) habitat loss and degradation, (2) climate change, and (3) increased fishery harvest rates (HCCC 2005). An additional factor cited in WDFW and PNPTT (2000) and HCCC (2005) was impacts associated with the releases of hatchery salmonids, which compete with naturally spawning stocks for food and other resources. Additional details describing the life history of Hood Canal summer-run chum salmon are provided in Appendix B.

CRITICAL HABITAT DESCRIPTION

A final designation of Hood Canal summer-run chum salmon critical habitat was published on September 2, 2005, with an effective date of January 2, 2006 (70 FR 52685). Nearshore marine waters within Hood Canal were included as part of this designation. Although critical habitat occurs in northern Hood Canal waters adjacent to the base (Figure 3.3–1), NAVBASE Kitsap Bangor is excluded by federal law (70 FR 52630; 81 FR 7226) from critical habitat designation for ESA-listed Hood Canal summer-run chum salmon. No Hood Canal summer-run chum salmon critical habitat is located in the immediate vicinity of the LWI or SPE project sites. The closest critical habitat is immediately beyond the northern and southern base boundaries.

OCCURRENCE AT LWI PROJECT SITES

Appendix B provides detailed information regarding the in-migration and spawn timing of adult Hood Canal summer-run chum salmon and out-migration of juveniles past NAVBASE Kitsap Bangor, and within the greater Hood Canal region. Juvenile chum salmon were much more abundant than any other salmonid species captured along the Bangor shoreline (SAIC 2006; Bhuthimethee et al. 2009; Appendix B, Figure B–1). From 2005 to 2008 a total of 58,667 salmonids were captured in beach seine surveys along the NAVBASE Kitsap Bangor waterfront (SAIC 2006; Bhuthimethee et al. 2009). During that time 55,554 of the total number of salmonids captured (approximately 94.7 percent) were juvenile chum salmon (Appendix B, Figure B–1). Young-of-the-year chum salmon migrate almost immediately after hatching in their natal streams, occurring along the NAVBASE Kitsap Bangor shoreline as early as January and as late as June (SAIC 2006; Bhuthimethee et al. 2009). Later releases by hatcheries in Hood Canal south of the base generally occur in April and May (SAIC 2006; Bhuthimethee et al. 2009). Summer-run chum adults return to Hood Canal from as early as August and September through the first week in October (Washington Department of Fisheries et al. 1993; WDFW and PNPTT 2000).

OCCURRENCE AT SPE PROJECT SITES

Due to the close proximity of the SPE project site to the south LWI project site, the occurrence of adult and juvenile summer-run chum salmon at the SPE project site would be comparable to occurrences at the south LWI project site.

3.3.1.3.3. PUGET SOUND STEELHEAD

The Puget Sound steelhead was listed in May 2007 under the ESA as a threatened distinct population segment (72 FR 26722). A distinct population segment (DPS) is a term used under the ESA to define a population or group of populations that is discrete from other populations of the species and significant in relation to the entire species. Stocks of the Puget Sound steelhead DPS are mainly winter-run, although a few small stocks of summer-run steelhead also occur (71 FR

15666). As indicated by NMFS (2011) the principal factor for decline for Puget Sound steelhead is the present or threatened destruction, modification, or curtailment of its habitat or range. Within the proposed project area these threats may include barriers to fish passage, adverse effects on water quality, loss of wetland and riparian habitats, and other urban development activities contributing to the loss and degradation of steelhead habitats in Hood Canal. Additional details describing the life history of Puget Sound steelhead are provided in Appendix B.

CRITICAL HABITAT DESCRIPTION

Puget Sound steelhead critical habitat was proposed in January 2013 (78 FR 2725) and designated in February 2016 (81 FR 9251). Within the Hood Canal Subbasin, currently occupied riverine habitat is proposed as Puget Sound steelhead critical habitat. NAVBASE Kitsap Bangor is excluded by federal law (70 FR 52630; 81 FR 7226) from critical habitat designation. No steelhead critical habitat is located in the immediate vicinity of the LWI or SPE project areas.

OCCURRENCE AT LWI PROJECT SITES

Steelhead would be expected to occur most frequently in the late spring and early summer months, but overall this species does not occur in large numbers along the Bangor shoreline (SAIC 2006; Bhuthimethee et al. 2009; Appendix B, Figure B–1). Numbers are insufficient to determine site preference along the Bangor shoreline (Appendix B). The majority of adult winter-run steelhead in Hood Canal (Skokomish, Hamma Hamma, Duckabush, Quilcene/Dabob Bay, and Dosewallips) spawn from mid-February to mid-June (WDFW 2002) (Appendix B). Information published to date indicates that adult winter-run steelhead spawning occurs from mid-February to early June. Spawn timing of summer-run steelhead in Hood Canal is not fully understood; however, spawning is believed to occur from February through April (WDFW 2002). From 2005 to 2008 a total of 58,667 salmonids were captured in beach seine surveys along the NAVBASE Kitsap Bangor waterfront (SAIC 2006; Bhuthimethee et al. 2009). During that time period only 58 of the total number of salmonids captured (approximately 0.1 percent) were juvenile steelhead (Appendix B, Figure B–1). In the 2013 proposed critical habitat notification, studies reviewed by NMFS indicated that "steelhead migratory behavior strongly suggest that juveniles spend little time (a matter of hours in some cases) in estuarine and nearshore areas and do not favor migration along shorelines" (78 FR 2725).

OCCURRENCE AT SPE PROJECT SITES

Due to the close proximity of the SPE project site to the south LWI project site, the occurrence of adult and juvenile steelhead at the SPE project site would be comparable to occurrences at the south LWI project site.

3.3.1.3.4. BULL TROUT

Currently, all populations of bull trout in the lower 48 states are listed as threatened under the ESA. The recovery plan for the coterminous U.S. bull trout population was published in September 2015 (USFWS 2015). Bull trout are in the char subgroup of salmonids and have both resident and migratory life histories (64 FR 58910). The Coastal-Puget Sound bull trout DPS reportedly contains the only occurrence of anadromous bull trout in the contiguous United States (64 FR 58912); Hood Canal is one of five geographically distinct regions within this DPS.

However, in a recent biological opinion, the USFWS noted summaries of recent tagging studies that indicated bull trout in the South Fork Skokomish River are not anadromous, and Cushman Dam currently blocks all upstream access and most downstream access to the marine environment for bull trout in the North Fork of the Skokomish River (USFWS 2011). Historical observations of bull trout in accessible anadromous reaches of several west Hood Canal tributary rivers (Quilcene, Hamma Hamma, Dosewallips, and Duckabush) are noted from the 1980s (as reviewed by USFWS 2009). Spawning was not believed to occur in these rivers and bull trout were presumed to use Hood Canal marine waters as a migration corridor (USFWS 2009).

Neither historic nor more recent fish surveys at the NAVBASE Kitsap Bangor waterfront (using beach and lampara seines and tow nets) have captured bull trout (Schreiner et al. 1977; Salo et al. 1980; Bax 1983; SAIC 2006; Bhuthimethee et al. 2009; WDFW 2015 unpublished data). Based on this information and the lack of documented anadromy from the Skokomish River core population, USFWS considered bull trout unlikely to migrate through the NAVBASE Kitsap Bangor waterfront from the Skokomish River (USFWS 2011).

CRITICAL HABITAT DESCRIPTION

Critical habitat was originally designated for bull trout in 2005 (70 FR 56212) with a final revision to this habitat published in 2010 (75 FR 63898). NAVBASE Kitsap Bangor is excluded by federal law (70 FR 52630; 81 FR 7226) from critical habitat designation. Although both the original and revised final bull trout critical habitat occur in Hood Canal, neither designates waters north of Hazel Point, at the southeastern tip of Toandos Peninsula (Figure 3.3–2). No bull trout critical habitat is located in the immediate vicinity of the LWI or SPE project areas.

OCCURRENCE AT LWI AND SPE PROJECT SITES

Bull trout in the Skokomish River system are thought to spawn from mid-September to December (WDFW 2004). For the species overall, emergence of fry occurs from early April to May (64 FR 58910). Not enough is known to fully describe the duration of juvenile out-migration specifically for bull trout in Hood Canal (WDFW 2004), although it is unlikely that bull trout migrate through the Bangor waterfront and past the LWI or SPE project site (USFWS 2010). Neither historic nor recent juvenile fish surveys (using beach and lampara seines and tow nets) have captured bull trout (Schreiner et al. 1977; Salo et al. 1980; Bax 1983; SAIC 2006; Bhuthimethee et al. 2009).

3.3.1.3.5. BOCACCIO

Puget Sound bocaccio, a species of rockfish, were federally listed as endangered under the ESA in 2010 (75 FR 22276) (Table 3.3–2). Although rockfish are typically long-lived, recruitment is generally poor as larval survival and settlement are dependent on a variety of factors including marine currents, adult abundance, habitat availability, and predator abundance (Palsson et al. 2009; Drake et al. 2010). The combination of these factors, and the threats described below, has contributed to declines in the species within Georgia Basin and Puget Sound in the last few decades (74 FR 18516). The species is believed to have commonly occurred along steep walls in most of Puget Sound prior to fishery exploitations, although they are currently very rare in these habitats (Love et al. 2002). Information on habitat requirement for most rockfishes is limited

Figure 3.3–2. Bull Trout Critical Habitat for Hood Canal Nearshore Marine Areas

despite years of research. Even less is known about bocaccio in Puget Sound (Palsson et al. 2009; Drake et al. 2010). Appendix B provides more detailed information regarding the general life history of bocaccio, and their prevalence within Puget Sound.

Threats to rockfish in Puget Sound include areas of low DO, commercial and sport fisheries (notably mortality associated with fishery bycatch), reduction of kelp habitat necessary for juvenile recruitment (74 FR 18516), habitat disruption (including exotic species), derelict gear (e.g., lost or abandoned fishing nets), climate change, species interactions (including predation and competition), diseases, and genetic changes (Palsson et al. 2009; Drake et al. 2010).

CRITICAL HABITAT DESCRIPTION

Critical habitat for yelloweye rockfish, canary rockfish, and bocaccio of the Puget Sound Georgia Basin was designated in November 2014 (79 FR 68042). The NMFS summary description of rockfish critical habitat locations, boundaries, and essential features is provided in Section 3.3.1.8.1. NAVBASE Kitsap Bangor is excluded by federal law (70 FR 52630; 81 FR 7226) from critical habitat designation, while NMFS' designation of rockfish critical habitat (79 FR 68041) specifically exempts the Bangor Naval Restricted Areas (Figure 1–2). Therefore, no designated rockfish critical habitat occurs in the immediate vicinity of the LWI or SPE project areas.

OCCURRENCE AT LWI AND SPE PROJECT SITES

Palsson et al. (2009) noted bocaccio were only recorded 110 times in their review of historical Puget Sound studies, with most records being associated with sport catch from the 1970s in Tacoma Narrows and Appletree Cove (near Kingston). There are only two records of bocaccio in Hood Canal, both in the 1960s, and there were no confirmed observations of bocaccio in Puget Sound for the 7-year period leading up to 2009 (74 FR 18516). A recent survey by WDFW detected only one bocaccio in the main basin of Puget Sound (Frierson et al. 2015, personal communication).

The most recent review of rockfish occurrence in Puget Sound included several citations for historical occurrences in Hood Canal (NMFS 2014a). WDFW is currently conducting rockfish surveys within Hood Canal, however preliminary results have not identified ESA-listed species (Frierson et al. 2015, personal communication). Therefore, bocaccio rockfish have the potential to occur within waters adjacent to the NAVBASE Kitsap Bangor waterfront, but they are anticipated to be extremely rare.

3.3.1.3.6. CANARY ROCKFISH

Puget Sound canary rockfish were federally listed as threatened under the ESA in 2010 (75 FR 22276) (Table 3.3–2). Similar to bocaccio, adult canary rockfish are considered associated with high-relief, rocky habitats, and larval and juvenile stages likely utilize open water and nearshore habitats. Appendix B provides more detailed information regarding the general life history of canary rockfish and their prevalence within Puget Sound. The same stressors contributing to the decline of bocaccio, described above, also affect canary rockfish (74 FR 18516; Palsson et al. 2009; Drake et al. 2010).

CRITICAL HABITAT DESCRIPTION

Critical habitat has been designated for the three ESA-listed rockfish species. Additional information is provided in Section 3.3.1.8.1.

OCCURRENCE AT LWI AND SPE PROJECT SITES

Palsson et al. (2009) noted 114 records of canary rockfish in Puget Sound prior to the mid-1970s, with most records attributed to sport catch from the 1960s to 1970s in Tacoma Narrows, Hood Canal, San Juan Islands, Bellingham, and Appletree Cove. Within Hood Canal, 14 records occurred: 1 in the 1930s and at least 13 in the 1960s (Miller and Borton 1980). However, a more recent review by NMFS noted multiple occurrences of canary rockfish in Hood Canal (NMFS 2014a). In the final critical habitat ruling for rockfish, NMFS cited WDFW unpublished data documenting canary rockfish at several locations in Hood Canal, but they have been caught in relatively low numbers for the past several years (79 FR 68042 and also see NMFS 2014a).

WDFW is conducting rockfish surveys within Hood Canal; however, preliminary results have not identified ESA-listed species (Frierson et al. 2015, personal communication). Therefore, canary rockfish have the potential to occur within waters adjacent to the NAVBASE Kitsap Bangor waterfront, but their occurrence would be expected to be rare.

3.3.1.3.7. YELLOWEYE ROCKFISH

Puget Sound yelloweye rockfish were federally listed as threatened under the ESA in 2010 (75 FR 22276) (Table 3.3–2). The same stressors contributing to the decline of bocaccio affect yelloweye rockfish in a similar manner (74 FR 18516; Palsson et al. 2009; Drake et al. 2010). Recent reviews of Puget Sound rockfish species and their habitats (Palsson et al. 2009; Bargmann et al. 2010; Drake et al. 2010) suggest little distinction between these rockfish species in terms of habitat use in Puget Sound. Therefore, consistent with the discussion in Appendix B for bocaccio, adult yelloweye rockfish are considered associated with deeper, high-relief, rocky habitats, and larval and juvenile stages may utilize open water and nearshore habitats. The same stressors contributing to the decline of bocaccio also affect yelloweye rockfish (74 FR 18516; Palsson et al. 2009; Drake et al. 2010).

CRITICAL HABITAT DESCRIPTION

Critical habitat has been designated for the three ESA-listed rockfish species. Additional information is provided in Section 3.3.1.8.1.

OCCURRENCE AT LWI AND SPE PROJECT SITES

Palsson et al. (2009) noted 113 documented Puget Sound yelloweye rockfish historical records associated with sport catch. Of these records, 14 occurred in Hood Canal waters: 1 in the 1930s and 13 in the 1960s (Miller and Borton 1980). In the final critical habitat ruling for rockfish, NMFS cited WDFW unpublished data that documented canary rockfish at several locations in Hood Canal, although they have been caught in relatively low numbers for the past several years (79 FR 68042 and also see NMFS 2014a).

Currently WDFW is conducting rockfish surveys within Hood Canal. Although several yelloweye were caught in other areas of Hood Canal (Frierson et al. 2015, personal communication), preliminary results have not identified ESA-listed species within waters adjacent to the NAVBASE Kitsap Bangor waterfront. Therefore, their occurrence would be expected to be rare.

3.3.1.4. NON-ESA-LISTED SALMONIDS

Non-ESA-listed anadromous salmonids that occur along the Bangor shoreline include hatchery and naturally produced fall-run chum salmon, coho salmon, pink salmon, sockeye salmon, and cutthroat trout. The different life history strategies of these species vary considerably, with different ages and timing for both in-migrating pre-spawn adults and out-migrating juveniles. Additional life history descriptions of non-ESA-listed salmonids are provided in Appendix B.

OCCURRENCE AT LWI AND SPE PROJECT SITES

Chum salmon (all runs combined) is the most abundant salmonid that occurs along the Bangor shoreline, accounting for approximately 94.7 percent of the salmonid catch during the 2005 through 2008 surveys (SAIC 2006; Bhuthimethee et al. 2009). Chum salmon are also the most abundant hatchery fish reared in Hood Canal (SAIC 2006; Bhuthimethee et al. 2009). As with pink salmon, chum salmon released from hatcheries are not marked (fin clipped). Thus, hatchery chum captured in Hood Canal surveys are indistinguishable in the field from naturally spawned chum (SAIC 2006; Bhuthimethee et al. 2009). Sockeye are the least abundant of these salmonids, as no sustainable runs occur within Hood Canal. Appendix B provides more detailed information regarding the migration timing and life history descriptions of non-ESA-listed salmonids with the potential to occur along the Bangor shoreline.

With respect to out-migrating juveniles, chum salmon and pink salmon migrate almost immediately after hatching in their natal streams, occurring along the Bangor shoreline as early as January and as late as June. These smaller, earlier migrating fish rely on nearshore habitats for food and refuge as they migrate within intertidal and shallow subtidal migratory pathways. Release of hatchery salmonids in Hood Canal south of the base, potential competitors for resources with naturally spawned, ESA-listed salmonids, generally occur in April and May (SAIC 2006; Bhuthimethee et al. 2009).

Other salmonids, such as Chinook, steelhead, and coho, can out-migrate as much larger yearlings or older, and tend to occur later in the spring and summer while also being released from hatcheries in April, May, and June. These larger fish are not as dependent on nearshore habitats for food and refuge, and occur in slightly deeper, offshore habitats. While they are not consistently abundant along the Bangor shoreline, coho occur in large schools for a limited time immediately following a hatchery release.

3.3.1.5. FORAGE FISH

Nearshore habitat requirements for forage fish are similar to those for salmonids with respect to water and sediment quality, physical and biological habitat use, and underwater noise. One notable difference is that forage fish species use some areas of Puget Sound shorelines for spawning habitat, whereas salmonids use freshwater systems for spawning. Suitable spawning habitat for forage fish is species-specific, as discussed below for each species.

3.3.1.5.1. Pacific Herring

Pacific herring are considered an important food resource for a variety of species in Puget Sound waters (Bargmann 1998). Therefore the condition of herring stocks, and other forage fish, can have broader marine community effects. The majority of herring spawning in Washington State waters occurs annually from late January through early April (Bargmann 1998). Pacific herring in Puget Sound typically return to natal holding and spawning areas (Bargmann 1998; Stick and Lindquist 2009). Typically, each stock has a pre-spawner holding area where ripening adult herring mill for three to four weeks prior to spawning. Herring spawn by depositing eggs on vegetation or other shallow-water substrate. Spawning generally occurs in the shallow subtidal zone, with eggs being deposited on vegetation or other shallow subtidal substrate (Bargmann 1998). Large holding spawning areas are found with patchy distribution in northern Hood Canal (Stick and Lindquist 2009); the closest to the project locations is found in Squamish Harbor, just under 7 miles (11 kilometers) to the north (Figure 3.3–3). Appendix B provides additional life history information regarding Pacific herring along the Bangor shoreline.

OCCURRENCE AT LWI PROJECT SITES

Appendix B provides additional detail on the life history and occurrence of Pacific herring along the shorelines of NAVBASE Kitsap Bangor. Pacific herring have been detected in small numbers during late winter months and large numbers in early summer months during recent surveys along the Bangor waterfront (SAIC 2006; Bhuthimethee et al. 2009). Large herring spawning areas are found with patchy distribution in northern Hood Canal (Stick and Lindquist 2009).

With respect to differences in occurrence at the LWI project sites, Bhuthimethee et al. (2009) concluded that herring collected along the Bangor shoreline likely were indicative of a large school migrating along the shoreline, rather than indicating site-specific preference by that school. Study findings also indicated that Pacific herring occurring in late spring and summer are found in distinct schools, insufficient in size to span across multiple sampling sites, and do not appear to be attracted to, reside for any extended period at, or show preference toward any specific location.

OCCURRENCE AT THE SPE PROJECT SITE

The inconsistent capture of Pacific herring at the SPE project site was similar to that described above for the two LWI project sites. As discussed for the LWI sites, the capture of herring along the Bangor shoreline likely reflects the presence of large schools of fish on a few occasions and probably does not indicate any preference for the SPE project site. Appendix B provides additional detail on the occurrence of Pacific herring along the shorelines of NAVBASE Kitsap Bangor.

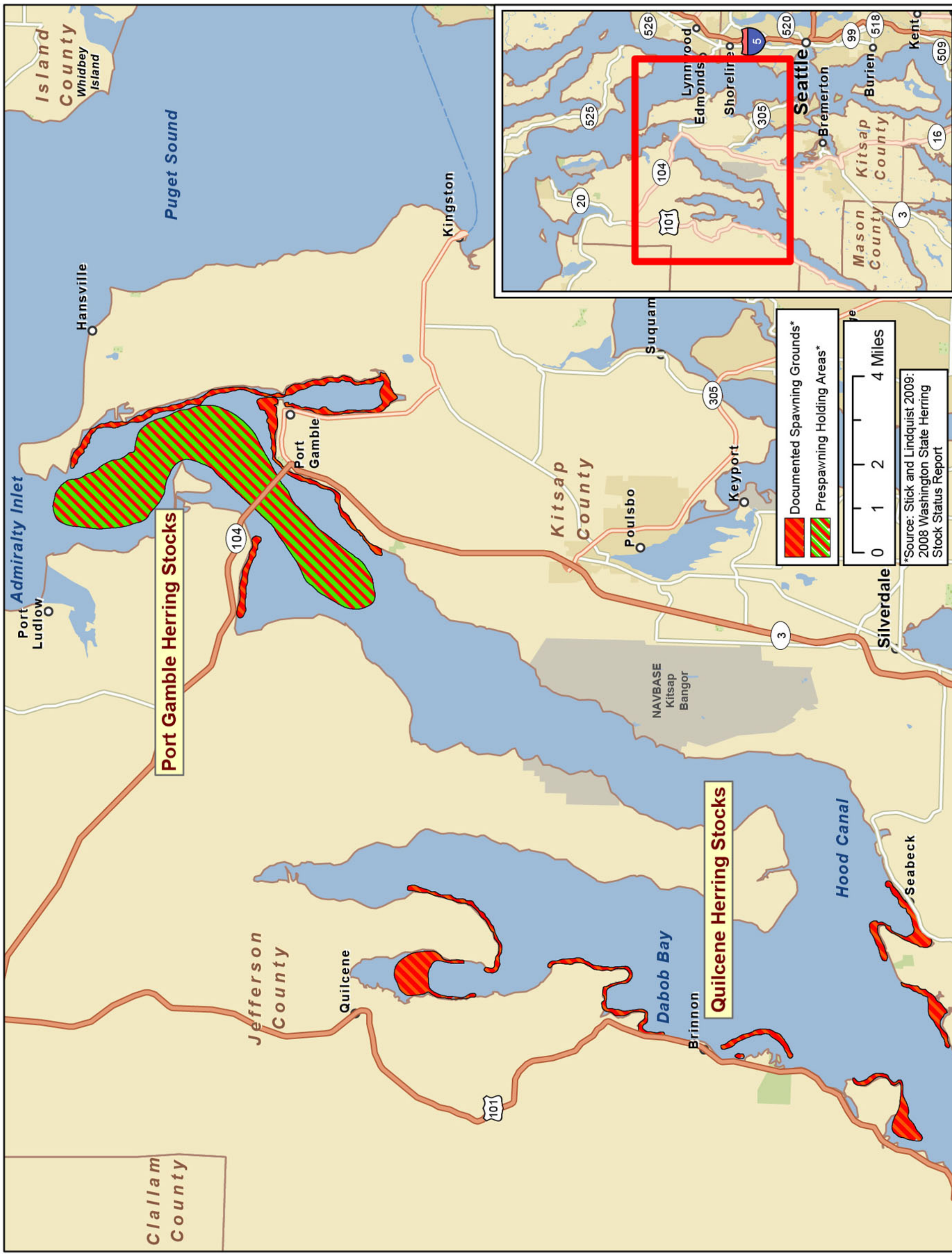


Figure 3.3–3. Port Gamble and Quilcene Bay Herring Stock Near NAVBASE Kitsap Bangor

3.3.1.5.2. SURF SMELT

Similar to herring, surf smelt (*Hypomesus pretiosus*) are a small schooling fish that are an important food resource for marine bird, mammal, and fish species (Penttila 2007). Surf smelt life history in Puget Sound, other than spawning, is not well known, and there is no evidence of widespread migrations to and from the outer coast, although a number of stressors related to spawning habitat impacts have been summarized (Bargmann 1998; Penttila 2007; WDFW 2010a). Stressors limiting surf smelt reproduction include piles, bulkheads, and other shoreline armoring that can adversely affect nearshore littoral drift and sediment composition on, or adjacent to, surf smelt spawning beaches. Shoreline development may progressively eliminate or coarsen sediment composition in otherwise suitable surf smelt spawning substrate. In addition to sediment composition changes, surf smelt can be adversely affected by overall water, sediment, and habitat quality degradation, as well as changes in available invertebrate food resources. Appendix B provides additional detail on the life history and occurrence of surf smelt along the shorelines of NAVBASE Kitsap Bangor.

OCCURRENCE AT LWI PROJECT SITES

While periods of spawning and general spawning habitat conditions and locations are becoming more completely understood, much of the remaining aspects of surf smelt life history in Puget Sound is not well known. However, it is known that juvenile surf smelt rear in nearshore waters (Bargmann 1998). Although young-of-the-year surf smelt have been detected in the project area, no surf smelt spawning habitat has been documented along this portion of Hood Canal (Penttila 1997, 1999; Bargmann 1998; WDFW 2013b). Field investigations were conducted in 2013 and 2014 at six NAVBASE Kitsap Bangor study locations (NAVFAC Northwest 2014). At least two eggs need to be found in a given sample for it to be counted as a positive sample and for the beach to be considered a potential spawning location. The 2013-2014 investigation found a single surf smelt egg in June of 2013 and another in February of 2014. These locations were marked as priority sampling areas for the ongoing forage fish spawning investigations. Appendix B provides additional detail on the occurrence of surf smelt along the shorelines of NAVBASE Kitsap Bangor.

In field surveys conducted along the shorelines of NAVBASE Kitsap Bangor from 2005 to 2008, surf smelt were detected from January through the mid-summer months along the Bangor waterfront (SAIC 2006; Bhuthimethee et al. 2009). Surf smelt occur in these waters as distinct schools and do not appear to be attracted to, reside for any extended period at, or show preference toward any specific location along the waterfront. Instead, when these schools occur they appear to be using the nearshore environment as a migratory pathway, similar to salmonids.

OCCURRENCE AT SPE PROJECT SITES

As described for the LWI project sites, surf smelt occur in these waters as distinct schools and do not appear to be attracted to, reside for any extended period at, or show preference toward any specific location along the waterfront, although their occurrence appeared to be infrequent at these locations (Bhuthimethee et al. 2009).

3.3.1.5.3. PACIFIC SAND LANCE

Pacific sand lance (*Ammodytes hexapterus*) is one of the most common and widely distributed forage fish in nearshore marine waters of Washington. In fact, it is possible that there are as many as thousands of tons of resident Pacific sand lance within these waters on a year-round basis (Bargmann 1998). As with other species of forage fish, Pacific sand lance are an important food resource for marine bird, mammal, and fish species (Penttila 2007). Although this species is common and widespread in Puget Sound, very little is known about the life history or biology of sand lance populations in Washington State. Stressors limiting sand lance reproduction include altered or degraded spawning habitats through mechanisms including physical burial under bulkhead-fill structures intruding into the intertidal zone from adjacent uplands, alteration of the normal supply and movement of beach sediments, oiling (Bargmann 1998) and other habitat elements (e.g., water and sediment quality). Appendix B provides additional life history information regarding Pacific sand lance along the Bangor shoreline.

OCCURRENCE AT LWI PROJECT SITES

Appendix B provides additional life history information regarding Pacific sand lance along the Bangor shoreline. Similar to juvenile surf smelt, juvenile and adult sand lance were captured near both LWI project sites from January through the mid-summer months (SAIC 2006; Bhuthimethee et al. 2009). At the north LWI project site, Pacific sand lance spawning habitat has been documented along an estimated 1,000-foot (305-meter) length of the shoreline, extending from the proposed abutment location southward (Figure 3.3–4; WDFW 2013b). At the south LWI project site, spawning habitat has been documented along the shoreline approximately 500 feet (150 meters) north of the proposed abutment location, extending approximately 1,600 feet (488 meters) to the north (Figure 3.3–4; WDFW 2013b).

Similar to herring and surf smelt, nearshore surveys of Pacific sand lance likely documented the periodic occurrence of large schools of this species, but site-specific captures were inconsistent and did not suggest site-specific preferences (Bhuthimethee et al. 2009). Appendix B provides additional occurrence information regarding Pacific sand lance along the Bangor shoreline.

OCCURRENCE AT SPE PROJECT SITE

In field surveys conducted along the shorelines of NAVBASE Kitsap Bangor from 2005 to 2008, the between-year occurrence of Pacific sand lance at Carlson Spit, immediately south of the SPE project site, was somewhat more consistent than along other portions of the shoreline (SAIC 2006; Bhuthimethee et al. 2009; Appendix B). Although sand lance occurred more consistently between years at this location, they did not appear to be more abundant than in other survey areas. One reason for their consistency at the site may be that Pacific sand lance spawning habitat has been documented on both sides of Carlson Spit, extending northward to include intertidal habitats under the existing Service Pier causeway (Figure 3.3–4; WDFW 2013b). Whether the January to mid-summer month occurrence of Pacific sand lance is the result of adult fish accessing spawning habitats is currently unknown.

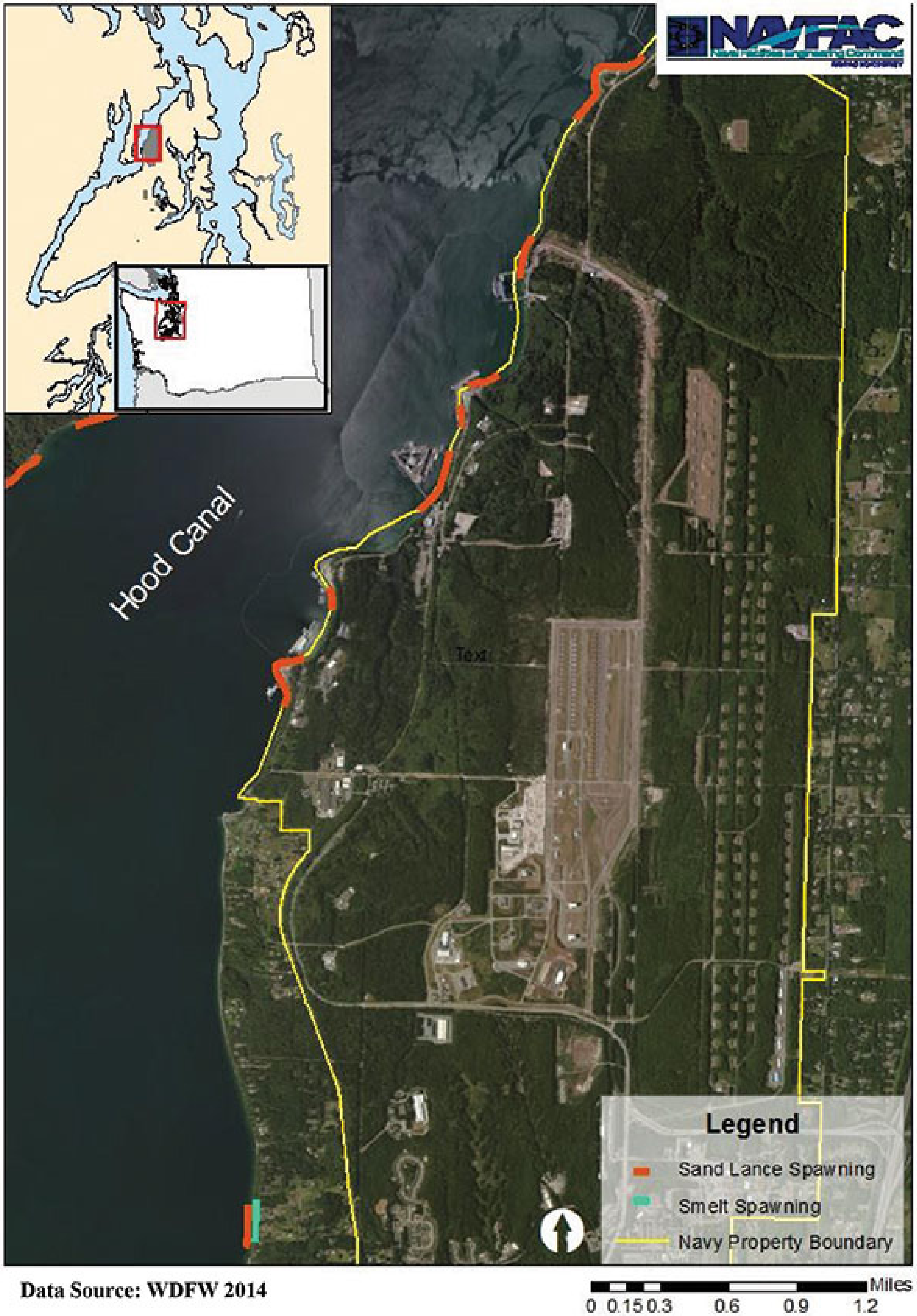


Figure 3.3–4. WDFW Documented Forage Fish Spawning at or near NAVBASE Kitsap Bangor

3.3.1.6. OTHER MARINE FISH SPECIES

In addition to the salmonids and forage fish previously discussed, the marine environment along the Bangor shoreline also provides habitat for a variety of other species, including perches, gunnels, pricklebacks, pipefish, threespine sticklebacks, tubesnouts, and flatfish species (Navy 1988; SAIC 2006; Bhuthimethee et al. 2009). For example, more than 44 non-salmonid finfish species from at least 21 families were recorded from nearshore fish surveys within the last 15 years along the Bangor waterfront (Appendix A, Table A–1) (SAIC 2006; Bhuthimethee et al. 2009). The high species richness in these waters can be attributed to the habitat complexity of the nearshore environment. With some minor differences in habitat preferences, marine habitat conditions for salmonids would apply similarly to other marine fish species. Some species prefer structured habitats and are found in the vicinity of the pile supports for wharves and piers, whereas others prefer flat benthic habitats. With some seasonal variability, the majority of the fish identified in recent surveys along the Bangor shoreline occur in these habitats year round.

OCCURRENCE AT LWI PROJECT SITES

Peak occurrence of fish species included in the “other marine fish species” group generally begins in May, with a decline in abundance by September or October (Bhuthimethee et al. 2009). The most abundant species of non-salmon, non-forage fish, detected in recent surveys along the Bangor shoreline is the shiner perch (SAIC 2006; Bhuthimethee et al. 2009). Other species that commonly occur during summer months include various sculpin species, English sole, and gunnels, among others. At the north LWI project site in 2007 and 2008, English sole occurred at much lower abundances than at other locations along the waterfront (Bhuthimethee et al. 2009). Similarly, shiner perch, although occasionally occurring in large numbers, were less abundant at this location than at other survey sites. At the south LWI project site, English sole occurred at even lower numbers than at the north LWI project site. However, shiner perch were more abundant at the south LWI project site than at any other location along the shoreline. This is likely due to the large, flat, intertidal and shallow subtidal environment, supplied by warmer, nutrient-rich waters exiting at the Devil’s Hole outlet. During summer months, the abundance of young shiner perch at this location suggest the site is utilized by adult female shiner perch for live-bearing their young.

OCCURRENCE AT SPE PROJECT SITE

Survey results from the two sampling locations that occur immediately south of the SPE project site did not indicate that this site was preferred by other marine fish species and diversity and abundance was limited (Bhuthimethee et al. 2009). However, many of the nearly 250 fish species documented in the marine waters of Hood Canal (Miller and Borton 1980; Burke Museum 2010) occur at depths much greater than could be effectively sampled by nearshore fish surveys (Schreiner et al. 1977; Prinslow et al. 1980; Bax 1983; Salo 1991; Bhuthimethee et al. 2009). Species that could occur in deeper offshore habitats affected by project actions likely include a variety of rockfish species, Pacific hake, walleye pollock, wolf eel, skates, sharks, ratfish, lanternfish, snailfish, and adult flatfish species. Piles that support a fouling community with both marine invertebrates and some attached vegetation likely serve as habitat for a variety of opportunistic fish species, including shiner perch, sculpin, gunnels, pricklebacks, and other opportunistic fish species. These structures are relatively shallow compared to habitats utilized by most adult rockfish species; therefore, it is unlikely that they utilize existing piles and other structures as habitat.

3.3.1.7. SALMONID MARINE HABITAT CONDITIONS

Marine and estuarine habitat requirements for juvenile and adult salmonids have been described by many authors (Fresh et al. 1981; Shepard 1981; Healey 1982; Levy and Northcote 1982; Weitkamp et al. 2000). Assessments of existing conditions and potential environmental consequences of proposed projects on key habitats are necessary to determine if potential effects would alter the habitats at a sufficient scale to affect long-term survival of the species. Since many of the habitats utilized by salmonids are also utilized by other marine fish species, this type of habitat analysis, as utilized for this Environmental Impact Statement (EIS), allows for a broader assessment across fish species. A characterization of baseline conditions of water and sediment quality, physical habitat and barriers, prey availability, aquatic vegetation, and underwater noise at both the LWI and SPE project sites as they relate to fish is provided in Section 2.0 of Appendix B.

3.3.1.8. CURRENT REQUIREMENTS AND PRACTICES

3.3.1.8.1. REGULATORY COMPLIANCE

The ESA of 1973 (16 USC 1531 et seq.) requires federal agencies to consult with NMFS about activities proposed, funded, authorized, or undertaken that may affect federally listed fish species, and designated critical habitat. The MSA (16 USC 1801-1882 et seq.) only requires federal agencies to consult with NMFS if these proposed activities may adversely affect EFH. The MSA, through the EFH provision, protects the waters and substrate necessary for spawning, breeding, feeding, or growth to maturity of certain commercially managed fisheries species. The MSA is currently undergoing reauthorization and is expected to be reauthorized by the time of project construction. The analysis of EFH in this EIS is based on the provisions of the current MSA.

ENDANGERED SPECIES ACT

The ESA (16 USC 1531 et seq.) established protection over and conservation of threatened and endangered species and the ecosystems upon which they depend. An “endangered” species is a species in danger of extinction throughout all or a significant portion of its range. A “threatened” species is one that is likely to become endangered within the near future throughout all or in a significant portion of its range. The USFWS and NMFS jointly administer the ESA and are also responsible for the listing of species (designating a species as either threatened or endangered). The ESA allows the designation of geographic areas as critical habitat for threatened or endangered species. Section 7(a)(2) requires each federal agency to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a federal agency’s action “may affect” a listed species, that agency is required to consult with NMFS or USFWS, depending on the jurisdiction (50 CFR 402.14(a)).

As discussed in Section 3.3.1.3, seven threatened or endangered marine fish species have the potential to occur in the waters of northern Hood Canal. For fish potentially affected by the projects addressed by this EIS, the Navy is consulting with NMFS (Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bocaccio, canary rockfish, and yelloweye rockfish) and USFWS (bull trout). Green sturgeon and Pacific smelt, two additional threatened or endangered species, were considered but eliminated from further analysis because they are not known to occur in Hood Canal (NMFS 2009; Longenbaugh 2010, personal communication).

PRIMARY CONSTITUENT ELEMENTS FOR DESIGNATED PUGET SOUND CHINOOK AND HOOD CANAL SUMMER-RUN CHUM SALMON AND PROPOSED PUGET SOUND STEELHEAD CRITICAL HABITAT

In the final rule designating critical habitat for 12 ESUs/DPSs of salmonids in Washington, Oregon, and Idaho, published on September 2, 2005 (70 FR 52630), NMFS defined the six primary constituent elements (PCEs) essential for conservation of these listed salmonids (including Puget Sound Chinook and Hood Canal summer-run chum). NMFS proposed critical habitat for Puget Sound steelhead (78 FR 2726) on January 14, 2013, and designated critical habitat on February 24, 2016 (81 FR 9251). NMFS re-evaluated the PCEs defined for Puget Sound Chinook and Hood Canal summer-run chum and determined that they were fully applicable to Puget Sound steelhead. However, whereas Puget Sound Chinook and Hood Canal summer-run chum designated critical habitat includes marine waters, critical habitat for Puget Sound steelhead within the Hood Canal Subbasin only includes occupied riverine habitat. All lands identified as essential and designated as critical habitat contain one or more of the PCEs. Although critical habitat occurs in northern Hood Canal, including waters adjacent to the base, NAVBASE Kitsap Bangor is excluded by federal law (70 FR 52630; 78 FR 2726; 81 FR 7226) from critical habitat designation for ESA-listed Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, and Puget Sound steelhead. However, since the project includes activities of sufficient nature and with the potential to impact critical habitat outside of the base boundaries it is important to assess the potential for project activities to impact these PCEs.

For the proposed projects, the nearest critical habitat designated for Puget Sound Chinook and Hood Canal summer-run chum salmonids is located immediately south and north of the NAVBASE Kitsap Bangor base boundary along the nearshore. In estuarine and nearshore marine areas, critical habitat includes areas contiguous with the shoreline from the line of extreme high water out to a depth no greater than 30 meters (100 feet) relative to MLLW (70 FR 52684). Puget Sound steelhead critical habitat includes occupied riverine habitats within the Hood Canal Subbasin. Within these areas, the PCEs essential for the conservation of these ESUs are those sites and habitat components that support one or more life stages, including:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
2. Freshwater rearing sites with: (i) water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) water quality and forage supporting juvenile development; and (iii) natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;
3. Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large

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

4. Estuarine areas free of obstruction and excessive predation with: (i) water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between freshwater and saltwater; (ii) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation;
5. Nearshore marine areas free of obstruction and excessive predation with: (i) water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and
6. Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

An analysis of potential impacts on nearshore marine fish habitats, including those listed in PCE Number 5, and offshore marine areas, including those listed in PCE Number 6, from construction and operation of each alternative of the two proposed projects is provided in Section 3.3.2. This habitat is important for juvenile Puget Sound Chinook and Hood Canal summer-run chum salmonids and returning adults. Since pile driving would be performed during the months when juvenile salmon are unlikely to be present, the underwater noise levels are unlikely to rise to the level that would preclude migration or force juveniles into deeper water where predation is more likely.

ELEMENTS OF DESIGNATED PUGET SOUND ROCKFISH CRITICAL HABITAT

On November 13, 2014, NMFS designated critical habitat for yelloweye rockfish, canary rockfish and bocaccio of the Puget Sound/Georgia Basin (79 FR 68041). In this notice NMFS did not use the PCE approach utilized for the designated Puget Sound Chinook, Hood Canal Summer-run chum salmon, or Puget Sound steelhead critical habitat descriptions. Instead, the designated critical habitat for the DPSs of these three species of rockfish was described as follows:

(a) Critical habitat is designated for the following DPSs in the following state and counties: WA–San Juan, Whatcom, Skagit, Island, Clallam, Jefferson, Snohomish, King, Pierce, Kitsap, Thurston, Mason.

(b) Critical habitat boundaries. In delineating nearshore (shallower than 30 m [98 ft]) areas in Puget Sound, we define designated critical habitat for canary rockfish and bocaccio, as depicted in the maps below, as occurring from the shoreline from extreme high water out to a depth no greater than 30 m (98 ft) relative to mean lower low water. Deepwater designated critical habitat for yelloweye rockfish, canary rockfish and bocaccio occurs in some areas, as depicted in the maps below, from depths greater than 30 m (98 ft). The critical habitat designation includes the marine waters above (the entire water column) the nearshore and deepwater areas depicted in the maps included in the listing.

(c) Essential features for juvenile canary rockfish and bocaccio. 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 and are useful in considering the conservation value of the associated feature and in determining whether the feature may require special management considerations or protection. These features also are relevant to evaluating the effects of a proposed action in an ESA section 7 consultation if the specific area containing the site is designated as critical habitat. These attributes include: (i) quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities; and (ii) water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities. Nearshore areas are contiguous with the shoreline from the line of extreme high water out to a depth no greater than 30 m (98 ft) relative to mean lower low water.

(d) Essential features for adult canary rockfish and bocaccio, and adult and juvenile yelloweye rockfish. Benthic habitats or sites deeper than 30 m (98 ft) that possess or are adjacent to areas of complex bathymetry consisting of rock and or highly rugose habitat are essential to conservation because these features support growth, survival, reproduction, and feeding opportunities by providing the structure for rockfish to avoid predation, seek food and persist for decades. Several attributes of these sites determine the quality of the habitat and are useful in considering the conservation value of the associated feature, and whether the feature may require special management considerations or protection. These attributes are also relevant in the evaluation of the effects of a proposed action in an ESA section 7 consultation if the specific area containing the site is designated as critical habitat. These attributes include:

(1) Quantity, quality, and availability of prey species to support individual growth, survival, reproduction, and feeding opportunities;

(2) Water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities; and

(3) Type and amount of structure and rugosity that supports feeding opportunities and predator avoidance.

As described previously for salmonid critical habitats, the NMFS description included that Section 4(a) of the ESA precludes military land from designation, where that land is covered by an Integrated Natural Resource Management Plan that the Secretary has found in writing will benefit the listed species. In addition, NMFS' rockfish critical habitat designation (79 FR 68041) specifically exempted the Bangor Naval Restricted Areas (Figure 1–2) from designation. It should be noted that designated rockfish critical habitat differs from salmonid critical habitat in that it includes deeper, offshore areas, as noted above. Since the project includes activities of sufficient nature and with the potential to impact critical habitat outside of these exempted areas, it is important to assess the potential for project activities to impact the physical or biological features described and considered essential for conservation.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The MSA (16 USC 1801-1881 et seq.), through the EFH provision, protects waters and substrate necessary for federally managed (commercially harvested) fisheries in Washington waters. Federal agencies are required to consult with NMFS about activities that may adversely affect EFH for species protected under the MSA. The MSA is currently undergoing reauthorization and is expected to be reauthorized by the time of project construction. The analysis of EFH in this EIS is based on the provisions of the current MSA.

In addition to the federal agencies that regulate threatened and endangered fish species, the PNPTT are co-managers with WDFW in regulating harvest management and supplementation programs for the Hood Canal summer-run chum ESU (71 FR 47180). The PNPTT include the Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes, who have treaty rights to U&A fishing across the summer-run chum geographic range (71 FR 47180). Additional groups that contribute to and oversee recovery planning include the PSTRT and the HCCC, respectively (71 FR 47182).

3.3.1.8.2. CONSULTATION AND PERMIT COMPLIANCE STATUS

As part of the regulatory and permitting process for the projects addressed by this EIS, the Navy submitted a Biological Assessment (BA) and EFH Assessment (EFHA) on March 10, 2015, and a revised BA on June 10, 2015, to the NMFS West Coast Region office and the USFWS Washington Fish and Wildlife Office. NMFS issued a Letter of Concurrence on November 13, 2015, concurring with the Navy's proposed ESA effect determination (*not likely to adversely affect*) and MSA effect determination (*may adversely affect*) for the LWI preferred alternative, and indicating formal ESA consultation would be required for the SPE project. In a concurrence letter dated March 4, 2016, USFWS stated that the LWI and SPE project impacts to bull trout are not measurable and therefore insignificant.

3.3.1.8.3. BEST MANAGEMENT PRACTICES AND CURRENT PRACTICES

Both the LWI and SPE projects include design measures to avoid or minimize environmental impacts (Section 2.3.1). BMPs and current practices proposed to avoid, minimize, or compensate for environmental impacts of the proposed projects on marine water resources (Section 3.1.1.2.3) and marine vegetation and benthic communities (Section 3.2.1.2.4) would also protect marine water, habitat, refuge, and food resources considered important to marine fish communities along the Bangor shoreline. In addition to previously mentioned practices, the following are essential for reducing impacts on marine fish:

- Construction activities with the greatest potential to harm fish, notably pile driving, will observe an in-water juvenile salmon work window. The Tidal Reference Area 13 (northern Hood Canal) in-water juvenile salmonid work window is currently July 15 to January 15, as outlined in WAC 220-660-330. The work window reflects best available science considerations for minimizing in-water project impacts on migrating juvenile salmonids, primarily Hood Canal summer-run chum.
- During construction, a vibratory pile driver would be used whenever possible to drive piles since it produces far less noise than an impact hammer, with a correspondingly

reduced impact on the surrounding environment. An impact hammer would be used to verify load bearing capacity ("proof load"), ensuring the piles are sufficiently stable to support their respective structures. Impact pile driving would not be used as the primary means to drive steel piles.

- For impact pile driving, a bubble curtain would be employed to decrease the amount of underwater pile driving noise. The bubble curtain is started prior to impact pile driving which would also allow fish an opportunity to move away from the immediate vicinity of the pile before full driving power is reached.
- BMPs will be implemented to control runoff and siltation and minimize impacts on surface water, per the *Stormwater Management Manual for Western Washington* (WDOE 2014).
- The Mitigation Action Plan (Appendix C) presents the marine habitat mitigation action that the Navy would undertake as part of the Proposed Action. This habitat mitigation action would compensate for impacts of the proposed projects on marine habitat and species.

3.3.2. Environmental Consequences

3.3.2.1. APPROACH TO ANALYSIS

The evaluation of project-related effects on marine fish in this section considers impacts on potentially occurring marine fish species and those marine habitats on which they depend for some portion of their life history, including foraging, migration, and reproduction. This section also includes an analysis of project-related effects on seven ESA-listed marine fish species.

The evaluation of impacts on marine fish and their habitat is based on whether the species is listed under the ESA, the species has important fishery value as a commercial, tribal, or recreational resource (including EFH protected under the MSA), a specific group has particular sensitivity to the proposed activities, and/or a substantial or important component of the group's habitat would be lost. For threatened and endangered species, an effect determination of "may affect, likely to adversely affect" indicates an impact of concern.

National Oceanic and Atmospheric Administration (NOAA) Fisheries guidance (NMFS 1996, 1999) indicates that an assessment must include a definition of the biological requirements of a listed fish species. A description of these requirements, with an emphasis on habitats, is provided in Appendix B. The analysis below is designed to specifically address the potential project-related marine habitat impacts with respect to salmonids. Many of these same habitat indicators would apply similarly to habitat requirements for other marine fish species. Habitat factors considered important to the health and recovery of ESA-listed rockfish species were identified in the most recent Puget Sound rockfish status review (Drake et al. 2010) and the recent assessment of Puget Sound rockfish populations (Palsson et al. 2009).

Construction may impact marine habitats used by fish. The greatest impact during construction would occur during pile driving. Pile driving would exceed the underwater noise guideline and thresholds for fish, established for both behavior and injury, and result in the greatest potential for adverse impacts on marine fish. Further, positioning and anchoring construction barges, pile placement and driving would locally increase turbidity, disturb benthic habitats and forage fish, and shade marine vegetation in the immediate project vicinity during the construction time period. Pile driving impacts on salmonids would be minimized by adhering to the in-water work period (July 15 to January 15), when approximately 95 percent of all juvenile salmonids that occur in NAVBASE Kitsap Bangor nearshore waters are expected to be absent (SAIC 2006; Bhuthimethee et al. 2009). The proposed project may also adversely affect EFH for coastal pelagic species, salmon, and groundfish. This analysis was provided in detail in the EFH Assessment, and is summarized in this section. Adhering to the in-water work window for construction activities with the greatest potential to adversely affect fish, would reduce the exposure of ESA-listed fish and other fish to harmful underwater noise levels during construction.

In contrast to the short-term impacts of construction (ranging from one to two in-water work seasons, depending on the alternative), operational impacts on marine fish would be permanent. The portions of piers, or other structures, located in intertidal habitats would decrease habitat value and potentially represent a partial barrier to nearshore migrating fish, as they may alter their migration, including temporarily stopping or swimming through or around a given structure. However, depending on the size of the fish and the type of in-water structure, little or no delay in overall migration rate is anticipated in most cases. In addition, the presence of the piles and overhead decking could reduce the biological productivity of the benthic community and marine vegetation, both of which are habitats used by marine fish, including salmonids and juvenile rockfish. Proposed piers and other design aspects, including floating PSBs, would occur over intertidal and shallow subtidal habitats. As a result, a band of nearshore shade would occur from these structures across the migratory pathway for juvenile salmonids and forage fish.

The analysis for impacts on marine fish addresses both construction and operational impacts on habitat, migration, and predation of Pacific salmonids, forage fish, rockfish, and other marine fish. Due to similar nearshore marine habitat use, impact analyses for forage fish are considered similar to those detailed for salmonids. Rockfish and other marine fish generally use different habitat types than salmonids and are discussed separately.

3.3.2.2. LWI PROJECT ALTERNATIVES

3.3.2.2.1. LWI ALTERNATIVE 1: NO ACTION

The LWI would not be built under the No Action Alternative and overall operations would not change from current levels. Therefore, the marine fish community would not be impacted under the LWI No Action Alternative.

3.3.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

CONSTRUCTION OF LWI ALTERNATIVE 2

Marine habitats used by fish species that occur along the Bangor waterfront include offshore (deeper) habitat, nearshore habitats (intertidal zone and shallow subtidal zone), and other habitats, including piles used for structure and cover. The following sections describe how project-related effects on physical and biological factors would impact the abundance and distribution of marine fish that could occur along the Bangor waterfront during construction.

ESSENTIAL FISH HABITAT

As detailed in the EFH Assessment, the primary construction-related impacts of concern for EFH include underwater noise generated from pile driving, marine benthic and vegetation community disturbance, substrate disruption and turbidity from pile driving, barge anchoring and spud deployment, and water column and substrate shading from construction barges and structures (detailed in Sections 3.1.2, 3.2.2, and Appendix D). Shading can affect eelgrass and kelp beds, which provide suitable habitat areas for various life stages of some EFH species. Up to 6.2 acres (2.5 hectares) of nearshore marine habitat and 6.9 acres (2.8 hectares) of habitats in deep water would potentially be disturbed during construction of LWI Alternative 2 (Section 3.2.2.2.2). Of those 13.1 acres, approximately 3 acres (1.2 hectares) support marine vegetation communities. Measures for minimizing impacts on salmonids during construction activities, described above in Section 3.3.1.8.3 and in Appendix C, would similarly minimize impacts on EFH.

Because there is the potential for nearshore construction-related impacts on EFH, construction of LWI Alternative 2 may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH. However, based on a review of the EFH species known to occur in Hood Canal, findings from site-specific fish surveys pertaining to EFH species occurrence in waters along the Bangor waterfront, review of the life histories, habitat requirements, and potential conservation measures from the FMPs, as well as review of the potential project impacts and mitigation measures that were developed to prevent adverse effects on ESA-listed fish species and their habitats, the current project approach and mitigation measures adequately address concerns pertaining to the potential for adverse construction-related effects on EFH.

THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN

Due to the similarity of life histories within ESA-listed species groups (salmonids and rockfish), impacts on ESA-listed species are discussed by listed species group rather than as individual species. As a result, the species group *ESA-Listed Hood Canal Salmonids* includes the following: Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, and bull trout. The species group *ESA-Listed Hood Canal Rockfish* includes bocaccio, yelloweye rockfish, and canary rockfish.

ESA-Listed Hood Canal Salmonids

The following paragraphs for ESA-listed Hood Canal salmonids provide an overview evaluation on habitats that are described in more detail below. The potential impacts of the proposed project on Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, and bull trout and the nearshore habitats they use are discussed below. Some project-related impacts could indirectly impact salmonids through alteration of nearshore habitats (e.g., aquatic vegetation disturbance), whereas other impacts can directly affect a given fish should it occur during the construction period (e.g., underwater noise). Juvenile salmonid species that are dependent on shoreline habitats as a migratory pathway (Appendix B) would not be able to avoid nearshore construction activities as easily as adults. However, up to 95 percent of juvenile salmon potentially occurring along the NAVBASE Kitsap Bangor shoreline would not be present during pile driving due to observance of the in-water work window (Schreiner et al. 1977; Salo et al. 1980; Bax 1983; SAIC 2006; Bhuthimethee et al. 2009).

Other Salmonids

Larger juvenile salmonids, including coho and ocean-type Chinook, are less dependent on the shallow, nearshore shoreline for migration and refuge than smaller pink and chum salmon. Tagging investigations have shown that juvenile coho and Chinook distribution and movement patterns are not well known (Chamberlin et al. 2011; Rohde 2013), but they have extended intra-basin residence times and may utilize these habitats for extended rearing periods, not just migratory corridors. Although nearshore in-water construction may result in these larger juvenile salmonids migrating around the activity, this change is not anticipated to substantially delay their migration.

Salmonid Marine Habitat Conditions

Impacts on marine habitats used by ESA-listed Hood Canal salmonids would be similar for all listed and non-ESA-listed salmonid species.

Water and Sediment Quality

As discussed in Section 3.1.2.2.2, construction-related impacts on water quality from LWI Alternative 2 would be limited to temporary and localized changes associated with resuspension of bottom sediments during pile and in-water mesh installation, barge and tug anchoring, and propeller wash. While large increases in turbidity have the potential to damage fish gills, the proposed project would only result in small-scale increases of suspended sediments (Section 3.1.2.2.2) and would not likely result in gill tissue damage to salmonids. Studies investigating similar impacts on steelhead and coho salmon from larger scale sediment dredging operations have shown that increased turbidity levels from these activities did not cause salmonid gill damage, although other adverse effects were evident (Redding et al. 1987; Servizi and Martens 1991). Redding et al. (1987) found that coho and steelhead were more susceptible to bacterial infection and displayed reduced feeding rates when exposed to elevated turbidity levels. Servizi and Martens (1991) found that coho were more susceptible to viral infections when exposed to elevated turbidity, and postulated that other impacts include reduced tolerance to environmental changes. Turbidity attributed to the bubble curtain is dependent on whether the bubble curtain unit design is confined or unconfined (Section 3.1.2.2.2). Because sediment disturbance is expected to be temporary and intermittent in nature, and fish are expected to avoid the immediate vicinity of construction activities, no long term effects to salmonid fitness are expected. However, elevated turbidity could temporarily decrease the availability of prey in the area, or the ability of salmonids to detect and capture prey species.

Because concentrations of organic matter in NAVBASE Kitsap Bangor sediments are low (Section 3.1.1.1.3), resuspension of these sediments is not expected to alter or depress DO below levels required by water quality standards. In surveys conducted along the Bangor waterfront from 2005 to 2006, DO was measured at levels below the Extraordinary Quality (EQ) standard of 7.0 mg/L, but not below the level considered to have adverse impacts on fish (5 mg/L) (Newton et al. 2002). Construction of LWI Alternative 2 would not result in violations of water quality standards for DO or cause sufficient local decrease in DO that would impact fish health in the project vicinity.

Resuspended sediments could cause the release of sediment-bound contaminants to near-bottom waters. However, sediments at both LWI locations contain low concentrations of organic carbon (i.e., TOC) and are characterized as having contaminants levels below applicable state standards (Section 3.1.1.1.3). Therefore, increases in chemical contaminant concentrations in marine waters as a result of sediment resuspension during pile installation would be minor. Because suspended sediment and contaminant concentrations would be low, and exposures would be limited to the six-month, in-water construction period during each of the two in-water construction years, localized, acute, or chronic toxicity impacts would not occur.

Another possible source for construction-related impacts on water quality would be from accidental debris spills from barges or construction platforms into Hood Canal. Debris spills could impact bottom sediments, with larger debris potentially acting as an obstruction to fish movement. The Navy would implement measures to prevent the discharge of construction debris into marine waters (Section 3.1.1.2.3). The facility response plan for the Bangor waterfront provides for responses to potential spills. Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups, in accordance with the debris management procedures that would be developed and implemented per the Mitigation Action Plan (Appendix C).

Construction of LWI Alternative 2 would not impact water temperature or salinity because construction activities would not discharge a waste stream. Steel piles installed for LWI Alternative 2 would be inert and would not contain creosote or other contaminants that could be toxic or biologically available.

Stormwater runoff potential impacts and protective measures would be similar to those described in Section 3.1.2.2.2, under Water Quality, for water quality impacts. Construction activities associated with LWI Alternative 2 would not result in major impacts on water temperature or salinity and would not violate any water quality standards.

Although some level of localized changes in sediment grain size is expected during construction activities for LWI Alternative 2, such as fine-grained sediments dispersing and settling outside the project site, impacts on sediment quality would be limited and localized to the general project area (Section 3.1.2.2.2). Construction activities would not discharge contaminants or otherwise appreciably alter the concentrations of trace metal or organic contaminants in bottom sediments. Although sediments could be adversely impacted by oil spills during in-water construction, the construction contractor would be required to prepare and implement a spill response plan (e.g., SPCC plan). If an accidental spill should occur, emergency cleanup measures would be implemented immediately in accordance with state and federal regulations. These cleanup procedures would minimize impacts on the surrounding environment.

<u>Physical Habitat and Barriers</u>

For LWI Alternative 2, up to 54 piles would be driven along a 280-foot (85-meter) linear stretch extending from the shoreline to the floating PSBs at the north LWI location, and up to

82 piles would be driven along a 730-foot (223-meter) linear stretch extending from the shoreline to the floating PSBs at the south LWI location. At each of these two locations, construction of the LWI abutments would require excavation below MHHW. The abutment stair landings and the placement of riprap would also occur below MHHW. A coffer dam would be utilized to minimize project impacts. The coffer dam would be 140-feet (43 meters) long for the north LWI and 160-feet (49 meters) long for the north LWI stairs. Along the south side, the coffer dam would be190-feet (58 meters) long for the LWI and 160-feet long for the LWI south stairs. This work would be done at low tide and is, therefore, likely to have minimal effect on fish movement in the project vicinity. The abutment piles would be driven “in the dry” and, therefore, are not included in the in-water noise analysis. Hughes (2015) indicates that the supratidal region, which occurs between the normal tidal range and extreme high tides, is used by salmonids and forage fish for migration. These habitats are inundated for short periods. In areas where construction of the two abutments occurs in supratidal habitats, these activities would result in the loss of physical habitat and function of these habitats for migration on an infrequent basis.

The pier length would extend across much of the nearshore juvenile salmonid migratory pathway (280 feet at the north LWI and 730 feet at the south LWI), defined as occurring from 12 feet (4 meters) above MLLW to 30 feet (9 meters) below MLLW. The dock attached to each pier would be anchored with four piles (included in the pier pile counts) and each gangway would be anchored with two piles. The relocation of the PSBs would remove one anchor in the vicinity of each pier. In this area, barrier impacts on salmonids would be associated with nearshore construction activity, installation of the in-water mesh, lighting of the construction area and construction platforms, vessel shading, barge anchoring and spud/anchor dragging, underwater noise, and localized, temporary plumes of increased suspended solids produced during pile-driving, anchoring, and mesh installation activities.

During construction of LWI Alternative 2, the impact of physical barriers on marine fish would be greatest in the habitats used by juvenile salmonids as a migratory pathway. Relative to younger age-classes, adult salmonids of all species have much greater mobility, and are unlikely to experience the same shallow-water barrier effect as nearshore-dependent juvenile salmonids. In general, adult salmonids would likely migrate around nearshore construction activity, with little or no overall delay in their movements.

Nightingale and Simenstad (2001a) cite multiple studies that indicate smaller juvenile salmon, notably fry, migrate within shallow nearshore waters. These studies have shown that smaller juveniles (e.g., fry less than 2 inches [5.1 centimeters]) migrate along the shoreline in waters less than 3 feet (0.9 meter) in depth (Schreiner 1977; Bax 1982; Whitmus 1985). Simenstad et al. (1999) refer to shallow-water habitat as “that portion of the nearshore estuarine and marine environment habitually occupied by migrating salmon fry (i.e., approximately 1 to 3 inches [2.5 to 7.6 centimeters] long), which includes the intertidal zone to approximately -6 feet (-2 meters) MLLW.” The most numerically abundant juvenile salmonids that occur along the waterfront at these smaller sizes are chum and pink salmon (SAIC 2006; Bhuthimethee et al. 2009). Larger juvenile salmonids (e.g., coho) move further offshore into deeper waters (Bax et al. 1980) where they may encounter larger piers, wharves, and bulkheads (Nightingale and Simenstad 2001a).

Pile driving activities would be conducted during the in-water work window (July 15 to January 15). Fish surveys along the Bangor shoreline in the 1970s and 2005 to 2008 indicated that most (approximately 95 percent) of the juvenile salmonid migration is complete by this time (Schreiner et al. 1977; Salo et al. 1980; Bax 1983; SAIC 2006; Bhuthimethee et al. 2009). However, other in-water, construction-related impacts could occur outside this window, and may increase turbidity, nearshore shade, or in-water noise (from vessels and cranes). Mesh installation in particular would serve as at least a partial disturbance to juvenile migration. Any avoidance response or similar behavior could result in migration delays or alterations from normal migration routes of nearshore-occurring, out-migrating juvenile salmonids. Returning adult salmonids would likely alter their migration patterns somewhat to avoid any active in-water construction activity. The potential barrier affect would be minor and not prevent adult salmonids from migrating southward along the shore to their natal streams for spawning. Although pile driving activities during the construction of LWI Alternative 2 would occur at a time when salmonids are least abundant, other construction activities would represent an increase of in-water barriers encountered by salmonids potentially present during the construction period.

Biological Habitat

Prey Availability. As discussed in Appendix B, both benthic invertebrate prey and forage fish are important food resources for juvenile salmonids. While this section addresses construction-related impacts from LWI Alternative 2 to the localized benthic prey community, the discussion of impacts on the forage fish community is provided below. Construction of LWI Alternative 2 would result in localized and temporary reductions of the benthic community during pile placement and other construction-related disturbances (Section 3.2.2.2.2). During the construction period, juvenile salmonids could experience minor loss of available benthic prey at both LWI locations due to disturbances from abutment construction, pile installation, in-water mesh installation, and barge use of spuds and anchors (Section 3.2.2.2.2). Benthic organisms that are disturbed during ongoing in-water construction would be expected to be reestablished within a 3-year period (CH2M Hill 1995; Romberg et al. 1995; Parametrix 1994a, 1999; Anchor Environmental 2002; Vivan et al. 2009). Total anticipated benthic impacts would last 5 years (2 construction years, 3 years for reestablishment), but would be limited in scope (Section 3.2.2.2.2).

Aquatic Vegetation. The aquatic vegetation habitat of principal concern for juvenile salmon foraging and refuge is eelgrass (*Zostera* sp.) (Simenstad et al. 1999; Nightingale and Simenstad 2001a,b; Redman et al. 2005). Intertidal and subtidal areas with extensive areas of eelgrass provide habitat for amphipods, copepods, and other aquatic invertebrates (Mumford 2007) used by juvenile salmonids as food resources. Copepods and other zooplankton represent the major food base for Puget Sound juvenile fish (Simenstad et al. 1979), including salmonids. In addition, during these small, vulnerable life stages juvenile salmonids use these nearshore vegetated habitats as a refuge from predators during out-migration. The two largest eelgrass beds along the Bangor shoreline occur near Devil's Hole and Cattail Lake, but a relatively narrow band of eelgrass occurs along nearly the entire shoreline (SAIC 2009).

A maximum of 1.1 acres (0.43 hectare) of eelgrass beds and 2.6 acres (1.1 hectares) of green macroalgae beds would be impacted during construction of LWI Alternative 2 (Table 3.2–3)

(Section 3.2.2.2.2). Impacts would be associated with in-water construction activities during pile driving, steel plate anchoring, mesh installation, and decking installation. From these activities, turbidity would affect nearby eelgrass and green macroalgae beds, potentially resulting in plant loss.

The presence of the overwater barges and structures and the shade they would cast during construction would limit the productivity of aquatic vegetation in the immediate project vicinity. During construction, eelgrass habitats would be affected, with some loss of function, due to barge shading, propeller wash, and anchoring (Section 3.2.2.2.2). Although the proposed construction activities would result in impacts on eelgrass populations at both LWI locations, the proposed compensatory aquatic mitigation action (Appendix C, Section 6.0) would compensate for impacts on eelgrass.

Underwater Noise. Construction of the LWI Alternative 2 structures would result in increased underwater noise levels in adjacent areas of Hood Canal, due primarily to the installation of piles supporting the two towers at the south LWI, the tower at the north LWI, and associated dolphin piles. Under LWI Alternative 2, up to a total of 256 in-water piles would be driven (Table 2–1). While pile driving is the construction action that would result in the greatest range over which fish could be affected, it would require no more than 80 days to complete, during a single in-water work season, with impact proofing conservatively lasting from 83 to 111 minutes per day.

In addition to the pile driving, other in-water work includes removing and relocating anchors and placing additional PSBs. Vessel activity required for in-water construction would result in temporary noise and visual disturbance in the immediate vicinity of some of these vessels. Barge activity during construction of the pier and pier decks, is also proposed. For LWI Alternative 2, an additional in-water work season would be required to complete marine construction, including steel plate anchoring and mesh installation at each pier. Additional vessel activity required for in-water construction would result in temporary noise and visual disturbance in the immediate vicinity of some of these vessels.

Appendix D describes the source levels that pile driving is expected to generate, as well as attenuation of these levels over increased distance. Source levels used for calculations under this Alternative for 24-inch (60-centimeter) steel piles were 210 decibel (dB) peak re 1 μPa at 33 feet (10 meters) and 193 dB root mean square (RMS). The RMS value is normalized over the event and thus is representative of an "average" measure of sound. To reduce underwater noise levels and associated impacts on underwater organisms during impact proofing of steel piles, a bubble curtain would be deployed. Therefore, an 8 dB reduction in sound levels was assumed during proofing activities. The estimated duration of impact pile driving would range from 83 to 111 minutes per day. The source level assumed for vibratory driving is 161 dB RMS re 1 μPa at 33 feet.

The underwater noise threshold for fish injury from a single impact hammer pile strike is at a sound pressure level (SPL) of 206 dB peak (Fisheries Hydroacoustic Working Group 2008). However, most pile driving would be accomplished using vibratory methods. Assuming no more than 200 impact strikes would be required to proof each steel pile, the maximum number of strikes on any active pile driving day would be 2,000. The cumulative Sound

Exposure Level (SEL) threshold accounts for the energy accumulated over a time period of exposure. The applicable criterion for injury to fish would be 187 dB cumulative SEL for a fish greater than or equal to 2 grams in weight and 183 dB cumulative SEL for a fish less than 2 grams in weight (Fisheries Hydroacoustic Working Group 2008). As reference points of total fish length at 2 grams weight in Puget Sound, including some variability due to fish health and food availability, juvenile Chinook salmon are approximately 2.7 to 2.8 inches (68 to 70 millimeters) (Tynan 2013, personal communication) and juvenile English sole are 2.4 to 2.8 inches (60 to 70 millimeters) (Hunt 2005).

In addition to the injury thresholds, Hastings (2002) recommended an underwater noise guideline for behavioral impacts on fish, including startle response, at a level of 150 dB RMS. This behavioral guideline applies to both impact hammer and vibratory pile driving. During pile driving, the associated underwater noise levels could result in a behavioral response, including project area avoidance. To reduce underwater noise levels and associated impacts on underwater organisms during active impact pile driving, a bubble curtain would be deployed. In addition to the benefit of a bubble curtain to attenuate underwater noise, the bubble curtain would be started prior to impact pile driving to allow fish an opportunity to move away from the immediate vicinity of the pile before full driving power is reached.

Table 3.3–3 details the calculated effect ranges for pile driving activities that would occur under LWI Alternative 2; Figures 3.3-5a and 3.3-5b illustrate these ranges.

Table 3.3–3. LWI Alternative 2 Fish Threshold and Guideline Levels and Effect Ranges for the Operation of Impact Hammer and Vibratory Pile Drivers Driving a 24-inch Steel Pile

Fish Threshold and Guideline Levels[1, 2]	LWI Alternative 2 Effect Ranges 24-inch Steel Pile[3]
206 dB peak, impact hammer (injury)[3]	18 feet (5 meters)
187 dB SEL (injury to fish ≥2g)[3]	607 feet (185 meters)
183 dB SEL (injury to fish <2g)[3]	1,122 feet (342 meters)
150 dB RMS, impact hammer (behavioral for all fish)	7,068 feet (2,154 meters)
150 dB RMS, vibratory driver (behavioral for all fish)	178 feet (54 meters)

dB = decibel; g = gram; RMS = root mean square; SEL (for this table) = Cumulative Sound Exposure Level

1. Underwater noise thresholds are taken from Fisheries Hydroacoustic Working Group (2008).
2. The underwater noise guideline for behavior is taken from Hastings (2002).
3. Bubble curtain assumed to achieve an average of 8 dB reduction in sound pressure levels.

To minimize underwater noise impacts during pile driving, vibratory pile drivers would be used to the maximum extent practicable. As noted above, no injury threshold has been identified for vibratory pile driving (Fisheries Hydroacoustic Working Group 2008). It is possible that the impact and vibratory pile drivers would operate concurrently at times. In this case, because the source levels for the impact driver are so much greater (several orders of magnitude) than source levels for vibratory drivers, the combined noise levels generated by concurrent operation of the two types of drivers would not be measurably greater than those generated by operation of the impact driver alone. Therefore, the above impact analysis of noise from operating the impact driver represents the worst-case noise impacts for pile driving for the Proposed Action.

Based on a recent laboratory study on juvenile Chinook salmon, Halvorsen et al. (2012a) attempted to provide quantitative data to define the levels of impulsive sound that could result in the onset of barotrauma to fish. The sounds produced in the study were designed to mimic the impulsive sounds generated by an impact hammer striking a hollow steel pile. Juvenile Chinook salmon were exposed to one of eleven impulsive sound treatments that varied in total energy (SEL_{CUM}). The total number of strikes, and therefore sound duration, was also investigated. Fish were either exposed to simulations of 1,920 strikes (48 minutes) or 960 strikes (24 minutes). Following exposure to the respective impulsive sound exposures, each fish was examined for barotrauma injuries both externally and internally. As predicted, higher energy exposures resulted in higher mortality and injury than lower energy exposures.

The authors concluded that the severity of injury to fish exposed to impulsive sound cannot be predicted from the SEL_{CUM} alone in an exposure consisting of many impulsive events and should consider the energy in the individual impulsive sounds (SEL_{SS}), as well the number of impulses that constitute the exposure. The authors also stated that it is not possible to compare their work with caged fish studies which are unable to control the physiological state of the test fish at exposure or any aspects of sound presentation (e.g., number of impulsive sounds, SEL_{SS} or SEL_{CUM}). Based on their findings, Halvorsen et al. (2012a) concluded that a minimum SEL_{CUM} of 210 dB was required to inflict injury on these fish, in contrast to the 187 dB or 183 dB set by the Fisheries Hydroacoustic Working Group. However, as indicated by PFMC (2014b), the Fisheries Hydroacoustic Working Group has not revised its criteria because of several concerns: (1) the study used undescribed energetic costs to weight the injuries; (2) the study was unable to assess the effects of noise exposure on the inner ear, an important sensory system that can be damaged by exposure to sounds; and (3) although eye hemorrhaging and bruising of the spleen were observed, they were excluded from the analysis because they were inconsistently scored and recorded.

Another recent study by Halvorsen et al. (2012b) examined a variety of representative species having different swim bladder characteristics to evaluate effects from impulsive sound. The studies included species with an open swim bladder (lake sturgeon – an appropriate proxy for salmonids), a closed swim bladder (Nile tilapia – an appropriate proxy for rockfish), and no swim bladder (hogchoker – an appropriate proxy for sand lance). Results indicated that physiological responses to simulated pile driving noise at 216 dB SEL (higher than the 214 dB cumulative SEL [SEL_{CUM}] that may be reached under LWI Alternative 2) varied widely, from renal hemorrhaging and swim bladder ruptures to (Nile tilapia only) to moderate injuries including hematomas and partially deflated swim bladders (both Nile tilapia and lake sturgeon). The hogchokers, representative of species lacking a swim bladder, displayed no external or internal injuries as a result of exposure to simulated pile driving noise (Halvorsen et al. 2012b). None of the fish used in the study treatments suffered acute mortality as a result of exposure to the simulated pile driving sounds. It is important to note that the study conditions attempted to replicate sound levels at a range of 32 feet (10 meters); however, other factors such as existing ambient noise and open waters which would allow fish to exhibit natural behaviors, including avoidance of aversive stimuli, were not incorporated.

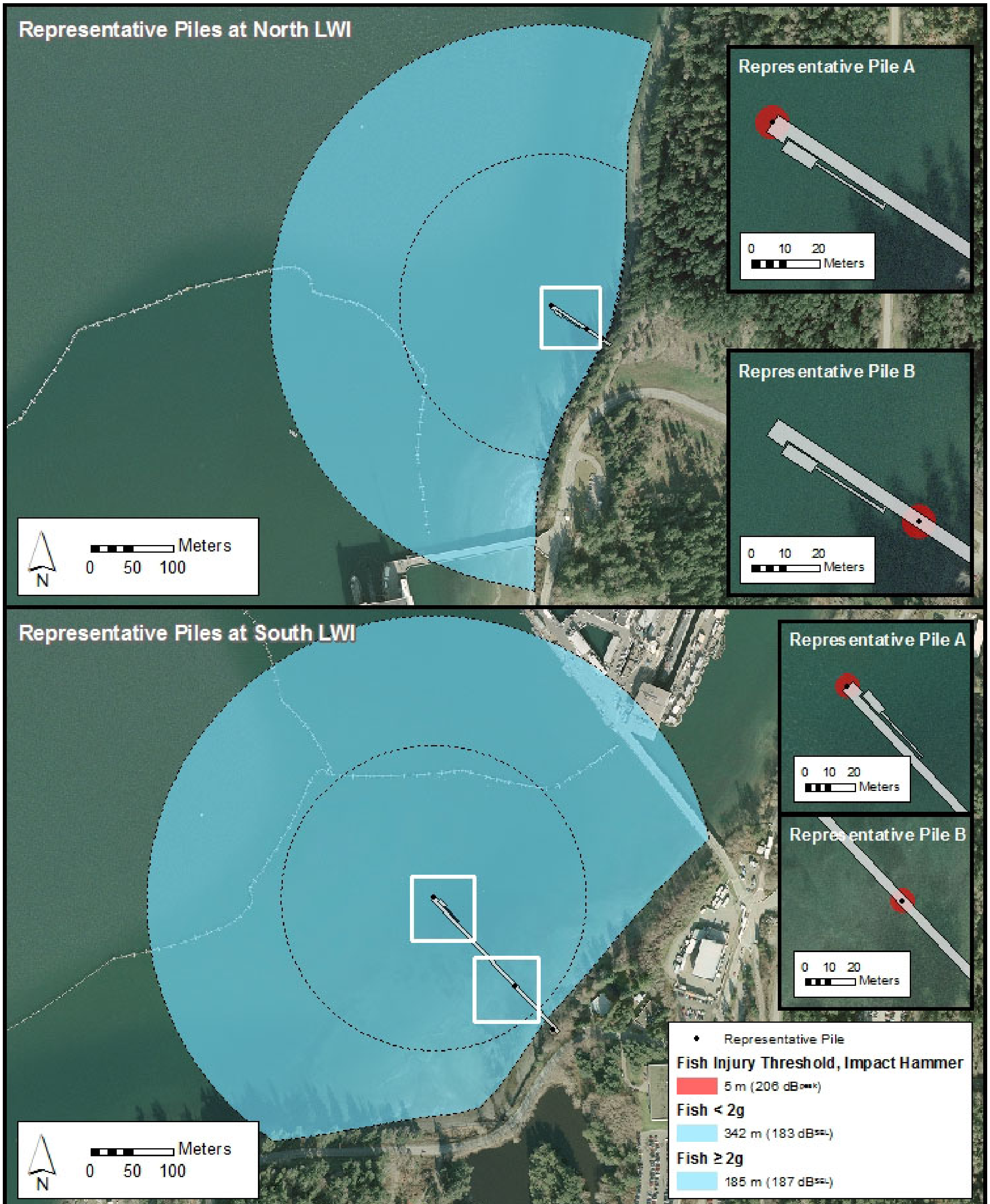


Figure 3.3-5a. Representative View for Fish Injury Threshold due to 24-inch Hollow Steel Pile Driving Noise during LWI Construction, Alternative 2

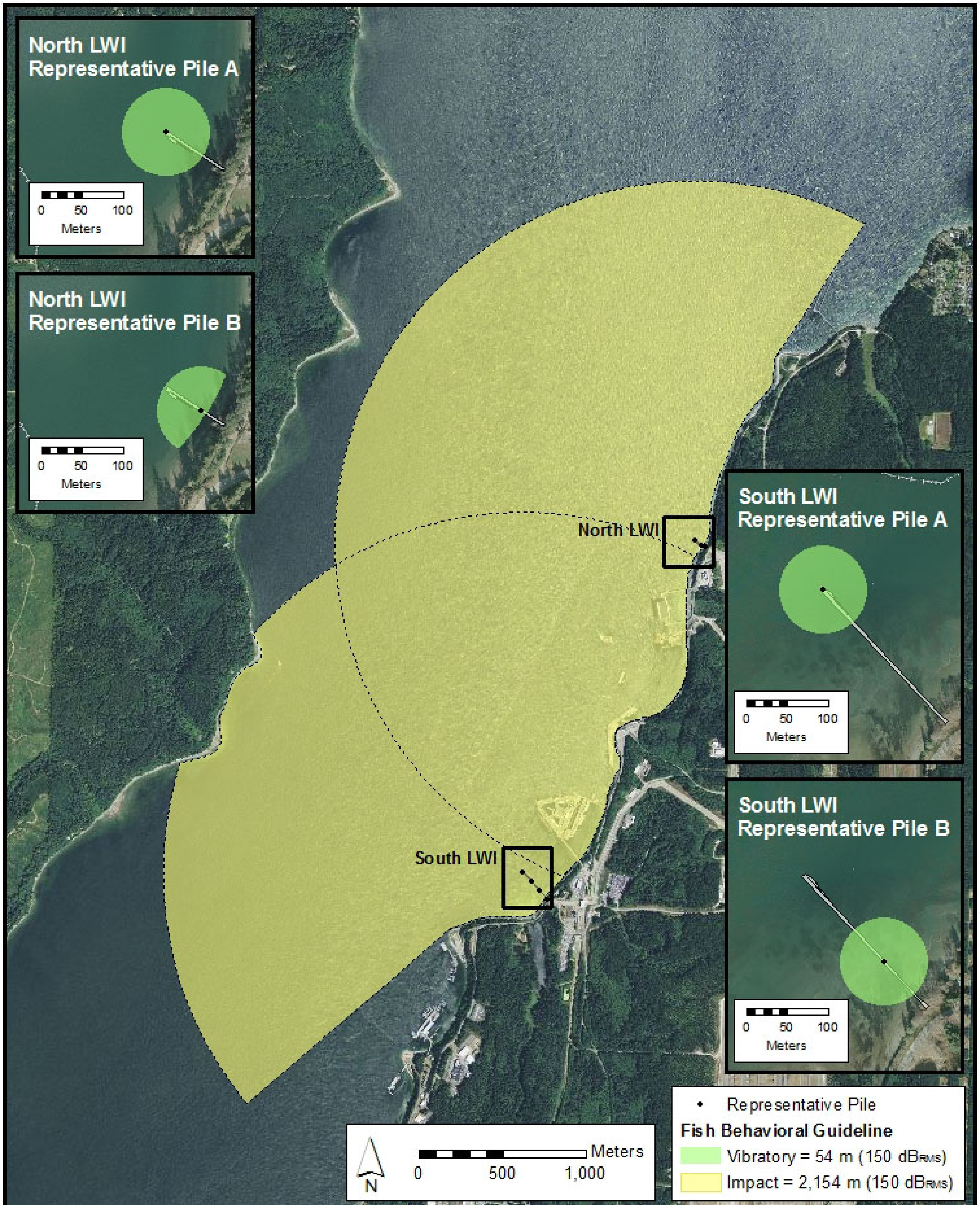


Figure 3.3-5b. Representative View for Fish Behavior Guideline due to 24-inch Hollow Steel Pile Driving Noise during LWI Construction, Alternative 2

Fish with swim bladders are more susceptible to barotraumas from impulsive sounds (sounds of very short duration with a rapid rise in pressure) because of swim bladder resonance (vibration at a frequency determined by the physical parameters of the vibrating object). When a sound pressure wave strikes a gas-filled space, such as the swim bladder, it causes that space to vibrate (expand and contract) at its resonant frequency. When the amplitude of this vibration is sufficiently high, the pulsing swim bladder can press against, and strain, adjacent organs, such as the liver and kidney. This pneumatic compression may cause injury, in the form of ruptured capillaries, internal bleeding, and maceration of highly vascular organs (CALTRANS 2002, Halvorsen et al. 2012b). Halvorsen et al. (2012b) noted that the results of the 2012 study support an argument that fishes appear to be less susceptible to energy from impulsive pile driving than is currently allowed before the onset of physiologically significant injuries and an increase in the current criteria may be warranted.

In estimating the potential effects to fish from noise generated by impact proofing, the acoustic model assumed 200 strikes per pile with up to 10 piles being proofed per day for the cumulative range to effect. However, the actual number of piles being driven in a given day, and the number of strikes per pile, may be significantly lower than what was modeled. Thus, the actual range to effect could be smaller than what is presented in Table 3.3–3 above.

Further, when the model applies the 187 or 183 dB re 1 μPa^2sec SEL injury thresholds it assumes fish are remaining within the range of effect during the entirety of a given 24-hour period. In other words, fish that remained within the calculated range for an entire day of pile driving activity would accumulate energy from every impact strike. Individuals that spent part of the day outside of this range due to avoidance or natural behavioral motivations would accumulate a lesser amount of energy, and may not reach the 187 or 183 dB re 1 μPa^2sec SEL injury thresholds. In a review of studies investigating the behavioral response of fish to impulse sounds such as those generated from pile driving, PFMC (2014b) found that fish response was variable. Some studies showed little or no avoidance response to impulsive sound at frequencies greater than 100 Hz (as reviewed in PFMC 2014b) and no observable behavioral response by caged coho salmon in the vicinity of impact pile driving (Ruggerone et al. 2008). Other studies found that impulse sounds were avoided (as reviewed in PFMC 2014b), or resulted in increased swimming speeds (Mueller-Blenkle et al. 2010) or other altered behavior (Feist et al. 1992; Fewtrell and McCauley 2012). As indicated by these studies, it is possible that fish in the project vicinity would display a range of behavioral responses during pile driving. NMFS (2012) stated that use of the SEL thresholds is less relevant for fish that typically are not expected to remain within the area during the entire duration of pile driving[1].

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[1] NMFS evaluated pile driving impacts on Atlantic and shortnose sturgeon in a 2012 biological opinion and concluded "*...in order for this criteria [SEL] to be relevant, we would need to expect that shortnose sturgeon would remain in that area for the entire duration of the pile driving activity. This is not a reasonable expectation because it does not take into account any behavioral response to noise stimulus. We expect sturgeon to respond behaviorally to noise stimulus and avoid areas above their noise tolerance. This behavioral response is expected to occur at noise levels of 150 dB re 1μPa RMS... we have determined that when assessing the potential for physiological impacts, the 206 dB re 1μPa peak criteria is more appropriate. This represents the instantaneous noise level. Thus, considering the area where this noise level will be experienced would account for fish that were in the area when pile driving started or were temporarily present in the area.*"

When assessing the potential for physiological impacts, the 206 dB re 1 μPa peak threshold for impact pile driving is more appropriate as it represents the instantaneous noise level versus a cumulative noise level that would be practically impossible to receive under real world conditions. Pile driving of all types produces particle motions that may be perceptible to fishes' lateral line, resulting in some degree of avoidance behavior for fish that are both close to the pile being driven and deeper in the water column. As discussed in the preceding paragraph, studies of fish response to impulse noise vary in their observation from an immediate startle or avoidance response, to little or no response. Fish that display a startle response and avoid the underwater noise source would be exposed to less underwater noise than fish remaining near the noise source.

If fish remain in the vicinity of pile driving for an extended period of time, they may be vulnerable to injury or potential mortality. During 2012–2013 monitoring of pile driving activities at EHW-2, one mortally wounded sculpin was documented during impact pile driving (Hart Crowser 2013a). Although several large schools of herring occurred throughout the monitoring period, no other stunned fish were detected (Navy 2013). During the 2014–2015 monitoring of pile driving activities at EHW-2, some fish stuns and mortalities were detected (Hart Crowser 2015). On five occasions in August and September, 2014, large schools of herring coincided during impact and vibratory pile driving of 36-inch piles. The number of fish detected ranged from one to approximately 100. Barotrauma was detected on the few fish evaluated during the study (Hart Crowser 2015).

In general, mortalities are limited to small fish (Yelverton et al. 1975; Fisheries Hydroacoustic Working Group 2008), although with some variation in fish response as discussed above. Many of the fish close to piles when pile driving begins are expected to react by leaving the area, and any individuals starting to approach the piles during pile driving would most likely avoid the area (Pearson et al. 1992; McCauley et al. 2000; LGL Ltd. 2008; NMFS 2012). On sensing pile driving noise at reduced intensity during soft starts fish may move away from the immediate vicinity of the activity before full driving intensity is reached, thereby reducing the likelihood of exposure to sound levels that could cause injury or further behavioral disturbance (NMFS 2012). This behavior combined with the intermittent occurrence of proofing for a maximum of just under 2 net hours per day suggests that while physiological or behavioral impacts may occur, they would be limited in duration, intensity, and continuity.

Impact driving of 24-inch (60-centimeter) steel piles has the potential to cause injury if the sound pressure waves injure or rupture the swim bladder or cause barotrauma. However, fish (including ESA-listed salmonids and rockfish) are not expected to be present within the 18-foot (5-meter) peak injury zone at the beginning of pile driving based on the small size of the zone, the low likelihood of their occurrence in the area, and the activities such as pile placement which would take place prior to the start of actual driving. Fish in the area where the behavioral disturbance guideline is exceeded may display a startle response during initial stages of pile driving and avoid the immediate project vicinity during construction activities, including pile driving. Although pile driving would adhere to the in-water work window (July 15 to January 15) to minimize underwater noise impacts to the large schools of outmigrating juvenile salmonids, some salmonids, including juvenile coho and juvenile and subadult Chinook salmon, may transit through the area during periods of pile driving.

No population-level impacts for Puget Sound Chinook salmon, Hood Canal summer-run chum, Puget Sound steelhead, and bull trout are anticipated, and the continued survival of these species would be unaffected.

Summary of Impacts and ESA-Listed Salmonid Determination

The majority of pile driving associated with LWI Alternative 2 would be conducted using a vibratory driver, which would not generate noise levels sufficient to cause injury to fish under the existing criteria. If impact proofing is required, it would be temporary and intermittent in nature, lasting for a net total of two hours or less on any given day. In estimating the potential impacts to fish from impact pile driving noise, the acoustic model assumes 200 strikes per pile. However, the actual number of strikes per pile may be significantly lower than what was modeled. Further, when the model applies the 187 or 183 dB re 1 μPa^2sec SEL injury thresholds it assumes fish are remaining within the range of effect during the entirety of a given 24-hour period. In other words, a fish that remained within the calculated range to effects (Table 3.3–3) for an entire day of pile driving activity would accumulate energy from every impact strike. Fish that spent part of the day outside of this range due to avoidance or natural behavioral motivations would accumulate a lesser amount of energy, and may not reach the 187 or 183 dB re 1 μPa^2sec SEL injury thresholds.

Fish occurring within the range to effect for the behavioral guideline (150 dB RMS) may exhibit minor behavioral changes such as avoidance (NMFS 2011, 2012; PFMC 2014b); these responses may resolve soon after pile driving ceases (NMFS 2014b). As noted in the PFMC (2014b) review discussed above, "some species of fishes, including Chinook salmon and Atlantic salmon (*Salmo salar*), have been shown to avoid continuous sounds (similar to vibratory pile driving) at frequencies below 30 Hz (infrasound), but not impulsive-type sounds (similar to those from impact pile driving) at frequencies above 100 Hz." It is unlikely that minor, short-term changes in behavior, such as avoidance of the pile driving site, would preclude a fish from completing normal behaviors such as resting, foraging, or migrating, or that the fitness of any individuals would be affected. Further, there is not expected to be an increase in energy expenditure sufficient to have a detectable effect on the physiology of individual fish or any future effect on growth, reproduction, or general health. Therefore, avoidance behavior by individual fish during pile driving activities would be considered discountable.

Critical habitat PCEs for Puget Sound Chinook and Hood Canal summer-run chum that would be affected include estuarine areas, nearshore marine areas, and offshore marine areas. Pile driving would produce noise above the fish behavioral thresholds during vibratory pile driving and above the behavioral and injury thresholds during impact pile driving in the portion of the action area that contains critical habitat. However, effects to these PCEs would be discountable with implementation of a noise attenuation device during impact pile driving of steel piles, primarily installing piles using a vibratory pile driver.

Within the Hood Canal Subbasin, currently occupied riverine habitat is designated as Puget Sound steelhead critical habitat. Since DoD installations with current Integrated Natural Resources Management Plans (INRMPs) are exempt from critical habitat designation, no critical habitat is designated at NAVBASE Kitsap Bangor. Underwater noise generated during pile driving would not exceed established thresholds in critical habitats designated for Puget Sound steelhead.

Based on the low likelihood of occurrence in the project area, the temporary and intermittent nature of elevated noise levels and sediment disturbance, limited potential impacts on aquatic vegetation and prey species relative to the overall availability of the resources in Hood Canal, conservative acoustic modeling assumptions, and the avoidance and minimization measures described above and in Appendix C, any potential effects to Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer-run chum salmon, or bull trout would be discountable. Any stressors that have the potential to affect critical habitat PCEs (e.g., disturbed sediments) would be highly localized to the immediate vicinity of in-water construction, and would not reach designated or proposed critical habitat. Therefore, the effect determination for all listed salmonid species is “may affect, not likely to adversely affect.” The effect determination for critical habitat is also “may affect, not likely to adversely affect,” except for bull trout and Puget Sound steelhead (no effect).

ESA-Listed Hood Canal Rockfish

Due to the similarity of life histories and habitat requirements between ESA-listed rockfish species, project-related impacts on these species are discussed by this species group rather than as individual species.

Threats to the recently listed bocaccio, yelloweye rockfish, and canary rockfish include areas of low DO, commercial and sport fisheries (notably, mortality associated with fishery bycatch), reduction of kelp habitat necessary for juvenile recruitment (74 FR 18516), habitat disruption (including by exotic species), derelict gear, climate change, species interactions (including predation and competition), diseases, and genetic changes (Palsson et al. 2009; Drake et al. 2010). LWI Alternative 2 would neither increase commercial or sport fisheries nor increase the presence of derelict gear, fish disease, or climate or genetic change; as a result, these limiting factors are not discussed further. The combination of these factors, in addition to rockfish life history traits, has contributed to declines in rockfish species within Georgia Basin and Puget Sound in the last few decades (74 FR 18516).

<u>Rockfish Habitat Requirements</u>

Larval and juvenile rockfish are dependent on a variety of habitat factors, including suitable current patterns for larval transport to recruitment habitat (i.e., kelp, eelgrass), good water quality, and abundant food resources (Palsson et al. 2009). Vegetated habitats are important for food and refuge for young-of-the-year rockfish that are moving from pelagic to benthic rearing environment in their first year prior to entering more structured juvenile and sub-adult rocky habitat. Due to typically poor rockfish dispersal between basins, if habitat suitable for adult rockfish does not exist within a specific area, the abundance of adults would be low, as would the recruitment of juveniles into adjacent juvenile habitat. Since rockfish have complex life history patterns that use specific food and habitat requirements at each life history stage (larval, juvenile, adult), effects on the habitats used at each stage can affect the long-term presence of these species in local and adjacent waters.

<u>Currents</u>

Rockfish larvae are pelagic (live in the water column), with their movements influenced by prevailing currents within a given basin (Palsson et al. 2009). Even if adults are abundant and a strong class of larvae is produced in a given year, recruitment to suitable habitat can be limited because larval survival and settlement are dependent on a wide variety of unpredictable chance events, including current, climate, the abundance of predators, suitable recruitment habitat, and other chance events (Drake et al. 2010). Therefore, current patterns play a large role in the recruitment and distribution of rockfish larvae within and between water basins (Palsson et al. 2009).

As discussed in Section 3.1.2.2.2, small-scale and temporary (over periods of hours) changes in current direction and intensity of flow are anticipated as a result of construction activities and associated structures/vessels. However, the overall circulation pattern and velocities into the nearshore and marine deeper-water areas along the Bangor waterfront would be unaffected. Thus, in-water construction activity would have very limited and localized effects on circulation and currents, with limited effects on rockfish larval recruitment.

Water Quality

Palsson et al. (2009) indicate that rockfish may avoid waters with DO conditions below 2 mg/L and temperatures greater than 11°C (Palsson et al. 2009). In 2002, 2003, 2004, and 2006, low-DO fish kills occurred in southern Hood Canal (Newton et al. 2007; Palsson et al. 2009). Rockfish, notably copper rockfish, experienced high mortality, with estimates of up to a quarter of all copper rockfish occurring at a southern Hood Canal marine preserve killed by these conditions (Palsson et al. 2009). However, within Hood Canal both the chronic and episodic events of low DO are typically limited to southern Hood Canal, with this pattern not as prevalent in northern Hood Canal waters (Newton et al. 2007), including off NAVBASE Kitsap Bangor. When conditions are not suitable at depths where they are normally present, rockfish tend to relocate to depths with more suitable conditions (Palsson et al. 2009; Drake et al. 2010), or are exposed to impacts from conditions such as low DO.

As noted for salmonids, the construction of LWI Alternative 2 would not degrade the existing DO concentrations in the project vicinity. Therefore, rockfish would not be subjected to any project-related increases in respiratory distress or altered distribution in response to DO reductions. The construction of LWI Alternative 2 would not result in water temperature increases. Therefore, rockfish would not experience impacts from elevated water temperatures as a result of LWI Alternative 2.

Limited information is available on the effects of turbidity on rockfish. However, effects would likely be similar to those described above for salmonids. Although construction activities would temporarily increase suspended solids, the levels would be insufficient to cause severe gill irritation or result in fish loss through mortality and conditions would return to background following the completion of in-water construction. If rockfish should encounter turbidity plumes with high levels of suspended sediment during construction activities, they would likely avoid these small plumes.

Habitat Alteration

Alteration of rockfish habitat can affect interrelated stressors identified by Palsson et al. (2009) and Drake et al. (2010), including reductions in the suitability of the habitat, and increased competition and predation. Limited or altered habitat could also affect prey availability and exotic species presence.

Suitable Habitat. As noted above, juvenile (three to four months old) rockfish recruit to nearshore habitats that include algae-covered rocks or sandy areas with eelgrass or drift algae (Mitchell and Hunter 1970; Leaman 1976; Boehlert 1977; Shaffer et al. 1995; Johnson et al. 2003; Hayden-Spear 2006). While these studies indicate that the fish recruit to natural habitat encountered in offshore surface waters, other studies have found that post-larval juvenile rockfish also recruit to manmade, in-water structures (Emery et al. 2006; Love et al. 2005, 2006). Palsson et al. (2009) notes that structured habitat is “extremely” limited within Puget Sound waters. In addition, these types of structures also serve as habitat for sub-adult and adult lingcod, rockfish, and greenling (Love et al. 2002), which are potential predators of juvenile rockfish (see below). However, if they were to occur in the vicinity, it is unlikely that juvenile rockfish would recruit to the piles or in-water mesh as structured habitat during active in-water construction. No dredging or removal of existing high-relief, structured habitat potentially used by rockfish would occur during construction. However, reduction of nearshore marine vegetation at both LWI locations during construction could result in impacts to rockfish habitat in the project area.

Predation. Construction activity is not expected to increase recruitment of rockfish predators to the project area or create a physical environment that increases the susceptibility of rockfish to their predators. Barge movement, pile driving, decking and mesh installation, and other construction activities would create visual and auditory stimuli that most fish and fish predators would avoid. In addition, the three ESA-listed rockfish species generally prefer deeper-water habitats than occur within the construction footprint (other than potential larval recruitment to nearshore marine-vegetated habitats). Consequently, even in the absence of construction activity, their presence would be limited. Therefore, construction activities for LWI Alternative 2 are not expected to increase predation on juvenile or subadult rockfish.

Competition. Construction activities would not create an environment that would increase competition between rockfish and other marine fish species. In addition to the construction footprint occurring in waters shallower than rockfish generally prefer, these activities would create visual and auditory stimuli that most fish would avoid, including rockfish competitors. Therefore, construction activities for LWI Alternative 2 are not expected to increase competition between listed rockfish and their competitors.

Prey Availability. During construction, bottom disturbance would result in decreased prey availability for juvenile rockfish, although construction of pile-supported piers would not decrease plankton used as a primary food source for larval rockfish (Section 3.2.2.2.2). Some prey species for older, larger rockfish, such as crabs, surf perch, and forage fish, may experience a decrease in habitat availability during construction due to the disturbance of vegetated marine habitats. As a result, older age classes of rockfish, should they occur in the immediate project vicinity, may experience a similar decrease in this small fish prey base during construction activities and associated underwater noise during pile driving. However, upon completion of pile driving, underwater noise levels would return to levels consistent with current conditions and these prey species would no longer be expected to avoid the immediate project vicinity.

Exotic Species. Exotic organisms in Puget Sound waters, including nonindigenous marine vegetation that replace existing native marine vegetation (notably eelgrass or kelp), could pose a threat to rockfish survival (Palsson et al. 2009; Drake et al. 2010). Whether *Sargassum muticum*, a nonindigenous brown alga, affects rockfish settlement is not currently known (Palsson et al. 2009). However, Drake et al. (2010) suggest a possible threat to Hood Canal rockfish from *Ciona savignyi*, an invasive tunicate that has rapidly expanded its range in Hood Canal, and further note that elsewhere invasive tunicates have had widespread unspecified adverse effects on rocky-reef fishes, including rockfish.

Construction of the LWI would not increase the prevalence of exotic species in Hood Canal waters. None of the piles, decking, or fencing for the project would have occurred previously in other marine waters and, therefore, would not include attached exotic organisms. In addition, the vessels used during construction would comply with U.S. Coast Guard regulations designed to minimize the spread of exotic species. Therefore, construction of the piers for LWI Alternative 2 is not anticipated to cause the introduction, spread, or increased prevalence of exotic organisms along the Bangor shoreline or the Hood Canal basin.

Underwater Noise

An additional project effect on rockfish that was not identified as a stressor in Drake et al. (2010), but is briefly mentioned in Palsson et al. (2009), is elevated levels of underwater noise. In a caged fish study investigating the effects of a seismic air gun on five species of rockfish (*Sebastes* spp.), Pearson et al. (1992) found that behaviors varied between species. In general, however, fish formed tighter schools and remained somewhat motionless.

Skalski et al. (1992) found the average rockfish catch for hook and line surveys decreased by 52 percent when the catches followed noise produced by a seismic air gun at the base of rockfish aggregations. Fathometer observations showed that the rockfish schools did not disperse but remained aggregated in schooling patterns similar to those prior to exposure to this noise. However, the aggregations did elevate themselves in the water column, away from the underwater noise source. Hastings and Popper (2005) indicate there are no reliable hearing data on rockfish, and it is not currently possible to predict their hearing capabilities based on morphology.

A more detailed description of effects on fish from anticipated underwater noise levels during construction is provided above for salmonids. Currently, underwater noise impact thresholds do not differentiate between fish species (Fisheries Hydroacoustic Working Group 2008). Although salmonids and rockfish have very different appearances and life histories, both groups use internal air bladders to maintain buoyancy.

As described above for salmonids, under LWI Alternative 2 if rockfish were to occur within the range to effect during pile driving or proofing, they would potentially be exposed to elevated underwater noise levels. Young-of-the-year rockfish weight-length relationships vary with species, habitat conditions, and food availability, but likely exceed 2 grams in weight upon reaching a length of approximately 1.8–2.4 inches (45–60 millimeters). Potential nearshore physical recruitment habitats would not be altered by underwater noise. This, combined with the intermittent occurrence of proofing for a maximum of just under

2 net hours per day during the first in-water work window, suggests that while physiological or behavioral impacts may occur, they would be limited in duration, intensity, and continuity.

Summary of Impacts and ESA-Listed Rockfish Determination

As noted in Sections 3.3.1.3.5, 3.3.1.3.6, and 3.3.1.3.7, bocaccio, yelloweye rockfish, and canary rockfish are rare in Hood Canal waters and are generally limited in Hood Canal by the lack of suitable habitat. Construction of the LWI piers would result in small-scale changes in current velocity and flow around in-water vessels. However, this effect would be too small and localized to alter existing nearshore currents or normal rockfish larval recruitment along the Bangor shoreline. Minor, temporary, and localized effects on water quality (notably small increases in turbidity) would occur, primarily during construction, but are not expected to decrease DO concentrations or increase water temperatures. Pile driving noise would exceed the fish behavioral threshold during vibratory pile driving and be above behavioral and injury thresholds during impact pile driving in the action area that contains critical habitat. However, effects to these PCEs would be discountable because pile driving would primarily use vibratory pile driving method, and would implement a soft-start approach.

Based on the low likelihood of occurrence in the project area, the temporary and intermittent nature of elevated noise levels and sediment disturbance, limited potential impacts on aquatic vegetation and prey species relative to the overall availability of the resources in Hood Canal, and the avoidance and minimization measures described above and in Appendix C, any potential effects to bocaccio, canary rockfish, or yelloweye rockfish would be discountable. No population-level impacts for these species are anticipated to occur, and their continued survival would be unaffected. Any stressors that have the potential to affect critical habitat essential features (e.g., water quality and substrate conditions) would be localized to the immediate vicinity of in-water construction, and would not reach designated critical habitat. Underwater noise exceeding the behavioral threshold would reach critical habitat, but would only occur during active pile driving, and would not alter designated critical habitat. Therefore, the effect determination for all listed rockfish species and their critical habitats is "may affect, not likely to adversely affect."

NON-ESA-LISTED SALMONIDS

Construction-related impacts on non-ESA-listed salmonids and their habitats would be similar to those described above for ESA-listed salmonids. Utilizing in-water work windows would also minimize impacts on non-ESA-listed salmonids, including hatchery fish, during pile driving due to their infrequent occurrence during the work window, and thereby resulting in limited exposure to elevated underwater noise.

FORAGE FISH

The only forage fish species with documented spawning habitat along the Bangor shoreline is the Pacific sand lance (Section 3.3.1.5). At the north LWI project site, Pacific sand lance spawning habitat has been documented along an estimated 1,000-foot (305-meter) length of the shoreline extending from the proposed abutment location southward (Figure 3.3–4). At the south LWI project site, spawning habitat has been documented along the shoreline approximately 500 feet (150 meters) north of the proposed abutment location, extending approximately

1,600 feet (488 meters) north. At each site, the excavation required for the abutment, placement of riprap, and abutment stair landings would occur below MHHW. At the north LWI project site these construction activities would impact documented sand lance spawning habitat. Sand lance spawning habitat in the footprint of the abutment would be lost, and the quality of sand lance spawning habitat in the immediate surrounding area affected by associated construction activities would be reduced relative to existing conditions. Although similar construction activities would occur at the south LWI project site, historic and ongoing surveys have not detected any forage fish spawning activity at that location (Penttila 1997, 1999; Bargmann 1998; WDFW 2013b; NAVFAC Northwest 2014).

Temporary increases of suspended solids during pile driving and other in-water construction activities would be expected, but due to strong nearshore currents and nearshore wind waves, the small amount of suspended fines that would settle out of the water column onto intertidal beaches would not be high enough to adversely impact the spawning success of the nearest forage fish (sand lance) spawning habitat at the south LWI project site. However, since the north LWI project site occurs at the northern extent of this spawning habitat area, there could be some loss of function and suitability of this habitat during construction due to sediment resuspension and the temporary settling on spawning habitats, along with direct disturbance of these habitats from construction activities.

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, forage fish, primarily surf smelt, have been shown to utilize the shoreline at the LWI project sites. Therefore, forage fish could be present and potentially affected by construction activities. During construction and post-construction reestablishment of disturbed vegetation and benthic communities, impacts on these communities may reduce available forage and refuge habitats for forage fish species. Due to behavioral responses, pre-spawn adult sand lance may reduce or avoid the use of this site during ongoing construction activity. Nighttime lighting associated with construction activities and daytime shadows cast from overwater structures and equipment would be expected to alter adult sand lance behavior at this site. Halvorsen et al. (2012b) determined that fish like sand lance that do not have swim bladders may be less susceptible to injury from simulated impact pile driving noise. In contrast, fish such as herring which migrate along the shoreline are considered “hearing specialists” and are able to detect frequencies up to at least 4,000 Hz. This heightened detection is enabled by a gas filled channel that connects the swimbladder to the otolith organs (Doksæter et al. 2009) but also makes them more susceptible to injury from impact pile driving. Nevertheless, because forage fish are expected to largely avoid the immediate vicinity of in-water construction, potential impacts to forage fish are expected to be limited to minor behavioral disturbance.

OTHER MARINE FISH SPECIES

Marine fish species occurring near the project area share the same habitats as salmonids and, with a few exceptions, would experience similar project-related impacts from the construction of LWI Alternative 2. As described above, construction of LWI Alternative 2 would not violate water or sediment quality standards (SQS) in the project area.

Project impacts on physical habitat and barriers during construction would include an increase in the number of barges and activities in the vicinity of intertidal and subtidal habitats. However, non-salmonids and forage fish occurring along the Bangor waterfront generally do not exhibit similar shoreline migrations (Hart 1973; Wydoski and Whitney 2003). Shiner perch is one of the most abundant other marine fish species in the project area and shows the greatest amount of migration near the Bangor shoreline. However, their migration is not along the shoreline but between shallow nearshore waters in the spring to bear their young and deeper offshore waters to overwinter (Hart 1973). During summer months when female shiner perch enter the shallows to bear their young, this species can be abundant at both the south and north LWI project sites (SAIC 2006; Bhuthimethee et al. 2009). However, when water temperature begins to cool in the fall, they are relatively absent at both locations. Since the majority of the construction would occur in cool water temperatures when this species is relatively absent, and because the piers under construction would be oriented parallel to their migration pathway, construction of this alternative would have only a minor impact on the movement of this species.

Benthic habitats used for marine fish foraging and rearing could be affected by construction activities (Section 3.2.2.2.2). Similar to salmonids, many non-salmonid fish species use forage fish as a food resource. As a result, any alteration in forage fish use of the site would reduce the local food resources of some non-salmonid fish species occurring in the area. Marine vegetation communities may also be affected during construction of LWI Alternative 2 (Section 3.2.2.2.2). Other marine fish species that have been found to frequent these marine vegetation habitats along the Bangor shoreline include shiner perch, gunnels, pricklebacks, sticklebacks, flatfish, and sculpin (SAIC 2006; Bhuthimethee et al. 2009). Construction impacts on these habitats could result in a corresponding loss of productivity in benthic organisms that use these habitats for foraging, refuge, and reproduction (Section 3.2.2.2.2) and a subsequent loss in available benthic food resources for marine fish species. However, these impacts are expected to limited in scope and intensity.

The in-water work window would be observed to protect ESA-listed salmonids from elevated underwater noise during pile driving. However, some of the most abundant non-salmonid or forage fish species captured in these waters, including juvenile and adult shiner perch, juvenile English sole, gunnels, pricklebacks, sticklebacks, and sculpin (SAIC 2006) may also occur during in-water work periods. Some fish may avoid the area, particularly closer to the location of in-water work, or alter their normal behavior while in this area. However, studies have shown that some fish species may habituate to underwater noise (Feist 1991; Feist et al. 1992; Ruggerone et al. 2008). Impacts from elevated underwater noise during pile driving would occur only during the in-water work window (July 15 to January 15). Upon completion of the pile driving effort, underwater noise would return to pre-construction levels.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 2

The primary impacts on marine fish from operation of LWI Alternative 2 would include an increase of physical barriers in the nearshore environment, alteration of nearshore habitats including some reduction in natural refugia, some reduction in prey availability, potential reduction in the forage fish community, and a decrease in nearshore aquatic vegetation. The following sections describe how each of these factors would impact abundance and distribution of marine fish that could occur along the Bangor waterfront during operation of LWI Alternative 2.

Maintenance of LWI Alternative 2 would include routine inspections, cleaning, repair, and replacement of facility components (except pile replacement) as required. Measures would be employed to prevent discharges of contaminants to the marine environment. These activities would not affect marine fish.

ESSENTIAL FISH HABITAT

EFH mostly would experience project-related impacts from operation of LWI Alternative 2 similar to those described below for salmonids; operation of LWI Alternative 2 would maintain water and sediment quality in the project area (Section 3.1.2.2.2). The EFHA provides a more comprehensive analysis of the EFH analysis as required by the MSA.

Long-term impacts on physical habitat and barriers would include an increase in overwater and in-water structures. Shading of marine vegetation and benthic habitats would be expected to result in a corresponding loss in EFH suitability and productivity (Section 3.2.2.2.2). Nearshore habitats would experience an increase in artificial lighting potentially reducing the quality and function of these habitats for nearshore fish that utilize these habitats for refuge, foraging, and migration. However, over-water lighting would be used very infrequently, during security responses only. While some EFH fish species (e.g., starry flounder and English sole) would experience a reduction in flat benthic habitat, others (e.g., greenling and cabezon) would experience an increase in high-relief habitat (e.g., vertical piles) more suitable for their life history. The addition of in-water structures to nearshore habitats utilized as migration corridors could alter this habitat such that it would represent a long-term barrier to juvenile salmonids. Groundfish species occurring along the Bangor waterfront do not display migration patterns consistent with salmonids and coastal pelagic species and, therefore, would not experience a migration barrier effect due to habitat alteration. However, due to the impacts on nearshore habitats utilized by all three species categories of EFH, potentially reducing habitat suitability and productivity, a determination was made that operation of the LWI under Alternative 2 may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH.

THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN

ESA-Listed Hood Canal Salmonids

Marine Salmonid Habitat Requirements

Water and Sediment Quality

Operation of the LWI under Alternative 2 would have little or no impact on localized temperature, salinity, DO, or turbidity (Section 3.1.2.2.2). Waterfront vessel activity would not be expected to increase substantially relative to existing conditions. In addition, BMPs implemented to minimize the degradation of water and sediment quality would be consistent with existing practices along the Bangor waterfront. Although some of the materials used for the LWI and PSBs would include galvanized metal, zinc loading in stormwater runoff is not expected to affect water quality at the project site as use of this galvanized metal is limited and the majority of other surfaces would consist of inert materials (Section 3.1.2.2.2). The in-water mesh is not composed of any materials that have the potential to degrade water quality along the Bangor shoreline.

Operation of LWI Alternative 2 would implement BMPs to minimize spill risks (Section 3.1.1.2.3). Operation of LWI Alternative 2 would not increase the risk of accidental spills because, other than minor small boat activities, project operations would not require the use of solvents, or other contaminants. No vehicular traffic would use the LWI structures and its surfaces would not generate pollution. Therefore, stormwater runoff from the LWI structures would not require treatment and could discharge directly into Hood Canal.

Changes in sediment grain size would only be anticipated in the immediate vicinity of each LWI structure, with little or no change in sediment characteristics beyond the footprint. Because sediments within the project area are considered uncontaminated, the small-scale changes in local sediment accretion and erosion during the operation of LWI Alternative 2 would not degrade existing conditions.

Physical Habitat and Barriers

Physical habitat and barriers are as described above under *Salmonid Marine Habitat Conditions*. Although numerous studies, summary reports, and white papers have investigated the effects of overwater structures on salmonid behavior, few have investigated the effects of fixed in-water mesh on these same species. Net pen rearing of juvenile salmonids uses variable mesh dimensions depending on the size of fish being reared. Mesh dimensions used for this industry, and the enclosures for field investigations of juvenile salmon, range from to 0.125 to 2 inches (0.32 to 5 centimeters) (Heard and Martin 1979; Mighell 1981; Zadina and Haddix 1990; Thrower et al. 1998). However, the mesh size of the in-water mesh would be larger than that used for captive rearing.

Regarding the potential barrier effect of the proposed LWI mesh, two studies in particular investigated juvenile fish response to various “trash rack” bar spacings in closed flume systems that were designed to simulate trash racks on fish passage structures for dams. Reading (1982) conducted observations of juvenile Chinook salmon (fork length of 35 to 75 millimeters [1.4 to 3.0 inches]) and American shad (fork length of 35 to 78 millimeters [1.4 to 3.1 inches]) behavior in a flume system when encountering various “trashrack bar spacings” of 7.6, 15.2, 22.9, and 30.5 centimeters (3, 6, 9, and 12 inches, respectively) at the Fish Screen Test Facility in Hood, California. In addition, this study investigated the effects of lighting and instream flow on the behavior of these two species. Reading (1982) concluded that channel velocity is the most important factor for juvenile Chinook salmon passage through trash racks, with no significant differences in salmon passage detected at the various bar spacings. In addition, salmon passage was found to be greater at night than during daylight hours. For American shad, Reading (1982) found that bar spacings less than 22.8 centimeters (9 inches) significantly reduced the passage of young American shad.

In a closed flume system, Hanson and Li (1983) examined the behavior of young-of-the-year Chinook salmon (mean fork length of 45.2 millimeters [1.8 inches]) when encountering in-water structures, in this case represented by bars separated at various distances (5.1, 7.6, 15.2, 22.9, and 30.5 centimeters [2, 3, 6, 9, and 12 inches, respectively]). Their findings indicated that bar spacings of less than 15.2 centimeters (6 inches) altered the behavior of the juvenile Chinook, whereas spacings of 15.2 centimeters and greater did not alter their behavior. Bar spacings of 5.1 and 7.6 centimeters resulted in reduced juvenile Chinook salmon transit time, with these juveniles "backing through" the bars, potentially subjecting themselves to elevated predation. The predation assumption is based on observations at the John E. Skinner Delta Fish Protective Facility, Tracy, California (Sacramento Bay Delta region) where a number of fish species frequently change their orientation prior to entering the "trash rack," resulting in entering tail first. Predation by yearling and adult striped bass on other fish species at the "trash rack" was extensive. The author's conclusions were that interbar spacings greater than 15 centimeters would not alter juvenile salmon transit times and should minimize predation rates of juvenile Chinook relative to predation rates that would occur with smaller bar spacings. Although these studies were conducted in closed systems and used bars rather than mesh, they suggest that an in-water mesh, with openings at least 15.2 centimeters, would allow for the passage of juvenile salmon up to 75 millimeters (3 inches) in length with little or no delay in their migration. However, it is likely that some fish greater than 75 millimeters in length would experience a behavioral response upon encountering an in-water mesh.

As indicated by larger 9-inch (23-centimeter) shad, passage by larger fish through a potential barrier was significantly reduced (Reading 1982). Based on this observation, it is likely that larger juvenile salmonid would hesitate prior to migrating through the structure, whereas others may not migrate through the structure, but would instead migrate around the most seaward point. Should juvenile salmonids during their nearshore migration concentrate either behind the mesh or around the seaward ends of either LWI, they have the potential to be exposed to increased predation by year-round occurring marine mammals and birds. Of greatest potential impact is that a delay in migration rate or alteration of the migration route may have the potential to affect survivability, as it could increase potential predation on nearshore-migrating juvenile salmonids. Any debris and/or fouling that collected on the mesh (e.g., floating marine vegetation, mussels, and barnacles) would reduce the effective size of the mesh, thereby increasing its influence as a barrier. To minimize this impact on juvenile salmonids, the Navy would, at a minimum, annually clean the mesh of floating debris and fouling organisms at the end of the standard work window, prior to the peak out-migration of juvenile salmonids. Although some portion of the juvenile salmonids that depend on nearshore habitats during their out-migration may migrate through the in-water mesh, particularly the smaller salmonids, many juvenile salmonids would potentially migrate along the mesh, toward deeper waters, and around the offshore end of each LWI mesh structure. Migrating around the structure would increase the length of their migration, requiring them to leave preferred nearshore habitats while potentially subjecting them to increased predation relative to existing conditions.

Because most species of adult salmonids are less dependent on nearshore habitats and also have much greater mobility, adults of these species would not experience the same barrier effects as nearshore-dependent juvenile salmonids as a result of the nearshore structures. However, due to their larger size, should they encounter these structures, they would be required to migrate around the entire structure, although this is expected to cause little or no delay in their overall movements. Due to the year-round occurrence of marine mammals at

NAVBASE Kitsap Bangor, some predation of adult salmonids may occur in the vicinity of the mesh if these fish congregate behind or become concentrated around the seaward ends of each LWI during their nearshore migration toward spawning streams.

Independent of the in-water mesh, there is some disagreement in the scientific literature regarding the scale and possible impacts of piles and overwater structures on juvenile salmonids when encountering these structures during shoreline migration and habitat use (Simenstad et al. 1999; Weitkamp et al. 2000; NMFS 2004). Some studies indicate that structures (such as the in-water piles and overhead decking of LWI Alternative 2) can represent barriers to shoreline-dependent juvenile salmon migrating along the Bangor shoreline (Salo et al. 1980; Simenstad et al. 1999; Nightingale and Simenstad 2001a; Southard et al. 2006). Juvenile salmonids have been shown to avoid crossing the shade/light line created by an overhead pier/dock (summarized in Simenstad et al. 1999; Nightingale and Simenstad 2001a; Southard et al. 2006). However, the height-over-water of a structure, such as a pier or trestle, has been noted as the most important design aspect for allowing increased light availability under a structure (Burdick and Short 1999). The design of the pier leading from the on-land support facility across the nearshore habitat and eventually connecting to the PSBs would be constructed with a deck height of approximately 17 feet (5 meters) above MLLW. The decking would include light-penetrating grating that would minimize the shade cast by the LWI structures. Therefore, only a narrow band of nearshore shade, with a reduced contrast due to grating, would be cast from the structures across the juvenile salmonid and forage fish migratory pathway. This effect would be greatest at higher tides when the height-over-water would range from 1 to 5 feet (0.3 to 1.5 meters). The shade cast from the structure alone would be minor, but combined with the effect of the in-water mesh would potentially result in behavioral responses by juvenile salmonids. Effects could include delays in seaward migration and likely increases in the prevalence of juvenile salmonids migrating around the end of the structure into deeper, offshore waters, with the potential for exposure to higher predation rates than would occur along normal nearshore pathways.

The LWI Alternative 2 abutments would occur above the normal tidal range, in supratidal habitats. Hughes (2015) indicates that these habitats are used by salmonids and forage fish for migration. During extreme high tides, which occur infrequently and for short periods, the presence of the two abutments would represent a migration barrier for those fish migrating in very shallow waters. Additionally, the presence of the two concrete abutments would result in a long-term change in physical habitat.

A potential migration barrier to juvenile salmon migration at night is artificial lighting. Marine fisheries utilize lights, and light intensity is managed, to attract and harvest a variety of marine species (Marchesan et al. 2005). Becker et al. (2013) demonstrated that both predator and prey species of fish can be attracted to light, although not all species demonstrate this behavior. Studies have also shown that salmonids have been attracted toward and congregate around structures with artificial lighting, thereby potentially delaying their migration (Prinslow et al. 1980; Simenstad et al. 1999; Nightingale and Simenstad 2001a). The active industrial Bangor waterfront supports eight major piers and docks, averaging nearly 150,000 square feet (3.4 acres [1.4 hectares]) each. The largest piers at the Bangor waterfront are outfitted with more than 100 industrial overhead, security, doorway, and walkway lights. The LWI project would use over-water lighting very infrequently, during security responses only. Therefore, there would be little or no risk of attraction of salmonids or resultant alternation in behavior, migration, or increased risk of predation.

Biological Habitat

Prey Availability. LWI Alternative 2 would result in the increase of shaded marine habitat (Section 3.2.2.2.2). As addressed for Marine Vegetation, impacts on eelgrass habitats would be mitigated as described in the Mitigation Action Plan (Appendix C, Section 6.0). In addition to construction-related effects on eelgrass, shading would result in some additional long-term impacts or loss of macroalgae habitat. In addition to the long-term occurrence of the piles supporting the LWI piers, the presence of the steel plate anchoring for the mesh would permanently reduce the productivity of benthic habitats, and therefore foraging habitats for marine fish at both LWI locations (Section 3.2.2.2.2). The loss or reduction of algae would result in a corresponding decrease in the productivity of epiphytes and benthic invertebrates that use this habitat. Nearshore-occurring fish also would be expected to experience some loss in the availability of benthic prey due to the presence of these structures (Section 3.2.2.2.2). The presence of the pile-supported piers and in-water mesh could result in minor impacts on forage fish migration, prey base, and Pacific sand lance spawning at the north LWI project site.

Aquatic Vegetation. The presence of LWI Alternative 2 would reduce eelgrass habitats available to juvenile salmon migrating along the Bangor shoreline, but successful mitigation is anticipated to offset this loss. Shading impacts on aquatic vegetation, including eelgrass, would be minimized due to the use of grating for the LWI decking. Steel plates and piles would permanently eliminate 0.076 acre (0.031 hectare) of marine vegetation including 0.024 acre (0.01 hectare) of eelgrass. The compensatory aquatic mitigation action (described in Appendix C, Section 6.0) would compensate for these impacts.

Underwater Noise

Operation of LWI Alternative 2 would not increase vessel activity or nearshore activity relative to existing conditions and thus would not increase vessel-related underwater noise. Little or no increase in underwater noise would occur from activities on the pier since no cranes, generators, compressors, or other machinery would be required to operate on these structures. As a result, operation of LWI Alternative 2 would not raise background noise above the thresholds of injury or guideline for behavioral effects for ESA-listed fish.

Summary of Impacts and ESA-Listed Salmonids Determination

Operation of LWI Alternative 2 may result in impacts on physical barriers, refugia, prey availability, forage fish community, and aquatic vegetation, which are considered important for ESA-listed salmonids. Based on the low likelihood of occurrence in the project area, no population-level effects to Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer-run chum, or bull trout are anticipated.

Nevertheless, operation of LWI Alternative 2 may affect Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer-run chum salmon, and bull trout. No operational stressors associated with the proposed project are anticipated in designated or proposed critical habitats.

Therefore, the effect determination for all listed salmonid species is "may affect, not likely to adversely affect." The effect determination for critical habitat is also "may affect, not likely to adversely affect," except for bull trout and Puget Sound steelhead (no effect).

ESA-Listed Hood Canal Rockfish

Rockfish Habitat Requirements

Currents

As discussed above for salmonids, due to the presence of the piles and in-water mesh structures, operation of the LWI under Alternative 2 would have only minor and local effects on water flow in the immediate vicinity of the piles and in-water mesh. In particular, there would be an increase in turbulent flow in the immediate vicinity of the piles and in-water mesh and a decreased flow immediately downstream (Section 3.1.2.2.2). However, these changes would be small scale and localized to the immediate vicinity of the in-water components of each pier structure. The overall flow of water in deeper water areas adjacent to the piers would not be affected by the structures. As a result, due to the limited and localized scale of project effects on currents, the operation of LWI Alternative 2 would not modify currents at a scale that would affect rockfish recruitment within northern Hood Canal waters.

Water Quality

As discussed above for salmonids, operation of the LWI under Alternative 2 would not impact existing DO levels in the project vicinity. Therefore, rockfish would not be subjected to any increases in respiratory distress or alter their distribution in response to DO reductions. In addition, due to the general maintenance of existing flow conditions, LWI operations would not result in water temperature increases over existing conditions and would not elevate levels of suspended solids sufficient to degrade water quality or cause impacts on these species (Section 3.1.1.1.2).

Habitat Alteration

As addressed below, rockfish habitat alteration can cause three interrelated stressors identified by Drake et al. (2010) and Palsson et al. (2009), associated with loss of suitable habitat, predation, and competition. Limited or altered habitat could also affect prey availability and the presence of exotic species.

Suitable Habitat. Some loss of marine vegetation, potentially used for juvenile rockfish recruitment, would occur due to overwater shading from the proposed structures. At some tidal elevations, shade-related effects would occur due to the low overwater height of the piers (17 feet [5 meters] above MLLW). Operations would not be expected to inhibit kelp growth because no attached, canopy-forming kelp beds occur along the Bangor waterfront (Section 3.2.1.1.2).

LWI Alternative 2 would result in the placement of up to 136 permanent piles to support both piers, attached docks, and gangways plus 120 temporary piles. These piles could serve as post-larval juvenile rockfish recruitment habitat. In addition, the presence of the in-water meshed structures would introduce structured habitat where it currently does not occur. In Hood Canal, suitable structured habitat for rockfish recruitment is very limited (PSAT 2007a; Palsson et al. 2009), with existing marine reserves accounting for almost 20 percent of the available nearshore rocky habitat (PSAT 2007a). Suitable habitat is limited between NAVBASE Kitsap Bangor and the Toandos Peninsula. WDFW conducted 24 trawls in this vicinity and did not capture any of the three ESA-listed rockfish (Palsson 2009, personal communication). The lack of suitable recruitment habitat within Hood Canal largely contributes to the patchy and limited distribution and abundance of rockfish in Hood Canal.

Although the in-water mesh may serve as potential structured habitat, the fence would be cleaned of fouling debris at least annually, just prior to the peak juvenile salmonid out-migration. This cleaning may reduce the suitability of this structure for other, non-salmonid, fish species such as rockfish. Although there are substantial difficulties comparing the loss of marine vegetation to the addition of manmade structures as habitat for juvenile rockfish recruitment, it is likely that the loss of marine vegetation habitat is offset, to some degree, by the addition of structured habitat. Whether the change in habitat type would be a net benefit or detriment to rockfish is unknown.

Predation. The same piles and in-water mesh that could serve as a potential recruitment benefit to juvenile bocaccio, yelloweye rockfish, and canary rockfish could also serve as habitat for rockfish predators (e.g., lingcod, and larger sub-adult rockfish). Baskett et al. (2006) found that, prior to commercial fishing pressure, predation and competition primarily shaped the rockfish community structure. This was mostly due to rockfish intra-guild predation, including large adult rockfish preying on smaller rockfish members, as well as predation by lingcod. Beaudreau and Essington (2007, 2009) found that rockfish comprise 11 percent of adult lingcod diet by mass. These studies showed that in structured habitats protected from fishing (i.e., marine reserves), lingcod can limit the prevalence of rockfish through predation. The average size and abundance of lingcod in the existing NAVBASE Kitsap Bangor pier habitats is unknown, but the piers and in-water mesh associated with this alternative could result in increased predation on juvenile rockfish. To what extent the annual cleaning of this mesh would affect its suitability as recruitment habitat for structure-dependent species is unknown. Further, it is unknown if the benefit of these structures for suitable recruitment habitat would be equivalent to any potential loss of juvenile rockfish to predators.

Competition. Habitat modification due to the piers and in-water mesh of this alternative would result in a benthic-to-structure community shift and may create habitat that is more suitable for one species of rockfish compared to others. As noted above, juvenile rockfish can occur in shallow, nearshore waters over rocks with algae or in sandy areas with eelgrass or drift algae. The presence of the more structured habitat may promote competition with species that use these habitat types for recruitment and rearing. Whether the existing benthic habitat or the proposed structured habitat would be more beneficial to rockfish is unknown. Whether the annual cleaning of this mesh would result in the absence of juvenile rockfish is also unknown.

Palsson et al. (2009) note that, in the absence of fishing pressure, the more aggressive copper and quillback rockfish species appear to limit the prevalence of brown rockfish. Both of these rockfish species appear to be more prevalent in Hood Canal waters than any of the three ESA-listed rockfish species and may out-compete other rockfish species for the limited structured habitat. Therefore, due to natural factors, including intra-guild competition, an increase in suitable structured habitat would not necessarily result in a corresponding increase of listed rockfish abundance in the project area.

Prey Availability. Since operation of LWI Alternative 2 would not decrease the local abundance or distribution of plankton along the Bangor shoreline (Section 3.2.2.2.2), larval bocaccio, yelloweye rockfish, and canary rockfish would not experience a decrease in food availability. The in-water structures would reduce the size and suitability of some habitats, notably marine vegetation used by forage fish and shiner perch (juvenile/sub-adult rockfish food resources). However, the piles and in-water mesh would provide structure used by other potential prey base species, including the invertebrate fouling community, crabs, juvenile rockfish, perches, sculpins, and greenling (Hueckel and Stayton 1982; Nightingale and Simenstad 2001a; Love et al. 2002). Whether the small local shift in community type would have a corresponding effect on rockfish is unknown.

Due to the construction and operation of the LWI structures under Alternative 2, the prey of benthic-obligate juvenile rockfish within the immediate project vicinity could decrease in abundance, whereas structure-dependent juvenile rockfish and their associated prey could increase. It is not known which of these effects would be greater. Therefore, a small, local change in the type of prey resources available would be likely, but with an unknown effect on total prey availability.

Exotic Species. Operation of the LWI under Alternative 2 would not introduce exotic species from foreign water bodies or increase the prevalence of existing exotic species in Hood Canal waters. Further, operation of the LWI would not create chronic disturbances that would facilitate colonization by non-indigenous species. Therefore, operation of the LWI under Alternative 2 is not anticipated to facilitate the spread or prevalence of exotic organisms along the Bangor shoreline or the Hood Canal basin.

Underwater Noise

As discussed above for salmonids, operation of LWI Alternative 2 would not increase vessel activity or nearshore activity relative to existing conditions and thus would not increase vessel-related underwater noise. Further, little or no increase in underwater noise would occur from activities on the pier as no cranes, generators, compressors, or other machinery would be required to operate on these structures. As a result, operational noise would not rise above background noise levels and exceed the thresholds of injury or guideline for behavioral disturbance for ESA-listed fish.

Summary of Impacts and ESA-Listed Rockfish Determination

As detailed in the sections above, operation of LWI Alternative 2 would not result in adverse impacts on water quality (Section 3.1.2.2.2) or increase the prevalence of exotic species. Bocaccio, yelloweye rockfish, and canary rockfish are extremely rare in Hood Canal waters. The structure-supporting piles and in-water mesh and anchoring systems would convert localized areas of existing soft-bottom benthic habitat to in-water hard substrate structures that could affect local prey availability, as well as the potential to increase recruitment of juvenile bocaccio, yelloweye rockfish, canary rockfish, and rockfish competitors and predators. However, based on the low likelihood of occurrence in the project area, these effects would be discountable, and no population-level impacts are anticipated.

Nevertheless, operation of LWI Alternative 2 may affect bocaccio, canary rockfish, and yelloweye rockfish. No operational stressors associated with the proposed project are anticipated in designated critical habitat. Therefore, the effect determination for all listed rockfish species and their critical habitats is "may affect, not likely to adversely affect."

NON-ESA-LISTED SALMONIDS

Impacts described above for ESA-listed salmonids due to operation of LWI Alternative 2 would be similar for other salmonids potentially occurring in the project area.

FORAGE FISH

Operation of LWI Alternative 2 would have little or no impact on surf smelt or Pacific herring spawning habitats or their reproductive success because no documented surf smelt or Pacific herring spawning grounds occur along the 4.3-mile (7-kilometer) long Bangor waterfront (Penttila 1997; Stout et al. 2001; WDFW 2013; NAVFAC Northwest 2014). However, at the north LWI project site, Pacific sand lance spawning habitat has been documented from the proposed abutment location southward (Figure 3.3–4, Section 3.3.1.5.3). At the south LWI project site, spawning habitat has been documented approximately 500 feet (150 meters) north of the proposed abutment location. Sand lance spawning habitat in the footprint of the north LWI project site abutment and abutment stair landings would be lost. The quality of sand lance spawning habitat in the immediate surrounding area of these structures would be reduced relative to existing conditions. The loss and potential reduction in quality of sand lance spawning habitat would not occur at a scale that would affect the overall population of sand lance in Hood Canal, or their overall availability as a food source to predators dependent on these populations. However, should sand lance no longer occur in the immediate vicinity of the project site due to the new structures, they would also no longer be available to predators in the immediate project vicinity. Although similar construction activities would occur at the south LWI project site, historic and ongoing surveys have not detected any forage fish spawning activity at that location (Penttila 1997, 1999; Bargmann 1998; WDFW 2013b; NAVFAC Northwest 2014). If ongoing studies find that this site is being utilized by forage fish, similar impacts would be experienced as described for the north LWI project site.

Hughes (2015) indicates that the supratidal region is used by forage fish for migration, foraging, refuge, and spawning. These areas are inundated infrequently for short periods. The LWI Alternative 2 abutments would extend from above the normal tidal range into supratidal habitats. Within the supratidal abutment footprints and immediate surrounding areas, these structures would be expected to result in the infrequent loss of function of these habitats with respect to forage fish migration, foraging, refuge, and spawning.

Although the presence of the in-water mesh may not be as substantial a barrier to larval and juvenile forage fish as to larger juvenile salmonids, the presence of in-water structures and the impacts affecting juvenile and adult forage fish behavior would be similar to those described above for salmonids. The close proximity of these structures to documented Pacific sand lance spawning habitat indicates that, depending on whether adults spawn upstream or downstream of a given structure, either adults migrating toward or larvae emerging from these locations would have to navigate through or around the barriers.

In a review of sand lance biology, Robards et al. (1999) found that some studies indicate sand lance behavior is strongly tied to food availability, water temperatures, and light intensity, including artificial nighttime lighting. The use of nighttime artificial lights along the pier is expected to be infrequent, with little or no risk of attracting forage fish, altering behavior (including migration), or increasing the risk of predation. Nearshore vessel activity associated with the new structure would not increase over existing conditions. Therefore, underwater noise associated with operation of LWI Alternative 2 would not increase above existing ambient levels. Additionally, operation of LWI Alternative 2 would not result in changes in the plankton community (the primary forage fish resource), and this resource would continue to occur in the project vicinity (Section 3.2.2.2.2). However, as discussed above for salmonids, operation of LWI Alternative 2 would adversely impact and reduce the function of nearshore benthic habitats. In addition, the presence of the piles, in-water mesh, and daytime shadows could result in a physical barrier effect on nearshore migrating fish, including forage fish.

OTHER MARINE FISH SPECIES

With a few exceptions, marine fish species that are found near the project area share the same habitats as salmonids and would experience project-related impacts from operation of LWI Alternative 2 similar to those described for salmonids, forage fish, and rockfish. As summarized above for these species, operation of LWI Alternative 2 would maintain water and sediment quality in the project area (Sections 3.1.2.2.2).

Project impacts on the physical habitat and barriers would include an increase in nearshore structures in intertidal and subtidal habitats. The presence of these structures would result in localized decreases in currents around the piles. The shading of marine vegetation and benthic habitats would be expected to result in a corresponding loss of productivity in benthic organisms that use these habitats for forage, refuge, and reproduction, thereby resulting in a loss of benthic food resources. While some fish species (e.g., flatfish including starry flounder and English sole) would experience a reduction in flat benthic habitat suitable for their life history, others (e.g., pile perch and greenling) would experience an increase in habitat suitable for their life history (Hart 1973). The loss of some nearshore vegetated habitat in the immediate vicinity of both LWI structures would decrease habitat value for female shiner perch bearing their young. However, since this habitat conversion would be a relatively small percentage of the total Bangor shoreline, the conversion would not result in a significant overall reduction of fish populations occurring along the Bangor shoreline.

As discussed for construction, the presence of nearshore structures would represent a migration barrier to salmonids and forage fish. However, few other species occurring along the Bangor waterfront exhibit shoreline migration patterns similar to those of salmonids (Hart 1973). For example, shiner perch, the most abundant non-salmonid or forage fish captured in these waters (SAIC 2006; Bhuthimethee et al. 2009), overwinter in deeper offshore waters and migrate into nearshore waters in the spring to bear their young (Hart 1973).

3.3.2.2.3. LWI Alternative 3: PSB Modifications (Preferred)

CONSTRUCTION OF LWI ALTERNATIVE 3

As described below in a comparative manner to the detailed analysis provided for Alternative 2, there are some differences in construction-related impacts between LWI Alternatives 2 and 3, including no in-water pile driving for Alternative 3, smaller overwater coverage, reduced impact on nearshore benthic and marine vegetated habitats, no in-water mesh, and a shorter duration of in-water construction.

Essential Fish Habitat

Impacts on EFH from the construction of LWI Alternative 3 would be similar in type, but smaller in extent and duration, than those described for LWI Alternative 2 (see detailed discussions in Sections 3.1.2 and 3.2.2). Differences include no in-water pile driving, and a slightly smaller area of potential construction impacts on water quality, seafloor, and marine vegetation for LWI Alternative 3 than for Alternative 2 (12.7 versus 13.1 acres [5.2 versus 5.3 hectares]). These differences would decrease in scale the project-related impacts on EFH. With the exception of no in-water pile driving noise, LWI Alternative 3 would affect EFH in a similar manner, but at a smaller scale, than described for LWI Alternative 2. LWI Alternative 3 construction activities would not adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH, as detailed below.

Threatened and Endangered Marine Species and Species of Concern

ESA-Listed Hood Canal Salmonids

<u>Salmonid Marine Habitat Conditions</u>

Impacts on marine habitats used by ESA-listed Hood Canal salmonids would be similar for all listed and non-ESA-listed salmonid species.

<u>Water and Sediment Quality</u>

Construction-related impacts from LWI Alternative 3 on water and sediment quality would be smaller in scale and shorter in duration than those for LWI Alternative 2 (Sections 3.1.2.2.2 and 3.1.2.2.3). Construction of LWI Alternative 3 would involve no in-water driving of piles and fewer in-water work days, as detailed above. Alternative 3 would impact a smaller footprint of benthic habitats (up to 12.7 acre [5.2 hectare] vs. 13.1 acre [5.3 hectare]) and though an increase in turbidity in the immediate project vicinity is expected Alternative 3 is not anticipated to violate water or sediment quality standards. In addition, the fish window precludes in-water construction occurring at a time when juvenile salmonids would be prevalent. Therefore, project-related effects on nearshore water and sediment quality used by salmonids under LWI Alternative 3 would be similar in type, but much smaller in scale, to those effects described for Alternative 2.

Physical Habitat and Barriers

Construction of the abutment would be the same as for Alternative 2, and therefore would not represent a substantial migration barrier to juvenile salmonids. Compared to LWI Alternative 2, construction activities for Alternative 3 would require no in-water pile driving, shorter in-water construction duration, a smaller benthic habitat footprint disturbed during constructions, and no installation of in-water mesh extending from the upper intertidal habitats through shallow subtidal habitats, perpendicular to the shoreline. The observation post piles (12 at each location) would be located in the upper intertidal and driven in the dry during low tides. A coffer dam would be utilized to minimize project impacts. The coffer dam would be 140-feet (43 meters) long for the north LWI and 160-feet (49 meters) long for the north LWI stairs. Along the south side, the coffer dam would be190-feet (58 meters) long for the LWI and 160-feet long for the LWI south stairs.

Construction activities that could constitute a behavioral disturbance barrier to salmonids, as well as other species, include vessel shading, barge anchoring and spud/anchor dragging, underwater noise, and turbidity plumes. Because it would not include the pile-supported pier or in-water mesh, LWI Alternative 3 would have fewer of these types of impacts and the associated barrier effect than Alternative 2. During installation of LWI Alternative 3, the construction equipment and activity occurring in habitats that serve as migratory pathways for nearshore fish species could affect their movement patterns and potentially represent a partial physical or visual barrier to migration.

Lighting would originate from construction barges, vessels, and equipment during the 1-year construction period. The presence of artificial light during construction could increase nighttime predation of fish by visual predators. Compared to LWI Alternative 2, nighttime lighting from LWI Alternative 3 construction activities would be smaller in scale and duration, and is expected to have a correspondingly lower potential effect on fish that would occur during in-water work.

Biological Habitat

Due to fewer in-water and overwater structures required for LWI Alternative 3, and the smaller overall project footprint, impacts on marine vegetation and benthic habitats and the vertebrate and invertebrate prey resources that utilize these habitats would be much smaller than for LWI Alternative 2 (Section 3.2.2.2.3). Because LWI Alternative 3 would require a shorter in-water construction duration than Alternative 2 and no in-water pile driving, the nearshore biological habitats used by salmonids would be exposed to much lower levels of underwater noise and for a shorter duration. Larger juvenile salmonids (e.g., Chinook and coho) and adult salmonids migrate further offshore in the neritic zone and are generally less dependent on nearshore biological habitats. However, should they utilize these resources in the project footprint during construction, these salmonids may experience temporary loss of available biological resources, including benthic prey. Similar to LWI Alternative 2, the project materials used for LWI Alternative 3 are not expected to introduce or increase the prevalence of exotic species to Hood Canal waters. Therefore, construction of LWI Alternative 3 would impact nearshore biological habitats utilized by salmonids, but impacts would be reduced for Alternative 3 compared to Alternative 2.

Underwater Noise

For underwater noise effects on fish, the greatest difference between LWI alternatives would be that Alternative 3 would involve no in-water pile driving. Although the general project area is the same, underwater noise during construction of LWI Alternative 3 would be limited to that generated by support vessels, small boat traffic, and barge-mounted equipment, such as generators. Vessel activity required for construction would result in temporary noise and visual disturbance in the immediate vicinity of some of these vessels.

Summary of Impacts and ESA-Listed Salmonid Determination

Construction-related impacts of LWI Alternative 3 on NAVBASE Kitsap Bangor marine habitats, described above for salmonids, would be much smaller in duration and scale than those described for LWI Alternative 2. Compared to LWI Alternative 2, construction activities for Alternative 3 would require no in-water pile driving, shorter in-water construction duration, a smaller benthic habitat footprint disturbed during construction, and no installation of in-water mesh extending from the upper intertidal habitats through shallow subtidal habitats. No element of LWI Alternative 3 construction would extend beyond NAVBASE Kitsap Bangor boundaries and reach proposed or designated critical habitat waters. Therefore, the effect determination for all listed salmonid species is “may affect, not likely to adversely affect.” The effect determination for critical habitat is also “may affect, not likely to adversely affect,” except for bull trout and Puget Sound steelhead (no effect).

ESA-Listed Hood Canal Rockfish

Impacts on currents, water quality, and habitats during construction of LWI Alternative 3 would be considerably smaller than those described for LWI Alternative 2. The greatest differences between the alternatives would be no in-water pile driving, shorter in-water construction duration, a smaller benthic habitat footprint disturbed during construction, and no in-water mesh installed for Alternative 3.

Nevertheless, construction of LWI Alternative 3 may affect bocaccio, canary rockfish, and yelloweye rockfish. Any stressors that have the potential to affect critical habitat essential features (e.g., water quality, substrate conditions) would be localized to the immediate vicinity of in-water construction, and would not reach designated critical habitat. Therefore, the effect determination for all listed rockfish species and their critical habitats is “may affect, not likely to adversely affect.”

NON-ESA-LISTED SALMONIDS

Construction-related impacts on non-ESA-listed salmonids and their habitats would be similar to those described above for ESA-listed salmonids. The use of in-water work windows would also minimize impacts on non-ESA-listed salmonids, including hatchery fish, due to their infrequent occurrence during the work window. Compared to LWI Alternative 2, construction activities for Alternative 3 would require no in-water pile driving, shorter in-water construction duration, a smaller benthic habitat footprint disturbed during construction, and no installation of in-water mesh extending from the upper intertidal habitats through shallow subtidal habitats. Therefore, impacts to non-ESA-listed salmonids would be minimal.

FORAGE FISH

Similar to Alternative 2, forage fish would likely experience some reduction in nearshore habitat availability during LWI Alternative 3 construction due to temporary increases in turbidity, nighttime lighting, and daytime shadows cast from overwater structures and equipment. This could potentially include sand lance avoiding intertidal spawning habitat in the vicinity of the north LWI project site. Construction-related impacts to forage fish spawning habitats would be similar to those of Alternative 2, but with the addition of impacts from installation of the observation post piles. At the north LWI project site, sand lance spawning habitat in the footprint of the abutment and observation post piles would be lost, and the quality of sand lance spawning habitat in the immediate surrounding area affected by associated construction activities would be reduced compared to existing conditions. The loss and potential reduction in quality of sand lance spawning habitat would not occur at a scale that would affect the overall population of sand lance in Hood Canal, or their availability as a food source to predators dependent on these populations. However, should sand lance no longer occur in the immediate vicinity of the project site due to the new structures, they would also no longer be available to predators in the immediate project vicinity. Although similar construction activities would occur at the south LWI project site, historic and ongoing surveys have not detected any forage fish spawning activity at that location (Penttila 1997, 1999; Bargmann 1998; WDFW 2013b; NAVFAC Northwest 2014). As described above for salmonids, LWI Alternative 3 construction would not require in-water pile driving and would be of a shorter duration than LWI Alternative 2. Therefore, impacts to forage fish would be minimal.

OTHER MARINE FISH SPECIES

Construction of LWI Alternative 3 would include no in-water pile driving, shorter in-water construction duration, a smaller benthic habitat footprint disturbed during construction, and no installation of in-water mesh extending from the upper intertidal habitats through shallow subtidal habitats compared to construction of LWI Alternative 2. Although some of these reductions are substantial compared to LWI Alternative 2, the construction of LWI Alternative 3 would still affect nearshore habitats utilized by other marine fish species for foraging, refuge, and reproduction. Therefore, impacts to other marine fish species would be minimal.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 3

The primary impacts on marine fish from operation of LWI Alternative 3 would include an increase of physical structures in the nearshore environment, alteration of nearshore habitats including some reduction in natural refugia, potential reduction in prey availability/forage fish community, and potential decrease in nearshore aquatic vegetation. The following sections describe how each of these factors would impact abundance and distribution of marine fish that could occur along the Bangor waterfront during operation of LWI Alternative 3.

Maintenance of LWI Alternative 3 would include routine inspections, cleaning, repair, and replacement of facility components (except pile replacement) as required. Measures would be employed to prevent discharges of contaminants to the marine environment. These activities would not affect marine fish.

ESSENTIAL FISH HABITAT

Some operational impacts on EFH from the operation of LWI Alternative 3 would be similar to those described for salmonid EFH and other marine fish EFH for LWI Alternative 2. Operational impacts on water and sediment quality (Section 3.1.2.2.3) would be similar, and vessel activity would not differ measurably between the two alternatives. However, other operational impacts from LWI Alternative 3 would be much smaller than for LWI Alternative 2. The total overwater area would be smaller for LWI Alternative 3 than for Alternative 2 (0.12 vs. 0.4 acre [0.05 vs. 0.16 hectare]) (Section 3.2.2.2.3). Additional differences would include fewer in-water piles, less overwater shading of benthic and marine vegetated habitats, and no in-water mesh for LWI Alternative 3. However, operational impacts of Alternative 3 would include grounding of the PSBs and buoys during low tide in shallow water EFH (Section 3.2.2.2.3). Operation of LWI Alternative 3 may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH.

THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN

ESA-Listed Hood Canal Salmonids

Marine Salmonid Habitat Requirements

Water and Sediment Quality

Long-term impacts on water and sediment quality from operation of LWI Alternative 3 would be similar to LWI Alternative 2 (Section 3.1.2.2.3), and would not violate water or sediment quality standards in habitats used by salmonids. In addition, BMPs implemented to minimize the degradation of water and sediment quality would be consistent with existing practices along the Bangor waterfront.

Physical Habitat and Barriers

With respect to potential physical barriers to fish movement in nearshore marine habitats, LWI Alternative 3 would have fewer in-water and overwater components and associated lighting than LWI Alternative 2. The most important difference between the alternatives regarding in-water barriers is that Alternative 3 would not include the in-water mesh structure perpendicular to the shoreline that would occur for Alternative 2. Under Alternative 3, the guard panels between the PSB pontoons would represent less of a barrier to fish movement in nearshore waters than the in-water mesh of Alternative 2. Alternative 3 would have far fewer in-water piles (24) than Alternative 2 (150). In addition, the overwater area associated with Alternative 3 (0.12 acre [0.05 hectare]), which includes nearshore PSBs and observation posts, would be much smaller than the overwater shading for Alternative 2 (0.34 acre [0.14 hectare]), which includes pile-supported piers and floating docks.

The PSBs are oriented such that they would occur in a line over nearshore habitats, would float in the top foot of water, and would cast minimal shadow, so the shade they would cast is not expected to represent a substantial in-water barrier to fish movement. From each of the floating PSBs, the metal grating (guard panels) would extend into the water less than 1 foot (30 centimeters) (Section 2.1.1.3.3). Salmonids encountering the floating PSBs in deeper water (e.g., depths greater than 8 to 10 feet [2.4 to 3.0 meters]) would not likely be affected by the presence of these structures, and would simply swim underneath the PSB and attached grating. However, smaller salmonids, notably fry, which encounter these structures in much shallower nearshore waters, may experience some combination of physical and/or visual barrier effects (Section 3.3.2.2.2). These fish would be expected to move toward slightly deeper water where they could more easily swim underneath the floating PSB units. Although there are few piles that would occur in the migratory pathway, and minimal lighting for the new structures, the year-round, semi-diurnal (twice daily) grounding of the PSBs in shallow waters could represent a partial barrier with respect to visual disturbance or avoidance of juvenile migration in these waters. However, the partial barrier would not differ greatly from other naturally occurring barriers encountered in the marine environment. For these reasons, the operation of LWI Alternative 3 could represent a partial nearshore barrier to fish movement, but it is not expected to have a measurable effect on the movement of fish in these habitats.

Biological Habitat

Because of a decrease in the number of piles, in-water and over-water structures, and total project footprint for LWI Alternative 3, the operational impacts on marine vegetation and benthic communities and their productivity would be smaller than those described for LWI Alternative 2 (Section 3.2.2.2.3). One operational aspect that would occur under Alternative 3 but not Alternative 2 would be the grounding of intertidal PSB units. Operation of the PSB segments would impact marine vegetation and benthic habitats in the intertidal zone where the PSB feet contact the bottom during low tide stages. In particular, the periodic (tidal-dependent) but repeated disturbance of the seafloor would affect the habitats in these disturbance zones. Over the long term, which would include extreme low tides, approximately 18 PSB units including 54 pontoons and three buoys would ground out in the intertidal zone. Five of these PSB units and one buoy would ground out at the north LWI and 13 PSB units and two buoys would ground out at the south LWI. It is estimated that approximately 2,594 square feet (241 square meters) of the intertidal zone would be disturbed over the long term (725 square feet [67 square meters] at the north LWI and 1,869 square feet [174 square meters] at the south LWI) (Section 2.1.1.3.3). Alternative 3 would relocate four existing PSB buoys and associated anchors at the North LWI project site, reducing the number of anchor legs and anchors for two of the four buoys. Three existing PSB buoys and associated anchors would be relocated and one new buoy and associated anchors would be added at the south LWI project site. Although the net effect would be a small decrease in the total number of PSB buoy anchors, the relocated buoys and anchors would be located in previously undisturbed areas, resulting in minor long-term impacts in those areas.

Predation

Operation of LWI Alternative 3 would increase the number of floating Port Security Barriers in the nearshore environment, including an increase in intertidal habitats. These floating structures have the potential to act as haulout sites for seals and sea lions, representing known predators on salmonids and other marine fish species. As documented by marine mammal surveys that commenced at Bangor Naval Base in 2008 (Section 3.4.1.1.3), the numbers of California and Steller sea lions hauling out on submarines at Delta Pier and Port Security

Barrier pontoons have increased without the addition of any new haulout sites. The majority of sea lions haul out on submarines rather than pontoons. Those sea lions that that have been detected on pontoons have been in close proximity to Delta Pier. The majority of the existing pontoons along the waterfront have never been used for hauling out by sea lions. Sea lions have not been detected hauling out elsewhere along the Bangor shoreline. Though it is possible that sea lions could use the additional pontoons installed under LWI Alternative 3 as haulout sites, marine mammal surveys have shown that the sea lions at Bangor appear to prefer to be in close proximity to the submarines at Delta Pier. Under current conditions, sea lions can readily access nearshore areas from existing Delta Pier haulout sites. As a result, the presence of the intertidal LWI pontoons is unlikely to increase the presence of sea lions at Bangor or the prevalence of sea lions in shallow nearshore and intertidal waters of the base. Therefore, operation of LWI Alternative 3 is unlikely to increase sea lion predation on salmonids or other marine fish along the Bangor shoreline.

Underwater Noise

Similar to LWI Alternative 2, the operation of LWI Alternative 3 would not increase vessel activity or nearshore activity relative to existing conditions and thus would not increase vessel-related underwater noise. However, under LWI Alternative 3, some increase in underwater noise, even though intermittent and localized, would occur from the anchor chains and PSB feet when they come in contact with the bottom or other LWI structures. This noise is not, however, expected to be sufficient to cause nearshore-migrating juvenile salmon to alter their normal migration route. As a result, underwater noise that would occur during the operation of LWI is not anticipated to affect the long-term presence or behavior of fish in the project area.

Summary of Impacts and ESA-Listed Salmonids Determination

The operational effects of LWI Alternative 3 on nearshore NAVBASE Kitsap Bangor marine habitats, described above for salmonids, would be much smaller for Alternative 3 than for LWI Alternative 2. No operational stressors associated with the proposed project are anticipated in designated or proposed critical habitats. Therefore, the effect determination for all listed salmonid species is “may affect, not likely to adversely affect.” The effect determination for critical habitat is also “may affect, not likely to adversely affect,” except for bull trout and Puget Sound steelhead (no effect).

ESA-Listed Hood Canal Rockfish

Rockfish Habitat Requirements

Similar to the conclusions noted above for operation of LWI Alternative 2, operation of LWI Alternative 3 would not result in adverse impacts on currents at a scale that would affect larval retention, water quality, or increase the prevalence of exotic species. Underwater noise from vessel operations is not anticipated to rise to a level that would limit rockfish occurrence. The greatest difference between the two alternatives would be the smaller overwater structure area and in-water piles for Alternative 3, and the absence of the in-water mesh. Although bocaccio, yelloweye rockfish, and canary rockfish are extremely rare in Hood Canal waters, the presence of the LWI structures under Alternative 3 would shade some portions of benthic habitats, potentially inhibiting the growth of marine vegetation. In addition, the structure-supporting piles and anchoring systems would convert localized areas of existing soft-bottom benthic habitat to in-water hard substrate structures that could have minor impacts to local prey availability. However, these impacts would be minor in scope and have the potential to affect only a very small proportion of the available habitat within Hood Canal.

Nevertheless, operation of LWI Alternative 3 may affect bocaccio, canary rockfish, and yelloweye rockfish. No operational stressors associated with the proposed project are anticipated in designated rockfish critical habitat. Therefore, the effect determination for all listed rockfish species and their critical habitats is "may affect, not likely to adversely affect."

NON-ESA-LISTED SALMONIDS

Impacts described above for ESA-listed salmonids due to operation of LWI Alternative 3 would be similar for other salmonids potentially occurring in the project area.

FORAGE FISH

Because the effects on nearshore water and sediment quality are similar for LWI Alternative 2 and Alternative 3, the operational impacts on these habitats with respect to forage fish would also be similar. Alternative 3 would also be similar to Alternative 2 in terms of nighttime lighting, which would be used very infrequently (security responses only) with little or no risk of attracting forage fish, altering behavior (including migration), or increasing the risk of predation. As with Alternative 2, vessel activity associated with Alternative 3 would not increase over existing conditions, and would not increase to levels that would alter existing forage fish distribution and occurrence along the shoreline. Additionally, operation of Alternative 3 would not result in changes in the plankton community (the primary forage fish resource), and this resource would continue to occur in the project vicinity. However, as discussed above, operation of Alternative 3 may result in minor impacts to nearshore benthic and vegetated habitats utilized for foraging and refuge.

Operation of LWI Alternative 3 is not anticipated to impact surf smelt or Pacific herring spawning habitats or their reproductive success, because surf smelt or Pacific herring spawning grounds have not been documented along the 4.3-mile (7 kilometer) long Bangor waterfront (Penttila 1997; Stout et al. 2001; WDFW 2013b; NAVFAC Northwest 2014). However, at the north LWI project site, Pacific sand lance spawning habitat has been documented from the proposed abutment location southward (Figure 3.3–4, Section 3.3.1.5.3). At the south LWI project site, spawning habitat has been documented approximately 500 feet (150 meters) north of the proposed abutment location. As described for LWI Alternative 2, sand lance spawning habitat in the footprint of the north LWI project site abutment, abutment stair landings, and piles supporting the observation posts (Alternative 3 only) would be lost, and the quality of sand lance spawning habitat in the immediate surrounding area of these structures would be reduced compared to existing conditions. The loss and potential reduction in quality of sand lance spawning habitat would not occur at a scale that would affect the overall population of sand lance in Hood Canal, or their availability as a food source to predators dependent on these populations. However, should sand lance no longer occur in the immediate vicinity of the project site due to the new structures, they would also no longer be available to predators in the immediate project vicinity. Although similar construction activities would occur at the south LWI project site, historic and ongoing surveys have not detected any forage fish spawning activity at that location (Penttila 1997, 1999; Bargmann 1998; WDFW 2013b; NAVFAC 2014). If ongoing studies find this site is being utilized by forage fish, it would experience similar impacts as described for the north LWI project site.

Although the LWI extends across intertidal and shallow subtidal habitats used as a nearshore migratory pathway, the presence of the floating PSBs and the limited shade they would cast would not represent a substantial in-water structure or overwater shade barrier to nearshore fish migration. The observation post piles that would occur at either the north or south LWI would not block nearshore forage fish movement because they would not extend across the nearshore migration route, they would be separated from each other, and they would not be of sufficient size to cast nearshore shade that would alter species behavior. Even the close proximity of these structures to documented Pacific sand lance spawning habitat at the north LWI should have little or no effect on the movement of adults migrating toward or larvae emerging from these locations. However, although no documented spawning habitat occurs at the south LWI project site, the grounding of the PSB pontoons would occur adjacent to Pacific sand lance spawning habitat at the LWI project site. Function of these spawning habitats may be slightly impacted, but the impacts would be minor in the context of the total available sand lance spawning habitat in Hood Canal.

OTHER MARINE FISH SPECIES

Operational impacts on other marine fish species for LWI Alternative 3 would be similar to those described for salmonids above. Alternative 3 would maintain water and sediment quality in the project area (Sections 3.1.2.2.2 and 3.1.2.2.3). In addition, Alternative 3 would include fewer in-water and over-water structures, and, most importantly, would not include the pile-supported pier and associated in-water mesh that would occur perpendicular to the shoreline under LWI Alternative 2. Minor reductions in marine vegetation and benthic productivity from shading and the daily grounding of PSB pontoons in intertidal habitats may occur. Alternative 3 would have fewer overall operational impacts on other marine fish species compared to Alternative 2.

3.3.2.2.4. SUMMARY OF LWI IMPACTS

Impacts on fish during the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.3–4.

Table 3.3–4. Summary of LWI Impacts on Fish

Alternative	Environmental Impacts on Fish
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Pier	*Construction:* Temporary degradation of turbidity and nearshore physical barriers; potential temporary decrease in function of habitats and aquatic vegetation used for foraging and refuge. Underwater noise guideline for behavioral disturbance and thresholds for injury would be exceeded during pile driving (this action would only occur during in-water work windows when juvenile salmon are generally not present). Potential disturbance of vegetated shallow-water habitats including 1.1 acre (0.43 hectare) of eelgrass habitat. *Operation/Long-term Impacts:* Potential localized changes in fish habitat including barrier effects on juvenile and adult migratory fish, and minor loss of forage fish spawning habitat (north LWI) and supratidal habitat.
	ESA: Alternative 2 “may affect, not likely to adversely affect” Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bull trout, bocaccio, canary rockfish, and yelloweye rockfish. For critical habitat: “may affect, not likely to adversely affect,” except for bull trout and Puget Sound steelhead (no effect). *EFH:* Impacts from construction and operation may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH.
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* Temporary degradation of turbidity and nearshore physical barriers; temporary decrease in function of habitats and aquatic vegetation used for foraging and refuge. No in-water pile driving. Potential disturbance of vegetated shallow-water habitats, including 1 acre (0.39 hectare) of eelgrass habitat, representing a smaller impact on marine habitats utilized by fish than would occur under Alternative 2. *Operation/Long-term Impacts:* Localized changes in fish habitat including a much smaller, but possible, barrier effect on juvenile and adult migratory fish, compared to Alternative 2. Minor loss of forage fish spawning habitat (north LWI) and supratidal habitat.
	ESA: Alternative 3 “may affect, not likely to adversely affect” Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bull trout, bocaccio, canary rockfish, and yelloweye rockfish. For critical habitat: “may affect, not likely to adversely affect,” except for bull trout and Puget Sound steelhead (no effect). *EFH:* Impacts from construction and operation may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH.
Mitigation: BMPs and current practices to reduce and minimize impacts on marine fish are described in Section 3.3.1.8.3. Under either alternative, proposed compensatory aquatic mitigation (Appendix C, Section 6.0) would compensate for the project’s aquatic habitat impacts.	
Consultation and Permit Status: The Navy addressed impacts on ESA-listed marine fish and MSA-covered habitats under consultation with the NMFS West Coast Region office under the ESA and MSA. An EFH Assessment (EFHA) was submitted to the NMFS West Coast Region office on March 10, 2015. A Biological Assessment (BA) was submitted to the NMFS West Coast Region office and the USFWS Washington Fish and Wildlife Office on March 10, 2015 and a revised BA was submitted on June 10, 2015. NMFS issued a Letter of Concurrence on November 13, 2015, concurring with the effect determinations noted above. In a concurrence letter dated March 4, 2016, USFWS stated that the LWI project impacts to bull trout are not measurable and therefore insignificant.	

BMP = best management practice; EFH = Essential Fish Habitat; ESA = Endangered Species Act; MSA = Magnuson-Stevens Act; NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service

3.3.2.3. SPE PROJECT ALTERNATIVES

3.3.2.3.1. SPE ALTERNATIVE 1: NO ACTION

The SPE would not be built under the No Action Alternative and overall operations would not change from current levels. Therefore, the marine fish community would not be impacted under the SPE No Action Alternative.

3.3.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

CONSTRUCTION OF SPE ALTERNATIVE 2

Marine habitats used by fish species that occur along the Bangor waterfront include offshore (deeper) habitat, nearshore habitats (intertidal zone and shallow subtidal zone), and other habitats, including piles used for structure and cover. The following sections describe project-related effects on physical and biological factors, including impacts on the abundance and distribution of marine fish that could occur along the Bangor waterfront during construction.

ESSENTIAL FISH HABITAT

As detailed in the EFH Assessment, the primary construction-related impacts of concern for EFH would include underwater noise generated from pile driving, marine benthic and vegetation community disturbance, substrate disruption and turbidity from pile driving, barge anchoring, and water column and substrate shading from construction barges and structures (detailed in Sections 3.1.2, 3.2.2, and Appendix D). Construction impacts on macroalgae could impact suitable habitat areas for various life stages of some EFH species. Up to 1 acre (0.42 hectare) of nearshore marine habitat and 2.9 acres (1.2 hectares) of habitats in deep water would potentially be disturbed during construction of SPE Alternative 2 (Section 3.2.2.3.2). Of those 3.9 acres, approximately 0.27 acre (0.11 hectare) supports marine vegetation communities. Mitigation measures, BMPs, and current practices for the protection of salmonids, described above in Section 3.3.1.8.3 and Appendix C, would minimize impacts on EFH due to construction.

Construction of SPE Alternative 2 may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH. However, based on review of EFH species known or likely to occur in Hood Canal; findings pertaining to EFH species occurrence in waters along the Bangor waterfront, based on site-specific fish surveys; review of the life histories, habitat requirements, and potential conservation measures from the FMPs; as well as review of the mitigation measures developed to prevent adverse effects on ESA-listed fish species and their habitats, it is concluded that the current project approach and mitigation measures sufficiently address concerns pertaining to the potential for adverse construction-related effects on EFH, as detailed below.

THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN

Due to the similarity of life histories within ESA-listed species groups (salmonids and rockfish), impacts on ESA-listed species are discussed by listed species group. As a result, the species group *ESA-Listed Hood Canal Salmonids* includes the following: Puget Sound Chinook, Hood

Canal summer-run chum salmon, Puget Sound steelhead, and bull trout. The species group *ESA-Listed Hood Canal Rockfish* includes bocaccio, yelloweye rockfish, and canary rockfish.

ESA-Listed Hood Canal Salmonids

Potential impacts of the proposed project on Puget Sound Chinook, Hood Canal summer-run chum salmon, Puget Sound steelhead, and bull trout and the nearshore habitats they use are discussed below. Some project-related impacts could indirectly impact salmonids through alteration of nearshore habitats (e.g., aquatic vegetation disturbance), whereas other impacts (e.g., underwater noise) can directly affect a given species that occurs during the construction period. While some construction-related impacts may permanently or temporarily degrade one or more marine habitat constituents, construction may have little or no impacts on other constituents. Although juvenile salmonid species that are dependent on shoreline habitats as a migratory pathway would not be able to avoid nearshore construction activities as easily as adults, the number of juvenile salmon present during construction would be minimized by utilizing the in-water work window (July 15 to January 15). In-water work windows are based on the best available site-specific information for protected fish species. Adherence to the in-water work window generally ensures that construction of in-water structures would have no more than a minimal direct effect on listed juvenile salmonids in the project area.

Salmonid Marine Habitat Conditions

Impacts on marine habitats used by ESA-listed Hood Canal salmonids would be similar for all listed and non-ESA-listed salmonid species, as well as forage fish and other marine fish species. The following impact assessment for marine fish summarizes project-related impacts on marine fish and the aquatic habitats upon which they depend at NAVBASE Kitsap Bangor.

Water and Sediment Quality

As discussed in Section 3.1.2.3.2, construction-related impacts on water quality from SPE Alternative 2 would be limited to temporary (two in-water work seasons) and localized changes associated with resuspension of bottom sediments during pile installation. While large increases in turbidity have the potential to damage fish gills, the proposed project would only result in small-scale increases of suspended sediments (Section 3.1.2.3.2) and is not expected to result in gill tissue damage to salmonids. Studies investigating similar impacts to steelhead and coho salmon from larger scale sediment dredging operations have shown that increased turbidity levels from these activities did not cause salmonid gill damage, although other adverse effects were evident (Redding et al. 1987; Servizi and Martens 1991). For example, Redding et al. (1987) found that coho and steelhead were more susceptible to bacterial infection and displayed reduced feeding rates when exposed to elevated turbidity levels. Further, Servizi and Martens (1991) found that coho were more susceptible to viral infections when exposed to elevated turbidity and postulated that other impacts include reduced tolerance to environmental changes. Turbidity attributed to bubble curtains is dependent on whether the unit design is confined or unconfined. Because sediment disturbance is expected to be temporary and intermittent in nature, and fish are expected to avoid the immediate vicinity of construction activities, no long term effects to salmonid fitness are expected. However, elevated turbidity could temporarily decrease the availability of prey in the immediate vicinity, or reduce the ability of salmonids to detect and capture prey species.

Because concentrations of organic matter in NAVBASE Kitsap Bangor sediments are low (Table 3.1–4; Section 3.1.1.1.3), resuspension of these sediments is not expected to alter or depress DO below levels specified by water quality standards. In surveys conducted along the Bangor waterfront from 2005 to 2006, DO was measured at levels below the EQ standard of 7.0 mg/L, but not below the level considered to have adverse impacts on fish (5 mg/L) (Newton et al. 2002). Construction of the SPE Alternative 2 would not result in violations of water quality standards for DO or cause local decreases to levels that would impact the health of fish. Therefore, construction of SPE Alternative 2 would not adversely affect water quality in the project vicinity.

The primary adverse impact on water quality from in-water construction activities, including pile installation, barge and tug anchoring, and propeller wash, would be suspension of bottom sediments and formation of a turbidity plume in near-bottom waters. Resuspended sediments could cause the release of sediment-bound contaminants to near-bottom waters. However, sediments at the SPE project site contain low concentrations of organic carbon (i.e., TOC) and, along with metals, are characterized as having contaminant levels below applicable state standards (Table 3.1–4; Section 3.1.1.1.3). Therefore, increases in chemical contaminant concentrations in marine waters as a result of sediment resuspension during pile installation would be minor. Because suspended sediment and contaminant concentrations would be low, and exposures would be limited to the in-water construction period during each of the two in-water construction years, localized, acute, or chronic toxicity impacts would not occur.

Construction of the SPE Alternative 2 would not impact water temperature or salinity because construction activities would not discharge a waste stream. Steel and concrete piles installed for SPE Alternative 2 would be inert and would not contain creosote or other contaminants that could be toxic or biologically available.

Stormwater runoff impacts and protective measures would be similar to those described in Section 3.1.1.2.3 for water quality impacts. Therefore, construction activities associated with SPE Alternative 2 would not result in alterations of water temperature or salinity and would not violate any water quality standards.

Although some level of localized changes in sediment grain size is expected during construction activities for SPE Alternative 2, such as fine-grained sediments dispersing and settling outside the project site, impacts on sediment quality would be limited and localized to the general project area (Section 3.1.2.3.2). Construction activities would not discharge contaminants or otherwise appreciably alter the concentrations of trace metal or organic contaminants in bottom sediments. Although sediments could be impacted by oil spills during in-water construction, the existing NAVBASE Kitsap Bangor spill prevention and response plans would reduce the potential for these impacts. If an accidental spill were to occur, emergency cleanup measures would be implemented immediately in accordance with state and federal regulations. These cleanup procedures would minimize impacts on the surrounding environment.

Another possible source for construction-related impacts on water and sediment quality would be from accidental debris spills into Hood Canal from barges or construction platforms. Debris spills could impact bottom sediments and create nuisance conditions by adding materials that could represent obstructions. The facility response plan for the Bangor waterfront provides for responses to potential spills. The construction contractor would be required to retrieve and clean up any accidental debris spills using BMPs and current practices in accordance with the debris management procedures that would be developed and implemented per the Mitigation Action Plan (Appendix C). As with the in-water construction activities, any removal of in-water construction debris would occur during the in-water work window. Following completion of in-water construction activities, an underwater survey would be conducted to remove any remaining construction materials that may have been missed during previous cleanups.

<u>Physical Habitat and Barriers</u>

During construction of SPE Alternative 2, the impact of physical barriers on marine fish would be greatest in the habitats used by offshore-occurring larger juvenile (e.g., Chinook and coho salmon) and adult salmonids, but not for the smaller nearshore migrating salmonids (e.g., chum and pink salmon) that migrate shoreward of the project footprint. Relative to younger age-classes, adult salmonids of all species have much greater mobility, and are unlikely to experience the same shallow water barrier effect as nearshore-dependent juvenile salmonids. In general, adult salmonids would likely migrate around this activity, with little or no overall delay in their movements.

Nightingale and Simenstad (2001a) cite multiple studies that indicate juvenile salmon, notably fry, migrate within shallow nearshore waters. These studies have shown that smaller juveniles (e.g., fry less than 2 inches [5.1 centimeters]) migrate along the shoreline in waters less than 3 feet (0.9 meter) in depth (Schreiner 1977; Bax 1982; Whitmus 1985). Simenstad et al. (1999) refer to shallow-water habitat as “that portion of the nearshore estuarine and marine environment habitually occupied by migrating salmon fry (i.e., approximately 1 to 3 inches [2.5 to 7.6 centimeters] long), which includes the intertidal zone to approximately -6 feet MLLW.” The most numerically abundant juvenile salmonids that occur along the waterfront are the smaller chum and pink salmon (SAIC 2006; Bhuthimethee et al. 2009) that would migrate shoreward of the vast majority of in-water construction activity. If larger juvenile salmonids (e.g., Chinook and coho) that occur offshore into deeper waters (Bax et al. 1980) are present during the in-water work window, they would likely encounter the construction activity and alter their migration route either shoreward or further offshore to avoid the activity.

During construction, removal of the existing wave screen on the shoreward side of Service Pier and installation of a similar-sized wave screen under the SPE is unlikely to adversely affect fish migration compared to existing conditions. All in-water construction would occur during the allowable in-water work window when juvenile salmonids are least abundant. Adult and subadult salmonids, should they occur during construction activities, would likely avoid the immediate vicinity of in-water construction activity, but would not be prevented from migrating around this activity.

Approximately 50 24-inch (60-centimeter), and 230 36-inch (90-centimenter), steel pipe support piles would be driven during the first in-water work window to support the pier extension. 105 18-inch (45-centimeter) square concrete piles would be driven during the second in-water work window to serve as fender piles. The footprint of the more shallow, southern edge of the pier would occur at water depths greater than 30 feet (9 meters) below MLLW (Figure 3.1–4), just beyond the nearshore juvenile salmonid migratory pathway, defined as occurring from 12 feet (4 meters) above MLLW to 30 feet below MLLW. However, due to the close proximity to this pathway and construction disturbance that would extend beyond the footprint into the pathway, barrier impacts on salmonids could occur due to construction activity.

All construction activities would be conducted during the in-water work window (July 15 to January 15). Fish surveys along the Bangor shoreline in the 1970s and 2005 to 2008 indicated that most (approximately 95 percent) of the juvenile salmonid migration is complete by this time (Schreiner et al. 1977; Salo et al. 1980; Bax 1983; SAIC 2006; Bhuthimethee et al. 2009). Returning adult salmonids, including the shoreline preferring summer-run chum, may alter their migration patterns somewhat to avoid any active in-water construction activity. However, although adult salmonids would likely avoid the immediate vicinity of in-water construction activity, this barrier affect would be minor and not prevent adult salmonids from migrating southward along the shore to their natal streams for spawning. Although construction of SPE Alternative 2 would occur at a time when salmonids are least abundant, construction activities could temporarily increase of in-water barriers encountered by salmonids that potentially would be present during the construction period.

Biological Habitat

Prey Availability. As discussed in Appendix B, both benthic invertebrate prey and forage fish are important food resources for juvenile salmonids. This section addresses construction-related impacts from SPE Alternative 2 to the localized benthic prey community, with the discussion of impacts on the forage fish community provided below. Construction of SPE Alternative 2 may result in localized and temporary reductions of the benthic community during pile placement and other construction-related disturbances (Section 3.2.2.3.2). Since the construction activity would occur offshore of the principal juvenile salmonid migratory pathway, smaller chum and pink salmon that are dependent on benthic invertebrates as a prey source during their out-migration would likely experience little or no change in available benthic food resources. Larger salmonids (e.g., Chinook and coho) that migrate further offshore in the neritic zone are generally less dependent on benthic invertebrates. Benthic organisms that are impacted during in-water construction would be expected to reestablish over a 3-year period (CH2M Hill 1995; Romberg et al. 1995; Parametrix 1994a, 1999; Anchor Environmental 2002; Vivan et al. 2009). Total anticipated benthic impacts could last up to 5 years (2 construction years, 3 years for reestablishment) (Section 3.2.2.3.2).

Aquatic Vegetation. The aquatic vegetation habitat of principal concern for juvenile salmon foraging and refuge is eelgrass (*Zostera* sp.) (Simenstad et al. 1999; Nightingale and Simenstad 2001a,b; Redman et al. 2005). Intertidal and subtidal areas with extensive areas of eelgrass provide habitat for amphipods, copepods, and other aquatic invertebrates

(Mumford 2007) used by juvenile salmonids as food resources. Copepods and other zooplankton represent the major food base for Puget Sound juvenile fish (Simenstad et al. 1979), including salmonids. In addition, at these small, vulnerable life stages, juvenile salmonids use these nearshore vegetated habitats as a refuge from predators during out-migration. Although the two largest eelgrass beds along the Bangor shoreline occur near Devil's Hole and Cattail Lake, a relatively narrow band of eelgrass occurs along nearly the entire shoreline (SAIC 2009).

Since construction water depths would mostly be greater than 30 feet (9 meters) below MLLW in the SPE Alternative 2 footprint, impacts on marine vegetation, including eelgrass beds, would be minimal (Section 3.2.2.3.2). This portion of the narrow nearshore strip of eelgrass would largely be unaffected by in-water construction activities during pile driving and decking installation. Turbidity would have little effect on nearby eelgrass beds, resulting in minimal plant loss.

The presence of overwater barges and structures and the shade they would cast during construction would also generally occur in deeper waters, with no impact to eelgrass beds. SPE construction would have little effect on the productivity of aquatic vegetation (Section 3.2.2.3.2). Any construction activities that would result in impacts, even though minimal, on marine vegetated communities from the Proposed Action would be compensated for via the proposed compensatory aquatic mitigation action (Appendix C, Section 6.0).

Underwater Noise

Construction of the SPE Alternative 2 would result in increased underwater noise levels in Hood Canal, due primarily to the installation of support and fender piles for these structures. Some noise would also be generated from support vessels, small boat traffic, and barge-mounted equipment, such as generators. However, the most significant in-water noise potentially affecting marine fish would be created by pile driving using an impact hammer. A detailed description of underwater noise calculations is provided in Appendix D.

The following analysis for underwater noise impacts on fish potentially resulting from SPE Alternative 2 utilizes source levels detailed in Table 3.3–5 below.

Table 3.3–5. Unattenuated Source Levels for SPE Acoustic Modeling

IMPACT DRIVING			
Pile Size / Type	**dB RMS re: 1 µPa @ 33 feet (10 meters)**	**dB peak re: 1 µPa @ 33 feet (10 meters)**	**dB SEL re: 1 µPa^2 sec @ 33 feet (10 meters)**
36-inch (90-cm) steel pipe	194	205	181
24-inch (60-cm) steel pipe	193	210	
18-inch (45-cm) square concrete	170	184	159
VIBRATORY DRIVING			
Pile Size / Type	**dB RMS re: 1 µPa @ 33 feet (10 meters)**	**dB peak re: 1 µPa @ 33 feet (10 meters)**	**dB SEL re: 1 µPa^2 sec @ 33 feet (10 meters)**
36-inch steel pipe	166	n/a	n/a
24-inch steel pipe	161		

dB = decibel; g = gram; RMS = root mean square; SEL = cumulative sound exposure level
Sources: Illingworth & Rodkin 2012; Navy 2014a

For SPE Alternative 2, the primary method of installation for the 24- and 36-inch (60- and 90-centimeter) steel piles would be vibratory driving. An impact hammer would be utilized to "proof" piles if needed; proofing a steel pile is assumed to require no more than 200 strikes of the impact hammer. Square concrete piles would be driven with an impact hammer only and require no more than 300 strikes per pile. To reduce underwater noise levels and associated impacts on underwater organisms during active impact pile driving of steel piles, a bubble curtain would be deployed. Bubble curtain performance is discussed in detail in Appendix D. For analysis under this Alternative, deployment of a bubble curtain is assumed to result in attenuation of source levels by 8 dB.

It is possible that the impact and vibratory pile drivers would operate concurrently at times. In this case, because the source levels for the impact driver are so much greater (several orders of magnitude) than source levels for vibratory drivers, the combined noise levels generated by concurrent operation of the two types of drivers would not be measurably greater than those generated by operation of the impact driver alone. Therefore, impact analysis of noise from operating the impact driver represents the reasonable worst-case noise impacts for pile driving under SPE Alternative 2.

Similarly, since 24- or 36-inch (60- and 90-centimeter) steel pipe piles may be driven interchangeably during the first in-water work window, the acoustic model utilizes the highest source levels (i.e., those of the 36-inch steel piles except for the dB peak value which is higher for 24-inch piles) for determining effect ranges (Table 3.3–6) for the various injury and behavior thresholds.

Table 3.3–6. SPE Alternative 2 Fish Threshold and Guideline Levels and Effect Ranges for the Operation of Impact Hammer and Vibratory Pile Drivers

Fish Threshold and Guideline Levels[1,2]	SPE Alternative 2 Effect Ranges		
	First In-Water Work Window		Second In-Water Work Window
	36-inch Steel Pile[3]	24-inch Steel Pile[3]	18-inch Concrete Pile
206 dB peak, impact hammer (injury)	18 feet (5 meters)	10 feet (3 meters)	1 foot (< 1 meter)
187 dB SEL (injury to fish ≥ 2 g)	607 feet (185 meters)		92 feet (28 meters)
183 dB SEL (injury to fish < 2 g)	1,122 feet (342 meters)		171 feet (52 meters)
150 dB RMS, impact hammer (behavioral for all fish)	8,242 feet (2,512 meters)	7,068 feet (2,154 meters)	707 feet (215 meters)
150 dB RMS, vibratory driver (behavioral for all fish)	384 feet (117 meters)	178 feet (54 meters)	n/a

dB = decibel; g = gram; RMS = root mean square; SEL (for this table) = Cumulative Sound Exposure Level

1. Underwater noise thresholds are taken from Fisheries Hydroacoustic Working Group (2008).
2. The underwater noise guideline for behavior is taken from Hastings (2002).
3. An 8 dB reduction in sound pressure levels is incorporated in range estimate.

Figures 3.3–6a through –7b illustrate the areas in which sound levels at or above the various fish injury and behavioral thresholds could occur during pile driving under this Alternative. Impact driving of concrete piles generates lower intensity, lower impulse energy, and lower dominant frequencies than impact driving of steel piles. The overall amplitude of the signals is also lower than those from steel piles that are impact driven. Correspondingly, potential effects on fish from underwater noise generated during impact pile driving of concrete piles would be reduced compared to steel piles. Because of these differences, the effect distances over which underwater noise generated during pile driving would exceed the established underwater noise threshold criteria and guidelines are discussed separately.

Based on the small size of the potential area in which injurious peak sound levels could occur, as well as the conservative modeling assumptions described in the *Underwater Noise* section for LWI Alternative 2, the noise produced from pile installation is not likely to result in the injury or mortality for any listed fish species. Fish are expected to avoid the area in the immediate vicinity of in-water construction based on increased levels of human activity and disturbance in the water column. In addition, installation would be conducted during the in-water work window to minimize impacts on juvenile salmonids.

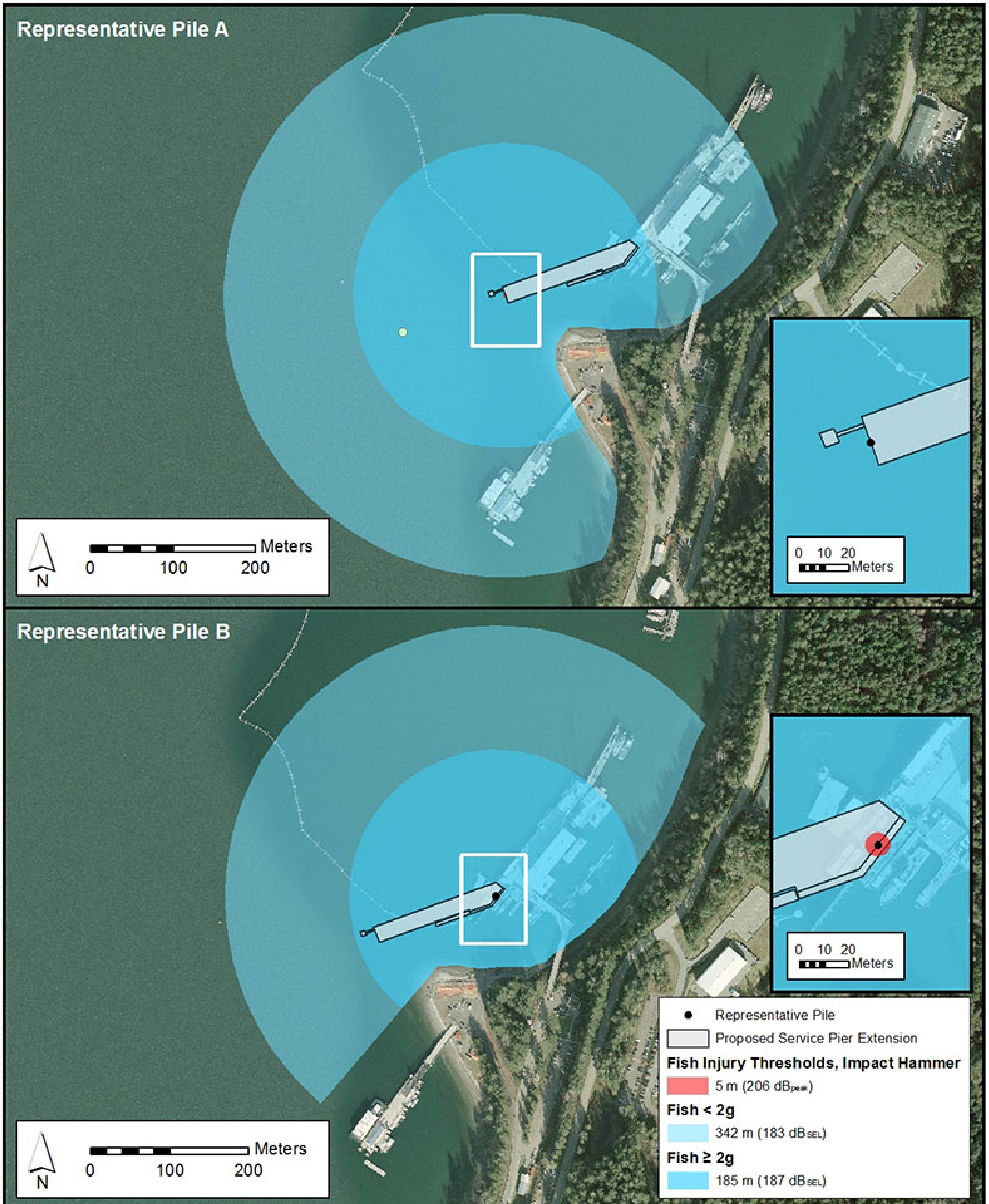


Figure 3.3-6a. Representative View for Fish Injury Threshold due to 36-inch Hollow Steel Pile Driving Noise during Construction of SPE Alternative 2

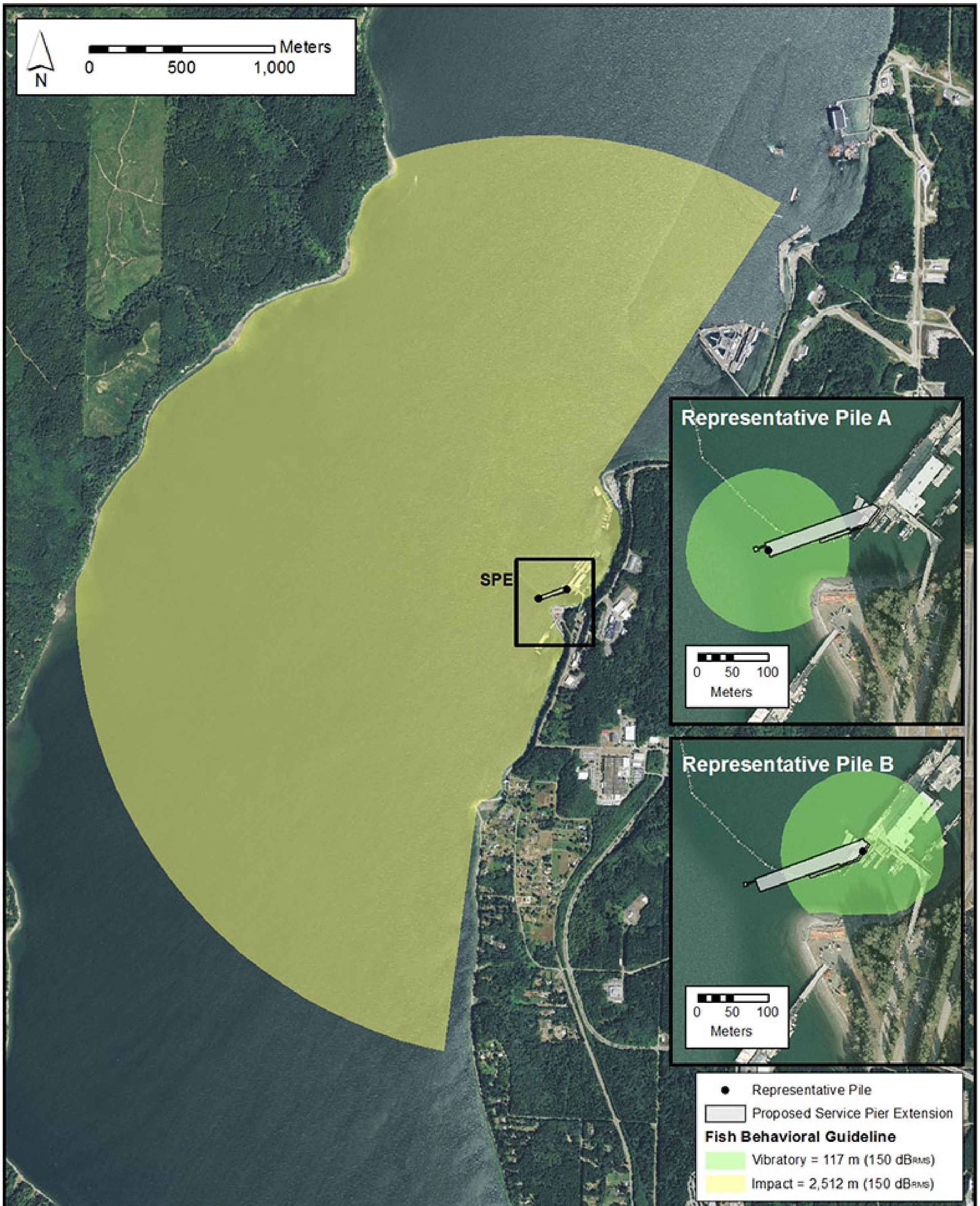


Figure 3.3-6b. Representative View for Fish Behavioral Guideline due to 36-inch Hollow Steel Pile Driving Noise during Construction of SPE Alternative 2

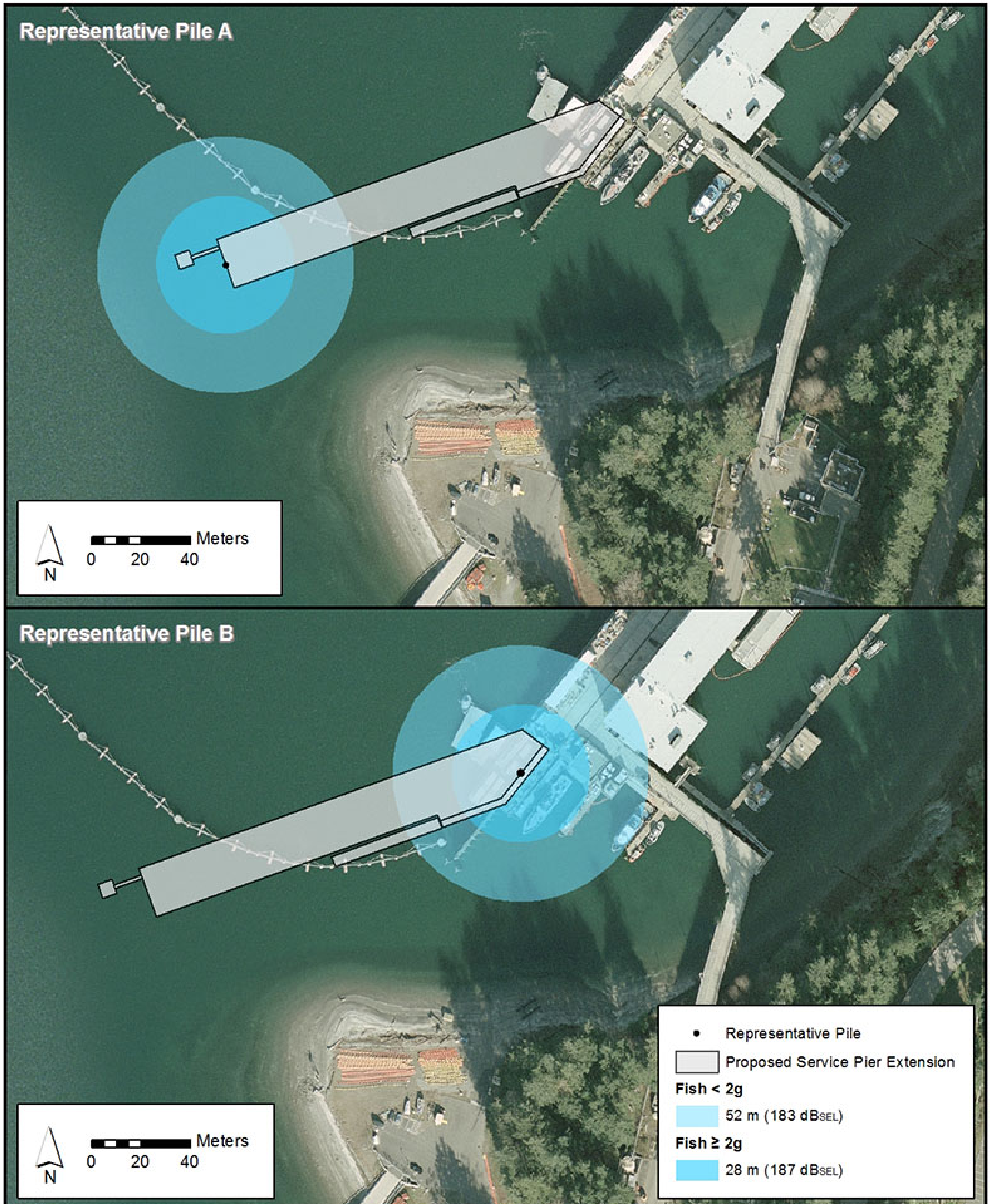


Figure 3.3-7a. Representative View for Fish Injury Guideline due to 18-inch Concrete Pile Driving Noise during Construction of SPE Alternative 2

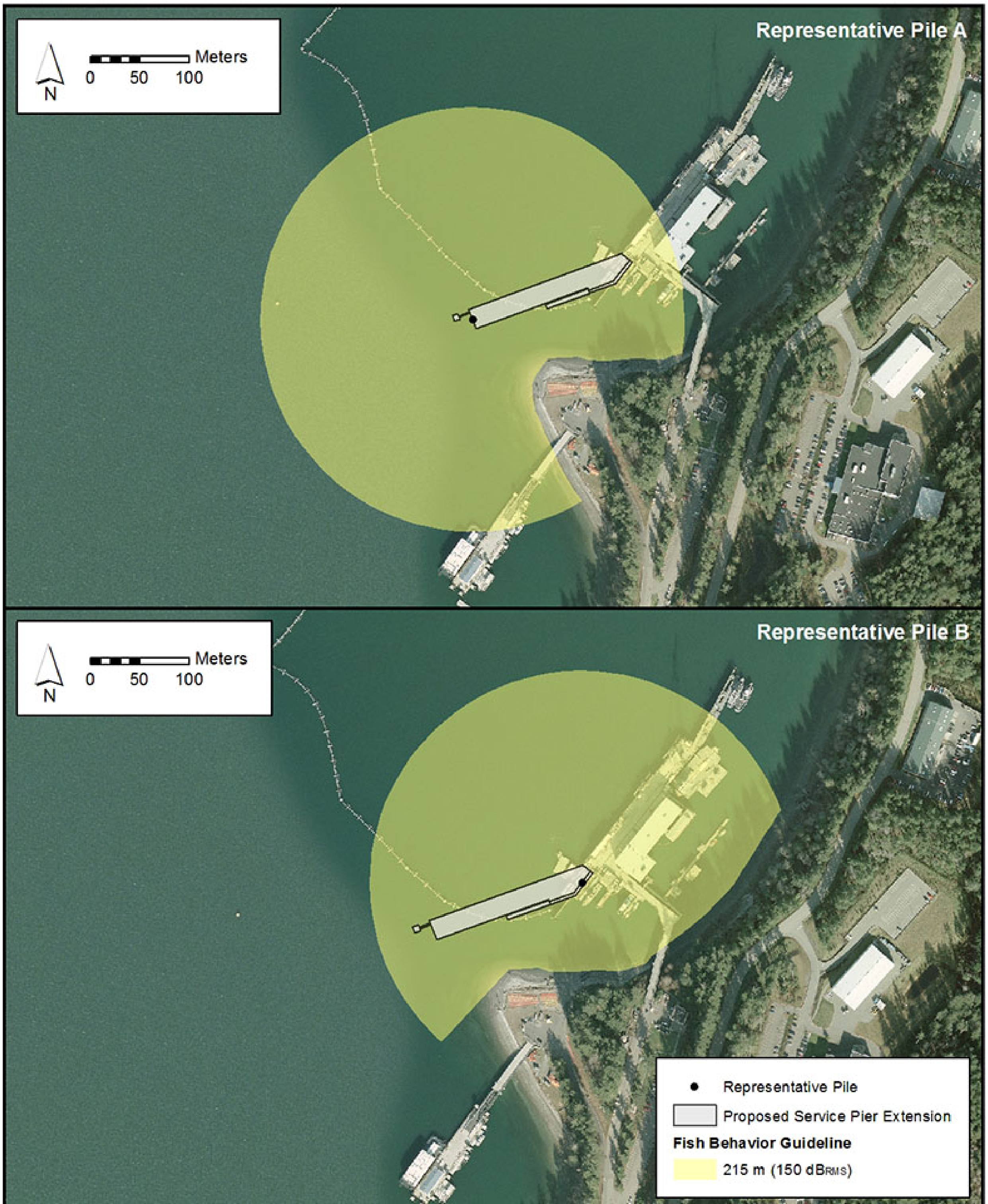


Figure 3.3-7b. Representative View for Fish Behavioral Guideline due to 18-inch Concrete Pile Driving Noise during Construction of SPE Alternative 2

Potential Behavioral Effects

Fish occurring within the effects range (Figures 3.3–6b and 3.3–7b, respectively) for the behavioral guideline (150 dB RMS) may exhibit minor behavioral changes such as avoidance (NMFS 2011, 2012), although these responses may resolve soon after pile driving ceases (NMFS 2014b). As explained in NMFS (2012), it is unlikely these minor changes in behavior would preclude a fish from completing any normal behaviors such as resting, foraging, or migrating, or that the fitness of any individuals would be affected. Further, there is not expected to be an increase in energy expenditure sufficient to have a detectable effect on the physiology of individual fish or any future effect on growth, reproduction, or general health. Therefore, avoidance behavior by individual fish during pile driving activities would be considered discountable.

In addition to the pile driving, other in-water work, including barge activity during construction of the pier and pier decks also would occur. Some noise also would be generated from support vessels, small boat traffic, and barge-mounted equipment, such as generators. However, levels are not expected to differ appreciably from those generated by other ongoing anthropogenic activity in the vicinity. Fish may temporarily alter their behavior but no long-term change in the occurrence of fish or their population composition in the vicinity of the project is expected.

Summary of Impacts and ESA-Listed Salmonid Determination

SPE Alternative 2 construction activities may result in temporary and intermittent (over two in-water work seasons) offshore (>30 feet [9 meters] below MLLW) impacts on water quality (e.g., increased turbidity), minor and temporary decreases in prey availability, benthic habitat conversion and loss, temporarily elevated noise levels, and non-eelgrass aquatic vegetation loss. This alternative would not cause a violation of state water quality standards or reduction in sediment quality (Section 3.1.2.3.2) due to adherence to appropriate water and sediment quality BMPs and current practices (Section 3.1.1.2.3). The presence of the barges and in-water construction activities occur offshore, out of the primary juvenile salmon migratory pathway, and would represent only a minor migratory barrier, limited to larger, offshore migrating juvenile and adult salmonids during construction. Pile driving activities would increase underwater noise above the injury thresholds and behavioral guideline for fish. Because construction of SPE Alternative 2 would occur during the in-water work window when salmonids are least abundant (July 15 to January 15), these impacts would be minimized due to the low risk of exposure.

Critical habitat PCEs for Puget Sound Chinook and Hood Canal summer-run chum that would be affected include estuarine areas, nearshore marine areas, and offshore marine areas. As noted in the PFMC (2014b) review, "some species of fishes, including Chinook salmon and Atlantic salmon (*Salmo salar*), have been shown to avoid continuous sounds (similar to vibratory pile driving) at frequencies below 30 Hz (infrasound), but not impulsive-type sounds (similar to those from impact pile driving) at frequencies above 100 Hz." Pile driving would produce noise above the fish behavioral thresholds during vibratory pile driving and be above the behavioral and injury thresholds during impact pile driving in the portion of the action area that contains critical habitat. However, effects to these PCEs would be discountable with implementation of a noise attenuation device during impact pile driving of steel piles, primarily installing piles using a vibratory pile driver.

Within the Hood Canal Subbasin, currently occupied riverine habitat is designated as Puget Sound steelhead critical habitat. Since DoD installations with current INRMPs are exempt from critical habitat designation, no critical habitat was designated at NAVBASE Kitsap Bangor. Underwater noise generated during pile driving would not exceed established thresholds in critical habitats designated for Puget Sound steelhead.

Based on the low likelihood of occurrence in the project area, the temporary and intermittent nature of elevated noise levels and sediment disturbance, and the avoidance and minimization measures described above and in Appendix C, any potential effects to Puget Sound Chinook salmon, Puget Sound steelhead, Canal summer-run chum, or bull trout would be discountable. Any stressors that have the potential to affect critical habitat PCEs (e.g., disturbed sediments) would be highly localized to the immediate vicinity of in-water construction, and would not reach proposed or designated critical habitat. Therefore, the effect determination for all listed salmonid species is "may affect, not likely to adversely affect." The effect determination for critical habitat is also "may affect, not likely to adversely affect," except for bull trout and Puget Sound steelhead (no effect).

ESA-Listed Hood Canal Rockfish

Due to the similarity of life histories and habitat requirements between ESA-listed rockfish species, project-related impacts on these species are discussed by this species group rather than as individual species.

Threats to the recently listed bocaccio, yelloweye rockfish, and canary rockfish can be caused by low DO, commercial and sport fisheries (notably mortality associated with fishery bycatch), reduced kelp habitat necessary for juvenile recruitment (74 FR 18516), habitat disruption (including exotic species), derelict gear, climate change, species interactions (including predation and competition), diseases, and genetic changes (Palsson et al. 2009; Drake et al. 2010). The combination of these factors, in addition to rockfish particular life history traits, has contributed to declines in rockfish species within Georgia Basin and Puget Sound in the last few decades (74 FR 18516).

<u>Rockfish Habitat Requirements</u>

Larval and juvenile rockfish are dependent on a variety of habitat factors, including suitable current patterns for larval transport to suitable recruitment habitat, good water quality, and abundant food resources (Palsson et al. 2009). Due to typically poor rockfish dispersal between basins, if habitat suitable for adult rockfish does not exist within a specific area, the abundance of adults would be low, as would the recruitment of juveniles into adjacent juvenile habitat. As rockfish have complex life history patterns that use specific food and habitat requirements at each life history stage (larval, juvenile, adult), effects on the habitats used at each stage can affect the long-term presence of these species in local and adjacent waters.

Since SPE Alternative 2 would neither increase commercial or sport fisheries nor increase the presence of derelict gear, fish disease, or climate or genetic change, these limiting factors are not discussed further.

Currents

Rockfish larvae are pelagic, with their movements somewhat influenced by prevailing currents within a given basin (Palsson et al. 2009). Even if adults are abundant and a strong class of larvae is produced in a given year, recruitment to suitable habitat can be limited, because larval survival and settlement are dependent on a wide variety of unpredictable chance events, including currents, climate, abundance of predators, suitable recruitment habitat, and other chance events (Drake et al. 2010). As summarized for coastal systems by Drake et al. (2010), onshore currents, eddies, upwelling shadows, and other localized circulation patterns create conditions that retain larvae rather than disperse them. In addition, the shallow sill (approximately 165 feet deep [50 meters]) at the mouth of Hood Canal further limits the circulation and exchange of water between this basin and waters of the Strait of Juan de Fuca and central Puget Sound (Babson et al. 2006). As a result, Puget Sound basins, including Hood Canal, have greater retention of and reliance on intra-basin rockfish larvae than coastal systems (Drake et al. 2010).

As discussed in Section 3.1.2.3.2, small-scale and temporary (over periods of hours) changes in current direction and intensity of flow are anticipated during construction. However, the overall circulation pattern and velocities into the nearshore and marine deeper-water areas along the Bangor waterfront would be relatively unaffected. Thus, in-water construction activity would have limited and localized effects on circulation and currents, with limited effects on rockfish larval recruitment.

Water Quality

Palsson et al. (2009) indicate that rockfish may avoid waters with DO conditions below 2 mg/L and temperatures greater than 11°C (Palsson et al. 2009). In 2002, 2003, 2004, and 2006, low-DO fish kills occurred in southern Hood Canal (Newton et al. 2007; Palsson et al. 2009). Rockfish, notably copper rockfish, experienced high mortality, with estimates of up to a quarter of all copper rockfish occurring at a southern Hood Canal marine preserve killed by these conditions (Palsson et al. 2009). However, within Hood Canal both chronic and episodic events of low DO are typically limited to southern Hood Canal, with this pattern not as prevalent in northern Hood Canal waters (Newton et al. 2007), including off NAVBASE Kitsap Bangor. When conditions are not suitable at depths where they are normally present, rockfish relocate to depths with more suitable conditions (Palsson et al. 2009; Drake et al. 2010), or they are exposed to impacts, including suffocation.

As noted for salmonids, the construction of SPE Alternative 2 would not affect DO concentrations in the project vicinity. Therefore, rockfish would not be subjected to any increases in respiratory distress or alter their distribution in response to DO reductions. Further, the construction of SPE Alternative 2 would not result in water temperature increases. Therefore, rockfish would not experience elevated water temperatures as a result of SPE Alternative 2.

Limited information is available on the effects of turbidity on rockfish. However, the effects would likely be similar to those described above for salmonids. Although construction activities would temporarily increase suspended solids, the levels would be insufficient to cause severe gill irritation or result in fish loss through mortality and would return to existing conditions following the completion of in-water construction. If rockfish should encounter turbidity plumes with high levels of suspended sediment during construction activities, they would likely avoid these localized plumes.

Habitat Alteration

Rockfish habitat alteration can affect interrelated stressors identified by Drake et al. (2010) and Palsson et al. (2009), including reduction of suitable habitat, and increased competition and predation. Limited or altered habitat could also affect prey availability and exotic species presence.

Suitable Habitat. As noted above, juvenile rockfish (as young as three to four months old) recruit to nearshore habitats that include algae-covered rocks or sandy areas with eelgrass or drift algae (Mitchell and Hunter 1970; Leaman 1976; Boehlert 1977; Shaffer et al. 1995; Johnson et al. 2003; Hayden-Spear 2006). While these studies indicate that the fish recruit to natural habitat encountered in offshore surface waters, other studies have found that post-larval juvenile rockfish also recruit to manmade, in-water structures (Emery et al. 2006; Love et al. 2005, 2006). Palsson et al. (2009) notes that structured habitat is "extremely" limited within Puget Sound waters. In addition, these types of structures also serve as habitat for sub-adult and adult lingcod, rockfish, and greenling (Love et al. 2002), which are potential predators of juvenile rockfish (see below). However, it is unlikely that juvenile rockfish would recruit to the piles as structured habitat during active in-water construction.

Nearshore marine vegetation potentially used for juvenile rockfish recruitment habitat would be affected during construction (Section 3.2.2.3.2. No dredging or removal of existing high-relief structured habitat potentially used by rockfish would occur during construction. However, reduction of marine vegetation in the project area during construction could reduce rockfish recruitment, if it occurs, at these locations. Relative to the total amount of habitat available for rockfish in the Puget Sound, these impacts would be negligible.

Predation. Construction activity is not expected to increase recruitment of rockfish predators to the project area or create a physical environment that increases the susceptibility of rockfish to predators. Barge movement, pile driving, decking installation, and other construction activities would create visual and auditory stimuli that most fish and fish predators would avoid. In addition, subadult and adult age classes of the three ESA-listed rockfish species generally prefer deeper-water habitats than occur within the construction footprint of the pier extension (other than potential larval recruitment to nearshore marine-vegetated habitats). Consequently, the presence of these species, even in the absence of construction activity, would be limited at best. Therefore, construction activities for SPE Alternative 2 are not expected to increase predation on juvenile or subadult rockfish.

Competition. Construction activities would not create an environment that would increase competition between rockfish and other marine fish species. In addition to the construction footprint occurring in waters shallower than rockfish generally prefer, these activities would create visual and auditory stimuli that most fish would avoid, including rockfish competitors.

Therefore, construction activities for SPE Alternative 2 are not expected to increase competition between listed rockfish and their competitors.

Prey Availability. During construction, bottom disturbance would result in decreased prey availability (Section 3.2.2.3.2) for juvenile rockfish. Construction of the SPE would not alter the plankton community used as a primary food source for larval rockfish (Section 3.2.2.3.2). Some prey species, such as surf perch and forage fish, for older, larger rockfish, may experience a decrease in habitat availability during construction due to the disturbance of vegetated marine habitats. As a result, older age classes of rockfish, should they occur in the immediate project vicinity, may experience a similar decrease in the small fish prey base during construction activities and associated underwater noise during pile driving. However, upon completion of pile driving, underwater noise levels would return to levels consistent with existing conditions and these prey species would no longer avoid the project vicinity.

During periods of active pile driving, construction of SPE Alternative 2 could temporarily affect (by behavioral disturbance or physical impacts) some rockfish prey species within the immediate project vicinity. However, planktonic food sources for larval rockfish are not expected to be affected.

Exotic Species. Exotic organisms, including nonindigenous marine vegetation that replaces existing native marine vegetation (notably eelgrass or kelp) in Puget Sound waters, could pose a threat to rockfish survival (Palsson et al. 2009; Drake et al. 2010). Currently, *Sargassum muticum*, a nonindigenous brown alga, is ubiquitous in Puget Sound nearshore waters where rocks and cobbles are present (Britton-Simmons 2004). Whether *S. muticum* affects rockfish settlement is not currently known (Palsson et al. 2009). Drake et al. (2010) suggest a possible threat to Hood Canal rockfish from *Ciona savignyi*, an invasive tunicate that is rapidly expanding its range in Hood Canal, and further note that invasive tunicates elsewhere have had widespread unspecified adverse effects on rocky-reef fishes, including rockfish.

Construction of the SPE would not increase the prevalence of exotic species in Hood Canal waters. None of the piles, decking, or fencing for this alternative would have occurred previously in marine waters and, therefore, would not include attached exotic organisms. In addition, the vessels used during construction would comply with U.S. Coast Guard regulations designed to minimize the spread of exotic species. Therefore, construction of SPE Alternative 2 is not anticipated to facilitate the introduction, spread, or prevalence of exotic organisms along the Bangor shoreline or the Hood Canal basin.

<u>Underwater Noise</u>

An additional project effect on rockfish that is not discussed in Drake et al. (2010) as a stressor, but is briefly mentioned in Palsson et al. (2009), is elevated levels of underwater noise. In a caged fish study investigating the effects of a seismic air gun on five species of rockfish (*Sebastes* spp.), Pearson et al. (1992) found that behaviors varied between species. In general, however, fish formed tighter schools and remained somewhat motionless, thereby indicating behavioral effects.

Skalski et al. (1992) found that average rockfish catches for hook and line surveys decreased by 52 percent when occurring after the noise produced by a seismic air gun at the base of rockfish aggregations. Fathometer observations showed that the rockfish schools did not disperse but remained aggregated in schooling patterns similar to those prior to exposure to this noise. However, these aggregations did elevate themselves in the water column, away from the underwater noise source. Hastings and Popper (2005) indicate there are no reliable hearing data on rockfish, nor is it currently possible to predict their hearing capabilities based on morphology.

A more detailed description of the effects on fish from anticipated underwater noise levels expected during construction is provided above for salmonids. Currently, underwater noise impact thresholds do not differentiate between fish species (Fisheries Hydroacoustic Working Group 2008). Although salmonids and rockfish have very different appearances and life histories, both groups have internal air bladders to maintain buoyancy.

As described above for salmonids and summarized in Table 3.3–6, rockfish occurring within the range to effect during pile driving or proofing would potentially be exposed to elevated underwater noise levels.

Summary of Impacts and ESA-Listed Rockfish Determination

As noted above in Sections 3.3.1.3.5, 3.3.1.3.6, and 3.3.1.3.7, bocaccio, yelloweye rockfish, and canary rockfish are rare in Hood Canal waters and are generally limited in Hood Canal by the lack of suitable habitat. Construction of SPE Alternative 2 would result in small-scale changes in current velocity and flow around the in-water vessels. However, this effect would be too small and localized to alter existing nearshore currents or normal rockfish larval recruitment along the Bangor shoreline. Minor, temporary (two in-water work seasons), and localized effects on water quality (small increases in turbidity) would occur, primarily during construction, but are not expected to decrease DO concentrations or increase water temperatures. Pile driving noise would exceed the fish behavioral threshold during vibratory pile driving and be above behavioral and injury thresholds during impact pile driving in the action area that contains critical habitat. However, effects to these PCEs would be insignificant because pile driving would primarily use vibratory pile driving method, and would implement a soft-start approach.

As noted above in Sections 3.3.1.3.5, 3.3.1.3.6, and 3.3.1.3.7, bocaccio, yelloweye rockfish, and canary rockfish are rare in Hood Canal waters, as generally limited by the lack of suitable habitat. Construction of SPE Alternative 2 would result in small-scale changes in current velocity and flow around the in-water vessels. However, this effect would be too small and localized to alter existing nearshore currents or normal rockfish larval recruitment along the Bangor shoreline. SPE Alternative 2 construction activities may result in temporary and intermittent (over two in-water work seasons) offshore (>30 feet [9 meters] below MLLW) impacts on water quality (e.g., increased turbidity), minor and temporary decreases in prey availability, benthic habitat conversion and loss, temporarily elevated noise levels, and loss of non-eelgrass aquatic vegetation. This alternative would not cause a violation of state water quality standards or reduction in sediment quality (Section 3.1.2.3.2), based on adherence to appropriate water and sediment quality BMPs and current practices (Section 3.1.1.2.3).

Pile driving activities would increase underwater noise above the injury thresholds and behavioral guideline for fish in some areas. Fish occurring within the effects range (Figures 3.3-6b and 3.3–7b, respectively) for the behavioral guideline (150 dB RMS) may exhibit minor behavioral changes such as avoidance (NMFS 2011, 2012), although these responses may resolve soon after pile driving ceases (NMFS 2014b). As explained in NMFS (2012), it is unlikely these minor changes in behavior would preclude a fish from completing any normal behaviors such as resting, foraging, or migrating, or that the fitness of any individuals would be affected. Further, there is not expected to be an increase in energy expenditure sufficient to have a detectable effect on the physiology of individual fish or any future effect on growth, reproduction, or general health. Therefore, avoidance behavior by individual fish during pile driving activities would be considered discountable. Based on the low likelihood of occurrence in the project area, the temporary and intermittent nature of elevated noise levels and sediment, vegetation, and prey base disturbance, and the avoidance and minimization measures described above and in Appendix C, any potential effects to bocaccio, canary rockfish, or yelloweye rockfish would be discountable. Any stressors that have the potential to affect designated critical habitat (e.g., water quality, substrate conditions) would be localized to the immediate vicinity of in-water construction, and would not reach proposed critical habitat. Underwater noise exceeding the behavioral threshold would reach critical habitat, but would only occur during active pile driving and would not alter designated critical habitat. Therefore, the effect determination for all listed rockfish species and their critical habitats is “may affect, not likely to adversely affect.”

NON-ESA-LISTED SALMONIDS

Construction-related impacts on non-ESA-listed salmonids and their habitats would be similar to those described above for ESA-listed salmonids. Utilizing in-water work windows would also minimize impacts on non-ESA-listed salmonids, including hatchery fish, due to their infrequent occurrence during this work window and result in limited exposure to construction activities.

FORAGE FISH

The only forage fish species with documented spawning habitat occurring along the Bangor shoreline is the Pacific sand lance (Section 3.3.1.5.3). At the SPE project site, Pacific sand lance spawning habitat has been documented along an estimated 1,650-foot (503-meter) length of the shoreline extending from the southern shoreline of Carlson Spit northward to the existing Service Pier causeway (Figure 3.3–4; WDFW 2013b). Temporary increase of suspended solids during pile driving and other in-water construction activities (two in-water work seasons) would be expected. However, 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 would not be high enough to adversely impact the spawning success of the nearest forage fish (sand lance) spawning habitat near the SPE project site.

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 SPE project site. Therefore, forage fish could be present and potentially affected by construction activities. Impacts on nearshore vegetation and benthic communities from construction would be minimal, with no likely impacts on eelgrass (Section 3.2.2.3.2). 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. Nighttime lighting associated with construction activities and daytime shadows cast from overwater structures and equipment could alter adult sand lance behavior, but the construction lighting occurs offshore, whereas adult sand lance spawn in intertidal habitats, away from the project activity and lighting. Halvorsen et al. (2012) determined that fish like sand lance that do not have swim bladders may be less susceptible to injury from simulated impact pile driving. Because all marine species are expected to avoid the immediate vicinity of in-water construction, potential impacts to sand lance are expected to be limited to minor behavioral disturbance.

OTHER MARINE FISH SPECIES

Marine fish species that are found near the project area share the same habitats as salmonids and, with a few exceptions, would experience similar project-related impacts from the construction of SPE Alternative 2. As described above, construction of SPE Alternative 2 is not anticipated to violate water or SQS in the project area.

Project impacts on physical habitat and barriers during construction would include an increase in the number of barges and activities in the vicinity of intertidal and subtidal habitats. However, non-salmonids and non-forage fish occurring along the Bangor waterfront generally do not exhibit similar shoreline migrations (Hart 1973; Wydoski and Whitney 2003). Although shiner perch migrate between nearshore and offshore habitats to bear their young in summer, and are one of the most abundant other marine fish species along the Bangor shoreline, shiner perch occur relatively infrequently at the SPE project site (SAIC 2006; Bhuthimethee et al. 2009). Since other species do not demonstrate similar migratory behavior as shiner perch, this alternative would generally not inhibit the migration of other marine species between nearshore and offshore habitats.

Benthic habitats used for marine fish foraging and rearing would be affected by construction activities (Section 3.2.2.3.2). Similar to salmonids, many non-salmonid fish species use forage fish as a food resource. As a result, any reduction in forage fish use of the site could reduce the local food resources of some non-salmonid fish species occurring in this area. Marine vegetation communities (<0.5 acre [0.2 hectare]) would also be affected during construction of SPE Alternative 2 (Section 3.2.2.3.2). Construction activities would potentially impact up to 3.9 acres (1.6 hectares) of benthic habitats. Potential impacts would be offset by actions summarized in the proposed compensatory aquatic mitigation plan (Appendix C, Section 6.0).

Some fish may avoid the area, particularly closer to the location of in-water work, or alter their normal behavior while in this area. However, studies have shown that some fish species may habituate to underwater noise (Feist 1991; Feist et al. 1992; Ruggerone et al. 2008) and would continue to occur within the behavioral disturbance zone (Figures 3.3–6b and 3.3–7b). These impacts would occur only during the in-water work window (July 15 to January 15). Upon completion of the pile driving effort, the underwater noise environment would return to pre-construction conditions.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 2

Marine habitats used by fish species that occur along the Bangor waterfront include offshore (deeper) habitat, nearshore habitats (intertidal zone and shallow subtidal zone), and manmade structures, such as piles used for cover. The primary impacts on marine fish from operation of SPE Alternative 2 would include an increase of overwater and in-water structures offshore of the primary juvenile salmonid migratory pathway, alteration of offshore habitats including some reduction in benthic community productivity, and an increase in offshore overwater shading. The following sections describe how each of these factors would impact abundance and distribution of marine fish that could occur along the Bangor waterfront during operation of SPE Alternative 2.

Maintenance of SPE Alternative 2 would include routine inspections, cleaning, repair, and replacement of facility components (except pile replacement) as required. Measures described in Section 3.1.1.2.3 (water and sediment quality BMPs and current practices) would be employed to prevent discharges of contaminants to the marine environment. As a result, maintenance activities are not anticipated to adversely affect marine fish.

ESSENTIAL FISH HABITAT

EFH, with few exceptions, would experience project-related impacts from operation of SPE Alternative 2 similar to those described below for salmonids (Section 3.1.2.3.2). Operation of SPE Alternative 2 would not affect the long-term water and sediment quality in the project area (Section 3.1.2.3.2).

Long-term impacts on physical habitat and barriers would include an increase in overwater and in-water structures. The shading of offshore benthic habitats would be expected to result in a corresponding loss in habitat productivity, but would be minimized by the depth of the new structure (Section 3.2.2.3.2). The added artificial lighting would occur over deeper water and have little or no effect on EFH utilized by migratory species of nearshore fish, such as forage fish and juvenile salmon. While the habitat utilized by some fish species (e.g., starry flounder and English sole) would experience a reduction in flat benthic habitat, other habitats would be created and utilized by fish species that prefer more structured habitat (e.g., greenling and cabezon). The in-water structures would occur offshore of the primary juvenile salmonid migratory pathway and not represent a long-term nearshore migration barrier. Based on these impacts, a determination was made that operation of the SPE under Alternative 2 may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH.

THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN

ESA-Listed Hood Canal Salmonids

Marine Salmonid Habitat Requirements

Water and Sediment Quality

Operation of the SPE under Alternative 2 would have little or no impact on localized temperature, salinity, DO, or turbidity (Section 3.1.2.3.2). Waterfront vessel activity would increase slightly relative to existing conditions, but not sufficient in scale to alter local water or sediment quality. Operation of SPE Alternative 2 would be consistent with existing practices along the Bangor waterfront, with limited potential to degrade water quality (Section 3.1.2.3.2). SPE Alternative 2 would implement BMPs to minimize spill risks (Section 3.1.2.3.2), including accidental releases of fuel, sewage or oil wastes, explosives, cleaning solvents, munitions, or other contaminants that would impact water quality in Hood Canal. Stormwater from the SPE project site would be collected in a trench drain on the pier, treated using an in-line canister system designed to meet the basic treatment requirements of the WDOE *Stormwater Management Manual for Western Washington* (WDOE 2014), and then discharged to Hood Canal in accordance with an NPDES permit. Therefore the SPE structure would not represent a source of substantial pollutant loadings to Hood Canal.

Changes in sediment grain size would only be anticipated in the immediate vicinity of the pier extension, with little or no change in sediment characteristics beyond the footprint. Because sediments within the project area are considered uncontaminated, small-scale changes in local sediment accretion and erosion during operation of SPE Alternative 2 would not degrade existing conditions.

<u>Physical Habitat and Barriers</u>

As described for construction, approximately 230 36-inch (90-centimeter) and 50 24-inch (60-centimeter) steel pipe support piles would be driven to support the pier extension, and approximately 105 18-inch (45-centimeter) square concrete piles would be driven to serve as fender piles. The pier length would occur parallel to, and largely offshore of, the nearshore juvenile salmonid migratory pathway, defined as occurring from 12 feet (4 meters) above MLLW to 30 feet (9 meters) below MLLW.

Operation of SPE Alternative 2 would include an increase of overwater and in-water structures and artificial lighting offshore of the primary juvenile salmonid migratory pathway. Since these structures occur in more offshore waters of at least 30 feet below MLLW, the presence of these structures, the associated artificial lighting, and the shade they would cast, is not anticipated to alter the behavior of juvenile salmonids using the nearshore migratory pathway. Replacing the existing wave screen on the shoreward side of Service Pier with a similar-sized wave screen under the SPE is unlikely to adversely affect fish migration relative to existing conditions. The new wave screen would be located further offshore and outside the nearshore migration pathway of juvenile salmonids than the existing wave screen (Figure 2–10). Because most species of adult salmonids are less dependent on nearshore habitats and also have much greater mobility, these age classes would not experience a substantial barrier effect and there would be little or no overall delay in their movements. However, for those adult salmonids that have the potential to encounter in-water piles supporting the SPE structure, due to the large space between piles, they are anticipated to experience little or no overall delay during their return migration to spawn in Hood Canal streams. Little or no increase in predation risk of adult salmonids from marine mammals is anticipated from the operation of SPE Alternative 2.

Biological Habitat

Prey Availability. SPE Alternative 2 would result in increases of shaded marine habitat (Section 3.2.2.3.2). However, as described above for Marine Vegetation, there would be no long-term operational shading of existing marine vegetation (Section 3.2.2.3.2). The long-term presence of the piles supporting the pier extension would alter foraging habitats for marine fish that currently utilize the SPE location. Shading of the benthic community and the change from flat-bottom to structured habitat could alter the benthic community and productivity at the SPE project site (Section 3.2.2.3.2). The presence of the SPE is unlikely to result in adverse effects on forage fish migration, prey base, and Pacific sand lance spawning along the nearshore habitats, and is not expected to decrease occurrence in the vicinity of the Service Pier.

Aquatic Vegetation. The extension of the Service Pier under Alternative 2 would add approximately 44,000 square feet (4,090 square meters) of overwater structure to the end of the existing pier (Section 2.3.2.2). Shading impacts of aquatic vegetation would not occur because the pier extension would be located in water depths of 30 feet (9 meters) below MLLW or deeper, beyond the depths where marine vegetation occurs in this area (Section 3.2.2.3.2). As a result, the presence of SPE Alternative 2 is not expected to reduce aquatic vegetation available to juvenile salmon or other marine fish species migrating along the Bangor shoreline.

Underwater Noise

Operation of SPE Alternative 2 may result in small increases in underwater noise relative to existing conditions may occur from activities on the pier, including cranes, generators, compressors, or other machinery. However, this increase is not expected to be discernable from existing variations in ambient noise.

Summary of Impacts and ESA-Listed Salmonids Determination

Due to the offshore location of the pier extension, the operation of SPE Alternative 2 would have little effect on habitats within the nearshore migratory pathway used by juvenile salmonids. SPE Alternative 2 would include an increase in offshore overwater and in-water structures and artificial lighting, but these increases would be limited compared to the availability of habitat and resources in Hood Canal. Due to offshore shading and the presence of piles where they currently do not exist, a minor shift in benthic community and productivity may occur. However, little or no change in the nearshore presence of, and habitat utilization by, forage fish, including sand lance spawning is anticipated since these species already inhabit areas adjacent to prior construction and infrastructure improvements. Significant changes in behavior or delays in migration are not anticipated. No operational stressors associated with the proposed project are anticipated in designated or proposed critical habitats. Therefore, the effect determination for all listed salmonid species is "may affect, not likely to adversely affect." The effect determination for critical habitat is also "may affect, not likely to adversely affect," except for bull trout and Puget Sound steelhead (no effect).

ESA-Listed Hood Canal Rockfish

Rockfish Habitat Requirements

Currents

As discussed above for salmonids, due to the presence of the piles, operations under SPE Alternative 2 would have minor and local effects on water flow in the immediate vicinity of the piles. There would be an increase in turbulent flow in the immediate vicinity of the SPE and a decreased flow immediately downstream (Section 3.1.2.3.2). However, these changes would be small scale and localized to the immediate vicinity of in-water components of each pier structure. The overall flow of water in deeper water areas adjacent to the pier would not be impeded by the extension. As a result, due to the limited and localized scale of project effects on currents, the operation of SPE Alternative 2 would not modify currents at a scale that would affect rockfish recruitment within northern Hood Canal waters.

Water Quality

As discussed above for salmonids, operation of SPE Alternative 2 would not affect existing DO levels in the project vicinity. Therefore, rockfish would not be subjected to any increases in respiratory distress or alter their distribution in response to DO reductions. In addition, due to the general maintenance of existing flow conditions, operation of the pier extension would not result in water temperature increases over existing conditions, and would not elevate levels of suspended solids sufficient to degrade water quality (Section 3.1.2.1.2.2).

Habitat Alteration

Rockfish habitat alteration can cause three interrelated stressors identified by Palsson et al. (2009) and Drake et al. (2010), including loss of suitable habitat, competition, and predation. Limited or altered habitat could also affect prey availability and exotic species presence.

Suitable Habitat. Very little loss of marine vegetation, as potentially used for juvenile rockfish recruitment, would occur due to displacement from the project footprint and associated overwater shading from the proposed structures. At some tidal elevations, shade-related effects would generally occur away from the shoreline since the additional overwater structures from the pier extension would occur at depths of 30 feet (9 meters) below MLLW or greater. Operations would not be expected to inhibit kelp growth because no attached, canopy-forming kelp beds occur along the Bangor waterfront (Section 3.2.1.1.2).

New piles to be installed could serve as post-larval juvenile rockfish recruitment habitat. In Hood Canal, suitable structured habitat for rockfish recruitment is very limited (PSAT 2007a; Palsson et al. 2009), with existing marine reserves accounting for almost 20 percent of the available nearshore rocky habitat (PSAT 2007a). Suitable habitat is limited between NAVBASE Kitsap Bangor and the Toandos Peninsula. WDFW conducted 24 trawls in this vicinity and did not capture any of the three ESA-listed rockfish (Palsson 2009, personal communication). The lack of suitable recruitment habitat in Hood Canal largely contributes to the patchy and limited distribution and abundance of rockfish in Hood Canal. Although there are substantial difficulties comparing the loss of marine vegetation to the addition of manmade structures as habitat for juvenile rockfish recruitment, it is likely that the loss of marine vegetation habitat is offset, to some degree, by the addition of structured habitat. Whether the change in habitat type would be a net benefit or detriment to rockfish is unknown.

Predation. The same piles that could serve as a potential recruitment benefit to juvenile bocaccio, yelloweye rockfish, and canary rockfish could also serve as habitat for rockfish predators (e.g., lingcod and larger sub-adult and adult rockfish). Baskett et al. (2006) found that, prior to commercial fishing pressure, predation and competition shaped the rockfish community structure. This was primarily due to rockfish intra-guild predation, including large adult rockfish preying on smaller rockfish members, as well as predation by lingcod. Beaudreau and Essington (2007, 2009) found that rockfish comprise 11 percent of adult lingcod diet by mass. These studies showed that in structured habitats protected from fishing (i.e., marine reserves), lingcod can limit the prevalence of rockfish through predation. The average size and abundance of lingcod in the existing NAVBASE Kitsap Bangor pier habitats is unknown, but the pier extension associated with this alternative would result in increased predator habitat and potential predation on juvenile rockfish. Further, it is unknown if the benefit of these structures for suitable recruitment habitat would be equivalent to any potential loss of juvenile rockfish to predators.

Competition. Habitat modification due to the pier extension of this alternative would result in a benthic-to-structure community shift and may create habitat that is more suitable for one species of rockfish compared to others. As noted above, juvenile rockfish can occur in shallow nearshore waters over rocks with algae or in sandy areas with eelgrass or drift algae. The presence of the more structured habitat may promote competition with species that use these habitat types for recruitment and rearing. Whether the existing benthic habitat or the proposed structured habitat would be more beneficial to rockfish is unknown.

Palsson et al. (2009) note that, in the absence of fishing pressure, the more aggressive copper and quillback rockfish species appear to limit the prevalence of brown rockfish. Both of these rockfish species appear to be more prevalent in Hood Canal waters than any of the three ESA-listed rockfish species and may out-compete other rockfish species for the limited structured habitat. Therefore, due to natural factors including intraguild competition, an increase in suitable structured habitat would not necessarily result in a corresponding increase of listed rockfish abundance in the project area.

Prey Availability. Since operation of SPE Alternative 2 would not decrease the local abundance or distribution of plankton along the Bangor shoreline (Section 3.2.2.3.2), larval bocaccio, yelloweye rockfish, and canary rockfish would not experience a decrease in food availability. The in-water structures would reduce the size and suitability of some habitats, notably marine vegetation used by forage fish and shiner perch (juvenile/sub-adult rockfish food resources). However, the piles would provide structure used by other potential prey base species, including the invertebrate fouling community, crabs, juvenile rockfish, perches, sculpins, and greenling (Hueckel and Stayton 1982; Nightingale and Simenstad 2001a; Love et al. 2002). Whether the small local shift in community type would have a corresponding effect on rockfish is unknown.

Due to the construction and operation of the pier extension under SPE Alternative 2, benthic-obligate juvenile rockfish prey within the immediate project vicinity could decrease in abundance, whereas structure-dependent juvenile rockfish and their associated prey organisms could increase. It is not known which of these effects would be greater.

Exotic Species. Operation of the SPE Alternative 2 would not introduce exotic species from foreign water bodies or increase the prevalence of existing exotic species in Hood Canal waters. Further, operation of SPE Alternative 2 would not create chronic disturbances that would facilitate colonization by nonindigenous species. Therefore, operation of this alternative is not anticipated to facilitate the spread or prevalence of exotic organisms along the Bangor shoreline, or the Hood Canal basin.

Underwater Noise

As discussed above for salmonids, operation of SPE Alternative 2 would increase vessel activity relative to existing conditions and, therefore, could slightly increase vessel-related underwater noise. A small increase in underwater noise would occur from increased activities on the pier such as cranes, generators, compressors, or other machinery.

Summary of Impacts and ESA-Listed Rockfish Determination

As detailed in the sections above, operation of SPE Alternative 2 would not result in long-term adverse impacts on water quality (Section 3.1.2.3.2) or increase the prevalence of exotic species. Bocaccio, yelloweye rockfish, and canary rockfish are extremely rare in Hood Canal waters. The structure-supporting piles would convert existing soft-bottom benthic habitat to a habitat with in-water structures that could affect local prey availability, as well as the potential to increase recruitment of juvenile bocaccio, yelloweye rockfish, canary rockfish, and rockfish competitors and predators. However, based on the low likelihood of occurrence in the project area, these effects would be discountable, and no population-level impacts are anticipated. No operational stressors associated with the proposed project are anticipated in designated critical habitats. Therefore, the effect determination for all listed rockfish species and their critical habitats is "may affect, not likely to adversely affect."

NON-ESA-LISTED SALMONIDS

Impacts described above for ESA-listed salmonids due to operation of SPE Alternative 2 would be similar for other salmonids potentially occurring in the project area.

FORAGE FISH

Operation of SPE Alternative 2 would have little or no impact on surf smelt or Pacific herring spawning habitats or their reproductive success because no documented surf smelt or Pacific herring spawning grounds occur along the 4.3-mile (7-kilometer) long Bangor waterfront (Penttila 1997; Stout et al. 2001; WDFW 2013b; NAVFAC Northwest 2014). However, Pacific sand lance spawning occurs shoreward of the pier extension site (Figure 3.3–4, Section 3.3.1.5.3) (WDFW 2013b). The presence of in-water structures and the impacts affecting juvenile and adult forage fish behavior would be similar to those described above for salmonids. Though further offshore, the small increase in vessel activity, and associated wakes, in close proximity to the nearby 1,650-foot (503-meter) documented Pacific sand lance spawning, could have a minor effect on the distribution and behavior of adult and larvae in the immediate project vicinity.

In a review of sand lance biology, Robards et al. (1999) found that some studies indicate sand lance behavior is strongly tied to food availability, water temperatures, and light intensity, including artificial nighttime lighting. Due to attraction, artificial lighting could result in minor delays or alteration of forage fish migration, similar to salmonids. In addition, the presence of artificial light could increase nighttime predation of forage fish. Nearshore vessel activity associated with the new structure would increase slightly over existing conditions. Additionally, localized distribution of the plankton community (the primary forage fish food resource) may take place, but these species would continue to occur in the project vicinity (Section 3.2.2.3.2).

OTHER MARINE FISH SPECIES

With a few exceptions, marine fish species that are found near the project area share the same habitats as salmonids and would experience project-related impacts from operation of SPE Alternative 2 that would be similar to those described for salmonids, forage fish, and rockfish. As summarized above for these species, operation of SPE Alternative 2 would not affect water and sediment quality in the project area (Section 3.1.2.3.2).

Project impacts on physical habitat would include an increase of overwater and in-water structures in offshore habitats. The presence of these structures would result in localized decreases in currents around the piles. The combination of shading of benthic habitats and the change from soft-bottom benthic to structured habitats (e.g., piles) would be expected to result in a corresponding change in benthic community composition. That could lead to a corresponding change in available benthic food resources for some fish species. While some fish species (e.g., flatfish including starry flounder and English sole) could experience a reduction in flat benthic habitat suitable for their life history, others (e.g., pile perch and greenling) would experience an increase in habitat suitable for their life history (Hart 1973). Operations are not expected to result in the loss through shading of aquatic vegetation and, therefore, are not expected to decrease habitat values for fish dependent on vegetation.

As discussed for construction, the presence of offshore structures would not represent a migration barrier to nearshore migrating juvenile salmonids and forage fish. Larger salmonids that migrate in offshore waters may encounter these structures, but would be able to migrate through or around them with little or no overall delay in migration. However, few other species occurring along the Bangor waterfront exhibit shoreline migration patterns similar to those of salmonids (Hart 1973). For example, shiner perch, the most abundant non-salmonid or forage fish captured in these waters (SAIC 2006; Bhuthimethee et al. 2009), overwinter in deeper offshore waters and migrate into nearshore waters in the spring to bear their young (Hart 1973). However, since shiner perch are relatively absent in the project area, and the SPE would be oriented parallel to shore, operation of this alternative would have little or no impact on the movement of this or other non-salmonid or forage fish species.

3.3.2.3.3. SPE ALTERNATIVE 3: LONG PIER

CONSTRUCTION OF SPE ALTERNATIVE 3

As described below, there are some differences in construction-related impacts between SPE Alternatives 2 and 3, including a longer pier configuration, a larger overwater structure, and more support and fender piles required for SPE Alternative 3 compared to Alternative 2. In general, however, the impacts on habitats utilized by marine fish (water and sediment quality, physical habitats, biological habitats, and underwater noise) would be similar for both alternatives.

ESSENTIAL FISH HABITAT

Impacts on EFH from the construction of SPE Alternative 3 would be similar to those described for SPE Alternative 2. However, differences include a greater number of piles (approximately 660 vs. 385) and a larger overwater structure (70,000 vs. 44,000 square feet) for SPE Alternative 3 than for Alternative 2. There would be a larger area of potential construction impacts on water quality and benthic EFH for SPE Alternative 3 than for Alternative 2 (6.6 versus 3.9 acres [2.7 versus 1.6 hectares]). Further, additional days of pile driving would be necessary under SPE Alternative 3 compared to Alternative 2 (up to 205 vs up to 161, respectively), but would still only require two in-water work seasons. These differences would not substantially increase or decrease project-related impacts on EFH, and overall effects would be similar to those described for SPE Alternative 2. Construction of the SPE may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH.

THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN

ESA-Listed Hood Canal Salmonids

Salmonid Marine Habitat Conditions

Water and Sediment Quality

Construction-related impacts from SPE Alternative 3 on water and sediment quality would be similar to those for SPE Alternative 2 (Sections 3.2.2.1.1 and 3.3.2.1.1). Although SPE Alternative 3 would involve a larger number of piles and more in-water work days for the construction of the longer pier extension, the fish window precludes in-water construction occurring at a time when juvenile salmonids would be prevalent. Therefore, project-related effects on nearshore water and sediment quality used by salmonids under SPE Alternative 3 would be similar to what is described for Alternative 2.

Physical Habitat and Barriers

SPE Alternative 3 physical habitat effects also would be similar to those described for SPE Alternative 2. The replacement of the existing wave screen with a new wave screen would be the same for both alternatives. However, a larger number of piles would be driven during construction of the longer pier extension, requiring more days of pile driving than SPE Alternative 2. Construction activity would not occur directly in the nearshore migratory pathway for juvenile salmonids (water depths less than 30 feet [9 meters]). However, due to the proximity of the project site to the migratory pathway, and that the construction disturbance extends beyond the footprint into the pathway, barrier impacts on nearshore salmonids would occur and include construction activity, lighting of the construction area and construction platforms, vessel shading, barge anchoring and anchor dragging, underwater noise, localized, temporary plumes of increased suspended solids produced during pile-driving, and anchoring activities that would occur over two in-water work seasons. Older age classes of salmon have much greater mobility, and are unlikely to experience the same shallow water barrier effects as nearshore-dependent juvenile salmonids. Because these minor differences would not substantially increase or decrease project-related impacts to marine fish, the overall effects on these species would be similar to those described for SPE Alternative 2.

Biological Habitat

The longer pier extension of SPE Alternative 3 would occur outside of the nearshore migratory pathway for juvenile salmonids, similar to SPE Alternative 2. As a result, impacts on the nearshore benthic community and aquatic vegetation (Section 3.2.2.3.2) used by juvenile salmonids and forage fish would also be the same. Larger juvenile salmonids (e.g., Chinook and coho) and adult salmonids migrate further offshore in the neritic zone, and are generally less dependent on benthic invertebrates. However, should they utilize these resources in the project footprint these salmonids may experience some loss of available benthic prey. The increase in the number of piles driven under SPE Alternative 3 is not expected to introduce or increase the prevalence of exotic species to Hood Canal waters. Therefore, other than increased exposure to underwater noise from additional pile driving days, impacts on nearshore biological habitats used by salmonids under SPE Alternative 3 would be similar to that described for SPE Alternative 2.

Underwater Noise

For underwater noise effects on ESA-listed fish, the greatest difference between Alternatives 2 and 3 would be the number of piles to be driven, the in-water construction duration, and distance from shore for in-water work.

Table 3.3–7 and Figures 3.3–8a though –9b illustrate the distances at which underwater noise from pile driving could exceed the behavioral guideline and injury thresholds for fish during construction under SPE Alternative 3.

Table 3.3–7. SPE Alternative 3 Fish Threshold and Guideline Levels and Effect Ranges for the Operation of Impact Hammer and Vibratory Pile Drivers

Fish Threshold and Guideline Levels[1,2]	SPE Alternative 3 Effect Ranges	
	First In-Water Work Window	Second In-Water Work Window
	24-inch Steel Piles[3]	18-inch Concrete Piles
206 dB peak, impact hammer (injury)	18 feet (5 meters)	1 foot (< 1 meter)
187 dB SEL (injury to fish ≥ 2 g)	607 feet (185 meters)	92 feet (28 meters)
183 dB SEL (injury to fish < 2 g)	1,122 feet (342 meters)	171 feet (52 meters)
150 dB RMS, impact hammer (behavioral for all fish)	7,068 feet (2,154 meters)	707 feet (215 meters)
150 dB RMS, vibratory driver (behavioral for all fish)	178 feet (54 meters)	n/a

dB = decibel; g = gram; RMS = root mean square; SEL = Cumulative Sound Exposure Level

1. Underwater noise thresholds are taken from Fisheries Hydroacoustic Working Group (2008).
2. The underwater noise guideline for behavior is taken from Hastings (2002).
3. An 8 dB reduction in sound pressure levels is incorporated in range estimate.

Summary of Impacts and ESA-Listed Salmonid Determination

Construction-related impacts of SPE Alternative 3 on NAVBASE Kitsap Bangor marine habitats, described above for salmonids, would be similar to those described for SPE Alternative 2, although they would be somewhat greater due to a longer duration of pile driving and more in-water piles.

Fish occurring within the effects range (Table 3.3–7 and Figures 3.3–8b and –9b) for the behavioral guideline (150 dB RMS) may exhibit minor behavioral changes such as avoidance (NMFS 2011, 2012), although these responses may resolve soon after pile driving ceases (NMFS 2014b). As explained in NMFS (2012), it is unlikely these minor changes in behavior would preclude a fish from completing any normal behaviors such as resting, foraging, or migrating, or that the fitness of any individuals would be affected. Further, there is not expected to be an increase in energy expenditure sufficient to have a detectable effect on the physiology of individual fish or any future effect on growth, reproduction, or general health. Therefore, avoidance behavior by individual fish during pile driving activities would be considered discountable. Any stressors that have the potential to affect critical habitat PCEs (e.g., disturbed sediments) would be highly localized to the immediate vicinity of in-water construction, and would not reach proposed or designated critical habitat. Therefore, the effect determination for all listed salmonid species is “may affect, not likely to adversely affect.” The effect determination for critical habitat is also “may affect, not likely to adversely affect,” except for bull trout and Puget Sound steelhead (no effect).

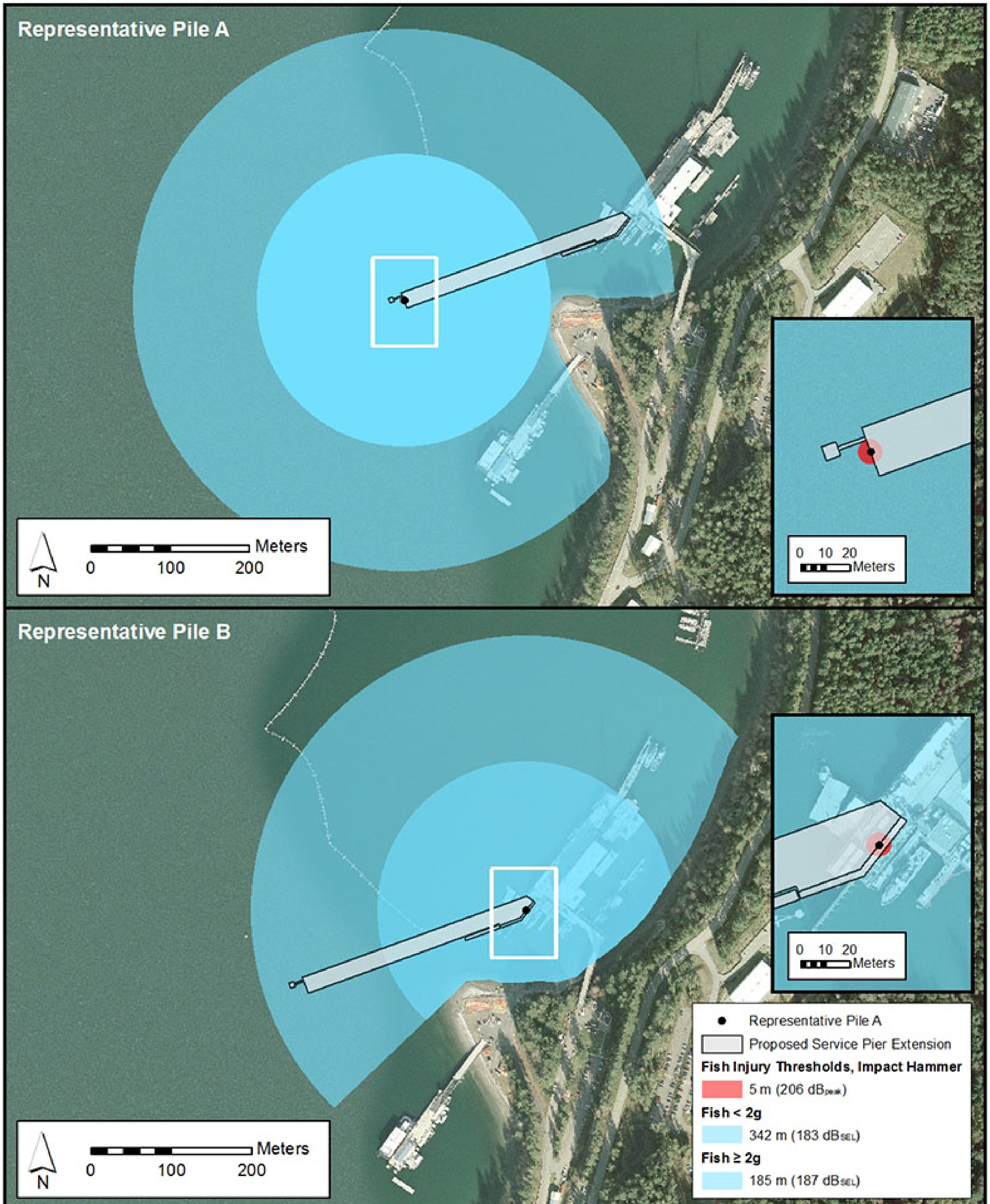


Figure 3.3-8a. Representative View for Fish Injury Threshold due to 24-inch Hollow Steel Pile Driving Noise during Construction of SPE Alternative 3

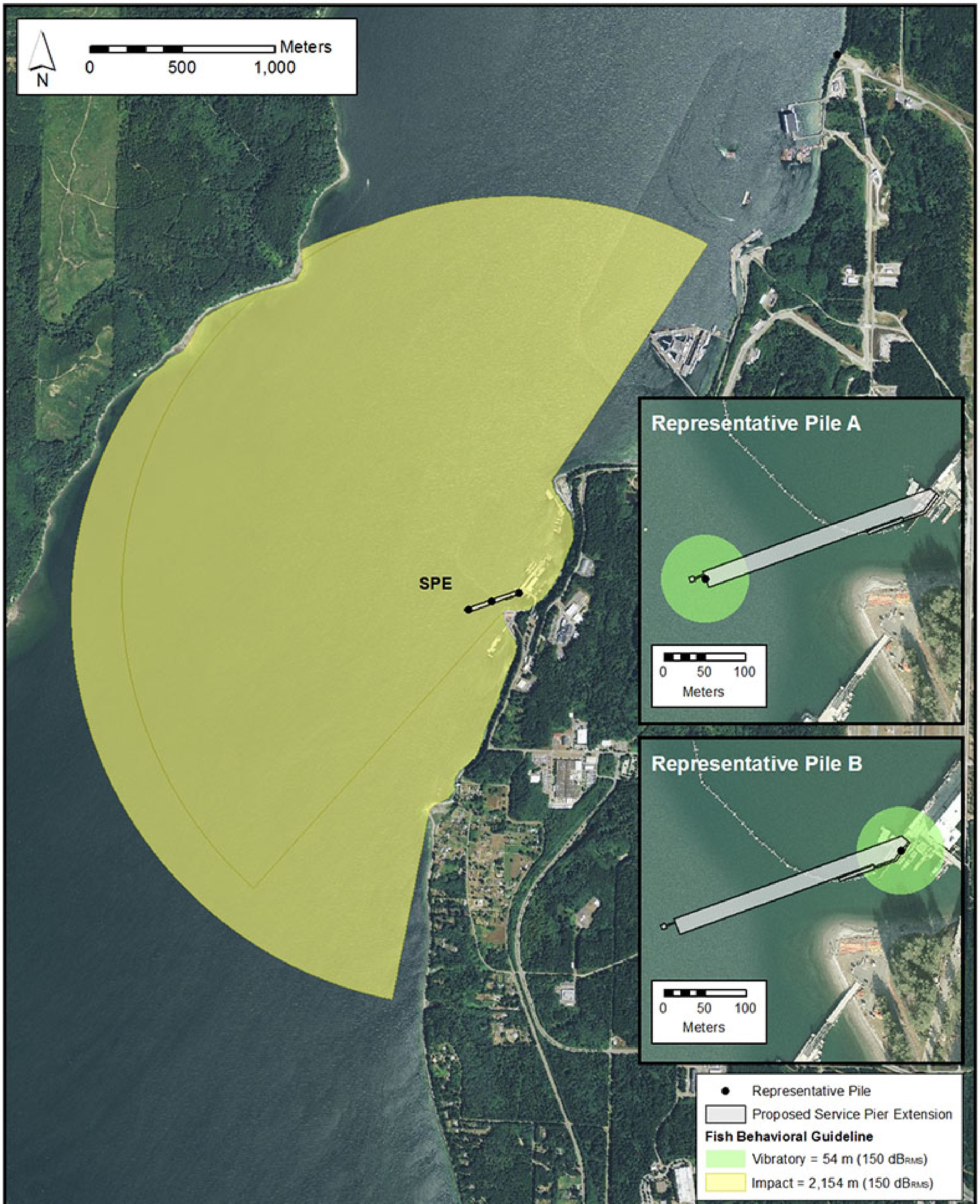


Figure 3.3-8b. Representative View for Fish Behavioral Guideline due to 24-inch Hollow Steel Pile Driving Noise during Construction of SPE Alternative 3

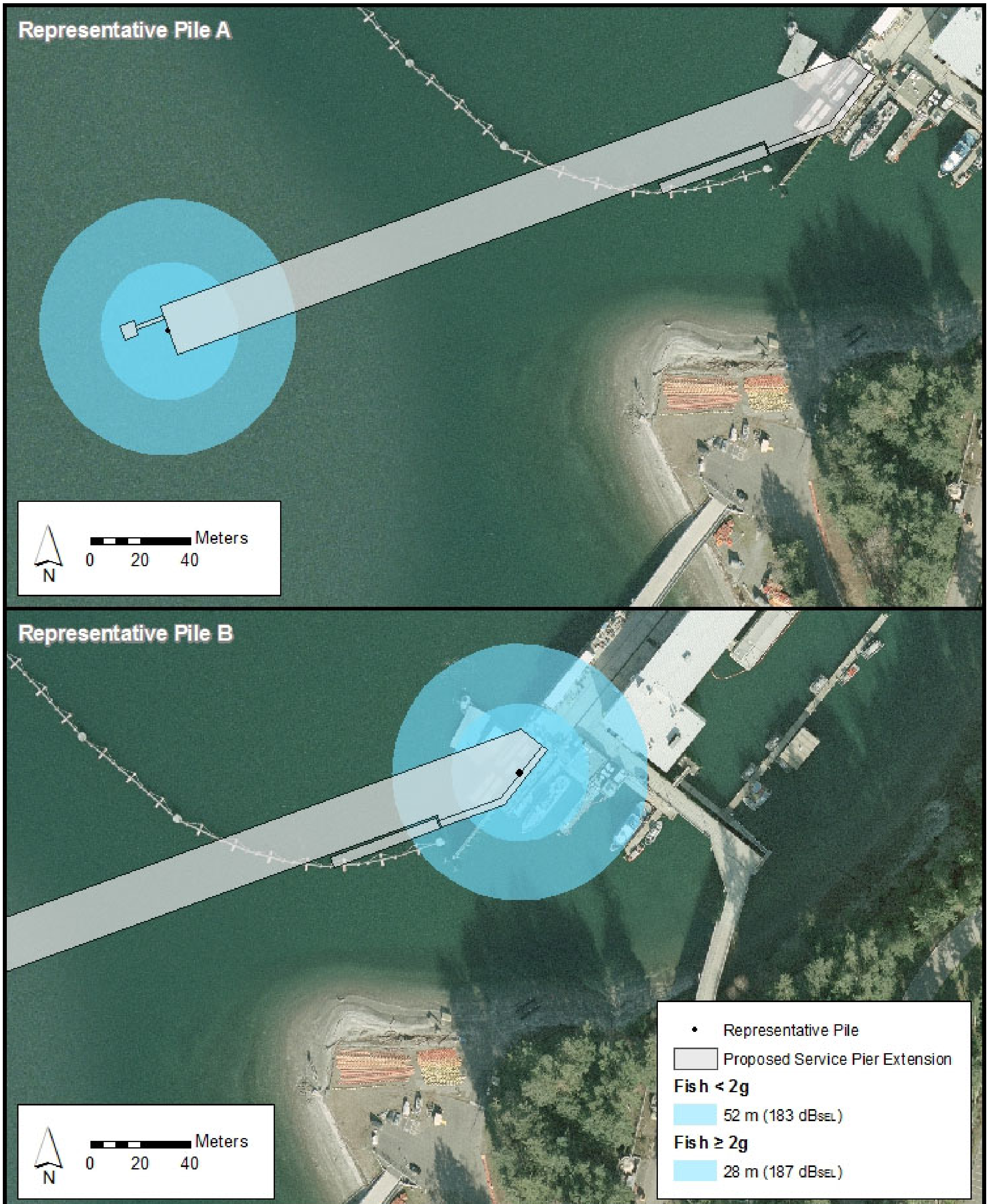


Figure 3.3-9a. Representative View for Fish Injury Guideline due to 18-inch Concrete Pile Driving Noise during Construction of SPE Alternative 3

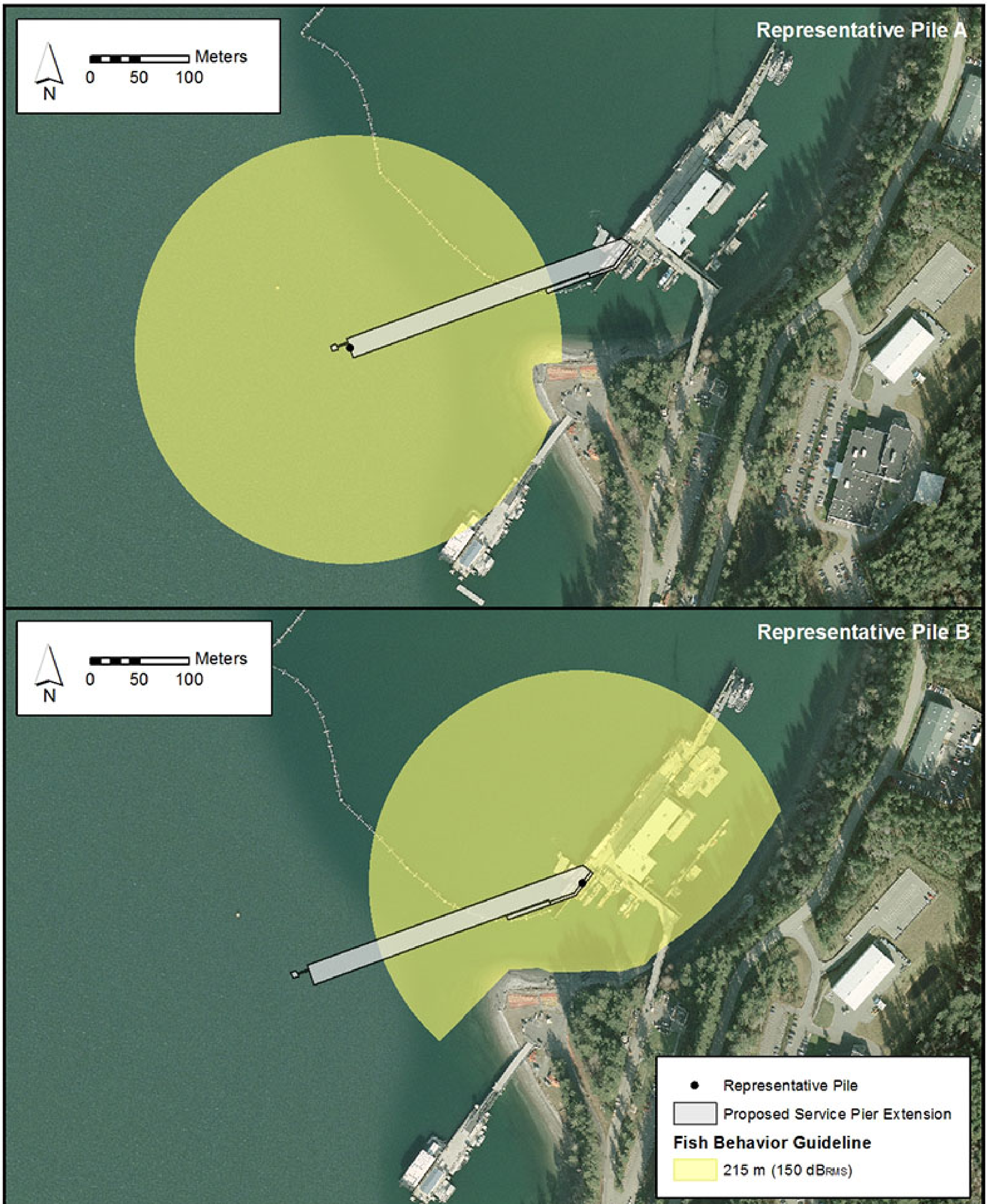


Figure 3.3-9b. Representative View for Fish Behavioral Guideline due to 18-inch Concrete Pile Driving Noise during Construction of SPE Alternative 3

ESA-Listed Hood Canal Rockfish

Impacts on currents, water quality, and habitats during the construction of SPE Alternative 3 would be similar to those described for SPE Alternative 2. The greatest differences between the alternatives would be more piles, more pile driving days, and more overwater structure for SPE Alternative 3. In addition, SPE Alternative 3 would involve a longer duration of in-water work and a larger footprint impact on benthic habitats from construction activities. However, these differences would be insufficient to alter the effect determination on ESA-listed Hood Canal rockfish and their habitats determined for SPE Alternative 2. Any stressors that have the potential to affect critical habitat PCEs (e.g., water quality, substrate conditions) would be highly localized to the immediate vicinity of in-water construction, and would not reach designated critical habitat. Therefore, the effect determination for all listed rockfish species and their critical habitats is "may affect, not likely to adversely affect."

NON-ESA-LISTED SALMONIDS

Construction-related impacts on non-ESA-listed salmonids and their habitats would be similar to those described above for ESA-listed salmonids. Complying with the permitted in-water work window would also minimize impacts on non-ESA-listed salmonids, including hatchery fish, due to their infrequent occurrence during this work window and resulting limited exposure to construction activities. However, due to a greater number of piles required, and the associated increase in pile driving time for SPE Alternative 3 compared to SPE Alternative 2, SPE Alternative 3 would have slightly greater impacts on habitat use, distribution, and migration of non-ESA-listed salmonids along the Bangor shoreline.

FORAGE FISH

Impacts on forage fish due to construction of SPE Alternative 3 would be similar to those described for SPE Alternative 2. Because the total number of piles for SPE Alternative 3 would be greater than for SPE Alternative 2, the number of days forage fish would experience elevated noise levels would similarly increase. However, similar to SPE Alternative 2, other than underwater noise impacts, SPE Alternative 3 would have little effect on the occurrence of forage fish occurring along the shoreline.

OTHER MARINE FISH SPECIES

Impacts on other marine fish species from SPE Alternative 3 would be similar to those described for SPE Alternative 2. However, differences would include a larger number of piles for construction of the longer pier extension and additional days of pile driving for SPE Alternative 3. These differences would not substantially increase or decrease SPE Alternative 3 project-related impacts on other marine fish species and the overall effects on these species would be similar to those described for SPE Alternative 2.

OPERATION/LONG-TERM IMPACTS

Maintenance of the pier extension under SPE Alternative 3 would have similar impacts on marine fish as SPE Alternative 2. Measures noted above would be employed to prevent discharges of contaminants to the marine environment. These activities would not affect marine fish.

ESSENTIAL FISH HABITAT

Operational impacts on EFH from the operation of SPE Alternative 3 would be similar to those described for SPE Alternative 2. The total overwater area would be greater for SPE Alternative 3 than for Alternative 2. Additional differences would include a larger number of piles for SPE Alternative 3. Minor differences between alternatives would not substantially increase or decrease operational impacts on EFH. Therefore, since the overall effects of SPE Alternative 3 would be similar to those described for SPE Alternative 2, operation of SPE Alternative 3 may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH.

THREATENED AND ENDANGERED FISH AND SPECIES OF CONCERN

ESA-Listed Hood Canal Salmonids

Marine Salmonid Habitat Conditions

Water and Sediment Quality

Long-term impacts on water and sediment quality (Section 3.1.2.3.3) from operation of SPE Alternative 3 would be the same as noted for SPE Alternative 2. Therefore, the operation of SPE Alternative 3 would not result in degraded water or sediment quality in habitats used by salmonids.

Physical Habitat and Barriers

The longer pier extension for SPE Alternative 3 would include more piles than SPE Alternative 2. However, the longer extension under SPE Alternative 3 would occur offshore of the nearshore juvenile salmonid migratory pathway, and would not increase barriers in this pathway, similar to conclusions for SPE Alternative 2. Because most species of adult salmonids are less dependent on nearshore habitats and also have much greater mobility, these age classes would also not experience a substantial barrier increase under SPE Alternative 3 compared to SPE Alternative 2.

Biological Habitat

Operational impacts on benthic productivity (Section 3.2.2.3.3) from SPE Alternative 3 would be similar to those described for SPE Alternative 2. The depth of the overwater structures would be sufficient such that no long-term impacts on aquatic vegetation are anticipated (Section 3.2.2.3.3). Similar to the design of the shorter pier under SPE Alternative 2, the long pier extension of SPE Alternative 3 would occur offshore of intertidal and shallow subtidal habitats, so potential effects on forage fish spawning habitats, nearshore habitat use, and migration would also be the same (Section 3.3.2.2.2).

Underwater Noise

Due to the same level of vessel and pier activity under each alternative, with the greatest difference being the location of this activity, underwater noise generated during the operation of SPE Alternative 3 would be similar to SPE Alternative 2.

Summary of Impacts and ESA-Listed Salmonids Determination

The operational effects of SPE Alternative 3 on nearshore NAVBASE Kitsap Bangor marine habitats, described above for salmonids, would be slightly greater for SPE Alternative 3 compared to Alternative 2. The long pier extension of SPE Alternative 3 would include an increase in overwater coverage and in-water piles compared to SPE Alternative 2. However, these increases would occur in deeper water habitats, away from the nearshore juvenile salmonid migratory pathway. These differences would neither increase or decrease species level threshold or habitat effects, and the SPE Alternative 3 effect determination on threatened and endangered fish species would be the same as described for SPE Alternative 2. No operational stressors associated with the proposed project are anticipated in designated or proposed critical habitats. Therefore, the effect determination for all listed salmonid species is "may affect, not likely to adversely affect." The effect determination for critical habitat is also "may affect, not likely to adversely affect," except for bull trout and Puget Sound steelhead (no effect).

ESA-Listed Hood Canal Rockfish

Similar to the conclusions noted above for operation of SPE Alternative 2, operation of SPE Alternative 3 would not result in adverse impacts on currents at a scale that would affect larval retention, water quality, or increase the prevalence of exotic species. Underwater noise from vessel operations is not anticipated to rise to a level that would limit rockfish occurrence. The greatest difference between the two alternatives would be the increase in overwater structures (70,000 vs. 44,000 square feet) and in-water piles (approximately 660 vs. 385) for SPE Alternative 3. Although the number of piles would increase for this alternative, this difference is considered insufficient to alter the effect determination on ESA-listed Hood Canal rockfish and their habitats determined for SPE Alternative 2. No operational stressors associated with the proposed project are anticipated in designated critical habitats. Therefore, the effect determination for all listed rockfish species is "may affect, not likely to adversely affect."

NON-ESA-LISTED SALMONIDS

Potential impacts described above for ESA-listed salmonids due to operation of SPE Alternative 3 would be similar for other salmonids. The long pier extension of SPE Alternative 3 would include an increase in overwater coverage and in-water piles compared to SPE Alternative 2. However, these increases would occur in deeper water habitats. Therefore, operation of SPE Alternative 3 may result in minor impacts to the habitat use and movement of non-ESA-listed salmonids through the project area. However, these impacts are not expected to be of a scope or intensity that would their overall distribution and abundance.

Forage Fish

Because the effects on nearshore water and sediment quality, physical habitat, biological habitat, and underwater noise for both SPE Alternative 2 and 3 would be similar, operational impacts on forage fish from SPE Alternative 3 would also be similar to those described for SPE Alternative 2. Since the pier extensions for both alternatives would occur offshore, away from the nearshore forage fish migratory pathway and intertidal Pacific sand lance spawning habitat, potential effects on forage fish spawning habitats, nearshore habitat use, and migration would also be limited. Similar to SPE Alternative 2, minor effects could occur from operation of SPE Alternative 3 as a result of increased vessel activity, and associated wakes in close proximity to the nearby 1,650-foot (503-meter) documented Pacific sand lance spawning habitat, and artificial lighting that could result in minor delays or alteration of forage fish migration.

Other Marine Fish Species

Operational impacts on other marine fish species for SPE Alternative 3 would be similar to those described for salmonids and other marine fish species for SPE Alternative 2. Differences would include a larger overwater structure and an increase in the number of piles under SPE Alternative 3. There would be some minor reductions in benthic productivity from shading and a greater alteration of flat-bottomed habitat to structured habitat due to the presence of the piles. Neither alternative would result in widespread impacts to aquatic vegetation (Sections 3.2.2.3.2 and 3.2.2.3.3), or water and sediment quality in the project area (Section 3.1.2.3.3). Although minor localized shifts in fish use are likely due to the presence of piles, the differences summarized above would not substantially increase or decrease operational impacts on other marine fish species, so the overall effects of SPE Alternative 3 on these species would be similar to those described for SPE Alternative 2.

3.3.2.3.4. Summary of SPE Impacts

Impacts on fish during the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.3–8.

Table 3.3–8. Summary of SPE Impacts on Fish

Alternative	Environmental Impacts on Fish
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	*Construction:* Temporary degradation of turbidity and nearshore physical barriers and habitat; temporary decrease in function of habitats and aquatic vegetation used for foraging and refuge. Underwater noise thresholds for injury and guideline for behavioral disturbance would be exceeded during pile driving (this action would only occur during in-water work windows when juvenile salmon are generally not present). Potential disturbance of only small areas of marine vegetation due to the deep water occurrence of the project. *Operation/Long-term Impacts:* Localized changes in fish habitat type from benthic to structured habitats in the project footprint, waters deeper than 30 feet (9 meters) below MLLW, with little or no barrier effect on juvenile and adult migratory fish.
	ESA: Alternative 2 “may affect, not likely to adversely affect” Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bull trout, bocaccio, canary rockfish, and yelloweye rockfish. For critical habitat: “may affect, not likely to adversely affect,” except for bull trout and Puget Sound steelhead (no effect). *EFH:* Impacts from construction and operation may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH.
SPE Alternative 3: Long Pier	*Construction:* Temporary degradation of turbidity and nearshore physical barriers and habitat; temporary decrease in the function of habitats and aquatic vegetation used for foraging and refuge. SPE Alternative 3 would exceed underwater noise thresholds for injury and the behavioral disturbance guideline for fish during pile driving (this action would only occur during in-water work windows when juvenile salmon are generally not present), for up to 44 days longer than for SPE Alternative 2. Potential disturbance of only small areas of marine vegetation due to deep water occurrence of the project.
	Operation/Long-term Impacts: SPE Alternative 3 would have approximately 275 more piles than Alternative 2 and would result in greater localized changes in fish habitat type from benthic to structured habitats in the project footprint, waters deeper than 30 feet below MLLW, with little or no barrier effect on juvenile and adult migratory fish. SPE Alternative 3 would create 26,000 sq ft more offshore overwater structure than SPE Alternative 2, potentially creating additional overwater shading effects on behavior of fish occurring in the area.
	ESA: Alternative 3 “may affect, not likely to adversely affect” Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bull trout, bocaccio, canary rockfish, and yelloweye rockfish. For critical habitat: “may affect, not likely to adversely affect,” except for bull trout and Puget Sound steelhead (no effect). *EFH:* Impacts from construction and operation may adversely affect Pacific salmonid, coastal pelagic, and Pacific groundfish EFH.
Mitigation: BMPs and current practices to reduce and minimize impacts on marine fish are described in Section 3.3.1.8.3. Under either alternative, proposed compensatory aquatic mitigation (Appendix C, Section 6.0) would compensate for the project’s aquatic habitat impacts.	
Consultation and Permit Status: The Navy is addressing impacts on ESA-listed marine fish and MSA-covered habitats under consultation with the NMFS West Coast Region office under the ESA and MSA. An EFHA was submitted to the NMFS West Coast Region office on March 10, 2015. A BA was submitted to the NMFS West Coast Region office and the USFWS Washington Fish and Wildlife Office on March 10, 2015 and a revised BA was submitted on June 10, 2015. In a concurrence letter dated March 4, 2016, USFWS stated that the SPE project impacts to bull trout are not measurable and therefore insignificant. Consultation under the ESA and MSA with NMFS is ongoing.	

BMP = best management practice; EFH = Essential Fish Habitat; ESA = Endangered Species Act; MLLW = mean lower low water; MSA = Magnuson-Stevens Fishery Conservation and Management Act; NMFS = National Marine Fisheries Service; USFWS = U.S. Fish and Wildlife Service.

3.3.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

3.3.2.4.1. SALMONIDS

Construction of the LWI and SPE projects, separately and combined, is expected to result in temporary and localized water quality effects, including increased turbidity. However, long-term degradation of nearshore water quality or violations of state water quality standards that would affect salmonid occurrence (Table 3.3–9) are not anticipated. Although the proposed projects may result in localized changes in flow patterns, these combined changes are not expected to be of sufficient scale to affect salmonid migration or the use of suitable habitats. In addition, in-water construction activities would only occur during the in-water work window (except non-pile driving work for the LWI project), when nearshore juvenile salmonids are least abundant.

Table 3.3–9. Summary of Combined LWI/SPE Impacts for Salmonids and Marine Fish

Resource	Combined LWI/SPE Impacts
Impact	
Salmonids	The combined effects of the LWI and SPE projects on salmonid habitats from construction would include increased turbidity and impacts to benthic and marine vegetated habitats and underwater noise, including up to 285 days of pile driving over four in-water work seasons. Long-term impacts to salmonid habitats would largely be minor and localized, with the exception of LWI Alternative 2, which may increase barriers to nearshore juvenile salmon migration, potentially resulting in highly localized, minor delays in migration and increased risk of predation.
Other Marine Fish Species	The combined effects of the LWI and SPE projects on habitats utilized by other marine fish species from construction would include increased turbidity and impacts to benthic and marine vegetated habitats and underwater noise, including up to 285 days of pile driving over four in-water work seasons. The long-term alteration of habitat may result in highly localized, minor changes in habitat use by non-salmonid marine fish species.

Within habitats utilized by salmonids, construction of the LWI and SPE projects may result in a combined loss, depending on the alternative, of up to about 0.1 acre (0.04 hectare) of marine vegetation, and conversion of up to 0.14 acre (0.056 hectare) of nearshore habitat and up to 0.045 acre (0.018 hectare) of offshore soft-bottom habitat to hard substrate. Benthic habitats outside of the long-term project footprints would reestablish after construction, whereas those in the relatively small footprints noted would be permanently lost as habitats that support salmonid foraging and refuge.

The maximum number of in-water pile driving days required for construction of the LWI and SPE projects combined would be up to 285 (up to 80 days for LWI and up to 205 days for SPE), with up to two in-water work seasons required for each project, for a total of four in-water work seasons under current schedules. Construction of the two projects would not overlap; therefore, concurrent or overlapping noise impacts would not occur. Once construction is completed, underwater noise during operations would return to levels similar to existing conditions.

The maximum combined coverage of overwater structures for combinations of the LWI and SPE alternatives would be 2 acres (0.8 hectare). However, all of the overwater coverage that would occur in the nearshore migratory pathway for these two projects would be associated with LWI Alternative 2.

The intertidal and shallow subtidal piles and mesh of LWI Alternative 2 may create a migration barrier to nearshore-migrating salmonids, resulting in a potential increase in predation risk. The combined maximum number of in-water permanent piles required for the LWI and SPE alternatives would be up to 810, depending on the alternative. However, although more piles could occur for the SPE alternative (up to 660) than LWI (up to 150), the offshore location of the SPE piles would not substantially increase the potential nearshore migration barrier effect represented by the intertidal and shallow subtidal LWI in-water structures alone.

3.3.2.4.2. Other Marine Fish Species

Combined impacts on other marine fish species from the construction and operation of the LWI and SPE projects would be similar to those described above for salmonids (Section 3.3.2.4.1). The in-water portions would result in direct habitat conversion from soft-bottom benthic habitats, to hard substrate (Section 3.3.2.4.1). These habitat impacts could reduce the amount of foraging and refuge habitats for some species, including shiner perch, gunnels and forage fish. However, some fish species prefer more structured habitats (e.g., pile perch, greenling, juvenile rockfish, and cabezon) and may benefit from in-water structures. Nearshore migrating forage fish may experience a similar potential barrier effect from LWI Alternative 2 (as described above for salmonids), but most are expected to be able to swim through the mesh. There is potential for them to delay or alter their migration, but these impacts would be highly localized the mesh itself.

3.4. MARINE MAMMALS

Marine mammals discussed in this section include species likely to be found in Puget Sound. Cetaceans (including whales, dolphins, and porpoises) live exclusively in aquatic environments, whereas pinnipeds (seals and sea lions) rest and bear their young on marine shorelines. Terrestrial mammals such as river otters and mink that primarily occur in freshwater environments are discussed in Section 3.6.

3.4.1. Affected Environment

3.4.1.1. EXISTING CONDITIONS

Eight marine mammal species have been documented in Hood Canal waters: humpback whale (*Megaptera novaeangliae*), Steller sea lion (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*), harbor seal (*Phoca vitulina*), transient killer whale (*Orcinus orca*), gray whale (*Eschrichtius robustus*), Dall's porpoise (*Phocoenoides dalli*), and harbor porpoise (*Phocoena phocoena*) (Table 3.4–1). With the exception of the Steller sea lion, these species may potentially occur year round in Hood Canal. One species (humpback whale) that has been detected in Hood Canal is federally listed under the ESA (Table 3.4–2).

Harbor seals and California sea lions are the most prevalent species of marine mammal in the vicinity of the Bangor waterfront. Harbor seals are present year round in Hood Canal and occur regularly at NAVBASE Kitsap Bangor. The California sea lion is also present year round, but with minimal numbers occurring June through August. The Steller sea lion is present from fall to spring (September to May). Because these three species are predictably present at NAVBASE Kitsap Bangor, they are included in the analysis. Further, harbor porpoise have been documented on multiple occasions in Hood Canal since 2011, and consequently are also included in the analysis. Humpback whales are occasionally present in small numbers in Puget Sound, and after an absence of sightings for over 15 years, individual humpback whales were seen in Hood Canal south of the Hood Canal Bridge in early 2012, and in early 2015. For this reason they are included in the analysis. Pods of transient killer whales have occurred on only two occasions in Hood Canal in the past decade. However, because these occurrences involved lengthy stays by the whale pods, this stock is included in the analysis.

Two rare species that have been documented in Hood Canal waters are not carried forward in the analysis. Dall's porpoise has only been documented once during marine mammal surveys (Tannenbaum et al. 2009a) and, therefore, is not included in the analysis. Gray whales have been infrequently documented in Hood Canal waters over the past decade, but the sightings are an exception to the normal seasonal occurrence of gray whales in Puget Sound feeding areas. Consequently, because gray whales are unlikely to be present in Hood Canal, the species is not included in this analysis.

The Southern Resident killer whale stock is resident to the inland waters of Washington State and British Columbia; however, it has not been seen in Hood Canal since 1995. This species is included in the analysis of indirect effects because its prey base includes salmonid species that may be affected by the project.

Table 3.4–1. Marine Mammals Historically Sighted in Hood Canal

Species	Stock(s) Abundance[1]	Season(s) of Occurrence	Relative Occurrence[a]
Humpback Whale *Megaptera novaeangliae* CA/OR/WA stock	1,918[3] (CV=0.03)	Year round in Puget Sound	Rare
Steller sea lion *Eumetopias jubatus* Eastern U.S. stock/DPS	63,160 – 78,198[2]	Fall to spring (late September – May)	Seasonal
California sea lion *Zalophus californianus* U.S. stock	296,750[3]	Year round in Hood Canal	Seasonal
Harbor seal *Phoca vitulina* Hood Canal stock	3,555[4]	Year round; resident species in Hood Canal	Likely
Killer whale *Orcinus orca* West Coast transient stock	243[2, b]	Year round in Puget Sound, last seen in Hood Canal in 2005	Rare
Harbor porpoise *Phocoena phocoena* WA inland waters stock	10,682[3] (CV=0.38)	Year round	Likely
Dall's porpoise *Phocoenoides dalli* CA/OR/WA stock	42,000[3] (CV=0.33	Year round in Puget Sound, last seen in Hood Canal in 2008	Rare
Gray whale Eastern North Pacific	19,126[3] (CV=.071)	Migrants and a few individuals present in spring in northern Puget Sound	Rare

Sources:

1. NMFS marine mammal stock assessment reports at: http://www.nmfs.noaa.gov/pr/sars/species.htm
2. Allen and Angliss 2014
3. Carretta et al. 2014
4. Based on Jeffries et al. 2003 sightings and London et al. 2012 correction factors.

CA = California; CV = coefficient of variation; OR = Oregon; WA = Washington

a. Rare: The distribution of the species is near enough to the area that the species could occur in the area or there are a few confirmed sightings (e.g., humpback in Hood Canal; transient killer whale in Hood Canal); Likely: Confirmed and regular sightings of the species in the area year round (e.g., harbor seal); Seasonal: Confirmed and regular sightings of the species in the area on a seasonal basis (e.g., California sea lion and Steller sea lion).

b. Minimum population estimate of killer whales that occur in the inside waters of southeastern Alaska, British Columbia, and northern Washington. This estimate does not include whales documented on the outer coast or in California.

Table 3.4–2. Federally Listed Threatened and Endangered Marine Mammals Potentially Affected by the Proposed Action

Wildlife	Federal Listing[1]	Critical Habitat	Critical Habitat at NAVBASE Kitsap Bangor
Humpback whale	Endangered *35 FR 18319* *December 2, 1970*	None Designated	None
Southern Resident killer whale	Endangered *70 FR 69903* *November 18, 2005*	Designated (> 20 ft [6 m] deep) *71 FR 69054* *November 29, 2006*	None; closest critical habitat is 8.5 mi (13.7 km) northeast of base

ft = feet; FR = Federal Register; km = kilometer; m = meter; mi = mile

1. DPS = Distinct population segment that is discrete from other populations and important to its taxon. A group of organisms is discrete if it is "markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, and behavioral factors" (DPS Policy; 61 FR 4722; February 7, 1996). Significance is measured with respect to the taxon (species or subspecies).

Other marine mammal species, including the minke whale and northern elephant seal, occur in inland marine waters of Washington State and British Columbia but are not included in the analysis because they have not been documented in Hood Canal in at least 15 years.

Habitats used by marine mammals in the vicinity of the LWI and SPE project sites include marine intertidal and subtidal zones associated with the nearshore, marine deeper water areas, and manmade structures (i.e., marine vessels, piers, wharves, and associated structures that are in marine waters), as described in Table 3.4–3.

3.4.1.1.1. MARINE MAMMAL HABITAT

NEARSHORE MARINE HABITAT

Nearshore marine habitats on the Bangor waterfront include intertidal and nearshore subtidal zones. For purposes of evaluating project impacts the edge of the nonphotic zone, 30 feet (9 meters) below MLLW, is used to bound the nearshore habitat. Pinnipeds (seals and sea lions) haul out of water on intertidal habitat; all other marine mammals occurring in Hood Canal occur in the subtidal zone of nearshore marine waters in addition to deeper water habitats. In Hood Canal, harbor seals (and to a lesser extent California sea lions) haul out on intertidal substrates, including river deltas and rocky outcrops (Jeffries et al. 2000). River deltas in Hood Canal are more accessible for haul-out activities at high tides, when greater numbers of harbor seals haul out (Huber et al. 2001; London et al. 2002). There are no river deltas near the LWI and SPE project sites, and neither harbor seals nor California sea lions have been observed hauled out on intertidal substrates in this area (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a).

Marine mammals occurring or potentially occurring at the Bangor waterfront use the subtidal zone of nearshore habitat to forage for food resources. Prey items range from invertebrates (consumed by seals), fish (consumed by whales, porpoises, seals, and sea lions), or other marine mammals (i.e., transient killer whales primarily consumed harbor seals during their recent occurrences in Hood Canal [London 2006]). In the nearshore community, fish that are consumed by marine mammals include migrating salmonids and forage fish such as surf smelt and

Table 3.4–3. Marine Mammal Habitats in the Vicinity of the LWI and SPE Project Sites

Habitat Type		Habitat Value	Relative Occurrence of Species in Hood Canal[1]
Nearshore Marine	Intertidal Zone	Areas within the intertidal zone provide haul-out sites for seals and sea lions. In Hood Canal, haul-out sites are primarily on river deltas, which occur outside the Bangor waterfront.	**Common:** California sea lion and harbor seal **Occasionally Present:** Steller sea lion
	Subtidal Zone	The subtidal zone of nearshore marine waters in Hood Canal provides foraging habitat for seals, sea lions, and transient killer whales. May provide foraging benefits for other marine mammals that occasionally occur in the area.	**Common:** California sea lion, harbor seal **Occasionally Present:** Steller sea lion, harbor porpoise **Rarely Present:** Transient killer whale, gray whale, humpback whale, Dall's porpoise
Marine Deeper Water		Same as Subtidal Zone of the Nearshore Marine.	**Common:** California sea lion, harbor seal **Occasionally Present:** Steller sea lion, harbor porpoise, **Rarely Present:** transient killer whale, gray whale, humpback whale, Dall's porpoise
Manmade Structures		Manmade structures at and near the LWI project sites represent unique haul-out habitat for California sea lions, which are not known to haul out in groups elsewhere in Hood Canal.	**Common:** California sea lion, harbor seal **Occasionally Present:** Steller sea lion

Sources: Jeffries et al. 2000; Johnson and O'Neil 2001; Jeffries 2007, personal communication; Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; Navy 2015a

1. Common: consistently present either year round (harbor seal) or during non-breeding season (California sea lion and Steller sea lion); occasionally present: documented at irregular intervals; rarely present: sporadic sightings, not occurring on a yearly basis.

Pacific herring, and some demersal fish. Habitat features in the subtidal zone, such as river mouths and adjacent estuarine habitat, and physical processes, such as eddies and upwelling, can spatially aggregate the forage resources of marine mammals (Hunt and Schneider 1987). For example, during the in-migration of adult salmonids, estuaries and river mouths provide relatively dense concentrations of salmonid prey for seals and sea lions (London et al. 2002; London 2006). Availability of forage resources for marine mammals in the subtidal nearshore is affected by time scales including time of day, season, and year. For example, the availability of prey that migrate vertically in the water column varies based on time of day. Additionally, forage fish are more available during the spawning season and salmonids are more available during periods of migration.

Migrating juvenile salmonids (including Chinook, coho, steelhead, and cutthroat trout) of an appropriate size to attract marine mammals, and adult surf smelt and Pacific herring were identified in beach seine surveys in both the LWI and SPE project areas (Section 3.3.1.1; Bhuthimethee et al. 2009). Their numbers varied at different survey locations on different survey dates, reflecting the use of the waterfront as a seasonal migratory pathway by schooling fish. These data do not indicate any attraction to, or extended residence at, any specific locations on the Bangor waterfront (Section 3.3.1.1).

The LWI project sites include subtidal habitats that support the seasonally available potential prey species described above for marine mammals. These prey species were sampled at a variety of survey sites along the Bangor waterfront, and there is no evidence that the project sites attract any particular concentration of prey with respect to other nearshore areas. The SPE would be located in deeper water habitat from 30 to 75 feet (9 to 23 meters) below MLLW (see Marine Deeper Water Habitat below). Adjacent nearshore marine habitats support the same seasonally available potential prey species observed elsewhere on the Bangor waterfront. Deeper water prey resources are described below.

MARINE DEEPER WATER HABITAT

Marine deeper water habitats described in this section refer to inland waters of Washington (Puget Sound including Hood Canal, Strait of Juan de Fuca, and the vicinity of the San Juan Islands). Food resources previously described for the nearshore zone (e.g., fish including salmonids, forage fish, and demersal fish) also occur in marine deeper water habitat. Deeper water habitats at NAVBASE Kitsap Bangor are likely to support migratory prey species (e.g., Pacific herring and juvenile salmonids) found in nearshore waters, in addition to adult/sub-adult salmonids such as Chinook, steelhead, and cutthroat trout. Aggregation of forage resources in marine deeper waters can be affected by the same processes described for nearshore marine habitat, generally resulting in a patchy distribution of forage resources for marine mammals and marine birds (Section 3.5) across time and space (Hunt and Schneider 1987). Although the LWI project would be constructed in shallower water, prey resources in deeper water habitats adjacent to the LWI and SPE project sites are as described in this section.

MANMADE STRUCTURES

California sea lions, harbor seals, and Steller sea lions use manmade structures along the Bangor waterfront as haul-out sites. Submarines intermittently dock at four of the overwater structures for service, and both Steller and California sea lions have been observed hauled out on the above-water portion of the submarines at Delta Pier. As many as 122 California sea lions have been observed hauled out on docked submarines, the pontoons that support the PSB, and other structures (Navy 2015a). Harbor seals have been observed on the PSBs, the wavescreen at Carderock Pier, on buoys, barges, and small marine vessels (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; Navy 2015a).

MANMADE STRUCTURES AT THE LWI PROJECT SITES

There are no manmade structures at the LWI project sites. The north LWI project site is approximately 1,000 feet (300 meters) from EHW and the south LWI project site is approximately 900 feet (275 meters) from Delta Pier. Submarines berthed at Delta Pier provide haul-out locations for California and Steller sea lions. Harbor seals haul out on the pontoons of the PSBs attached to Delta Pier and EHW-1.

MANMADE STRUCTURES AT THE SPE PROJECT SITE

Unconfirmed reports of the Port Operations crew indicate that harbor seals use the northeast side of the Service Pier for pupping.

3.4.1.1.2. THREATENED AND ENDANGERED MARINE MAMMAL SPECIES

The Biological Assessment for the LWI and SPE project addressed two ESA-listed marine mammals: humpback whale and Southern Resident killer whale. The humpback whale is included in the analysis because it has been sighted in Hood Canal on several occasions since 2012. The Southern Resident killer whale does not occur in Hood Canal, but it is included in the analysis because the project may adversely affect its prey (Hood Canal salmonid species).

HUMPBACK WHALE

STATUS

Humpback whales were listed as endangered under the ESA in 1973 due to depletion by commercial whaling (35 FR 18319). A recovery plan for humpback whales was finalized in November 1991 (NMFS 1991). Critical habitat has not been designated for humpback whales. NMFS proposed on April 20, 2015 to reclassify the species into 14 distinct population segments, ten of which do not warrant ESA listing (80 FR 22304). Two of the humpback whale DPSs migrate and feed along the west coast of Washington. Under the proposed rule, the Mexico DPS, which breeds on the Pacific coast of Mexico and feeds along the California/Oregon/ Washington coast would not be listed. The Central America DPS, which breeds along the Pacific coast of Costa Rica, Panama, Guatemala, El Salvador, Honduras, and Nicaragua and primarily feeds offshore of California and Oregon, with some feeding off northern Washington/southern British Columbia, would be listed as threatened.

RANGE OF HUMPBACK WHALE

Humpback whales in the North Pacific migrate seasonally from northern latitude feeding areas in summer to low-latitude breeding areas in winter. Feeding areas are dispersed across the Pacific Rim from California to Hokkaido, Japan. Within these regions, humpback whales have been observed spending the majority of their time feeding in coastal waters. More than half of the North Pacific Ocean humpback whales feed in U.S. waters. Breeding areas in the North Pacific are more geographically separated than the feeding areas and include (1) regions offshore of Central America; (2) regions offshore of mainland Mexico, the Revillagigedos Islands, and Baja California; (3) Hawaii; and (4) regions offshore of Japan and the Philippines. About half of the humpback whales in the North Pacific breed and calve in the U.S. waters off Hawaii.

POPULATION SIZE

The Mexico DPS abundance is thought to be 6,000 to 7,000 individuals (Calambokidis et al. 2008) or higher (Barlow et al. 2011). Estimates of population growth trends do not exist for the Mexico DPS by itself, but population growth throughout most of the primary feeding areas of the Mexico DPS (from California to the Gulf of Alaska) suggests that this DPS is unlikely to be declining. The abundance of the Central America DPS is thought to be 500 to 600 individuals with unknown trend (Calambokidis et al. 2008; Barlow et al. 2011).

BEHAVIOR AND ECOLOGY

Humpback whales spend the majority of their time during summer months on mid- to northern-latitude feeding areas where they build up fat stores that they will live off of during the winter. Humpback whales filter feed on tiny crustaceans (primarily krill), plankton, and small fish and can consume up to 3,000 pounds (1,360 kilograms) of food per day. In winter they migrate to calving areas in subtropical or tropical waters, undertaking the longest recorded migrations of any mammals. During migration, humpback whales remain near the surface of the ocean. While feeding and calving, humpback whales prefer shallow waters.

OCCURRENCE OF HUMPBACK WHALE IN THE ACTION AREA

Humpback whales were sighted in Hood Canal on 8 days in January and February 2012, 1 day in May 2013, and 5 days in January and February 2015 (Orca Network 2015). Review of the multiple sightings in 2012 indicated the occurrences were one individual (Calambokidis 2012, personal communication). Locations in 2012 included Dabob Bay and other locations south to the Great Bend. In May 2013 a humpback whale was observed north of Hood Canal Bridge heading toward Port Gamble. In 2015 single humpback whales were observed near NAVBASE Kitsap Bangor and elsewhere in Hood Canal.

Prior to the 2012 sightings, there were no confirmed reports of humpback whales entering Hood Canal (Calambokidis 2012, personal communication). No other reports of humpback whales in Hood Canal were found in the Orca Network database, the scientific literature, or agency reports. Construction of the Hood Canal Bridge in 1961 may have contributed to the lack of historical sightings (Calambokidis 2010, personal communication). A few records of humpback whales near Hood Canal, but north of the bridge, were found in the Orca Network database.

Construction and operation of the LWI and SPE would not be likely to adversely affect the humpback whale directly, because humpback sightings within Hood Canal are rare and, based on past evidence as noted above, it is unlikely that humpbacks would occur in the Action Area during the short duration of pile driving activity. In the event a whale did enter the Action Area, active pile-driving would be stopped by the monitors immediately upon sighting. Indirect effects of the Proposed Actions on transiently occurring humpbacks from a reduction of their regional prey base or other habitat-related effects are not predicted (see Sections 3.3.1.1. and 3.4.1.1.1 for background). For these reasons, the FEIS does not perform detailed impact analyses on the humpback whale.

SOUTHERN RESIDENT KILLER WHALE

STATUS

Southern Resident killer whales were listed as endangered under the ESA in 2005 (70 FR 69903), a recovery plan was approved in 2008 (73 FR 4176), and critical habitat was designated in 2006 (71 FR 69054). A combination of factors including ocean conditions, reductions in prey resources, disturbance from vessel traffic, and toxins most likely contributed to the whales' decline (NMFS 2008b). Critical habitat for the Southern Resident killer whale does not include Hood Canal (NMFS 2006b), and NMFS has not confirmed any sightings of this whale stock in Hood Canal since 1995 (NMFS 2008b). Ongoing genetic and morphological studies of Puget Sound killer whales indicate that Southern Resident killer whales are a distinct population. Although their geographic ranges overlap considerably with transient and Northern Resident killer whales, which inhabit the Strait of Georgia and coastal British Columbia, they do not appear to associate or interbreed with the other killer whale populations (Ford et al. 2000).

RANGE OF SOUTHERN RESIDENT KILLER WHALE

The Southern Resident killer whale stock consists of three pods (J, K, and L) that reside primarily in Puget Sound, the Strait of Juan de Fuca, and the Strait of Georgia (British Columbia) during the spring, summer, and fall (McCluskey 2006; Hauser et al. 2007; Hanson and Emmons 2011). Less information is available on their winter distribution and movements, but opportunistic sightings and dedicated surveys have detected Southern Resident pods in coastal waters off Oregon, Washington, Vancouver Island, the mouth of the Columbia River, and as far south as Monterey Bay, California (Ford et al. 2000; Krahn et al. 2004; Black 2011; Northwest Fisheries Science Center 2013). There have been no confirmed sightings of Southern Resident killer whales in Hood Canal since 1995 (Unger 1997; Bain 2006; NMFS 2006b).

POPULATION SIZE

In July 2014 the population consisted of 80 individuals (Center for Whale Research 2014). Population censuses from 1974 to the present show variations from 71 individuals in 1974 to 99 individuals in 1995 (Carretta et al. 2014).

BEHAVIOR AND ECOLOGY

Unlike transient killer whales, which prey on marine mammals, Southern Residents primarily consume salmonids (especially Chinook and chum salmon), and also Pacific halibut, rockfish species, and Pacific herring (Ford and Ellis 2005; Hanson et al. 2010; Hanson 2011).

OCCURRENCE OF SOUTHERN RESIDENT KILLER WHALE IN THE ACTION AREA

Southern Resident killer whales have not been detected in Hood Canal since 1995. The species is carried forward in the impacts analysis for the proposed projects because the projects may indirectly affect killer whales through effects on their preferred prey species. They are not carried forward in the analysis of potential noise impacts.

3.4.1.1.3. NON-LISTED MARINE MAMMALS

STELLER SEA LION

STATUS

The Steller sea lion is distributed from Japan through the North Pacific, including the Aleutian Islands, central Bering Sea, Gulf of Alaska, southeast Alaska, and south to central California (55 FR 49204). The Steller sea lion was listed as threatened under the ESA in 1990 (55 FR 49204), and critical habitat was designated 3 years later (58 FR 45269). In 1997, NMFS reclassified the Steller sea lion into distinct western and eastern population segments based on demographics and genetics, as authorized by NMFS (62 FR 30772). The eastern DPS, which occurs from southeast Alaska southward to California (east of 144˚ West longitude), was delisted under the ESA in November 2013 (78 FR 66140).

RANGE OF EASTERN DPS OF STELLER SEA LION

There are no known rookeries in Washington State, but eastern DPS Steller sea lions are present along the outer coast of Washington at four major haul-out sites year round (NMFS 2008a). These animals are most likely immature or non-breeding adults from rookeries in other areas (NMFS 2008a), including the southern coastline of Vancouver Island. In addition, Steller sea lions are occasionally present in Puget Sound at the Toliva Shoals haul-out site in south Puget Sound (Jeffries et al. 2000), a haul-out near Marrowstone Island (NMFS 2010), a net pen in Rich Passage, and navigation buoys in Puget Sound (Jeffries 2012, personal communication). Steller sea lions have been observed hauled out on submarines at Delta Pier from 2008 to the present during fall through spring months (late September to May) (Navy 2015a). As many as 13 Steller sea lions have been reported on a given day at this location (Navy 2015a).

POPULATION SIZE

The eastern DPS has continuously increased at an annual rate of 3 percent over the past 30 years. The most recent population estimate for the Eastern stock ranges from 63,160 to 78,198 individuals (Allen and Angliss 2014).

BEHAVIOR AND ECOLOGY

Steller sea lions occupy all marine water habitats for foraging and they haul out on manmade structures such as jetties, buoys, rafts, floats, and vessels (Jeffries et al. 2000; Navy 2015a), and natural sites such as islands and rocky shorelines. They are opportunistic predators, feeding primarily on fish and cephalopods, and their diet varies geographically and seasonally (Merrick et al. 1997). Foraging habitat is primarily shallow, nearshore and continental shelf waters; rivers; and also deep waters (Reeves et al. 2008; Scordino 2010). All reported occurrences of Steller sea lions on NAVBASE Kitsap Bangor have been of animals hauled out on submarines, but it is likely they also forage in surrounding waters. Their prey is not well documented in these marine waters, but they are expected to be opportunistic foragers, similar to California sea lions.

OCCURRENCE OF STELLER SEA LION AT THE LWI PROJECT SITES

Steller sea lions have not been detected at either LWI project site. They haul out on submarines docked at Delta Pier, which is located approximately 1 mile (1.6 kilometers) from the north LWI project site, and 1,000 feet (300 meters) from the south LWI project site.

OCCURRENCE OF STELLER SEA LION AT THE SPE PROJECT SITE

Steller sea lions have not been detected at the SPE project site, which is located approximately 0.9 mile (1.5 kilometers) from the Steller sea lions' haul-out location at Delta Pier.

HARBOR SEAL

RANGE OF HARBOR SEAL

Harbor seals are the only species of marine mammal that is consistently abundant and resident year round in Hood Canal (Jeffries et al. 2003). The geographic distribution of harbor seals includes the U.S. west coast from Baja California north to British Columbia and coastal Alaska, including southeast Alaska, the Aleutian Islands, the Bering Sea, and the Pribilof Islands (Carretta et al. 2014). For management purposes harbor seals are separated into separate stocks along the west coast of the continental U.S, including stocks in California, the outer coast of Oregon and Washington, and Washington inland waters (Carretta et al. 2014). Recent genetic evidence indicates that three genetically distinct populations occur within the Washington inland waters stock, including a Southern Puget Sound stock, a Washington Northern Inland Waters stock, and a Hood Canal stock (Huber et al. 2010, 2012; Carretta et al. 2014). The Hood canal stock is the only population that is expected to occur within the project area. Harbor seals may occur anywhere along the Bangor waterfront in subtidal or deeper waters, and have been observed in every month based on surveys conducted from 2007 to 2015 (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; HDR 2012; Hart Crowser 2013b; Navy 2015a).

POPULATION SIZE

Harbor seals are the most abundant marine mammal in Hood Canal (Jeffries et al. 2003). Currently published population estimates were derived from data collected in 1999 (Jeffries et al. 2003) which calculated a population size of approximately 1,000 individuals. However, more recent unpublished data (2004, 2006, 2010, and 2013) show that although the population size is variable from year to year it has increased (DeLong 2015, personal communication) (Table 3.4–1).

BEHAVIOR AND ECOLOGY

Harbor seals use all marine habitats, such as, the intertidal zone and manmade structures are used for haul-out activities, and subtidal nearshore marine, inside marine deeper water habitats, and the lower reaches of rivers are used for foraging (Reeves et al. 2008) (Table 3.4–3). The main haul-out locations for harbor seals in Hood Canal are on river delta and tidally exposed areas at the Quilcene, Dosewallips, Duckabush, Hamma Hamma, and Skokomish River mouths, with the closest haul-out area located 10 miles (16 kilometers) southwest of NAVBASE Kitsap Bangor at the Dosewallips River mouth (London 2006). Modeled haul-out behavior of Hood Canal harbor seals indicates that the highest probability of haul-out occurs during the 1.5 hours after high tide, and is influenced by human disturbance, the timing of pupping and molting, and the presence of marine predators (London et al. 2012).

Harbor seals mate at sea and females in most areas give birth during the spring and summer. The Navy has documented harbor seal pupping at NAVBASE Kitsap Bangor, from June through August, with peak births occurring in July (Navy 2015a). This is earlier and shorter than described previously for Hood Canal. The pupping season for the Hood Canal population has been described inconsistently, extending anywhere from mid-July through January (Ferrero and Fowler 1992; Huber et al. 2001; Seekins 2009).

Harbor seals are opportunistic foragers, and their diverse diet varies by location and season (Lance and Jeffries 2006, 2007; Luxa 2008; Lance et al. 2012). Their diet in Puget Sound includes many prey species that are present in nearshore and deeper waters, including Pacific herring, Pacific hake, walleye pollock, shiner perch, Pacific sand lance, and adult and out-migrating juvenile salmonids. Analysis of scat samples indicates that Pacific hake, Pacific herring, and salmon species are the three major components of the harbor seal diet in Hood Canal (London 2006). Harbor seals in Hood Canal feed on returning adult salmon, including pink salmon during odd years and threatened summer-run chum, where the average percent escapement of summer-run chum consumed primarily by harbor seals over 5 years of study was 8 percent (London 2006).

OCCURRENCE OF HARBOR SEAL AT NAVBASE KITSAP BANGOR

Harbor seals have been observed swimming in the waters along NAVBASE Kitsap Bangor in every month of surveys conducted from 2007 to 2015 (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; HDR 2012; Hart Crowser 2013b; Navy 2015a). Harbor seals accounted for the vast majority of marine mammal sightings during the TPP and EHW-2 construction projects (HDR 2012; Hart Crowser 2013b). At the EHW-2 project site, harbor seals have been observed hauling out on floats/docks. Most documented occurrences of harbor seals hauling out along the Bangor waterfront were on pontoons of the PSBs and on manmade floating structures near KB Dock and Delta Pier. On two occasions, the group size was four to six individuals near Delta Pier. Harbor seals also have been observed hauled out on logs and manmade structures such as the floating security fences, wavescreen at Carderock Pier, buoys, barges, and marine vessels (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a).

The first documented birth at NAVBASE Kitsap Bangor was on August 5, 2011, when a harbor seal gave birth on the wavescreen dock at Carderock Pier, approximately 1,000 feet (300 meters) south of the SPE project site. Additional births have been documented at Bangor, but they were not located at the project sites. A harbor seal mother and pup were observed on August 13, 2012, on a dock next to the Magnetic Silencing Facility pier (over 1 mile [1.6 kilometers] north of the north LWI project site and almost 3 miles [4.8 kilometers] north of the SPE project site). Harbor seal afterbirth was found on a floating dock at the EHW-2 project site on August 1, 2013, approximately 0.35 mile (0.57 kilometer) from the north LWI site, and 1 mile (1.6 kilometers) from the south LWI site, and 1.5 miles (2.4 kilometers) north of the SPE project site. In addition, a few days prior on July 25, 2013, at the EHW-2 project site, a pregnant harbor seal hauled out on a workboat and subsequently died. This death was reported to NMFS in accordance with permit requirements.

OCCURRENCE OF HARBOR SEAL AT THE LWI PROJECT SITES

Harbor seals occur in all subtidal and deeper water areas along the Bangor waterfront, and have been observed swimming in the vicinity of the LWI project sites. There is no evidence of a preference for either of these sites. A few records exist of individual harbor seals hauled out primarily on manmade structures on the Bangor waterfront, but none of these records are in close proximity to the LWI project sites (Tannenbaum et al. 2009a, 2011a; Navy 2015a).

Occurrence of Harbor Seal at the SPE Project Site

In December 2013, a harbor seal was observed hauled out along the shoreline of NAVBASE Kitsap Bangor at Carlson Spit, just south of the Service Pier (Navy 2015a). A Navy worker anecdotally reported in late 2013 that for the last 13 years harbor seals have been pupping on concrete floats on the northeast side of Service Pier. This has not yet been documented by Navy biologists.

CALIFORNIA SEA LION

Range of California Sea Lion

The geographic distribution of California sea lions includes a breeding range from Baja California to southern California. The non-breeding distribution extends from Baja California north to Alaska for males, and encompasses waters of California and Baja California for females (Maniscalco et al. 2004; Reeves et al. 2008).

As many as 122 California sea lions have been observed hauled out on manmade structures (submarines, the floating PSB security fence, and barges) at NAVBASE Kitsap Bangor (Navy 2015a). California sea lions can be present year round, but are typically sighted from late August through June, with peak occurrence in the fall (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; HDR 2012; Hart Crowser 2013b; Navy 2015a).

Population Size

An estimated 3,000 to 5,000 California sea lions migrate to Washington and British Columbia waters during the non-breeding season from September to May (Jeffries et al. 2000).

Behavior and Ecology

California sea lions use a variety of haul-out substrates, from rocky outcrops to beaches, as well as manmade structures such as navigational buoys (Jeffries et al. 2000), and likely forage in both nearshore marine and inside marine deeper water habitats. Like harbor seals, California sea lions are opportunistic foragers whose diet varies by season and location. In the greater Puget Sound region, California sea lions primarily prey on Pacific hake and Pacific herring (London 2006). In some locations where sea lions and salmon runs co-exist, California sea lions also feed on returning adult and out-migrating juvenile salmonids (review in London 2006).

Occurrence of California Sea Lion at the LWI Project Sites

California sea lions have been observed swimming in the vicinity of the LWI project sites, although there is no evidence of any preference for either of these sites. They haul out on submarines at Delta Pier, which is approximately 1 mile (1.6 kilometers) from the north LWI project site and 1,000 feet (300 meters) from the south LWI project site, and also on pontoons of the floating security barrier (PSB).

OCCURRENCE OF CALIFORNIA SEA LION AT THE SPE PROJECT SITE

California sea lions have been observed swimming in the vicinity of the SPE project site, which is 0.9 mile (1.5 kilometers) from their haul-out site at Delta Pier.

HARBOR PORPOISE

RANGE OF HARBOR PORPOISE

The harbor porpoise is a coastal species found in fjords, bays, estuaries, and harbors (Reeves et al. 2008), using nearshore marine and inside deeper water marine habitats. Along the Pacific coast, this species occurs from Monterey Bay, California, north to the Aleutian Islands and west to Japan (Reeves et al. 2008). Harbor porpoise are known to occur in Puget Sound year round (Osmek et al. 1996, 1998; Carretta et al. 2014), and they may occasionally occur in Hood Canal (Jeffries 2006, personal communication). Harbor porpoises have been observed in deeper water in the vicinity of NAVBASE Kitsap Bangor (Tannenbaum et al. 2011a; HDR 2012; Hart Crowser 2013b).

POPULATION SIZE

Surveys from 2002 and 2003 for the inside waters stock of harbor porpoise yielded a corrected abundance estimate of 10,682 individuals (Carretta et al. 2014). Osmek et al. (1998) suggested that harbor porpoise abundance in other inside waters of northern Washington and British Columbia (Strait of Juan de Fuca and San Juan Islands) has likely been stable (has not declined) over the past 5 years. A substantial decline in the abundance of harbor porpoise occurred in southern Puget Sound after the 1940s, and no harbor porpoises were sighted during surveys in 1991 and 1994 in southern Puget Sound (Osmek et al. 1995, 1996). Harbor porpoise observations in northern Hood Canal have increased in recent years (Calambokidis 2010, personal communication).

BEHAVIOR AND ECOLOGY

Harbor porpoises are usually seen in small groups of two to five animals. Little is known about their social behavior. Studies of this species in the Gulf of Maine showed that they mature at an earlier age, reproduce more frequently, and live for shorter periods than other toothed whales (Read and Hohn 1995). Females reach sexual maturity at 3 to 4 years and may give birth every year for several years in a row. Calves are born in late spring (Read 1990; Read and Hohn 1995). Dall's and harbor porpoises appear to hybridize relatively frequently in the Puget Sound area (Willis et al. 2004). Harbor porpoises can be opportunistic foragers but primarily consume schooling forage fish (Osmek et al. 1996; Bowen and Siniff 1999; Reeves et al. 2008). Along the coast of Washington, they primarily feed on Pacific herring (C*lupea pallasii*), market squid, and smelts (Gearin et al. 1994).

OCCURRENCE OF HARBOR PORPOISE AT THE LWI PROJECT SITES

Harbor porpoise have not been detected at the LWI project sites.

OCCURRENCE OF HARBOR PORPOISE AT THE SPE PROJECT SITE

Harbor porpoise have not been detected at the SPE project site.

TRANSIENT KILLER WHALE

SPECIES RANGE

The geographical range of the West Coast stock of transient killer whales includes the northeast Pacific from California to southeastern Alaska (Allen and Angliss 2014). This stock spends most of its time along the outer coast, but they also enter inside marine waters of Washington and British Columbia. Transient killer whale occurrences in inside marine waters have increased between 1987 and 2010, possibly because the abundance of some prey species (seals, sea lions, and porpoises) has increased (Houghton et al. 2015). Transient killer whales were observed in Hood Canal in 2003 and 2005, but prior to these occurrences, transients were rarely seen in Hood Canal. The 2003 occurrence consisted of 11 killer whales seen for 59 days between January and March, and the 2005 event consisted of 6 killer whales seen for 172 days between January and June (London 2006).

POPULATION SIZE

Preliminary analysis of photographic data has identified 521 individual transient killer whales in the West Coast stock (Allen and Angliss 2014). However, the subpopulation most likely to occur in the inside waters of southeastern Alaska, British Columbia, and Washington is smaller. A mark-recapture estimates the West Coast stock in 2006 that excluded a poorly known "outer coast" subpopulation and whales from California is 243 individuals (95 percent probability interval = 180–339) (Allen and Angliss 2014). The number in Washington waters at any given time is probably fewer than 20 individuals (Wiles 2004).

BEHAVIOR AND ECOLOGY

Transient killer whales feed on marine mammals and some seabirds, but they apparently do not consume fish, unlike Southern Resident killer whales (Morton 1990; Baird and Dill 1996; Ford et al. 1998, 2005; Ford and Ellis 1999). While present in Hood Canal, transient killer whales prey on harbor seals in the subtidal zone of the nearshore marine and marine deeper water habitats (London 2006). Other observations of foraging transient killer whales indicate that they prefer to forage for pinnipeds in shallow, protected waters (Heimlich-Boran 1988; Saulitis et al. 2000).

OCCURRENCE OF TRANSIENT KILLER WHALE AT THE LWI PROJECT SITES

Transient killer whales have not been detected at the LWI project sites.

OCCURRENCE OF TRANSIENT KILLER WHALE AT THE SPE PROJECT SITE

Transient killer whales have not been detected at the SPE project site.

3.4.1.2. HEARING AND UNDERWATER SOUND

Marine mammals produce sounds that are linked to their peak hearing capabilities in order to interact with one another, but their hearing sensitivity extends beyond that peak range to allow them to detect acoustic cues from their environment (Ketten 2004). They use sound to navigate in limited visibility conditions, detect prey, and detect and respond to predators. Manmade sound in the marine environment that is in excess of certain levels can affect marine mammals behaviorally and physiologically. Measurements of marine mammal vocalizations and hearing capabilities provide some basis for assessing whether exposure to a particular sound source may impact the ability of these species to function in their environment. Specifically, noise level (dB) and frequency (Hz) can affect the susceptibility of marine mammals to underwater sound. Sound frequency bands relevant to marine mammal species are based on measured or estimated hearing ranges (Southall et al. 2007) as well as vocalizations. The following sections summarize information available for the species that have been identified as occurring in Hood Canal.

3.4.1.2.1. MARINE MAMMAL VOCALIZATIONS AND HEARING

Table 3.4–4 summarizes sound production and hearing capabilities for marine mammal species in the project area. The estimated auditory bandwidth is the lower to upper frequency hearing cut-off. The bandwidth of best hearing sensitivity is the portion of this range with lowest hearing thresholds measured in laboratory studies. Direct measurement of hearing sensitivity under laboratory conditions exists for approximately 20 of the nearly 130 species of marine mammals (Southall et al. 2007), including smaller toothed whales such as dolphins and porpoises, killer whales, and pinnipeds. Hearing sensitivity of larger whales has been modeled based on ear anatomy obtained from stranded animals or inferred from vocalizations and responses to sound in their environment (Ketten 1998; Parks et al. 2007). Species differ in absolute sensitivity and the frequency range of best hearing sensitivity. In general, marine mammals are arranged into the following functional hearing groups based on their generalized hearing sensitivities: high-, mid- and low-frequency cetaceans, phocid pinnipeds (true seals), and otariid pinnipeds (sea lions and fur seals) (Southall et al. 2007; NOAA 2015).

PINNIPEDS

Pinnipeds are amphibious, meaning that all foraging activity takes place in the water, but offspring are born on land at coastal rookeries (Mulsow and Reichmuth 2008). Thus, underwater and in-air frequency ranges for hearing and vocalizations are relevant to these species. On land, territorial male Steller sea lions regularly use loud, relatively low-frequency calls/roars to establish breeding territories (Schusterman et al. 1970; Loughlin et al. 1987). Individually distinct vocalizations exchanged between mothers and pups are thought to be the main way in which mothers reunite with their pups after returning to crowded rookeries following foraging at sea (Mulsow and Reichmuth 2008). On land, California sea lions make raucous barking sounds, with most of the sound energy occurring at less than 2 kilohertz (kHz) (Schusterman 1974). As amphibious mammals, pinniped hearing differs in air and in water (Kastak and Schusterman 1998), and separate auditory ranges have been measured in each medium. Phocid species have demonstrated an extended underwater frequency range of hearing, especially in the higher frequencies (Hemilä et al. 2006; Kastelein et al. 2009; Reichmuth et al. 2013), compared to the otariid species. Phocid ears have anatomical features that appear to adapt them better to hearing underwater than otariids (Hemilä et al. 2006). Harbor seals hear almost equally as well in air as underwater and have lower underwater sound detection thresholds at lower frequencies (below 64 kHz) than California sea lions (Kastak and Schusterman 1998). This difference is thought to make harbor seals more vulnerable to low-frequency manmade sounds such as ships and oil platforms.

Table 3.4–4. Hearing and Vocalization Ranges for Marine Mammal Functional Hearing Groups and Species Potentially within the Project Area

Functional Hearing Group[1]	Functional Hearing Group – Estimated Auditory Bandwidth[1]	Species Represented in Project Area	Vocalization Dominant Frequencies (citation)	Best Hearing Sensitivity Range (citation)
High-Frequency Cetaceans	200 Hz to 180 kHz[1]	Harbor Porpoise	120 to 140 kHz (pulses; Tyack and Clark 2000; Hansen et al. 2008); 110 to 150 kHz (Ketten 1998)	16 to 140 kHz (bimodal; reduced sensitivity at 64 kHz; maximum sensitivity 100 to 140 kHz; Kastelein et al. 2002)
Mid-Frequency Cetaceans	150Hz to 160 kHz[1]	Killer Whale	1.5 to 6 kHz (pulses; Richardson et al. 1995) 35 to 50 kHz (echolocation; Au et al. 2004) 6 to 12 kHz (whistles; Richardson et al.1995)	18 to 42 kHz (Szymanski et al. 1999)
Low-Frequency Cetaceans	7 Hz to 25 kHz[2,3]	Humpback Whale	200 Hz to 24 kHz (Au et al. 2006)	
Phocid Pinnipeds (true seals)	In-water: 75 Hz to 100 kHz[2] In-air: 75 Hz to 30 kHz	Harbor Seal	In-water: 250 Hz to 4 kHz (males-grunts, growls, roars; Hanggi and Schusterman 1994) In-air: 100 Hz to 1 kHz (males-snorts, grunts, growls; Richardson et al. 1995)	In-water: 1 to 50 kHz (Southall et al. 2007) In-air: 6 to 16 kHz (Richardson et al. 1995; Wolski et al. 2003)
Otariid Pinnipeds (sea lions)	In-water: 100 Hz to 48 kHz[2] In-air: 50 Hz to 75 kHz[4]	Steller Sea Lion	In-water: <1 kHz (male-pulses; Schusterman et al. 1970) In-air: 150 Hz to 1 kHz (females; Campbell et al. 2002)	In-water: 1 to 16 kHz (male; Kastelein et al. 2005) 16 to 25 kHz (female; Kastelein et al. 2005) In-air: 5 to 14 kHz (Schusterman 1974; Mulsow & Reichmuth 2008; Mulsow & Reichmuth 2010)
		California Sea Lion	In-water: 500 Hz to 4 kHz (clicks, pulses, and barks; Schusterman et al. 1966, 1967; Schusterman & Balliet 1969) In-air: 250 to 5 kHz (barks; Schusterman 1974)	In-water: 1 to 28 kHz (Schusterman et al. 1972) In-air: 4 to 16 kHz (Mulsow et al. 2011a,b)

Hz = Hertz; kHz = kilohertz

1. Source: Southall et al. 2007
2. Source: NOAA 2015.
3. Estimated hearing range for low-frequency cetaceans is based on behavioral studies, recorded vocalizations, and inner ear morphology measurements. No direct measurements of hearing ability have been successfully completed.
4. Source: Mulsow and Reichmuth 2010

KILLER WHALE

Killer whales produce several types of underwater sounds, including: (1) clicks used for echolocation, (2) highly variable whistles produced while whales socialize, and (3) pulsed signals generated at high repetition rates (Ford 1987). Both behavioral and auditory brainstem response measurements indicate they can hear in a frequency range of 1 to 100 kHz and are most sensitive at 20 kHz. This is one of the lowest maximum-sensitivity frequencies known among toothed whales (Szymanski et al. 1999).

Killer whales are “mid-frequency” cetaceans; that is, their echolocation signals use a frequency range that is somewhat lower than some of the other toothed whales, such as harbor porpoise. Social signals generally involve a lower frequency range. The most abundant and characteristic sound type produced by killer whales is pulsed signals, which are highly repetitive and fall into distinctive structural categories (Ford 1987). These are referred to as discrete calls, and one of their potential functions may be to help whales maintain contact while they are out of sight of each other (Ford and Ellis 1999).

The discrete call repertoire of Pacific Northwest transients is smaller than that of resident whales, with only four to six calls, none of which is used by resident whales. Moreover, transients are far quieter than residents when foraging, suggesting that transients must remain relatively silent to avoid alerting their prey because marine mammals such as pinnipeds are highly sensitive to sounds in the frequency range of sonar clicks (Barrett-Lennard et al. 1996).

HARBOR PORPOISE

The harbor porpoise is a “high-frequency” cetacean, meaning that the species uses high-frequency sounds for echolocation and lower frequency signals for social interactions (Southall et al. 2007). Its auditory range includes very high frequencies (estimated auditory bandwidth for the high-frequency category is 200 Hz to 180 kHz) (Southall et al. 2007).

3.4.1.2.2. SUSCEPTIBILITY OF MARINE MAMMALS TO UNDERWATER SOUND

PHYSIOLOGICAL IMPACTS OF SOUND

Marine mammals are susceptible to physiological impacts from noise exposure including temporary or permanent loss of hearing sensitivity or other physical injuries (Ketten 1995, 2000, 2004; Wartzok and Ketten 1999). Injury could consist of permanent hearing loss, referred to as permanent threshold shift (PTS), or other tissue damage. This type of injury has not been documented for pile driving or other construction-related noises because it is not feasible to measure pre- and post-exposure audiograms of individuals at construction sites. Temporary loss of hearing sensitivity, referred to as temporary threshold shift (TTS), has been documented in controlled settings using captive marine mammals exposed to strong sound exposure levels at various frequencies (Ridgway et al. 1997; Kastak et al. 1999; Finneran et al. 2005), but it has not been documented in wild marine mammals exposed to pile driving. TTS is an undesirable outcome of noise exposure because it can potentially affect communication and/or the ability to detect predators or prey.

BEHAVIORAL RESPONSES TO SOUND

Behavioral responses to sound are highly variable and context specific. For each potential behavioral change, the magnitude of the change ultimately determines the severity of the response. A number of factors may influence an animal's response to noise, including its previous experience; auditory sensitivity; biological and social status, including age and sex and behavioral state and activity at the time of exposure. Characteristics of the noise, such as duration and whether the sounds start suddenly or gradually, play a role in determining the animal's response. Indicators of disturbance may include sudden changes in the animal's behavior or avoidance of the affected area. A marine mammal may show signs that it is startled by the noise and/or it may swim away from the sound source and avoid the area. Behavioral changes such as increased swimming speed, increased surfacing time, and cessation of foraging in the affected area would indicate disturbance or discomfort.

Controlled experiments with captive marine mammals showed pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway et al. 1997; Finneran et al. 2003). Observed responses of wild marine mammals to loud sound sources (typically seismic guns or acoustic harassment devices) have been varied, but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds 2002; also see reviews in Gordon et al. 2004; Wartzok et al. 2003/2004; and Nowacek et al. 2007). However, some studies of acoustic harassment and acoustic deterrence devices have found habituation in resident populations of seals and harbor porpoises (see review in Southall et al. 2007; Blackwell et al. 2004).

Studies of marine mammal responses to continuous noise, such as vibratory pile installation, are limited. Marine mammal observers did not detect adverse reactions to the Test Pile Program (TPP) project or to the first year of EHW-2 construction at NAVBASE Kitsap Bangor (HDR 2012; Hart Crowser 2013b). During the TPP project, pinnipeds were more likely to dive and sink when closer to pile driving activity, and a greater variety of other behaviors were observed with increasing distance from pile driving (HDR 2012). Harbor seals observed during the EHW-2 project were equally likely to swim, dive, or sink as their ultimate behavior if they were inside the buffer zone and most likely to dive if they were outside the Waterfront Restricted Area (WRA) (Hart Crowser 2013b). Relatively few observations of cetacean behaviors were obtained during pile driving for both projects, and all were outside the WRA. Most harbor porpoises were observed swimming or traveling through the project area and no obvious behavioral changes were associated with pile driving.

A comprehensive review by Nowacek et al. (2007) of acoustic and behavioral responses to noise exposure concluded that displacement is one of the most common behavioral responses. To assess the significance of displacements, it is necessary to know the areas to which the animals relocate, the quality of that habitat, and the duration of the displacement in the event that they return to the pre-disturbance area. Short-term displacement may not be of great concern unless the disturbance happens repeatedly. Similarly, long-term displacement may not be of concern if adequate replacement habitat is available.

3.4.1.2.3. SUSCEPTIBILITY OF MARINE MAMMALS TO AIRBORNE SOUND

Exposure to airborne sound is primarily a concern for pinnipeds that are hauled out or swimming or resting with their ears out of the water. Airborne sound does not readily penetrate the air/water interface (Richardson et al. 1995) and is less significant for cetaceans. In general, pinnipeds are less sensitive to airborne sound than are most terrestrial carnivores and less sensitive to underwater sound than strictly aquatic mammals (e.g., cetaceans), within the range of best sensitivity (Kastak and Schusterman 1998). Pinniped hearing represents a compromise between aerial and aquatic adaptations, but the extent of adaptation for underwater hearing varies among pinniped families. California sea lions (members of the Otariidae, or eared seal family) appear to be better adapted to in-air hearing than underwater hearing, in comparison to harbor seals (members of the Phocidae, or hair seal family) which are better adapted to hearing underwater (Richardson et al. 1995; Kastak and Schusterman 1998). Within the range 100 Hz to 1.6 kHz, harbor seals hear nearly as well in air as underwater and have lower thresholds (i.e., greater sensitivity) than California sea lions (Kastak and Schusterman 1998). In air, harbor seals are most sensitive to frequencies between 6 and 16 kHz (Richardson et al. 1995; Terhune and Turnbull 1995; Wolski et al. 2003), but have functional hearing between 100 Hz and 30 kHz (Richardson et al. 1995; Kastak and Schusterman 1998). Thus, construction noise such as pile driving is well within the low-frequency range for this species. California sea lions are most sensitive at frequencies between 2 and 16 kHz (Schusterman 1974), and thus have functional hearing that includes lower-frequency construction noise (Kastak and Schusterman 1998).

A general discussion of behavioral responses to noise is provided in Section 3.4.1.2.2. Monitoring studies of hauled-out marine mammals near construction sites have generally reported negative results with respect to airborne sound (i.e., no apparent behavioral harassment), possibly because of habituation and the distances between the construction and the haul-out sites. Blackwell et al. (2004) reported that ringed seals hauled out as close as 1,640 feet (500 meters) to pile driving showed no adverse reaction. The marine mammal monitoring reports for the San Francisco–Oakland Bay Bridge East Span Seismic Safety Project (CALTRANS 2001, 2006, 2010) indicated that pile driving noise at the Yerba Buena Island harbor seal haul-out site, located from 2,953 feet (900 meters) to 4,920 feet (1,500 meters) from the pile driving barges, did not appear to elicit reactions from the seals.

3.4.1.3. CURRENT REQUIREMENTS AND PRACTICES

ENDANGERED SPECIES ACT

The ESA (16 USC 1531 et seq.) protects fish, wildlife, and plant species that are listed as threatened or endangered in the United States or elsewhere. Provisions are made for listing species, as well as for recovery plans and the designation of critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking or approving actions that may jeopardize listed species. The ESA also protects the designated critical habitat of listed species from adverse modification or destruction. NMFS is authorized to oversee compliance with the ESA for federally listed marine mammals. The LWI and SPE projects could indirectly affect humpback whales and Southern Resident killer whales because of effects on their prey base. The Navy prepared a biological assessment and requested informal consultation with NMFS (West Coast Region Office) regarding humpback whales and Southern resident killer whales under the ESA because the preferred alternative would not be likely to affect these listed species. As part of informal consultation, NMFS issued a Letter of Concurrence with this finding for the LWI project and requested formal ESA consultation for the SPE project (for potential effects on ESA-listed fish species).

MARINE MAMMAL PROTECTION ACT

The Marine Mammal Protection Act (MMPA) (16 USC 1361 et seq., as amended) places a moratorium on the taking and importation of all marine mammal species in the project area, with provisions for allowing incidental take and other regulated takings. NMFSHQ administers the MMPA for all 10 of the species of cetaceans, seals, and sea lions that occur in the vicinity of the LWI and SPE project sites. An Incidental Harassment Authorization (IHA) or Letter of Authorization (LOA) may be issued for projects involving taking of marine mammals due to harassment. Except with respect to certain activities not pertinent here, the MMPA defines "harassment" as any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment) (50 CFR, Part 216 Subpart A, Section 216.3-Definitions). The Navy has submitted an IHA application to NMFS HQ for Level B harassment due to construction of the SPE. The Navy did not request an IHA for construction of the LWI preferred alternative because it does not entail in-water pile driving and is not expected to result in harassment of marine mammals as defined by the MMPA.

Underwater Sound Injury and Behavioral Harassment Thresholds

Since 1997, NMFS has used generic sound exposure thresholds to determine when an activity in the ocean that produces sound might harm a marine mammal (70 FR 1871). These thresholds are used to determine compliance with the MMPA (16 USC 1362 Sec. 3 (13)) and the ESA (16 USC 1531 et seq.), although the effects determinations and language used to report exposure to harmful noise levels are different for the two statutes. The MMPA imposes a moratorium on the taking of marine mammals, where "take" means to harass, among other actions. The MMPA defines two levels of harassment, each of which has been assigned a noise exposure threshold. Injury-level thresholds apply in situations where the noise "has the potential to injure a marine mammal or marine mammal stock in the wild" (Level A harassment) (16 USC 1362 Sec. 3 (18)(A)(i)). Behavioral disturbance (harassment) thresholds are applied in situations where the noise "has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering" (Level B harassment) (16 USC 1362 Sec. 3 (18)(A)(ii)). The Navy submitted an application for an IHA for SPE in November 2014, updated in June 2015, from NMFSHQ under the MMPA [Sec. 101(a)(5)(D)], listing the estimated number of marine mammals exposed to harassment incidental to construction of the project.

Airborne Sound Behavioral Harassment Thresholds

As described above for *Underwater Sound Injury and Behavioral Harassment Thresholds*, NMFS has used generic sound exposure thresholds to determine when an activity in the ocean that produces sound might result in impacts such as injury to a marine mammal (70 FR 1871). NMFS has identified behavioral harassment threshold criteria for airborne noise generated by pile driving for pinnipeds regulated under the MMPA. Injury threshold criteria for airborne noise have not been established. The behavioral harassment threshold for harbor seals is 90 dB RMS (unweighted) and for all other pinnipeds is 100 dB RMS (unweighted).

3.4.2. Environmental Consequences

3.4.2.1. APPROACH TO ANALYSIS

The evaluation of impacts on marine mammals considers the importance of the resource (i.e., legal, recreational, ecological, or scientific); the proportion of the resource affected relative to its occurrence in the region; the particular sensitivity of the resource to project activities; and the duration of environmental impacts or disruption. Impacts on resources would be critical if any of the following conditions apply:

- Habitats of high concern are adversely affected over relatively large areas;
- Disturbances to small, essential habitats would lead to regional impacts on a protected species; or
- Disturbances harass or impact the ability of species to acquire resources and ultimately impact the abundance or distribution of federally listed threatened or endangered species.

The analysis of impacts on marine mammals addresses construction and operational impacts on behavior, habitat, movement, and prey base for the eight species described in Section 3.4.1.1. Direct effects causing behavioral disturbance or injury and effects of permanent habitat loss are concerns, as is continued or progressive habitat degradation.

The primary impacts on marine mammals from construction of the LWI and SPE would be associated with water quality changes (turbidity) in nearshore habitats, noise associated with impact and vibratory pile driving, construction vessel traffic, and changes in prey availability. In particular, underwater pile driving noise during the construction period has the potential to disrupt marine mammal foraging, resting, and transit in the vicinity of the LWI and SPE project sites. The zones of impact due to construction noise are described in following sections. Pile driving would exceed some of the underwater noise thresholds for marine mammals established by NMFS for behavioral harassment and injury, and result in the greatest potential for adverse impacts on marine mammals. Construction impacts on marine mammals are anticipated to be temporary and highly localized to the construction area, as discussed below in detail for each project alternative, with the exception of impacts due to vibratory pile driving noise, which would extend over a large area as described in Sections 3.4.2 and 3.4.3.

Long-term operation of the LWI and SPE would include the presence of in-water barriers in areas that currently do not have in-water barriers. Marine mammals are highly mobile and would be able to swim around the nearshore (LWI) barriers and the deeper water SPE. However, these barriers may affect the migratory pathways and distribution of some fish populations that are preyed upon by marine mammals, as described in Section 3.3.2.2.

3.4.2.2. LWI PROJECT ALTERNATIVES

3.4.2.2.1. LWI ALTERNATIVE 1: NO ACTION

There would be no activities related to construction or operations that would disturb marine mammals in the project area under the No Action Alternative. Therefore, this alternative would have no impacts on marine mammals.

3.4.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

Construction of the LWI would directly impact marine mammals primarily through underwater noise generated by pile driving. Underwater noise thresholds for behavioral disturbance would be exceeded, as described below, with potential adverse impacts (takes) as defined by the MMPA. Project-related changes in water quality, vessel traffic, and prey availability may also affect marine mammals indirectly or directly.

Long-term indirect impacts would result from localized changes in benthic prey population composition (Section 3.2) and marine fish populations (Section 3.3). The primary impacts on marine fish from operation of LWI Alternative 2 would include an increase of physical barriers in the nearshore environment, alteration of nearshore habitats including some reduction in natural refugia, some reduction in prey availability, a potential reduction in the forage fish community, and a decrease in nearshore aquatic vegetation.

Impacts on marine mammals from operation of this alternative are anticipated to be highly localized because marine mammals are wide-ranging and have a large foraging habitat available in Hood Canal, relative to the foraging area that might be impacted by operation of the LWI.

CONSTRUCTION OF LWI ALTERNATIVE 2

The primary impacts on marine mammals from construction of the LWI would be associated with water quality changes (turbidity) in nearshore habitats, noise associated with impact and vibratory pile driving and other construction equipment, construction vessel traffic, and changes in prey availability. Since harbor seals are resident in Hood Canal, they would be present during the entire proposed construction season for the LWI (August 2016 through January 15, 2017). California sea lions, harbor porpoises and transient killer whales also may occur at any time during the year. Steller sea lions are present during fall and winter months (about 4 months out of the 6 months of in-water construction work). Marine mammals are likely to avoid (indicating behavioral disturbance) the vicinity of pile driving. The likelihood of adverse impacts on these species would be minimized through application of mitigation measures described in the Mitigation Action Plan (Appendix C).

The following sections describe how each of these factors would impact abundance and distribution of marine mammals present or potentially present on NAVBASE Kitsap Bangor during construction.

WATER QUALITY

Construction of the LWI would affect water quality in the project area due to installation of piles and steel plate anchors for the mesh barrier, anchoring of barges and tugs, relocation of PSB buoys, and work vessel movements, as discussed in Section 3.1.2.2.2. Water quality would be impacted during tug and barge operations and installation of piles, because bottom sediments would be temporarily resuspended and spread up to approximately 100 feet (30 meters). A maximum of 13.1 acres (5.3 hectares) of benthic habitat may be temporarily disturbed within the construction footprint. Resuspended sediments would increase turbidity periodically during in-water construction activities, but turbidity is expected to be localized (within the 100-foot construction corridor) and temporary during the course of project construction. Metals and organic contaminants that may be present in sediments could also become suspended in the water column in the construction impact zone, but these contaminants are within sediment quality guidelines, as discussed in Section 3.1.1.1.3. Water quality could also be impacted by stormwater discharges (contaminant loading), and spills (contaminant releases). However, construction-period conditions are not expected to exceed water quality standards, and measures for the protection of marine water quality and the seafloor would be implemented to minimize impacts (Mitigation Action Plan, Appendix C). Marine mammals are expected to avoid the immediate construction area due to increased vessel traffic, noise and human activity, increased turbidity, and potential difficulty in finding prey. Because suspended sediment and contaminant concentrations would be low, and exposures would be localized, no impacts on marine mammals are expected due to changes in water quality during construction. Considering the wide distribution of marine mammals in inland marine waters, water quality changes due to LWI Alternative 2 would not significantly affect these populations or overall distribution.

VESSEL TRAFFIC

Vessel movements have the potential to affect marine mammals directly by accidentally striking or disturbing individual animals. For example, several studies have linked vessels with behavioral changes in killer whales in Pacific Northwest inside waters (Kruse 1991; Kriete 2002; Williams et al. 2002; Bain et al. 2006), although it is not well understood whether the presence and activity of the vessel, the vessel noise, or a combination of these factors produces the changes. It seems likely that both noise and visual presence of vessels play a role in prompting reactions from these animals. The probability and significance of vessel and marine mammal interactions is dependent on several factors including numbers, types, and speeds of vessels; the regularity, duration, and spatial extent of activities; and the presence/absence and density of marine mammals.

Behavioral changes in response to vessel presence include avoidance reactions, alarm/startle responses, temporary abandonment of haul-outs by pinnipeds, and other behavioral and stress-related changes (e.g., altered swimming speed, direction of travel, resting behavior, vocalizations, diving activity, and respiration rate) (Watkins 1986; Würsig et al. 1998; Terhune and Verboom 1999; Ng and Leung 2003; Foote et al. 2004; Mocklin 2005; Bejder et al. 2006; Nowacek et al. 2007). In other cases neutral behavior (i.e., no obvious avoidance or attraction) has been reported (review in Nowacek et al. 2007). Little is known about the biological importance of changes in marine mammal behavior under prolonged or repeated exposure to high levels of vessel traffic, such as increased energetic expenditure or chronic stress, which can produce adverse hormonal or nervous system effects (Reeder and Kramer 2005).

Marine mammals on NAVBASE Kitsap Bangor encounter vessel traffic associated with daily operations, maintenance, and security monitoring along the waterfront, and it is assumed that individuals frequenting the waterfront have habituated to existing levels of vessel activity. During construction of the LWI, several additional vessels would operate in the project area, including one barge with a crane, one supply barge, a tug boat, and work skiffs. Construction activity involving vessel traffic may occur over 24 months, but the greatest activity levels would be associated with pile driving (up to 80 days during one in-water work season). Approximately 16 total transits of barges and tugs are expected for the duration of the project (Table 2–1). These vessels would operate at low speeds within the relatively limited construction zone and access routes during the in-water construction period. Low speeds are expected to reduce the impact of boat movements in the construction zone during this period. Marine vessel traffic would potentially pass near marine mammals on an incidental basis, but short-term behavioral reactions to vessels are not expected to result in long-term impacts on individuals, such as chronic stress, or to marine mammal populations in Hood Canal.

Collisions of vessels and marine mammals, primarily cetaceans, are not expected during construction because vessel speeds would be low. All of the cetaceans likely to be present in the project area are fast-moving odontocete species that tend to surface at relatively short, regular intervals allowing for increased detectability and avoidance of vessels. Vessel impacts are more frequently documented in relation to slower-moving cetaceans or those that spend extended periods of time at the surface, but these species are rarely encountered in Hood Canal.

PREY AVAILABILITY

The prey base for the most common marine mammal species (harbor seal and California sea lion) in the project area potentially includes a wide variety of fishes including Pacific hake, forage fish such as Pacific herring, adult and juvenile salmonids, flatfish, and other finfish. Steller sea lions in the project area probably also consume a variety of pelagic and bottom fish. Harbor porpoise are also occasionally seen in Hood Canal, where they probably feed on schooling forage fishes, such as Pacific herring, smelt, and squid. Transient killer whales consume marine mammals; in Hood Canal they preyed on harbor seals during prolonged stays in 2003 and 2005 (London 2006). Southern Resident killer whales do not occur in Hood Canal, but consume adult salmonids (with strong preferences for Chinook salmon and chum salmon [Hanson et al 2010a,b]) that may originate in Hood Canal tributaries.

As described in Section 3.3.1.1, fish species and groups that occur in the LWI project area include forage fish (Pacific sand lance, surf smelt, Pacific herring) and salmonids (yearling Chinook salmon, coho salmon, and steelhead; summer-run chum salmon; and cutthroat trout) (Bhuthimethee et al. 2009). As described in Section 3.2.1.1, a number of benthic invertebrate species are abundant and diverse at both LWI project sites. These nearshore resources offer suitable prey for some of the marine mammals that have been documented in Hood Canal and the Bangor waterfront, but available information is not sufficiently detailed to support a comparison of these sites with other known or potential foraging sites in inland waters.

Impacts on prey availability for fish-eating marine mammals due to construction activities are discussed in detail for marine fish (Section 3.3.2.2.2). Some of the prey species, including forage fish and juvenile salmonids are considered more vulnerable to project impacts than deeper-water species such as adult salmonids and Pacific hake. The greatest impacts on prey species during construction would result from nearshore benthic habitat displacement and degradation (13.1 acres [5.3 hectares]) (Table 3.2-8), resuspension of sediments, localized turbidity, physical barriers to fish migration in nearshore waters, and behavioral disturbance due to pile driving noise. Anchoring of construction barges, propeller wash, pile driving, mesh installation, and installation of anchor plates would locally displace or disturb nearshore benthic habitats and increase turbidity, while the presence of barges and construction of decking would shade benthic habitat and marine vegetation in the immediate project vicinity. All of these actions would indirectly affect marine mammals by degrading foraging and refuge habitat quality for prey species, and thereby reducing their availability to predators. Mitigation efforts, including scheduling in-water pile driving for the period when most juvenile Chinook and chum salmon are not present, as described in Section 3.3.2.2.2, and protection of water and seafloor quality, as described in Section 3.1.1.2.3, would minimize these potential adverse effects on the prey base.

Injury and behavioral disturbance of fish species due to underwater pile driving noise would directly affect the prey base for marine mammals. Fish potentially would be disturbed by pile driving noise resulting from operation of vibratory and impact rigs within 7,068 feet (2,154 meters) of impact pile driving noise and 178 feet (54 meters) of vibratory pile installation (Section 3.3.2.2.2) but may actually avoid a much smaller area. Thus, prey availability within an undetermined portion of the impact zone for fish would be reduced during construction due to noise. Mitigation measures designed to minimize noise effects on fish are described in the Mitigation Action Plan (Appendix C).

Some of the effects described above, such as barge placement, increased turbidity, and pile driving noise, would occur only during the in-water construction period and thus would be temporary (up to 6 months in each of two in-water work seasons), and localized within the fish behavioral disturbance zone. Mesh installation and relocation of PSBs and anchors could occur for up to 24 months. Long-term effects on prey availability are described below under Operation/Long-term Impacts. While effects of project construction may affect the prey base of pinnipeds that occur in the immediate project vicinity, in the overall context of the Hood Canal harbor seal and California sea lion population ranges the affected area is too small to represent a significant adverse impact on population numbers and distribution.

With respect to the ESA-listed Southern Resident killer whale, the project has the potential to affect this population by indirectly affecting its prey base, which includes a disproportionate number of adult Chinook and chum salmon (Ford et al. 1998, 2010; Hanson et al. 2010a,b). Available information on the proportion of Hood Canal Chinook salmon in the diet of Southern Resident killer whales indicates that it is about 20.4 percent in May (although this is based on a sample size of only nine), but it is less than 5 percent in other months (June to September) for which data are available. The stock identification of chum salmon in Southern Resident killer whale diets has not been reported and therefore the importance of Hood Canal chum salmon is not known. Adult Hood Canal Chinook and chum salmon returns are subject to many variables, among which the effects of LWI are likely to be minor. Mitigation efforts, including scheduling in-water construction for the period when juvenile Chinook and chum salmon are not present and using a bubble curtain for impact pile driving would minimize this potential adverse effect. Alternative 2 may indirectly affect Southern Resident killer whales through their prey populations, but the project's effect on the species' prey base would be minimal. Therefore, the ESA effect determination for construction activities under LWI Alternative 2 is "may affect, not likely to adversely affect" Southern Resident killer whales. The project would have no effect on critical habitat for Southern Resident killer whales because no critical habitat has been designated in Hood Canal.

UNDERWATER NOISE

Average underwater noise levels measured along the Bangor waterfront are elevated over ambient conditions at undeveloped sites due to waterfront operations, but are within the minimum and maximum range of measurements taken at similar environments within Puget Sound (see Appendix D). In 2009, the average broadband ambient underwater noise levels were measured at 114 dB re 1 μPa between 100 Hz and 20 kHz (Slater 2009). Peak spectral noise from industrial activity was noted below the 300 Hz frequency, with maximum levels of 110 dB re 1 μPa noted in the 125 Hz band. In the 300 Hz to 5 kHz range, average levels ranged between 83 and 99 dB re 1 μPa. Wind-driven wave noise dominated the background noise environment at approximately 5 kHz and above, and ambient noise levels flattened above 10 kHz. Underwater ambient noise measurements taken at EHW-1 (approximately 1,500 feet [450 meters] from the north LWI and 5,900 feet [1,800 meters] from the south LWI) during the TPP project in 2011, ranged from 112.4 dB re 1 μPa RMS between 50 Hz and 20 kHz at mid depth to 114.3 dB at deep depth (Illingworth & Rodkin 2012).

Increased vessel activity and barge-mounted construction equipment such as cranes and generators would elevate underwater noise levels in the project. Noise from tugs associated with barge movement would produce intermittent noise levels of approximately 142 dB re 1 μPa at 33 feet (10 meters). Except at very close range, these noise sources and noise from other vessels and equipment would not exceed the marine mammal thresholds for disturbance due to impact sound (160 dB RMS). These noise levels are typical of an industrial waterfront where tugs, barges, and other vessels are in operation, and consistent with noise levels experienced daily by marine mammals under existing conditions in the vicinity of the Bangor waterfront. Vessel noise includes narrowband tones at specific frequencies and broadband sounds, with energy spread over a range of frequencies that are audible to marine mammals. Smaller vessels that would be used in construction tend to generate low-frequency noise below 5 kHz; for example, tugs operating barges generate sounds from 1 kHz to 5 kHz, and small crewboats generate strong tones up to several hundred hertz (Richardson et al. 1995).

Underwater noise associated with pile driving activities is likely to cause the most significant impacts on marine mammals present during construction of the LWI. Detailed analyses of pile driving noise propagation and pile driving source levels are presented in Appendices D and H, along with a discussion of the use of a bubble curtain to attenuate impact pile driving noise. The LWI north pier would require installation of up to 54 permanent hollow steel piles, 24 inches (60 centimeters) in diameter. The LWI south pier would require up to 82 piles of the same type. The abutment piles would be installed in the dry during low tides and would not generate underwater noise. Approximately 120 hollow, 24-inch steel piles would be installed temporarily during the construction phase and then would be removed. It is expected that up to four piles would be installed per day and the total number of pile driving days would be up to 80 days during a single in-water construction season that includes the period August through January 15. Most piles would be driven with a vibratory driver, and an impact hammer would be used to "proof" these piles. In cases where substrate conditions do not allow vibratory installation, an impact hammer may be needed to drive piles for part or all of their length.

Vibratory pile driving of 24-inch (60-centimeter) steel piles would produce noise levels of approximately 161 dB RMS re 1 µPa at 33 feet (10 meters) from the pile. As described in Appendix D, a bubble curtain would be used to reduce sound levels of impact pile driving of steel piles. Impact pile driving using a single-acting diesel impact hammer would produce average RMS noise levels of 185 dB RMS re 1 µPa at 33 feet while using a bubble curtain that reduces noise levels by 8 dB (Appendix H). Other mitigation measures include a soft-start approach for pile driving operations and marine mammal monitoring and shutdown zones during pile driving, as described in the Mitigation Action Plan (Appendix C). Most of the energy in pile driving sound underwater is contained in the frequency range 25 Hz and 1.6 kHz, with the highest energy densities between 50 and 350 Hz (Reyff et al. 2002). In some studies, underwater pile driving noise has been reported to range up to 10 kHz with peak amplitude below 600 Hz (Laughlin 2005).

Sound from impact pile driving would be detected above the average background noise levels at any location in Hood Canal with a direct acoustic path (i.e., line-of-sight from the driven pile to receiver location). Intervening land masses would block sound propagation outside of those paths.

Responses to Underwater Pile Driving Noise at the LWI Project Sites

Marine mammals encountering pile driving operations during the in-water construction season would likely avoid affected areas in which they experience noise-related discomfort, limiting their ability to forage or rest there. Individual responses to pile driving noise are expected to be variable; some individuals may occupy the project area during pile driving without apparent discomfort, but others may be displaced by undetermined long-term effects. Avoidance of the affected area during pile driving operations would reduce the likelihood of injury impacts but would reduce access to foraging areas in nearshore and deeper waters of Hood Canal. Noise-related disturbance across the 1.5-mile (2.4-kilometer) width of Hood Canal may inhibit some marine mammals from transiting the area. However, habituation may occur over time, along with a decrease in the severity of responses. Also, since pile driving would only occur during daylight hours, marine mammals transiting the project area or foraging or resting in the project area at night would not be affected. Any potential impacts from pile driving activities could be experienced by individual marine mammals, but would not cause population level impacts or affect the continued survival of the species.

Underwater Injury and Behavioral Harassment Thresholds

The following analysis of noise-related impacts on marine mammals provides calculations of incidental harassment exposures of all marine mammal species that occur in the LWI project area, as required by the MMPA. "Take" under the MMPA is calculated at two levels, injury exposure and behavioral harassment exposure, using the same threshold values for each level of noise exposure for each statute. The effects analysis uses the terms "injury exposure" and "behavioral harassment exposure" for MMPA effects and states the number of exposures that the Navy will request for each marine mammal species in its IHA application.

NMFS identified threshold criteria for determining injury exposure to underwater noise as 190 dB RMS re 1 µPa for pinnipeds and 180 dB RMS re 1 µPa for cetaceans (65 FR 16374-16379) (Table 3.4–5). Injury exposure criteria have been used by NMFS to define the impact zones for seismic surveys and impact hammer pile driving projects, within which project activities may be shut down if protected marine mammals are present (some examples are cited in 71 FR 4352, 71 FR 6041, 71 FR 3260, and 65 FR 16374). NMFS has identified different thresholds for exposure to behavioral harassment for impact pile driving (an impulsive noise impact) versus vibratory pile driving (a continuous noise impact). For both cetaceans and pinnipeds, the behavioral harassment threshold for impact pile driving is 160 dB RMS re 1 µPa, and the threshold for continuous noise such as vibratory pile driving is 120 dB RMS re 1 µPa.

NOAA (2015) updated draft acoustic threshold levels for determining the onset of PTS and TTS (permanent and temporary hearing threshold shifts) in marine mammals in response to underwater impulsive and non-impulsive sound sources. The draft criteria use cumulative SEL metrics (dB SEL_{CUM}) and peak pressure (dB peak) rather than the currently used dB RMS metric. NOAA equates the onset of PTS, which is a form of auditory injury, with Level A harassment under the MMPA and "harm" under the ESA. The onset of TTS would be a form of Level B harassment under the MMPA and "harassment" under the ESA. Both forms of harassment would constitute "take" under these statutes. The draft injury criteria are currently in public review and are expected to be finalized in late 2015. Revised behavioral harassment criteria not involving TTS (but resulting in Level B take) are currently in review. If the new injury criteria are adopted by NOAA prior to the completion of the Record of Decision (ROD) for the project, the noise effects analysis for marine mammals would be updated. Otherwise, the noise analysis would not be updated.

Under current underwater noise guidelines (Table 3.4–5) and with a properly functioning bubble curtain in place on the impact hammer rig, construction of the LWI pile-supported piers would likely result in noise-related injury to pinnipeds and cetaceans within 16 feet (5 meters) and 72 feet (22 meters) from a driven pile, respectively (Table 3.4–6). Injury exposure to intense underwater noise could consist of PTS or other tissue damage. However, marine mammals are unlikely to be injured by pile driving noise at these short distances because the high level of human activity and vessel traffic would cause avoidance of the immediate construction area. Cetaceans, in particular, are unlikely to swim this close to manmade structures. In addition, marine mammal monitoring and shutdown during construction (Mitigation Action Plan, Appendix C, Section 4.2) would prevent exposure to injury from pile driving noise.

Table 3.4–5. Current Marine Mammal Injury and Behavioral Harassment Thresholds for Underwater and Airborne Sounds

Marine Mammals	Airborne Marine Construction Thresholds (Impact and Vibratory Pile Driving) (dB re 20 μPa unweighted)	Underwater Vibratory Pile Driving[2] Threshold (dB re 1 μPa)		Underwater Impact Pile Driving[3] Thresholds (dB re 1 μPa)	
	Disturbance Guideline Threshold[1]	Injury Threshold	Behavioral Harassment Threshold	Injury Threshold	Behavioral Harassment Threshold
Cetaceans (whales, dolphins, porpoises)	N/A	180 dB RMS	120 dB RMS	180 dB RMS	160 dB RMS
Pinnipeds (seals, sea lions, except harbor seal)	100 dB RMS	190 dB RMS	120 dB RMS	190 dB RMS	160 dB RMS
Harbor seal	90 dB RMS	190 dB RMS	120 dB RMS	190 dB RMS	160 dB RMS

dB = decibel; μPa = micropascal; N/A = not applicable, no established threshold; RMS = root mean square

1. Sound level at which pinniped haul-out disturbance has been documented. Not an official threshold, but used as a guideline.
2. Non-pulsed, continuous sound.
3. Impulsive sound.

Table 3.4–6. Calculated Maximum Distance(s) to the Underwater Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Current Noise Thresholds, LWI Alternative 2

Affected Area	Impact Injury Pinnipeds (190 dB RMS)[1]	Impact Injury Cetaceans (180 dB RMS)[1]	Impact Behavioral Harassment Cetaceans & Pinnipeds (160 dB RMS)[1]	Vibratory Behavioral Harassment Cetaceans & Pinnipeds (120 dB RMS)[1, 2]
Distance to Threshold[1]	16 ft (5 m)	72 ft (22 m)	1,522 ft (464 m)	3.4 mi (5.4 km)
Area Encompassed by Threshold	850 sq ft (79 sq m)	16,372 sq ft (1,521 sq m)	0.2 sq mi (0.5 sq km)	11.0 sq mi (28.5 sq km)

dB = decibel; ft = feet; km = kilometer; m = meter; mi = mile; sq ft = square feet; sq km = square kilometer; sq m = square meter; sq mi = square mile; μPa = micropascal; RMS = root mean square

1. Bubble curtain assumed to achieve 8 dB reduction in sound pressure levels (or SPLs) during impact pile driving. Sound pressure levels used for calculations were 185 dB re 1 μPa at 33 feet (10 meters) for impact hammer with bubble curtain and 161 dB re 1 μPa for vibratory driver for 24-inch (60-centimeter), hollow steel pile. All sound levels are expressed in dB RMS re 1 μPa.
2. Calculated area is greater than actual sound propagation through Hood Canal due to intervening land masses. Thus, 3.4 miles (5.4 kilometers) is the greatest line-of-sight distance from pile driving locations unimpeded by land masses that would block further propagation of sound.

No physiological impacts are expected from pile driving operations occurring during construction of the LWI for the following reasons. First, vibratory pile driving, which would be the primary installation method, does not generate high enough peak sound pressure levels (or SPLs) to produce physiological damage. Assuming 45 pile strikes per minute, 5,000 strikes could be accomplished in less than 2 hours per day. Thus, under the worst-case scenario, marine mammals in the vicinity of the LWI project sites would experience elevated noise levels for only a portion of the day. Additionally, the bubble curtains that the Navy would employ during impact pile driving (Appendix D) would greatly reduce the chance that a marine mammal may be exposed to sound pressure levels that could cause physical harm. During impact pile driving, the Navy would employ a bubble curtain to attenuate initial sound pressure level. Moreover, the Navy would have trained biologists monitoring a shutdown zone equivalent to the potential physiological injury zone (Mitigation Action Plan, Appendix C) to reduce the potential for injury of marine mammals.

The areas encompassed by these threshold distances are shown in Table 3.4–6 for the south LWI pier, representing the most conservative scenario for calculating above-threshold noise levels because it is a longer structure and is closer to the haul-out site for sea lions at Delta Pier. Table 3.4–6 is based on calculations of the areas affected by pile driving at a representative location at the end of the south LWI. Placement of pile driving rigs at other locations along the LWI alignments would generate above-threshold noise levels in slightly different areas. A representative scenario of areas affected by above-threshold noise levels is shown in Figure 3.4–1. Conservatively, the representative areas in Figure 3.4–1 depict effects related to operation of a pile driver at one location at the seaward end of the north and south LWI piers, but pile driving would occur along the entire length of both piers. Only one impact pile driver would operate at a time.

Behavioral disturbance due to impact pile driving is calculated at approximately 1,522 feet (464 meters) from the driven pile, resulting in an affected area of approximately 0.2 square mile (0.5 square kilometer) around the driven pile. Marine mammals within this area would be susceptible to behavioral harassment during impact pile driving operations. The calculated distance for the behavioral harassment threshold due to vibratory installation is approximately 3.4 miles (5.4 kilometers), but intervening land masses would truncate the propagation of underwater sound from the driven pile (Figure 3.4–1). The area encompassed by the truncated threshold distance is approximately 11.0 square miles (28.5 square kilometers) around the pile drivers (Figure 3.4–1). Marine mammals within this area would be susceptible to behavioral harassment due to vibratory pile driving operations.

As described in Section 3.4.1.2.2, behavioral responses of marine mammals to underwater noise are variable and context specific. Some individuals may habituate to the elevated construction noise levels and continue to use the affected area, while other animals may avoid the area or respond by modifying feeding or resting behaviors. Temporary loss of hearing sensitivity in marine mammals (TTS) is a possible outcome of exposure to intense underwater noise that would be considered a form of behavioral harassment, as TTS is considered to be physiological fatigue rather than injury (Popper et al. 2006). TTS is an undesirable outcome of noise exposure because it can potentially affect communication and/or the ability to detect predators or prey. Behavioral harassment can also be indicated by actions such as avoidance of the construction area, changes in travel patterns, diving behavior, respiration, or feeding behavior.

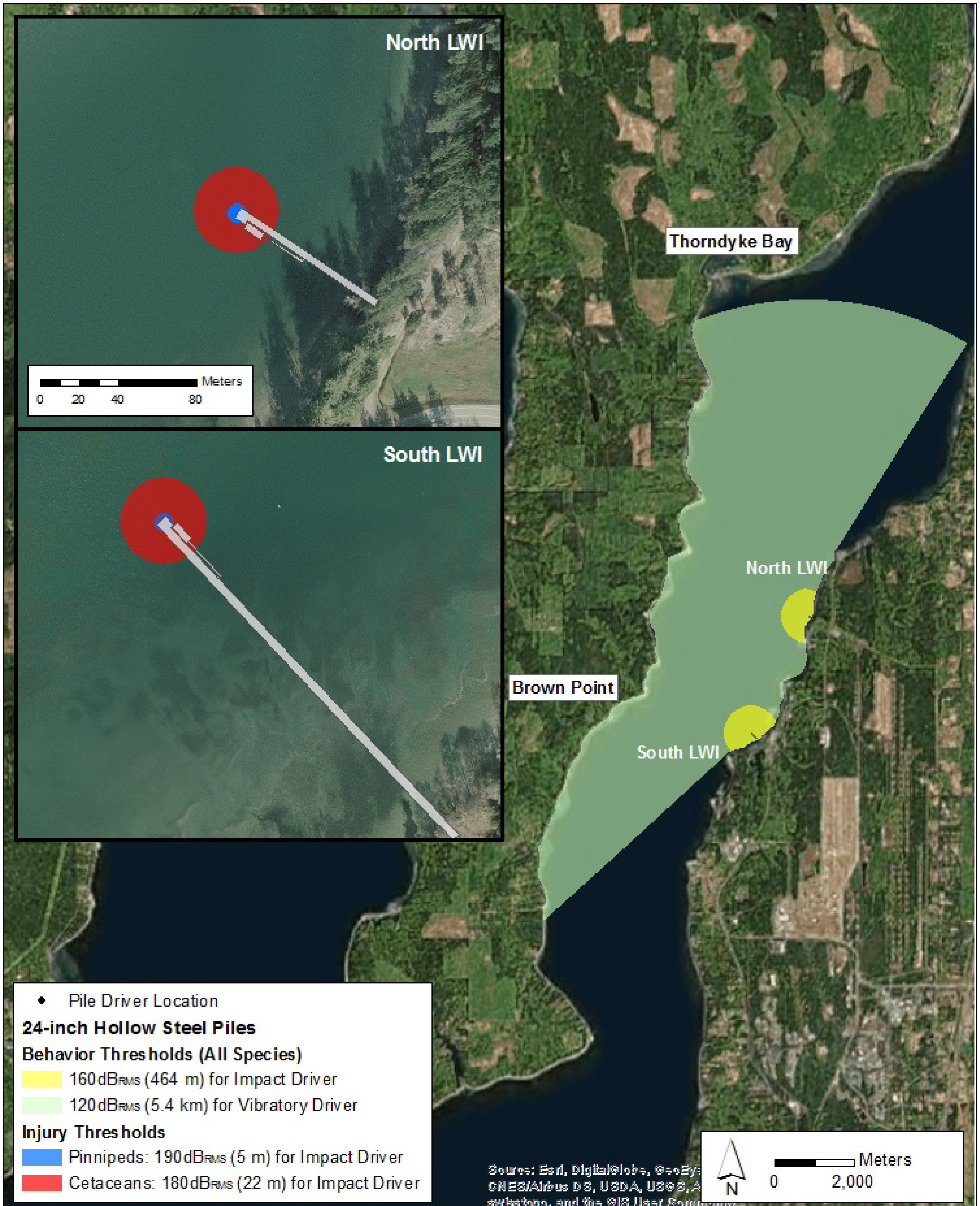


Figure 3.4-1. Representative View of Affected Areas for Marine Mammals Due to Underwater Pile Driving Noise during Construction of LWI Alternative 2

AIRBORNE NOISE

Construction of the LWI would result in increased airborne noise in the vicinity of the construction sites, as discussed in Section 3.9.3.2. The highest noise source levels would be associated with impact pile driving up to 54 24-inch (60-centimeter) steel piles in water at the north LWI project site and up to 82 piles in water at the south LWI project site, and 15 36-inch [90-centimeter]) steel piles driven in the dry at the north LWI site and 16 36-inch steel piles at the south site. Pile driving noise source levels are estimated to be 110 dB RMS maximum noise level (Lmax) re 20 µPa (unweighted) at 50 feet (15 meters) from the pile for an impact hammer, and 92 dB RMS equivalent sound level (Leq) re 20 µPa (unweighted) at 50 feet from the pile for vibratory pile driving (Section 3.9.3.2.2). The dominant airborne noise frequencies produced by pile driving would be between 50 and 1,000 Hz (Washington State Department of Transportation [WSDOT] 2013). Airborne noise would primarily be an issue for pinnipeds that are swimming or hauled out in the project area. Mitigation measures for pile driving noise, including a soft-start approach to pile driving and marine mammal monitoring, are described in the Mitigation Action Plan (Appendix C, Sections 3.2 and 4.2).

In addition to pile driving, other LWI construction activities and equipment would generate lower noise levels that are comparable to ambient levels elsewhere along the Bangor waterfront where ongoing operations use trucks, forklifts, cranes, and other equipment (Section 3.9.3.2). Construction equipment for the LWI project would include backhoes, bulldozers, loaders, graders, trucks, and cranes. Activities that would generate elevated noise levels could include excavation for the abutments; construction of the pier deck and fence, stairways, and road construction. Average noise levels are expected to be in the 60 to 68 A-weighted decibel (dBA) range, consistent with urbanized or industrial environments where equipment is operating and similar to the range of noise measured on Delta Pier (Navy 2010). Operation of non-pile driving, heavy construction equipment would produce airborne noise levels ranging from 78 to 90 dBA at 50 feet (15 meters) (WSDOT 2013). In the absence of pile driving noise and with simultaneous operation of two types of heavy equipment, the maximum construction noise level is estimated to be 94 dBA at a distance of 50 feet (Section 3.9), but this noise level would be occasional.

Responses to Airborne Pile Driving Noise at the LWI Project Sites

Pinnipeds have habituated to existing airborne noise levels at Delta Pier on NAVBASE Kitsap Bangor, where they regularly haul out on submarines and the pontoons supporting the PSB. Most likely, airborne sound would cause behavioral responses similar to those discussed above in relation to underwater noise. For instance, elevated airborne construction noise could cause hauled out pinnipeds to return to the water, reduce vocalizations, or cause them to temporarily abandon their usual or preferred haul-out locations and move farther from the noise source. Pinnipeds swimming in the vicinity of pile driving may avoid or withdraw from the area or show increased alertness or alarm (e.g., head out of the water and looking around).

Airborne Sound Behavioral Harassment Thresholds

Pile driving can generate airborne noise that could potentially result in disturbance to marine mammals (pinnipeds) that are hauled out or at the water's surface. As result, the Navy analyzed the potential for pinnipeds hauled out or swimming at the surface near NAVBASE Kitsap Bangor to be exposed to airborne noise that could result in behavioral harassment, as defined by the MMPA. There are no criteria for injury due to elevated airborne sound. NMFS has defined the airborne noise threshold for behavioral harassment for all pinnipeds except harbor seals as 100 dB RMS re 20 µPa (unweighted) (Table 3.4–5). The threshold value for harbor seals is 90 dB RMS re 20 µPa (unweighted).

Impact pile driving noise for the LWI would likely result in behavioral harassment to harbor seals at a distance of 492 feet (150 meters) and to other pinnipeds (California sea lions and Steller sea lions) at a distance of 154 feet (47 meters) (Table 3.4–7). Vibratory pile driving noise would likely result in behavioral harassment to harbor seals at a distance of 62 feet (19 meters) and to other pinnipeds at a distance of 20 feet (6 meters) (Table 3.4–7). The areas encompassed by these threshold distances are shown in Table 3.4–7 and a representative scenario of areas affected by above-threshold noise levels for an impact pile driving rig is shown in Figure 3.4–2. Other areas would be included in the above-threshold noise areas if the analysis was performed for pile driving rigs at other locations on the LWI structures.

Table 3.4–7. Calculated Maximum Distances in Air to Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Noise Thresholds, LWI Alternative 2

Affected Area	Impact Behavioral Harassment Harbor Seal (90 dB RMS)[1]	Impact Behavioral Harassment Other Pinnipeds (100 dB RMS)[1]	Vibratory Behavioral Harassment Harbor Seal (90 dB RMS)[1]	Vibratory Behavioral Harassment Other Pinnipeds (100 dB RMS)[1]
Distance to Threshold[1]	492 ft (150 m)	154 ft (47 m)	62 ft (19 m)	20 ft (6 m)
Area Encompassed by Threshold	0.03 sq mi (0.07 sq km)	0.003 sq mi (0.007 sq km)	12,076 sq ft (1,134 sq m)	1,216 sq ft (113 sq m)

dB = decibel; ft = feet; m = meter; sq ft = square feet; sq km = square kilometer; sq m = square meter; sq mi = square mile; RMS = root mean square

1. Sound pressure levels used for calculations were 110 dB RMS re 20 µPa at 50 feet (15 meters) (Section 3.9.3.2.2) for impact hammer for 24-inch (60-centimeter) steel pile, and 92 dB RMS re 20 µPa at 50 feet (15 meters) for vibratory driver for 24-inch steel pile. All distances are calculated over water.

The distance between the south LWI project site and haul-out sites at Delta Pier is 1,000 feet (300 meters) and the distance between the north LWI project site and haul-out sites is 1 mile (1.6 kilometers), both of which would be beyond the airborne behavioral harassment threshold for California sea lion and Steller sea lions. Haul-out sites on the existing PSB at the south end of the WRA are immediately adjacent to the south LWI site and would be within the threshold for behavioral disturbance; however, some individuals that are hauled out on a portion of the PSB may be disturbed by pile driving. The airborne behavioral harassment threshold for harbor seal would encompass portions of Delta Pier and the existing PSB, although this species was not observed hauled out in this area during at-sea marine mammal surveys (Tannenbaum et al. 2009a, 2011a).

Harbor seals were observed swimming in the threshold area during these surveys, however, and may be susceptible to airborne noise disturbance resulting from pile driving. No threshold has been identified for injury to marine mammals due to airborne sound.

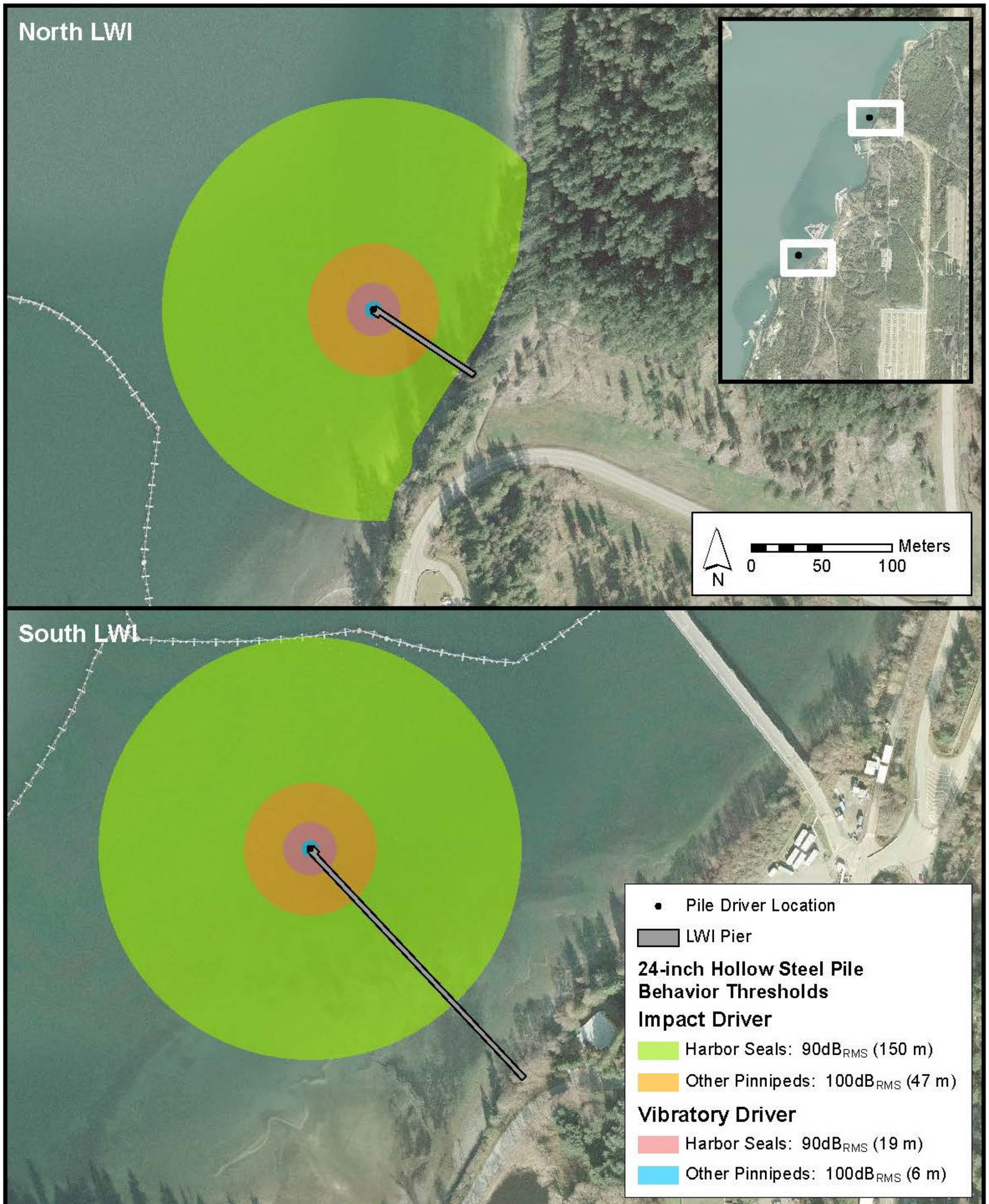


Figure 3.4-2. Representative View of Affected Areas for Marine Mammals due to Airborne Pile Driving Noise during Construction of LWI Alternative 2

CALCULATIONS OF EXPOSURE OF MARINE MAMMALS TO NOISE IMPACTS

The analysis approach in the following section focuses on quantifying potential exposure of marine mammals to project impacts based on their density in the project area and the duration of project activities that may affect these species. The term exposure in this analysis signifies "take" under the MMPA, as detailed above in Section 3.4.2.2.2, under Underwater Noise. The following species are included in the analysis because their occurrence in Hood Canal has been confirmed by specific observations during the past decade: harbor seal, California sea lion, Steller sea lion, harbor porpoise, and transient killer whale (see Section 3.4.1 for marine mammal species accounts).

Method of Incidental Taking (MMPA)

Pile driving activities associated with construction of the LWI, as described above, have the potential to disturb or displace marine mammals, but injury is not anticipated given the methods of installation and measures designed to minimize the possibility of injury to marine mammals. Vibratory pile drivers would be the primary method of installation, which are not expected to cause injury to marine mammals due to the relatively low source levels (161 dB). Also, no impact pile driving would occur without bubble curtain, and pile driving would either not start or would be halted if marine mammals approach the shutdown zone. Although the Proposed Action may affect the prey and other habitat features of marine mammals, none of these effects is expected to rise to the level of take under MMPA, as described in the following sections. The ESA-listed Southern Resident killer whale was included in the analysis of indirect effects on its prey base, as described above in Section 3.4.2.2.2, under Prey Availability, but is not carried forward in the noise effects analysis because its occurrence has not been confirmed in Hood Canal since 1995. The humpback whale is not included in the noise effects analysis because they are rarely observed in Hood Canal, and infrequent sightings of the species have shown them occurring at the end of the in-water work window, when pile driving activities would be concluded. Therefore, no noise impacts are expected for Southern Resident killer whale or humpback whale.

Description of Exposure Calculation

The calculations presented here rely on the best data currently available for marine mammal population densities and abundance in Hood Canal (Navy 2013). The Navy's database (Navy Marine Species Density Database [NMSDD]) is the overarching database for all Navy projects within its operating areas. The Navy has utilized the NMSDD, in tandem with local observational data, to support several pile driving projects whose applications have been submitted to NMFS. The Northwest region's NMSDD densities were finalized in 2012. The calculations presented in this section rely on NMSDD data for harbor seals and harbor porpoises that occur in Hood Canal (Table 3.4–8). Site-specific abundance data are available from monitoring of Steller sea lions and California sea lions at NAVBASE Kitsap Bangor (see Tables 3.4–9 and 3.4–11, respectively; Navy 2015a). Transient killer whale exposure calculations are described below.

Table 3.4–8. Marine Mammal Species Densities in Hood Canal

Species	Density in Hood Canal[1] animals/sq mi (animals/sq km)	Months Present in Hood Canal
Harbor seal[2]	20.55 (7.93)	Year round
Harbor porpoise	0.38 (0.149)	Potentially year round

Source: Navy 2013

sq km = square kilometer; sq mi = square mile

1. Density is the largest estimate available from fall, summer, and winter estimates. Spring (March 1 through May 31) estimates were not included because the time period is outside the in-water work period.
2. Includes correction for the estimated portion of the harbor seal population that is not hauled out at a given time (London et al. 2012).

Successful implementation of mitigation measures (visual monitoring and the use of shutdown zones) would preclude injury exposures for marine mammals, but exposures to pile driving noise would result in behavioral disturbance. Results of noise effects exposure assessments should be regarded as conservative overestimates that are influenced by limited occurrence data and the assumption that individuals may be present every day of pile driving.

The method for calculating potential exposures to impact and vibratory pile driving noise includes the following assumptions:

- Each species' population is at least as large as any previously documented highest population estimate.
- Each species would be present in the project area during construction at the start of each day, based on observed patterns of occurrence in the absence of construction. The timeframe for exposures would be one potential exposure per individual per 24 hours.
- All piles to be installed would have an underwater noise disturbance distance equal to the noise disturbance distance (Zone of Influence[1] [ZOI]) from the pile that would cause the greatest noise disturbance (i.e., the pile farthest from shore). The underwater ZOI was calculated based on the pile driving method that produces the largest ZOI (i.e., vibratory pile driving). Although some piles would be installed with an impact hammer, the ZOI for an impact hammer would be encompassed by the larger ZOI for the vibratory driver.[2]
- All piles to be installed would have an airborne noise disturbance distance equal to the noise disturbance distance (ZOI) from the pile that would cause the greatest noise disturbance (i.e., the pile farthest from shore). The airborne ZOI was calculated based on the pile driving method that produces the largest ZOI (i.e., impact pile driving). Impact pile driving was assumed to occur on all days of pile driving. Exposures to airborne noise were only calculated for pinnipeds.

[1] Zone of Influence (ZOI) is the area encompassed by all locations where the sound pressure levels equal or exceed the threshold being evaluated.

[2] Although pile driving noise source levels are higher for impact-driven piles than vibratory-driven piles, the behavioral disturbance criterion for vibratory-driven piles (120 dB RMS) encompasses a much greater area than the criterion for impact-driven piles (160 dB RMS).

- Pile driving would occur up to 80 days for LWI Alternative 2.
- In the absence of site-specific underwater acoustic propagation modeling, the practical spreading loss model was used to determine the ZOI for underwater noise.
- Some type of mitigation (i.e., bubble curtain) would be used for impact pile driving and achieve 8 dB reduction in source levels.

For species with density estimates (e.g., harbor seal, harbor porpoise), exposures are estimated by:

Exposure estimate = (n * ZOI)* X days of pile driving activity,

where:

n = density estimate used for each species,
ZOI = noise threshold zone of influence (ZOI) impact area, and
X = number of days of pile driving estimated based on the total number of piles and the estimated number of piles installed per day.

The ZOI impact area is the estimated range of impact on the noise criteria thresholds for both underwater and airborne noise. The distances specified in Tables 3.4–6 and 3.4–7 for LWI were used to calculate the overwater areas that would be encompassed within the threshold distances for injury or behavioral harassment. All calculations were based on the estimated threshold ranges using a bubble curtain with 8 dB attenuation as a mitigation measure for impact pile driving. The greatest area affected by construction noise was defined as the calculated distance from LWI pile driving locations to the behavioral harassment threshold (120 dB sound pressure level) or the greatest line-of-sight distance (3.4 miles [5.4 kilometers]) that underwater sound waves could travel from pile driving locations unimpeded by land masses (Figure 3.4–1). The affected area was determined to be 11.0 square miles (28.5 square kilometers) (Table 3.4–6).

The product of n*ZOI was rounded to the nearest whole number before multiplying by the number of pile driving days. If the product of n*ZOI rounds to zero, the number of exposures calculated is zero regardless of the number of pile driving days. The exposure assessment methodology is an estimate of the numbers of individuals exposed to the effects of pile driving activities exceeding NMFS-established thresholds for underwater and airborne noise. Of significant note in these exposure estimates is that (1) implementation of one mitigation method (bubble curtain use during impact pile driving) would result in quantifiable reduction in exposures of marine mammals to pile driving noise, (2) successful implementation of other mitigation measures such as soft starts for pile driving is not reflected in exposure estimates, and (3) exposure calculations do not include Level A take because marine mammal monitoring/shutdown implementation would preclude exposure to injurious noise levels. Results from acoustic impact exposure assessments should be regarded as conservative overestimates that are strongly influenced by limited marine mammal population data.

For species with counts of animals in the project area (Steller and California sea lions) available, exposures are estimated by:

Exposure estimate = (Abundance) * X days of pile driving activity,

where:

Abundance = average monthly maximum counts during the months when pile driving will occur.

SUMMARY OF PROJECT IMPACTS AND ESTIMATED EXPOSURES FOR SPECIES PRESENT IN THE LWI PROJECT AREA

Steller Sea Lion

Steller sea lions are occasionally present in Washington inside waters from late fall to late spring (Jeffries et al. 2000; NMFS 2010) and have been detected in Hood Canal during the period from late September to May (Bhuthimethee 2008, personal communication; Navy 2015a; Table 3.4-9). Most detections of Steller sea lions in Hood Canal have been individuals hauled out on submarines docked at Delta Pier (Navy 2015a).

Table 3.4–9. Steller Sea Lions Observed at NAVBASE Kitsap Bangor, April 2008–December 2015

	Maximum Number of Steller Sea Lions Observed in Single Survey								
		2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	MAX Average
In-water Work Window July 15 - January 15	July	0	0	0	0	0	0	0	0
	August	0	0	0	0	0	0	0	0
	September	0	0	5	0	0	0	0	1
	October	0	0	4	3	6	9	3	4
	November	4	6	4	5	4	11	13	7
	December	0	3	2	4	4	N/A	7	3
	January	0	2	1	3	N/A	1	6	2
	February	0	0	2	2	2	0	0	1
	March	0	2	2	3	N/A	1	1	2
	April	0	4	6	4	0	2	1	2
	May	0	0	6	3	0	2	0	2
	June	0	0	0	0	N/A	0	0	0
	Average of in-water work window								**2**

Source: Navy 2015a
N/A = no survey was conducted

Although the Navy has determined a density for Steller sea lions in Hood Canal (Navy 2013), when more site-specific data are available it is preferable to use that data to determine the number of individuals that may be exposed to noise effects. This is because a density analysis assumes an even distribution of animals, whereas Steller sea lion distribution within the project area actually is concentrated at Delta Pier. Therefore, the noise exposure calculation for Steller sea lions uses the average of monthly maximum abundance of the species during the in-water work window, defined as the average of the monthly maximum number of individuals per month present during surveys at Delta Pier from July to January during the years 2008 through 2015. The abundance trend for Steller sea lions at Delta Pier has increased since they were first detected in November 2008.

Exposures to underwater pile driving noise were calculated using the abundance-based formula presented above, under Description of Exposure Calculation. Table 3.4–10 depicts the number of potential behavioral harassment exposures that are estimated from underwater vibratory and impact pile driving. Using the abundance-based analysis, the most conservative criterion for behavioral harassment (the 120 dB continuous noise harassment threshold), and an average daily abundance of 2 individual Steller sea lions, the noise exposure formula above predicts 160 exposures to underwater noise within the behavioral harassment threshold for vibratory pile installation over the 80 days of pile driving.

Table 3.4–10. Number of Potential Exposures of Marine Mammals, 24-inch (60-centimeter) Steel Piles, LWI Alternative 2

	Underwater Behavioral Harassment	Airborne Behavioral Harassment
Species	All Species (120 dB RMS)	Harbor Seal (100 dB RMS), Other Pinnipeds (90 dB RMS)
Steller sea lion	160	0
California sea lion	2,880	0
Harbor seal	18,080	0
Harbor porpoise	320	N/A
Transient killer whale	180	N/A

All underwater sound levels are expressed as dB re 1 μPa; all airborne sound levels are expressed as dB re 20 μPa.
dB = decibel; RMS = root mean square

Steller sea lions are unlikely to be injured by pile driving noise because they are unlikely to be within the injury threshold distance for pile driving noise (16 feet [5 meters] from the driven pile). Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities (see the Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures) for the presence of marine mammals, and they would alert work crews when to begin or stop work due to the presence of sea lions in or near the shutdown zones, thereby reducing the potential for injury.

The airborne exposure calculations assumed that 100 percent of the in-water animals would be available at the surface to be exposed to airborne sound. Sea lions hauled out on submarines at Delta Pier would be beyond the areas encompassed by the airborne noise behavioral harassment threshold for both south and north LWIs (Figure 3.4–2) and are unlikely to be affected by construction activities. Animals swimming with their heads above the water would potentially be affected by elevated airborne pile driving noise within a small ZOI (154 feet [47 meters]). Given that both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance ZOIs, pinniped takes would already occur as a result of underwater exposures. Therefore, no additional takes for exposure to airborne pile driving noise were requested for Steller sea lions, and the total number of behavioral harassment exposures over the entire pile driving period for this alternative is estimated to be 160 (all underwater) (Table 3.4-10).

Steller sea lions would most likely avoid waters within the areas affected by above-threshold noise levels during impact pile driving around the LWI project sites. Steller sea lions exposed to elevated noise levels could exhibit behavioral changes such as avoidance of the affected area, increased swimming speed, increased surfacing time, or decreased foraging activity. Pile driving would occur only during daylight hours, and therefore would not affect nocturnal movements of Steller sea lions in the water. Most likely, Steller sea lions affected by elevated underwater or airborne noise would move away from the sound source and be temporarily displaced from the affected areas. However, they likely would continue using submarines at Delta Pier as haul-out sites during pile driving, based on evidence cited in Section 3.4.1.2.3 regarding responses of pinnipeds to construction noise including pile driving. Given the absence of any rookeries and only one haul-out area near the project site (i.e., submarines docked at Delta Pier), and infrequent attendance by a small number of individuals at this site, potential disturbance exposures would have a negligible effect on individual Steller sea lions and would not result in population-level impacts.

The prey base of Steller sea lions includes forage fish and salmonids, which potentially would be less available for predators within the fish injury exposure and behavioral harassment zones (described in Section 3.3) during the 6-month, in-water construction window. The potential impact on Steller sea lions would be a localized (within the fish behavioral harassment zones), temporary loss of foraging opportunities (during in-water construction) and potential exposure to behavioral harassment as they transit the project area.

California Sea Lion

No regular haul-outs of California sea lions were documented during aerial surveys of pinniped populations in Hood Canal over a decade ago (Jeffries et al. 2000), but Navy observations of animals hauled out on submarines and the PSB on NAVBASE Kitsap Bangor in recent years indicate that California sea lions are present in Hood Canal during much of the year (Navy 2015a). During the in-water construction period (July 15 to January 15), the largest monthly attendance averaged for each month ranged from 1 to 74 individuals. The largest monthly average (74 animals) during the in-water work window was recorded in November, as was the largest daily count (122) (Table 3.4–11). The likelihood of California sea lions being present at the Bangor waterfront was greatest from October through May, when the frequency of occurrence in surveys was at least 0.80 (i.e., 80 percent of surveys had California sea lions present).

The noise exposure analysis for California sea lions is similar to the analysis described above for Steller sea lions. The Navy used the average maximum abundance of the species during the in-water work window, defined as the average of the monthly maximum number of individuals present during surveys at Delta Pier from July 15 to January 15. The average of the monthly maximum number present during the in-water work window was approximately 36 animals (Table 3.4-11). Using the abundance-based analysis and the most conservative criterion for behavioral harassment (the 120 dB continuous noise harassment threshold), and an average daily abundance of 36 individual California sea lions, the noise exposure formula above predicts 2,880 exposures to underwater noise within the behavioral harassment threshold for vibratory pile installation over the 80 days of pile driving.

Table 3.4–11. California Sea Lions Observed at NAVBASE Kitsap Bangor, April 2008–December 2015

	Maximum Number of California Sea Lions Observed in Single Survey								
		2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	MAX Average
In-water Work Window July 15 - January 15	July	0	0	0	0	3	0	1	1
	August	0	1	3	4	5	0	15	4
	September	12	32	33	14	11	35	44	26
	October	47	44	42	56	70	88	84	62
	November	50	58	42	81	70	122	93	74
	December	27	38	50	64	69	N/A	63	52
	January	4	44	33	43	N/A	48	43	36
	February	28	34	42	48	44	42	32	39
	March	37	40	54	82	N/A	65	55	56
	April	46	51	66	52	32	49	48	49
	May	33	17	54	18	N/A	20	12	26
	June	3	12	17	4	N/A	8	8	9
								Average of in-water work window	**36**

Source: Navy 2015a
N/A = no survey was conducted

Sea lions are unlikely to be injured by pile driving noise because they are unlikely to be within the injury threshold distance for pile driving noise (16 feet [5 meters] from the driven pile). Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities (see the Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures) for the presence of marine mammals, and they would alert work crews when to begin or stop work due to the presence of sea lions in or near the shutdown zones, thereby reducing the potential for injury.

California sea lions would most likely avoid waters within the areas affected by above-threshold noise levels during impact pile driving around the LWI project sites. Sea lions exposed to elevated noise levels could exhibit behavioral changes such as avoidance of the affected area, increased swimming speed, increased surfacing time, or decreased foraging activity. Pile driving would occur only during daylight hours, and therefore would not affect nocturnal movements of sea lions in the water. Most likely, sea lions affected by elevated underwater or airborne noise would move away from the sound source and be temporarily displaced from the affected areas. However, they may continue using vessels at Delta Pier as haul-out sites during pile driving, based on evidence cited in Section 3.4.1.2.3 regarding responses of pinnipeds to construction noise including pile driving. Given the absence of any rookeries and only one haul-out area near the project site (i.e., submarines docked at Delta Pier and pontoons of the PSB), potential disturbance exposures would have a negligible effect on individual California sea lions and would not result in population-level impacts.

The prey base of California sea lions includes forage fish and salmonids, which would be less available for predators within the fish injury exposure and behavioral harassment zones (described in Section 3.3) during the 6-month, in-water construction window. The potential impact on California sea lions would be a localized (within the fish behavioral harassment zone), temporary loss (during in-water construction) of foraging opportunities, and potential exposure to behavioral harassment as they transit the project area.

Harbor Seal

Harbor seals are the most abundant marine mammal in Hood Canal. Jeffries et al. (2003) completed a comprehensive stock assessment of the Hood Canal in 1999 (on September 21 between the hours of 3:00 and 4:00 p.m.) and counted 711 harbor seals hauled out. An estimate of the Hood Canal harbor seal population size was based on this survey data and haul-out behavior described by London et al. (2012), who calculated an approximate correction factor for the survey count. Using haul-out probability from Figure 4 in London et al. (2012) the correction factor is calculated as follows:

> Approximate probability of an animal to be hauled out during that time frame in that month is 0.20. The inverse of this (1/0.20) provides a correction factor of 5.0. When applied to the survey count data of 711, the correction factor yields a population estimate of 3,555 animals.

Exposures to underwater and airborne pile driving noise were calculated using a density derived from the number of harbor seals that may be present in the water at any one time (80 percent of 3,555 or 2,844 individuals), divided by the area of Hood Canal (138.4 square miles [358.4 square kilometers]) (Jeffries et al. 2003; London et al. 2012). The density of harbor seals calculated in this manner is 20.55 individuals/square mile [7.93/square kilometer]. The Navy acknowledges that a uniform density spread out over the Hood Canal is not ideal, and that the density would be higher around haul-out sites such as Dabob Bay and farther south in Hood Canal, which are 10 miles away from Bangor and those Bangor activities. Since the haul-out sites are not located near the Bangor waterfront, density is expected to be much lower near the project area. However, since a detailed geographically stratified density estimate is not currently available, the analysis uses the uniform density to calculate exposures to pile driving noise. Therefore, the exposure estimate for harbor seals presented here is likely a significant overestimate.

The airborne exposure calculations assumed that 100 percent of the in-water injury exposures would be available at the surface to be exposed to airborne sound. Exposures to underwater noise were calculated with the formula in Section 3.4.2.2.2, under Underwater Noise, and the ZOI in Table 3.4–6. Table 3.4–10 depicts the number of behavioral harassment exposures that are estimated from vibratory and impact pile driving both underwater and in-air.

Based on the density analysis of 20.55 individuals/square mile (7.93/square kilometer) and using the most conservative criterion for behavioral disturbance (the 120 dB vibratory harassment threshold with an area of 11.0 square miles [28.5 square kilometers]), up to 226 individual harbor seals may experience sound pressure levels on a given day that would qualify as behavioral harassment. The estimated number of individuals exposed per day amounts to approximately 6 percent of the estimated population, and as noted above is likely a significant overestimate of potential exposures. Thus, not all animals in the population would be expected to be exposed to the activities at Bangor but only a subset of the population that may travel through or haul-out on manmade structures near the waterfront. Furthermore, the behavioral harassment does not appear to be biologically significant based on observations from waterfront surveys conducted by the

Navy (Navy 2015a): (1) harbor seals are always present in Bangor waters and occasionally use manmade structures (underside of piers, ladders in the water, wavescreen, floating oil boom, etc.) as haulouts; and (2) pupping occurs from the northern end to the southern end of the waterfront.

Over the 80 days of pile driving, the noise exposure formula above predicts 18,080 exposures to noise within the behavioral harassment threshold for vibratory pile driving. Zero exposures to underwater noise were calculated within the injury threshold (with an area of 850 square feet [79 square meters]). Zero exposures to airborne pile driving noise were calculated by the formula above. Therefore, the total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 18,080 (all underwater) (Table 3.4–10).

Harbor seals would most likely avoid waters within areas affected by above-threshold noise levels during impact pile driving around the LWI project sites. They are unlikely to be injured by pile driving noise because they are unlikely to be within the injury threshold distance for pile driving noise (16 feet [5 meters] from the driven pile). Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities (see the Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures) for the presence of marine mammals, and they would alert work crews when to begin or stop work due to the presence of harbor seals in or near the shutdown zones, thereby reducing the potential for injury.

The prey base of harbor seals includes forage fish and salmonids, which would be less available for predators within the fish injury exposure and behavioral harassment zones (described in Section 3.3) during the 6-month, in-water construction window. The potential impact on harbor seals would be a localized (within the fish behavioral harassment zone), temporary loss of foraging opportunities (during in-water construction) and potential exposure to behavioral harassment as they transit the project area.

Harbor Porpoise

Harbor porpoises may be occasionally present in Hood Canal year round and conservatively are assumed to use the entire area. The Navy conducted boat surveys of the waterfront area from July to September 2008 (Tannenbaum et al. 2009a) and November 2009 to May 2010 (Tannenbaum et al. 2011a). During one of the surveys a single harbor porpoise was sighted in May 2010 in deeper waters in the vicinity of EHW-1. Overall, these nearshore surveys indicated a low occurrence of harbor porpoise within waters adjacent to the base. Surveys conducted during the TPP indicate that the abundance of harbor porpoises within Hood Canal in the vicinity of NAVBASE Kitsap Bangor is greater than anticipated from earlier surveys and anecdotal evidence (HDR 2012). During these surveys, while harbor porpoise presence in the immediate vicinity of the base (i.e., within 0.6 mile [1 kilometer]) remained low, harbor porpoises were frequently sighted within several kilometers of the base, mostly to the north or south of the project area, but occasionally directly across from the proposed EHW-2 project site on the far side of Toandos Peninsula. These surveys reported 38 individual harbor porpoise sightings on tracklines of specified length and width, resulting in a density of 0.149 individuals/square kilometer.

The density used in the underwater sound exposure analysis was 0.149 animals/square kilometer (Navy 2013). Exposures to underwater pile driving noise were calculated using the formula in

Section 3.4.2.2.2, under Underwater Noise, and the ZOI in Table 3.4–6. Table 3.4–10 depicts the number of potential behavioral harassment exposures that are estimated from underwater vibratory and impact pile driving.

Based on the density analysis of 0.38 individuals/square mile [0.149/square kilometer] (Navy 2013) and using the most conservative criterion for behavioral disturbance (the 120 dB vibratory harassment threshold with an area of 11.0 square miles [28.5 square kilometers]), up to 4 individual harbor porpoises may experience sound pressure levels on a given day that would qualify as behavioral harassment. Over the 80 days of pile driving, the noise exposure formula above predicts 320 exposures to noise within the behavioral harassment threshold for vibratory pile driving. Zero exposures to underwater noise were calculated within the injury threshold (with an area of 16,372 square feet [1,521 square meters]). The total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 320 over the estimated 80 days of pile driving (Table 3.4–10).

Harbor porpoise that are exposed to pile driving noise could exhibit behavioral reactions such as avoidance of the affected area. Harassment from underwater noise impacts is not expected to be significant because it is estimated that only a small number of harbor porpoise would ever be present in the project area. Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities (see the Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures) for the presence of marine mammals, and they would alert work crews when to begin or stop work due to the presence of harbor porpoise in or near the shutdown zones, thereby precluding the potential for injury.

Transient Killer Whale

Transient killer whales are rarely present in Hood Canal. In 2003 and 2005, groups of transient killer whales (6 to 11 individuals per event) visited Hood Canal to feed on harbor seals and remained in the area for significant periods of time (59 to 172 days) between the months of January and July (London 2006). These whales used the entire expanse of Hood Canal for feeding. No other confirmed sightings of transient killer whales in Hood Canal have been reported.

Even though transient killer whales are rare in Hood Canal and an applicable density value is not available, the Navy calculated potential exposures for the LWI project in the event that a group may occur within the LWI behavioral disturbance ZOI. For transient killer whales, there have only been two documented time periods of occurrence within Hood Canal and, therefore, a reliable density estimate is not available.

Take estimates were calculated based on the in-water work associated with the LWI Alternative 2: Pile Supported Pier. The pier would consists of 136 permanent 24-inch piles and 120 temporary trestle piles, and would take no more than 80 days to construct within the in-water work window (see Section 1.1.1.3.2). Exposures to underwater pile driving were calculated using the second equation described in the *Description of Exposure Calculation* (page 3.4-38) where the exposure estimate was determined by multiplying the group size times the number of days transient killer whales would be anticipated in the Hood Canal during pile driving activities.

West Coast transient killer whale mean group size in the Salish Sea was 4 individuals during the period from 1987–1993 (mode = 3 individuals) (Baird and Dill 1996). More recently, during the period from 2004–2010, mean group size appears to have increased to 5 individuals (mode = 4 individuals) (Houghton et al. 2015). According to Houghton unpublished data, the most commonly observed group size in Puget Sound (specifically south of Admiralty Inlet) from 2004–2010 data was 6 whales (mode = 6, mean = 6.88) (Houghton 2012, personal communication).

Based on the two documented residence times transient killer whales remained in Hood Canal (59 to 172 days between the months of January and July), NMFS concluded that whales could be exposed to behavioral disturbance due to pile driving noise for 30 days (NMFS 2014). The 30 day estimate reasonably assumes that the whales would not remain in the area for the typical residence time due to the harassing stimuli.

Using this rationale, 180 potential exposures of transient killer whales are estimated (6 animals times 30 days of exposure). Based on this analysis, the Navy requests Level B incidental takes for behavioral harassment of 180 killer whales. Animals of any age or sex could be exposed. Any exposures are anticipated to be short in duration as animals transit through the ZOI during vibratory pile driving.

Transient killer whales that are exposed to pile driving noise could exhibit behavioral reactions such as avoidance of the affected area. Harassment from underwater noise impacts is not expected to be significant because it is estimated that only a small number of transient killer whales would ever be present in the project area. Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities (see the Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures) for the presence of marine mammals, and they would alert work crews when to begin or stop work due to the presence of transient killer whales in or near the shutdown zones, thereby precluding the potential for injury.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 2

LWI Alternative 2 would create an in-water pier that would be 280 feet (85 meters) long at the north location and 730 feet (223 meters) long at the south location. Cetaceans are unlikely to be present in the shallow nearshore waters affected by the LWI. Pinnipeds may swim through the area but are highly mobile and their movements would not be significantly affected by the presence of this in-water barrier. Pinnipeds would encounter the mesh that would extend from the bottom of the pier walkway to the seafloor and likely swim around it. The mesh would be a high visibility material that is not directly comparable to fishing nets but rather would be more like a semi-flexible grate with fairly wide partitions between the mesh openings. Unlike fishing nets, the LWI mesh would be permanently fixed, highly visible, and would not provide any attractant to marine mammals because it is not designed for, nor would it be likely to trap fish. There may be some potential for entanglement of pinnipeds, such as curious juvenile harbor seals that may attempt to insert their heads in the mesh. Information in the literature on entanglement of marine mammals in gill nets, trawl nets, other fishing gear, and aquaculture net pens does not provide much insight into the potential for adverse impacts due to installation of the mesh at the LWI piers. This is because of physical differences between the LWI mesh and these other materials, as well as active deployment of fishing nets as opposed to the passive deployment of the LWI mesh. All factors considered, the risk would not be significant for most marine mammals in the project area.

Prey Availability

The LWI would impact marine mammals by changing their prey base (primarily salmonids and schooling fishes). The potential long-term impacts on the prey base are discussed in Section 3.4.2.2.2. The LWI would permanently convert approximately 0.14 acre (0.06 hectare) of benthic habitat as discussed in Section 3.2.2.2.2 (Table 3.2–8) with a corresponding loss of habitat suitability and productivity for some prey species. However, it is possible that the LWI pier and mesh may facilitate predation because the piles and mesh would create a physical barrier to movements of juvenile salmonids and forage fish (Section 3.3.2.2.2) in the nearshore environment, causing them to hesitate at the mesh and/or migrate around the seaward ends of the piers. These fish may be more vulnerable to marine mammal predators. Adult salmonids are less dependent on nearshore habitats than juveniles and are more mobile, but they may congregate at the seaward ends of the LWI, where they would be more exposed to marine mammal predation. Artificial lighting used during security responses at the LWI is expected to have negligible impact on fish species hunted by marine mammals, as described in Section 3.3.2.2.2. Thus, localized changes to the prey base for some marine mammals are possible with the proposed project but these changes cannot be quantified with available information.

Prey populations in the context of the inside waters of Washington State and Hood Canal, which encompass the foraging area of the marine mammal species that occur in the LWI project area, would not be significantly impacted by the construction and future operation of Alternative 2. Operations impacts of the LWI would be limited to the small area including an adjacent to the structures. The Mitigation Action Plan (Appendix C) describes the marine habitat mitigation actions that the Navy would undertake as part of the Proposed Action. This habitat mitigation action would compensate for impacts of the Proposed Action to marine habitats and species.

Noise and Visual Disturbance

Operation of the LWI would include increased noise and visual disturbance from human activity and artificial light. Under existing conditions, the Bangor waterfront produces an environment of complex and highly variable noise and visual disturbance for marine mammals, although Steller and California sea lions haul out on manmade structures and harbor seals regularly forage in the nearshore and deeper waters along the Bangor waterfront in close proximity to ongoing operations. Because future operations of the LWI would not exceed existing levels, most individual marine mammals are likely to habituate to the post-construction activity levels, as they have habituated to activity levels at other developed portions of the waterfront. Thus, no additional MMPA take is expected with operation of the LWI.

Maintenance of the LWI would include routine inspections, repair, and replacement of facility components as required (but no pile replacement). These activities could affect marine mammals through noise impacts and increased human activity and vessel traffic. However, noise levels would not be appreciably higher than existing levels elsewhere at the Bangor industrial waterfront, to which marine mammals appear to have habituated. Further, measures would be employed (Section 3.1.1.2.3) to avoid discharge of contaminants to the marine environment. Therefore, maintenance would have negligible impacts on marine mammals.

California sea lions, Steller sea lions, and harbor seals use various manmade structures at the Bangor waterfront for hauling out, including pontoons that support the existing PSB. The shoreline in the project area is not used for hauling out by any pinniped species under existing conditions, and it is unlikely that pinnipeds would haul out on the shoreline in the vicinity of the LWI under Alternative 2 in the future. The LWI piers would be vertical structures with deck surfaces that are 10 feet (3 meters) above MHHW and therefore inaccessible to pinnipeds, but floating pontoons of the PSB would likely be used as haul outs. The south LWI and north LWI shoreline abutments would be vertical structures 12 feet (4 meters) and 38 feet (12 meters) high, respectively, and would not be accessible for hauling out.

3.4.2.2.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

LWI Alternative 3 would modify the existing PSB system to extend across the intertidal zone and attach to concrete abutments at the shoreline, but would not include the pile-supported pier proposed under Alternative 2. As described in Chapter 2, no piles would be installed in the water and the PSB guard panels would be less of a barrier to nearshore movement of marine biota than the Alternative 2 pier and underwater mesh barrier. LWI Alternative 3 would include the same concrete abutments described for LWI Alternative 2. Consequently, pinnipeds potentially would be exposed to airborne noise associated with pile driving for these structures, all of which would be installed from the shoreline in the dry. Long-term operations of the LWI under Alternative 3 would result in some potential indirect effects on prey species, although the consequences for marine mammal populations are likely to be insignificant.

CONSTRUCTION OF LWI ALTERNATIVE 3

Marine mammals are expected to avoid the construction areas because of increased vessel traffic, noise and human activity, and increased turbidity. General construction period impacts on water quality, vessel traffic, prey availability, and non-pile-driving construction noise would be the same as for LWI Alternative 2, but overall LWI Alternative 3 would have fewer and shorter-lasting impacts on marine mammals in the project area.

The following sections describe how construction would affect the abundance and distribution of marine mammals present or potentially present at NAVBASE Kitsap Bangor, and compares the effects of LWI Alternative 3 with effects of LWI Alternative 2.

WATER QUALITY

Tug and barge operations and placement of PSB buoy anchors would resuspend contaminants that may be present in sediments and increase turbidity levels, as discussed in Section 3.1.2.2.3. A smaller seafloor area (up to 12.7 acres [5.2 hectares]) would be disturbed under LWI Alternative 3 compared to Alternative 2 (approximately 13.1 acres [5.3 hectares]) (Table 3.2–8). Similar to Alternative 2, water quality effects of Alternative 3 including seafloor disturbance would be temporary and localized, and construction-period impacts are not expected to exceed water quality standards. Measures for the protection of marine water quality and the seafloor would be implemented to minimize impacts (Mitigation Action Plan, Appendix C).

Marine mammals are expected to avoid the immediate construction area due to increased vessel traffic, noise and human activity, increased turbidity, and potential difficulty in finding prey. Because suspended sediment and contaminant concentrations would be low, and exposures would be localized, no impacts on marine mammals are expected due to changes in water quality during construction. Considering the wide distribution of marine mammals in inland marine waters, water quality changes due to LWI Alternative 3 would not significantly affect these populations or overall distribution.

VESSEL TRAFFIC

Vessel movements associated with construction of the LWI under Alternative 3 have the potential to impact marine mammals directly by accidentally striking or disturbing individual animals. Construction activity involving vessel traffic may occur over 12 months. However, because no in-water piles would be installed with LWI Alternative 3, lower levels of vessel traffic including barge and tug trips would be required (3 total round trips with Alternative 3 compared to 16 total round trips with Alternative 2). Thus, Alternative 3 would result in lower overall disturbance levels for marine mammals in the project vicinity, along with reduced likelihood of collision, and would likely displace them for shorter periods of time. The affected area for both alternatives would be limited to the project vicinity and, relative to the wide distribution of marine mammal populations in inland waters, would not represent a significant impact.

PREY AVAILABILITY

Construction of Alternative 3 would displace and degrade benthic habitats and marine vegetation used by prey populations for foraging and refuge as described in Section 3.3.2.2.3. However, the amount of foraging and refuge habitat supporting prey populations that potentially would be degraded by project construction would be slightly less under Alternative 3 (up to 12.7 acres [5.2 hectares]) than Alternative 2 (up to 13.1 acres [5.3 hectares]) (Table 3.2–8), and the disturbance would occur during only one in-water work season (Alternative 2 would have two in-water work seasons). Under Alternative 3 there would be fewer barriers to fish movements in the nearshore because no pier/mesh barrier system would be installed with this alternative (although the PSB guard panels would be something of a barrier to juvenile salmon migration). In addition, there would be no disturbance of fish due to in-water pile driving. Thus, adverse behavioral responses of prey populations due to project construction would be greatly reduced under Alternative 3, although the magnitude of the effects of the project alternatives cannot be quantified with available information.

While project construction may affect the prey base of pinnipeds that occur in the immediate project vicinity, relative to the wide distribution of marine mammal species and their prey resources in inland marine waters, effects of Alternative 3 on prey availability would not amount to a significant impact on marine mammal population numbers and distribution. Alternative 3 may indirectly affect Southern Resident killer whales through their prey populations, but the project's effect on the species' prey base would be minimal. Therefore, the ESA effect determination for construction activities under LWI Alternative 3 is "may affect, not likely to adversely affect" Southern Resident killer whales. The project would have no effect on critical habitat for Southern Resident killer whales because no critical habitat has been designated in Hood Canal.

NOISE

As described in Section 2.1.1.3.3, Alternative 3 would require pile driving for the LWI abutments. A total of 31 36-inch (90-centimeter), 24 30-inch (76-centimeter), and 30 24-inch (60-centimeter) hollow steel piles would be driven in the dry using a land-based pile driving rig. Piles would be driven using vibratory and impact drivers as required. Unlike the pile-supported pier under Alternative 2, no in-water pile driving would be required for Alternative 3, and the total number of driven piles would be substantially fewer (136 permanent in-water piles, 120 temporary in-water piles, and 41 land-installed piles for Alternative 2 compared with 24 permanent and 20 temporary piles driven in the dry and 41 land-installed piles for Alternative 3). Exposure of marine mammals to pile driving noise would be limited to airborne noise impacts under Alternative 3, and the duration of the exposure would be substantially shorter. Up to 30 days of pile driving would be required for construction of Alternative 3 compared with up to 80 days of pile driving for Alternative 2.

With respect to airborne pile driving noise source levels and propagation (described in Section 3.9.3.2) and effects of elevated noise levels on the behavior of marine mammals, the analysis is the same for both project alternatives. The following comparison of noise impacts focuses on the number of exposures of marine mammals to elevated airborne pile driving noise. It is assumed that daily abundances of marine mammal species would be the same for both alternatives. As in the exposure analysis for Alternative 2, the airborne noise disturbance distance (ZOI) was calculated based on the pile driving method that produces the largest ZOI (i.e., impact pile driving). It is assumed that only pinnipeds would be affected by elevated airborne noise levels and, consequently, upland areas were eliminated from the ZOI. For 30-inch (76-centimeter) hollow steel piles, the thresholds for airborne impact pile driving noise would be reached at 413 feet (126 meters) for harbor seals and 131 feet (40 meters) for other pinnipeds (Table 3.4–12). Thresholds for vibratory pile driving would occur at shorter distances from the driven pile (59 feet [18 meters] for harbor seals and 20 feet [6 meters] for other pinnipeds). The areas encompassed by these threshold distances are shown in Table 3.4–12.

Table 3.4–12. Calculated Maximum Distances in Air to Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Noise Thresholds, LWI Alternative 3

Affected Area	Impact Behavioral Harassment Harbor Seal (90 dB RMS)[1]	Impact Behavioral Harassment Other Pinnipeds (100 dB RMS)[1]	Vibratory Behavioral Harassment Harbor Seal (90 dB RMS)[1]	Vibratory Behavioral Harassment Other Pinnipeds (100 dB RMS)[1]
Distance to Threshold[1]	413 ft (126 m)	131 ft (40 m)	59 ft (18 m)	20 ft (6 m)
Area Encompassed by Threshold	North: 264,814 sq ft (24,602 sq m) South: 284,921 sq ft (26,470 sq m)	North: 27,222 sq ft (2,529 sq m) South: 28,298 sq ft (2,629 sq m)	North: 5,597 sq ft (520 sq m) South: 5,716 sq ft (531 sq m)	North: 646 sq ft (60 sq m) South: 624 sq ft (58 sq m)

dB = decibel; ft = feet; m = meter; sq ft = square feet; sq m = square meter; RMS = root mean square

1. Sound pressure levels used for calculations were 112 dB RMS re 20 μPa at 50 feet (15 meters) (Section 3.9.3.2.2) for impact hammer for 36-inch steel pile, and 95 dB RMS re 20 μPa at 50 feet for vibratory driver for 36-inch steel pile. All distances are calculated over water.

A representative view of areas within the ZOIs for behavioral harassment due to airborne pile driving noise is shown in Figure 3.4–3. The distance between the south LWI project site and sea lion haul-out sites at Delta Pier is 1,000 feet (300 meters) and the distance between the north LWI project site and haul-out sites is 1 mile (1.6 kilometers), both of which would be beyond the airborne behavioral harassment threshold for sea lions. Sea lions that are hauled out in the vicinity of Delta Pier are not expected to be exposed to airborne pile driving noise under Alternative 3, but animals swimming within the threshold areas may be susceptible to airborne noise disturbance. Given the small size of the ZOIs for airborne pile driving noise and their locations in areas that are not frequented by sea lions, no exposures to above-threshold airborne noise levels are predicted for these species. The density-based noise exposure formula described in Section 3.4.2.2.2 for harbor seals, which regularly swim in but rarely haul out in the project area, predicts no exposures to above-threshold airborne noise levels. Therefore, no MMPA exposures due to airborne pile driving noise under Alternative 3 are expected.

Airborne sound due to other construction equipment would be similar to the levels described for non-pile driving construction noise under Alternative 2 in Section 3.4.2.2.2. Average noise levels are expected to be in the 60 to 68 A-weighted dBA range, consistent with urbanized or industrial environments where equipment is operating and similar to the range of noise measured on Delta Pier (Navy 2010). Operation of non-pile driving, heavy construction equipment would produce airborne noise levels ranging from 78 to 90 dBA at 50 feet (15 meters) (WSDOT 2013). In the absence of pile driving noise and with simultaneous operation of two types of heavy equipment, the maximum construction noise level is estimated to be 94 dBA at a distance of 50 feet (Section 3.9), but this noise level would be occasional. Because noise levels produced by non-piling driving equipment are lower than noise levels produced by pile drivers, no MMPA take is expected from the operation of other construction equipment.

OPERATION/LONG-TERM IMPACTS FOR LWI ALTERNATIVE 3

LWI Alternative 3 would modify the existing PSB system to extend across the intertidal zone and attach to concrete abutments at the shoreline, and the pile-supported pier and mesh proposed under Alternative 2 would not be constructed. Thus, no barrier to movement of marine biota would occur under Alternative 3. The potential long-term effects on the prey base due to habitat loss and degradation (discussed in Section 3.4.2.2.3) would be less significant compared to impacts from Alternative 2. Alternative 3 would permanently displace a small amount of benthic habitat (0.0033 acre [0.0013 hectare]) compared with the displacement of 0.14 acre (0.06 hectare) under Alternative 2, with a corresponding loss of habitat suitability and productivity of some prey species (Table 3.2–8). In addition to the project footprint, some PSB units and buoys would regularly ground out on the seafloor at low tide under Alternative 3, resulting in a net reduction in functional value of a small area of nearshore habitat (approximately 0.06 acre [0.024 hectare]) used by prey species. Marine mammals are wide-ranging and have extensive foraging habitat available in Hood Canal, relative to the foraging area that might be impacted by operation of the LWI. Similar to Alternative 2, localized changes in prey availability are possible under Alternative 3, but impacts cannot be quantified with available information and are expected to be insignificant. The Mitigation Action Plan (Appendix C) describes the marine habitat mitigation that the Navy would undertake as part of the Proposed Action. This habitat mitigation would compensate for impacts of the Proposed Action on marine habitats and species and which, consequently, might indirectly affect the marine mammal prey base.

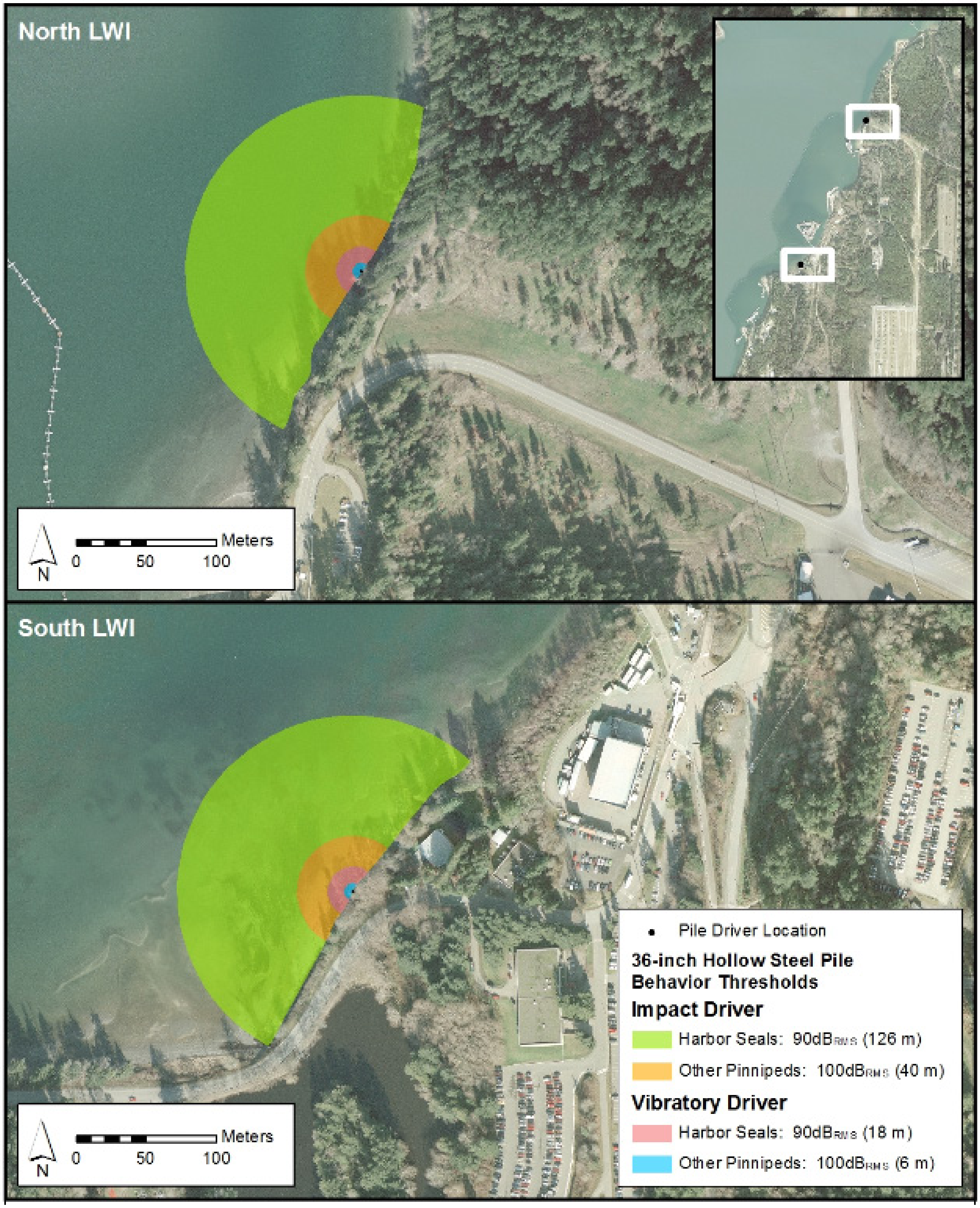


Figure 3.4–3. Representative View of Affected Areas for Marine Mammals due to Airborne Pile Driving Noise during Construction of LWI Alternative 3

Operation and maintenance of the LWI under Alternative 3 would include increased noise and visual disturbance from human activity and artificial lighting used during security operations. However, disturbance levels would not be appreciably higher than existing levels elsewhere at the Bangor waterfront, to which marine mammals appear to have habituated. Because LWI lighting would be used only during security responses, use of artificial lighting at the LWI is expected to have a negligible impact on fish species preyed on by marine mammals, as described in Section 3.3.2.2.3. Pontoons of the PSB may be used by California sea lions as haul-outs, but the south and north shoreline abutments would not be accessible for hauling out. In conclusion, direct and indirect effects of project operations on marine mammals would be negligible, and no MMPA take is expected.

3.4.2.2.4. SUMMARY OF IMPACTS FOR LWI PROJECT ALTERNATIVES

Impacts on marine mammals during the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.4–13.

Table 3.4–13. Summary of LWI Impacts on Marine Mammals

Alternative	Environmental Impacts on Marine Mammals
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Pier	*Construction:* Direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability due to installation of pile-supported pier. Construction noise (primarily due to pile driving) sufficient to exceed NMFS disturbance thresholds. Construction disturbance due to in-water work would occur over two seasons, including a total of 80 days of in-water and land-based pile driving during one in-water work season. *Operation/Long-term Impacts:* Indirect impacts on prey species due to loss and degradation of benthic habitat, and barriers to migratory fish.
	MMPA: The Proposed Action would expose marine mammal species in the area to noise levels that would result in behavioral disturbance due to underwater vibratory pile driving. No injurious exposures to noise are expected due to the use of vibratory pile driving as the primary pile installation method, the small size of the injury zone from impact pile driving, and monitoring of the injury zone so that a shutdown would occur if a marine mammal approaches the zone. *ESA:* Effect determination for the humpback whale (based on infrequent occurrence) and Southern Resident killer whale is "may affect, not likely to adversely affect"; and "no effect" on Southern Resident killer whale critical habitat.
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* Direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability, construction noise (primarily due to pile driving) not sufficient to exceed NMFS disturbance thresholds. Construction disturbance due to in-water work would occur over one season. Airborne noise from land-based pile driving up to 30 days. No in-water pile driving would occur. *Operation/Long-term Impacts:* Indirect impacts on prey species due to loss and degradation of benthic habitat, but minor barriers to migratory fish, in contrast to Alternative 2. Potentially additional haul-out opportunities for pinnipeds on additional PSB pontoons.
	MMPA: No exposure to injury or behavioral disturbance due to airborne pile driving noise is expected based on distance from sea lion haul-out locations, the small size of the disturbance zones, and low density of harbor seals. *ESA:* Effect determination for the humpback whale (based on infrequent occurrence) and Southern Resident killer whale is "may affect, not likely to adversely affect"; and "no effect" on Southern Resident killer whale critical habitat.

Table 3.3-13. Summary of LWI Impacts on Marine Mammals (continued)

Alternative	Environmental Impacts on Marine Mammals
Mitigation: Marine mammals would be monitored during all in-water pile installation activities of the LWI project, and shutdown procedures would be implemented if any marine mammal enters the injury threshold zone for pile driving. Please see Appendix C (Mitigation Action Plan) for more detailed mitigation measures. A detailed marine mammal monitoring plan would be developed in consultation with NMFS.	
Consultation and Permit Status The Navy consulted with the NMFS West Coast Region Office on the humpback whale and Southern Resident killer whale under the ESA and submitted a Biological Assessment on March 10, 2015, and a revised Biological Assessment on June 10, 2015. NMFS issued a Letter of Concurrence on November 13, 2015, concurring with the Navy's effect determinations for Alternative 3. The Navy did not request an authorization under the Marine Mammal Protection Act for the LWI Preferred Alternative 3 because the Proposed Action does not include in-water pile driving.	

ESA = Endangered Species Act; IHA = Incidental Harassment Authorization; MMPA = Marine Mammal Protection Act; NMFS = National Marine Fisheries Service

3.4.2.3. SPE PROJECT ALTERNATIVES

3.4.2.3.1. SPE ALTERNATIVE 1: NO ACTION

There would be no activities related to construction or operations that would disturb marine mammals in the project area under the No Action Alternative. Therefore, this alternative would have no impacts on marine mammals.

3.4.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

Construction of the SPE would directly impact marine mammals, primarily through underwater noise generated by pile driving. Underwater noise thresholds for behavioral disturbance would be exceeded, as described below, with potential adverse impacts (takes) as defined by the MMPA. Project-related changes in water quality, vessel traffic, and prey availability may also affect marine mammals indirectly or directly.

Long-term indirect impacts would result from localized changes in benthic prey population composition and vegetation (Section 3.2), which could affect marine fish populations (Section 3.3) and, consequently, marine mammals that prey on fish. Impacts on marine mammals from operation of this alternative are anticipated to be highly localized because marine mammals are wide-ranging and have a large foraging habitat available in Hood Canal, relative to the foraging area that might be impacted by operation of the LWI.

CONSTRUCTION OF SPE ALTERNATIVE 2

The primary impacts on marine mammals from construction of SPE Alternative 2 would include water quality changes (turbidity) in nearshore habitats, construction vessel traffic, changes in prey availability, and noise associated with impact and vibratory pile driving and other construction equipment. Since harbor seals are resident in Hood Canal, they would be present during the entire proposed construction season for the SPE (July 15 through January 15). Harbor porpoise and transient killer whales also may occur at any time during the year. California sea lions are present year round with minimal numbers occurring June through August, and Steller sea lions are present during fall through winter months (about 4 months out of the 6 months of in-water construction work). Marine mammals are likely to avoid (indicating behavioral disturbance) the vicinity of pile driving. The likelihood of adverse impacts on these species would be minimized through application of mitigation measures described in the Mitigation Action Plan (Appendix C).

WATER QUALITY

Construction of the SPE would affect water quality in project area waters due to anchoring of barges and tugs, installation of piles, and work vessel movement, as described in Section 3.1.2.3.2. The majority of impacts are expected to occur within the construction corridor surrounding pile locations (100 feet [30 meters]). A maximum of 3.9 acres (1.6 hectares) of bottom sediment may be disturbed within the construction footprint. Resuspended sediments would increase turbidity during in-water construction activities, but turbidity would be localized and temporary during the course of project construction, as discussed in Section 3.1.2.3.2. Metals and organic contaminants that may be present in sediments could also become suspended in the water column in the construction impact zone, but these contaminants are within sediment quality guidelines, as discussed in Section 3.1.1.1.3. Water quality could also be affected by stormwater discharges (contaminant loading), and spills (contaminant releases). However, construction-period conditions are not expected to exceed water quality standards, and measures for the protection of marine water quality and the seafloor would be implemented to minimize impacts (Mitigation Action Plan, Appendix C). Therefore, no impacts on marine mammals are expected due to changes in water quality during construction.

VESSEL TRAFFIC

Marine mammals at NAVBASE Kitsap Bangor encounter vessel traffic associated with daily operations, maintenance, and security monitoring along the waterfront, and it appears that individuals that frequent the waterfront have habituated to existing levels of vessel activity. During construction of the SPE, several additional vessels would operate in the project area. Construction activity involving vessel traffic may occur over 24 months, but the greatest activity levels would be associated with pile driving (up to 161 days during two in-water work seasons). Approximately six round trip barge and tug transits per month are expected for the duration of the project (Table 2–2). These vessels would operate at low speeds within the relatively limited construction zone and access routes during the in-water construction period. Low speeds are expected to reduce the impact of boat movements in the construction zone during this period. Marine vessel traffic would potentially pass near marine mammals on an incidental basis, but short-term behavioral reactions to vessels are not expected to result in long-term impacts on individuals, such as chronic stress, or to marine mammal populations in Hood Canal.

Collisions of vessels and marine mammals, primarily cetaceans, are not expected during construction because vessel speeds would be low. All of the cetaceans likely to be present in the project area are fast-moving odontocete species that tend to surface at relatively short, regular intervals allowing for increased detectability and avoidance. Vessel impacts are more frequently documented for slower-moving cetaceans or those that spend extended periods of time at the surface, but these species are rarely encountered in Hood Canal.

PREY AVAILABILITY

The prey base for the most common marine mammal species (harbor seal and California sea lion) in the project area potentially includes a wide variety of fishes including Pacific hake, forage fish such as Pacific herring, adult and juvenile salmonids, flatfish, and other finfish. Steller sea lions in the project area probably also consume a variety of pelagic and bottom fish. Harbor porpoise are occasionally seen in Hood Canal, where they probably feed on schooling forage fishes, such as Pacific herring, smelt, and squid. Transient killer whales consume marine mammals; in Hood Canal they preyed on harbor seals during prolonged stays in 2003 and 2005 (London 2006). Southern Resident killer whales do not occur in Hood Canal, but consume adult salmonids (with a strong preference for Chinook and chum salmon) that may originate in Hood Canal tributaries.

As described in Section 3.3.1.1, fish species and groups that occur in the deeper-water SPE project area include some forage fish (e.g., Pacific sand lance and Pacific herring) and salmonids (juvenile Chinook salmon, coho salmon, and steelhead; adult/sub-adult Chinook salmon, steelhead; and cutthroat trout) (Bhuthimethee et al. 2009). Other marine fish species likely are not abundant or diverse at the SPE project site. Benthic organisms are likely not as abundant at the SPE project site since it is located in waters deeper than 30 feet (9 meters) below MLLW, and the adjacent nearshore appears to support less diversity than the SPE project sites. The project site portion of the Bangor shoreline has a steep subtidal grade, lacks a flat bottom benthic habitat, and has no nearby freshwater nutrient input. These deeper-water resources offer suitable prey for some of the marine mammals that have been documented in Hood Canal and the Bangor waterfront, but available information is not sufficiently detailed to support a comparison of the SPE project site with other known or potential foraging sites in inland waters.

The greatest impacts on prey species during construction of the SPE project would result from resuspension of sediments, localized turbidity, and behavioral disturbance due to pile driving noise, as described in Section 3.3.2.3.2. Injury and behavioral disturbance of fish species due to underwater pile driving noise would directly affect the prey base for marine mammals. For SPE Alternative 2, fish potentially would be disturbed by pile driving noise resulting from operation of vibratory and impact rigs within 8,242 feet (2,512 meters) of impact pile driving noise and 384 feet (117 meters) of vibratory pile installation (Section 3.3.2.3.2), but may actually avoid a much smaller area. Thus, prey availability within an undetermined portion of the impact zone for fish would be reduced during construction due to noise. Mitigation measures designed to minimize noise effects on fish are described in the Mitigation Action Plan (Appendix C).

Some of the effects described above, such as barge placement, increased turbidity, and pile driving noise, would occur only during the in-water construction period and thus would be temporary (up to 6 months) and localized within the fish behavioral harassment zone. Long-term effects on prey availability are described below under Operation/Long-term Impacts. While localized effects of project construction may affect the prey base of pinnipeds that occur in the project vicinity, in the overall context of the Hood Canal harbor seal and California sea lion populations, the affected area is too small to represent a significant adverse impact.

With respect to the ESA-listed Southern Resident killer whale, the project has the potential to affect this population by indirectly affecting its prey base, which includes a disproportionate number of adult Chinook and chum salmon (Ford et al. 1998, 2010; Hanson et al. 2010; Hanson 2011). Available information on the proportion of Hood Canal Chinook salmon in the diet of Southern Resident killer whales indicates that it is about 20.4 percent in May (however, this is based on a sample size of only nine), but is less than 5 percent in other months (June to September) for which data are available. The stock identification of chum salmon in Southern Resident killer whale diets has not been reported and therefore the importance of Hood Canal chum salmon is unknown. Adult Hood Canal Chinook and chum salmon returns are subject to many variables (Section 3.3), among which the effects of the SPE are likely to be minor. Mitigation efforts, including scheduling in-water construction for the period when juvenile Chinook salmon are not present and using a bubble curtain for impact pile driving, would minimize this potential adverse effect. Therefore, the project's effect on Southern Resident killer whale prey base would be minimal. The ESA effect determination for construction activities under SPE Alternative 2 is "may affect, not likely to adversely affect" Southern Resident killer whales. The project would have no effect on critical habitat for Southern Resident killer whales because no critical habitat has been designated in Hood Canal.

UNDERWATER NOISE

Average underwater noise levels measured along the Bangor waterfront are elevated over ambient conditions at undeveloped sites due to waterfront operations, but are within the minimum and maximum range of measurements taken at similar environments within Puget Sound (see Appendix D). In 2009, the average broadband ambient underwater noise levels were measured at 114 dB re 1 μPa between 100 Hz and 20 kHz (Slater 2009). Peak spectral noise from industrial activity was below the 300 Hz frequency, with maximum levels of 110 dB re 1 μPa noted in the 125 Hz band. In the 300 Hz to 5 kHz range, average levels ranged between 83 and 99 dB re 1 μPa. Wind-driven wave noise dominated the background noise environment at approximately 5 kHz and above, and ambient noise levels flattened above 10 kHz. Underwater ambient noise measurements taken approximately 1.85 miles (3 kilometers) from the project area at EHW-1, during the TPP project in 2011, ranged from 112.4 dB re 1 μPa RMS between 50 Hz and 20 kHz at mid depth to 114.3 dB at deep depth (Illingworth & Rodkin 2012).

Increased vessel activity and barge-mounted construction equipment such as cranes and generators would elevate underwater noise levels in the project area. Noise from tugs associated with barge movement would produce intermittent noise levels of approximately 142 dB re 1 μPa at 33 feet (10 meters). Except at very close range, these noise sources and noise from other vessels and equipment would not exceed marine mammal thresholds for disturbance due to impact sound (160 dB RMS). These noise levels are typical of an industrial waterfront where tugs, barges, and other vessels are in operation, and consistent with noise levels experienced daily by marine mammals under existing conditions in the vicinity of the Bangor waterfront. Vessel noise includes narrowband tones at specific frequencies and broadband sounds, with energy spread over a range of frequencies that are audible to marine mammals. Smaller vessels that would be used in construction tend to generate low-frequency noise below 5 kHz. For example, tugs operating barges generate sounds from 1 kHz to 5 kHz, and small crewboats generate strong tones up to several hundred hertz (Richardson et al. 1995).

Underwater noise associated with impact and vibratory pile driving is likely to cause the most significant impacts on marine mammals present during construction of the SPE. Detailed analyses of pile driving noise propagation and pile driving source levels are presented in Appendix D, along with a discussion of the use of a bubble curtain to attenuate impact pile driving noise of steel piles. SPE Alternative 2 would require installation of 230 36-inch (90-centimeter) steel pipes, 50 24-inch (60-centimeter) steel piles, and 105 18-inch (45-centimeter) concrete fender piles over two in-water work seasons including comprising 125 days of driving steel support piles and 36 days of driving concrete fender piles. Most steel piles would be driven with a vibratory driver, and an impact hammer would be used to "proof" these piles. In cases where substrate conditions do not allow vibratory installation, an impact hammer may be needed to drive piles for part or all of their length.

Vibratory pile driving of 36-inch (90-centimeter) steel piles would produce noise levels of approximately 166 dB RMS re 1 μPa at 33 feet (10 meters) from the pile. Impact pile driving of 36-inch steel piles using a single-acting diesel impact hammer would produce average RMS noise levels of 186 dB RMS re 1 μPa at 33 feet, while using a bubble curtain that reduces noise levels by 8 dB. Vibratory pile driving of 24-inch (60-centimeter) steel piles would produce noise levels of approximately 161 dB RMS re 1 μPa at 33 feet from the pile. Impact pile driving of 24-inch steel piles using a single-acting diesel impact hammer would produce average RMS noise levels of 185 dB RMS re 1 μPa at 33 feet, while using a bubble curtain that reduces noise levels by 8 dB. Other mitigation measures, including a soft-start approach for pile driving operations and marine mammal monitoring and shutdown zones during pile driving, are described in the Mitigation Action Plan (Appendix C). The project would also require pile driving of 18-inch (45-centimeter) square concrete piles. The source level for this pile driving is 170 dB RMS re 1 μPa at 33 feet (Appendix D). All of the concrete piles would be installed with an impact hammer. A bubble curtain would not be used for installation of concrete piles because the source level at 33 feet (10 meters) is lower than the injury impact thresholds for marine mammals (180 dB RMS for cetaceans and 190 dB RMS for pinnipeds) (Table 3.4–14). Most of the energy in pile driving sound underwater is contained in the frequency range 25 Hz and 1.6 kHz, with the highest energy densities between 50 and 350 Hz (Reyff et al. 2002). In some studies, underwater pile driving noise has been reported to range up to 10 kHz with peak amplitude below 600 Hz (Laughlin 2005).

Sound from impact pile driving would be detected above the average background noise levels at locations in Hood Canal with a direct acoustic path (i.e., line-of-sight from the driven piles to receiver location). Intervening land masses would block sound propagation outside of direct paths.

Responses to Underwater Pile Driving Noise at the SPE Project Sites

Marine mammals encountering pile driving operations during the in-water construction season would likely avoid affected areas in which they experience noise-related discomfort, limiting their ability to forage or rest there. Individual responses to pile driving noise are expected to be variable. For example, some individuals may occupy the project area during pile driving without apparent discomfort, but others may be displaced by undetermined long-term effects. Avoidance of the affected area during pile driving operations would reduce the likelihood of injury impacts but also would reduce access to foraging areas in nearshore and deeper waters of Hood Canal. Noise-related disturbance across the 1.5-mile (2.4-kilometer) width of Hood Canal may inhibit some marine mammals from transiting the area. During pile driving over the two in-water construction season, there is a potential for displacement of marine mammals from the affected area due to these behavioral disturbances during the in-water construction season. However, habituation may occur over time, along with a decrease in the severity of responses. Also, since pile driving would only occur during daylight hours, marine mammals transiting the project area or foraging or resting in the project area at night would not be affected. Any potential impacts from pile driving activities could be experienced by individual marine mammals, but would not cause population level impacts or affect the continued survival of the species.

Underwater Injury and Behavioral Harassment Thresholds

The following analysis of noise-related impacts on marine mammals provides calculations of incidental harassment exposures of all marine mammal species that occur in the SPE project area, as required by the MMPA. "Take" under the MMPA is calculated at two levels, injury exposure and behavioral harassment exposure. The effects analysis uses the terms "injury exposure" and "behavioral harassment exposure" for MMPA effects and states the number of exposures that the Navy will request for each marine mammal species in its IHA applications. NMFS identified threshold criteria for determining injury exposure to underwater noise as 190 dB RMS re 1 μPa for pinnipeds and 180 dB RMS re 1 μPa for cetaceans (65 FR 16374-16379) (Table 3.4–14). Injury exposure criteria have been used by NMFS to define the impact zones for seismic surveys and impact hammer pile driving projects, within which project activities may be shut down if protected marine mammals are present (e.g., examples cited in 71 FR 4352, 71 FR 6041, 71 FR 3260, and 65 FR 16374). NMFS has identified different thresholds for exposure to behavioral harassment for impact pile driving (an impulsive noise impact) versus vibratory pile driving (a continuous noise impact). For both cetaceans and pinnipeds, the behavioral harassment threshold for impact pile driving is 160 dB RMS re 1 μPa, and the threshold for continuous noise such as vibratory pile driving is 120 dB RMS re 1 μPa.

Table 3.4–14. Current Marine Mammal Injury and Behavioral Harassment Thresholds for Underwater and Airborne Sounds

Marine Mammals	Airborne Marine Construction Thresholds (Impact and Vibratory Pile Driving) (dB re 20 μPa unweighted)	Underwater Vibratory Pile Driving[2] Threshold (dB re 1 μPa)		Underwater Impact Pile Driving[3] Thresholds (dB re 1 μPa)	
	Disturbance Guideline Threshold[1]	Injury Threshold	Behavioral Harassment Threshold	Injury Threshold	Behavioral Harassment Threshold
Cetaceans (whales, dolphins, porpoises)	N/A	180 dB RMS	120 dB RMS	180 dB RMS	160 dB RMS
Pinnipeds (sea lions and seals, except harbor seal)	100 dB RMS	190 dB RMS	120 dB RMS	190 dB RMS	160 dB RMS
Harbor seal	90 dB RMS	190 dB RMS	120 dB RMS	190 dB RMS	160 dB RMS

dB = decibel; μPa = micropascal; N/A = not applicable, no established threshold; RMS = root mean square

1. Sound level at which pinniped haul-out disturbance has been documented. Not an official threshold, but used as a guideline.
2. Non-pulsed, continuous sound.
3. Impulsive sound.

NOAA (2015) has recently developed draft acoustic threshold levels for determining the onset of PTS and TTS (permanent and temporary hearing threshold shifts, respectively) in marine mammals in response to underwater impulsive and non-impulsive sound sources. The draft criteria use cumulative SEL metrics (dB SEL_{CUM}) and peak pressure (dB peak) rather than the currently used dB RMS metric. NOAA equates the onset of PTS, which is a form of auditory injury, with Level A harassment under the MMPA and "harm" under the ESA. The onset of TTS would be a form of Level B harassment under the MMPA and "harassment" under the ESA. Both forms of harassment would constitute "take" under these statutes. The draft injury criteria are currently in public review and have not been finalized. Revised behavioral harassment criteria not involving TTS (but resulting in Level B take) are currently in review. If the new injury criteria are adopted by NOAA prior to the completion of the ROD for the project, the noise effects analysis for marine mammals would be updated. Otherwise, the noise analysis would not be updated.

With a properly functioning bubble curtain in place on the impact hammer rig, construction of SPE Alternative 2 would likely result in noise-related injury to pinnipeds and cetaceans within 16 feet (5 meters) and 82 feet (25 meters) from a driven pile, respectively (Table 3.4–15). Injury exposure to intense underwater noise could consist of PTS or other tissue damage. However, marine mammals are unlikely to be injured by pile driving noise at these short distances because the high level of human activity and vessel traffic would cause them to avoid the immediate construction area. Cetaceans in particular are unlikely to swim this close to manmade structures. In addition, marine mammal monitoring during construction (Mitigation Action Plan, Appendix C, Section 4.2) would preclude exposure to injury from pile driving noise.

No physiological impacts are expected from pile driving operations during construction of the SPE for the following reasons. First, vibratory pile driving, which would be the primary installation method, does not generate high enough peak sound pressure levels to produce physiological damage. For SPE Alternative 2, the primary method of installation for the 24- and 36-inch (60-and 90-centimeter) steel piles would be vibratory driving. An impact hammer would be utilized to "proof" piles if needed; proofing a steel pile is assumed to require no more than 200 strikes of the impact hammer. Square concrete piles would be driven with an impact hammer only and require no more than 300 strikes per pile. Thus, under the worst-case scenario, marine mammals in the vicinity of the SPE project sites would experience elevated noise levels for only a portion of the day. Additionally, the bubble curtains that the Navy would employ during impact pile driving (Appendix D) would greatly reduce the chance that a marine mammal may be exposed to sound pressure levels that could cause physical harm. During impact pile driving, the Navy would employ a bubble curtain to attenuate initial sound pressure level. Moreover, the Navy would have trained biologists monitoring a shutdown zone equivalent to the potential physiological injury zone (Mitigation Action Plan, Appendix C) to preclude the potential for injury of marine mammals.

The areas encompassed by these threshold distances within the SPE Alternative 2 project area are shown in Table 3.4–15, and a representative scenario of areas affected by above-threshold noise levels is shown in Figure 3.4-4. The representative areas in Figure 3.4–4 depict effects related to operation of a pile driver at one location at the seaward end of the SPE, but pile driving would occur along the entire length of the pier during the course of project construction. Only one impact pile driver would operate at a time. Table 3.4–15 shows the ZOIs affected by pile driving at this representative location. Placement of pile driving rigs at other locations along the SPE alignment would generate above-threshold noise levels in slightly different areas.

Table 3.4–15. Calculated Maximum Distance(s) to the Underwater Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Current Noise Thresholds, SPE Alternative 2

Affected Area	Impact Injury Pinnipeds (190 dB RMS)[1]	Impact Injury Cetaceans (180 dB RMS)[1]	Impact Behavioral Harassment Cetaceans & Pinnipeds (160 dB RMS)[1]	Vibratory Behavioral Harassment Cetaceans & Pinnipeds (120 dB RMS)[2]
36-inch (90-centimeter) Steel Piles				
Distance to Threshold[1]	16 ft (5 m)	82 ft (25 m)	1,775 ft (541 m)	7.2 mi (11.7 km)
Area Encompassed by Threshold	850 sq ft (79 sq m)	21,022 sq ft (1,953 sq m)	0.30 sq mi (0.77 sq km)	19.3 sq mi[2] (50.1 sq km)
24-inch (60-centimeter) Steel Piles				
Distance to Threshold[1]	16 ft (5 m)	72 ft (22 m)	1,522 ft (464 m)	3.4 mi (5.4 km)
Area Encompassed by Threshold	850 sq ft (79 sq m)	16,372 sq ft (1,521 sq m)	0.21 sq mi (0.53 sq km)	9.6 sq mi[2] (24.8 sq km)
18-inch (45-centimeter) Concrete Piles				
Distance to Threshold[3]	<2 ft (<1 m)	7 ft (2 m)	151 ft (46 m)	N/A
Area Encompassed by Threshold	Negligible	Negligible	0.003 sq mi (0.007 sq km)	N/A

dB = decibel; ft = feet; m = meter; RMS = root mean square; sq ft = square feet; sq km = square kilometer; sq m = square meter; sq mi = square mile

1. Bubble curtain assumed to achieve 8 dB reduction in sound pressure levels during impact pile driving. Sound pressure levels used for calculations were: 186 dB re 1 µPa at 33 feet (10 meters) for impact hammer with bubble curtain and 166 dB re 1 µPa for vibratory driver for 36-inch (90-centimeter), hollow steel pile. All sound levels are expressed in dB RMS re 1 µPa.
2. Calculated area is greater than actual sound propagation through Hood Canal due to intervening land masses. Thus 7.2 miles (11.7 kilometers) is the greatest line-of-sight distance from pile driving locations unimpeded by land masses.
3. Sound pressure levels used for calculations were 170 dB re 1 µPa at 33 feet (10 meters) for impact hammer without bubble curtain.

Behavioral disturbance due to impact pile driving is calculated at approximately 1,775 feet (541 meters) from the driven pile, resulting in an affected area of approximately 0.30 square mile (0.77 square kilometer) around the driven pile. Marine mammals within this area would be susceptible to behavioral harassment during impact pile driving operations. The calculated distance for the behavioral harassment threshold due to vibratory installation is approximately 7.2 miles (11.7 kilometers), but intervening land masses would truncate the propagation of underwater pile driving sound from a driven pile (Figure 3.4–4). The area encompassed by the truncated threshold distance is approximately 19.3 square miles (50.1 square kilometers) around the pile drivers (Figure 3.4–4). Marine mammals within this area would be susceptible to behavioral harassment due to vibratory pile driving operations.

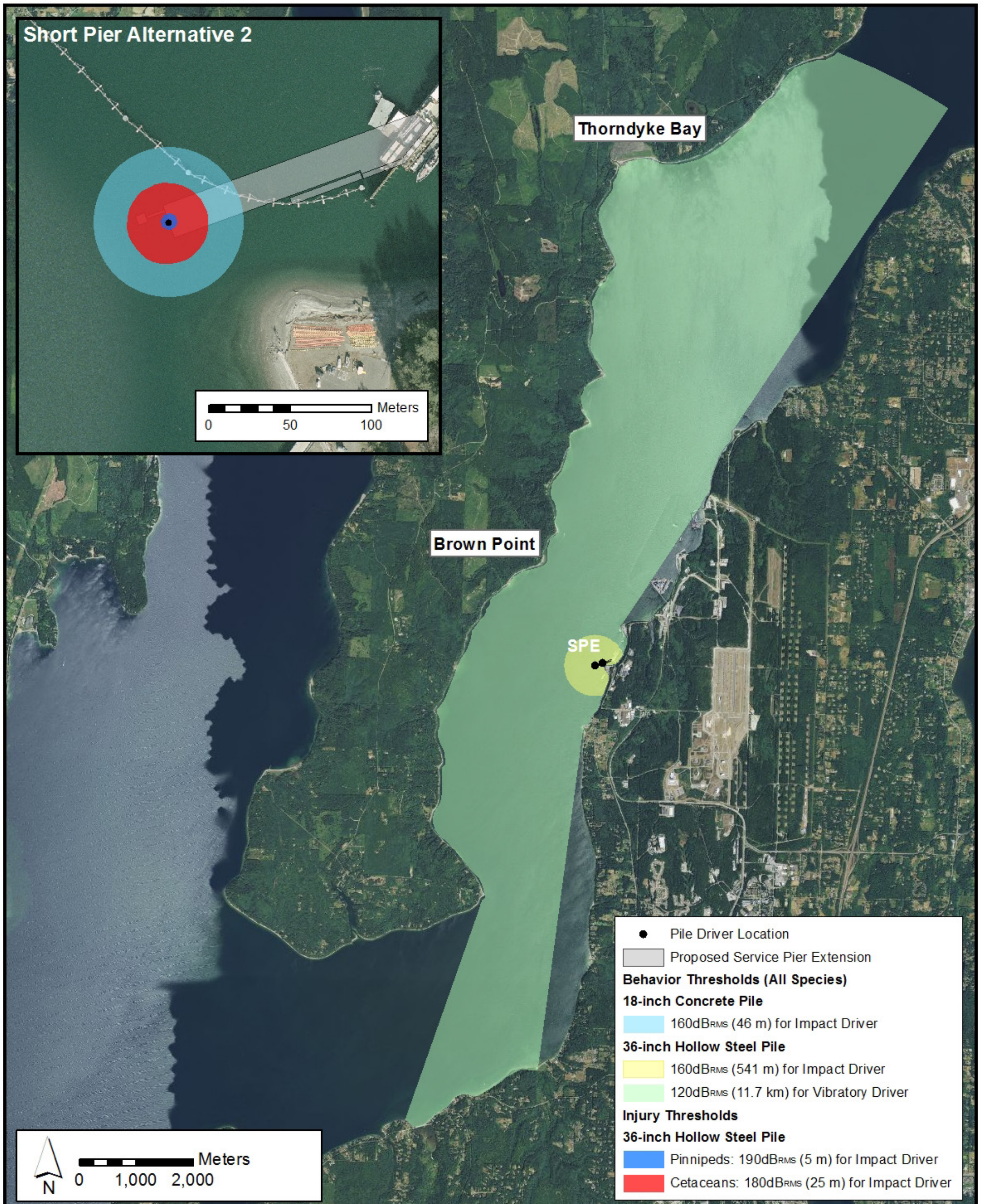


Figure 3.4-4. Representative View of Affected Areas for Marine Mammals due to Underwater Pile Driving Noise during Construction of SPE Alternative 2

As described in Section 3.4.1.2.2, behavioral responses of marine mammals to underwater noise are variable and context-specific. Some individuals may habituate to the elevated construction noise levels and continue to use the affected area, while other animals may avoid the area or respond by modifying feeding or resting behaviors. Temporary loss of hearing sensitivity in marine mammals (TTS) is a possible outcome of exposure to intense underwater noise that would be considered a form of behavioral harassment, as TTS is considered to be physiological fatigue rather than injury (Popper et al. 2006). Notwithstanding, TTS is an undesirable outcome of noise exposure because it can potentially affect communication and/or the ability to detect predators or prey. Behavioral harassment can also be indicated by actions such as avoidance of the construction area, changes in travel patterns, diving behavior, respiration, or feeding behavior.

AIRBORNE NOISE

Construction of SPE Alternative 2 would result in increased airborne noise in the vicinity of the construction site, as discussed in Section 3.9.3.3. The highest noise source levels would be associated with impact pile driving (230 36-inch [90-centimeter] steel pipes, 50 24-inch [60-centimeter] steel support piles and 105 18-inch [45-centimeter] concrete fender piles). The worst-case pile driving source level (for 36-inch steel piles) is estimated to be 112 dB RMS re 20 μPa (unweighted) at 50 feet (15 meters) from the pile for an impact hammer, and 95 dB RMS re 20 μPa (unweighted) at 50 feet from the pile for vibratory pile driving (Section 3.9.3.3.2).

The dominant airborne noise frequencies produced by pile driving are between 50 and 1,000 Hz (WSDOT 2013). No airborne source levels were available for 18-inch concrete pile. Modeled distances to airborne thresholds would likely be considerably smaller for concrete piles than for steel piles.

Airborne noise would primarily be an issue for pinnipeds that are swimming or hauled out in the project area. Mitigation measures for pile driving noise, including a soft-start approach to pile driving operations and marine mammal monitoring, are described in the Mitigation Action Plan (Appendix C).

In addition to pile driving, other SPE construction activities and equipment would generate lower noise levels that are comparable to ambient levels elsewhere along the NAVBASE Kitsap Bangor waterfront where ongoing operations use trucks, forklifts, cranes, and other equipment (Section 3.9.3.3). Construction equipment for the SPE project would include backhoes, bulldozers, loaders, graders, trucks, and cranes. Activities that would generate elevated noise levels could include removal of creosote timber piles, installation of a new wave screen, construction of the Pier Services and Compressor building (Figure 2–9), and other upland construction. Average noise levels are expected to be in the 60 to 68 dBA range, consistent with urbanized or industrial environments where equipment is operating and similar to the range of noise measured on Delta Pier (Navy 2010). Operation of non-pile driving, heavy construction equipment would produce airborne noise levels ranging from 78 to 90 dBA at 50 feet (15 meters) (WSDOT 2013). In the absence of pile driving noise and with simultaneous operation of two types of heavy equipment, the maximum construction noise level is estimated to be 94 dBA at a distance of 50 feet (see Section 3.9), but this noise level would be occasional.

Responses to Airborne Pile Driving Noise at the SPE Project Sites

Pinnipeds have habituated to existing airborne noise levels at Delta Pier on NAVBASE Kitsap Bangor, where they regularly haul out on submarines and the pontoons supporting the PSB. Most likely, airborne sound would cause behavioral responses similar to those discussed above in relation to underwater noise. For instance, elevated airborne construction noise could cause hauled out pinnipeds to return to the water, reduce vocalizations, or cause them to temporarily abandon their usual or preferred haul-out locations and move farther from the noise source. Pinnipeds swimming in the vicinity of pile driving may avoid or withdraw from the area or show increased alertness or alarm (e.g., head out of the water and looking around).

Airborne Sound Behavioral Harassment Thresholds

Pile driving can generate airborne noise that could potentially result in disturbance to marine mammals (pinnipeds) that are hauled out or at the water's surface. As a result, the Navy analyzed the potential for pinnipeds hauled out or swimming at the surface near NAVBASE Kitsap Bangor to be exposed to airborne noise that could result in behavioral harassment as defined by the MMPA. There are no criteria for injury due to elevated airborne sound. NMFS has defined the airborne noise threshold for behavioral harassment for all pinnipeds except harbor seals as 100 dB RMS re 20 µPa (unweighted) (Table 3.4–14). The threshold value for harbor seals is 90 dB RMS re 20 µPa (unweighted).

Airborne impact pile driving noise for 36-inch (90-centimeter) steel piles for the SPE would likely result in behavioral harassment to harbor seals at a distance of 620 feet (189 meters) and to other pinnipeds (California sea lions and Steller sea lions) at a distance of 197 feet (60 meters) (Table 3.4–16). Vibratory pile driving noise would likely result in behavioral harassment to harbor seals at a distance of 89 feet (27 meters) and to other pinnipeds at a distance of 26 feet (8 meters) (Table 3.4–16). The areas encompassed by these threshold distances are shown in Table 3.4–16 and a representative scenario of areas affected by above-threshold airborne noise levels for an impact pile driving rig is shown in Figure 3.4–5. Other areas would be included in the above-threshold noise areas if the analysis was performed for pile driving rigs at other locations on the SPE structure.

Table 3.4–16. Calculated Maximum Distances in Air to Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Noise Thresholds, SPE Alternative 2

Affected Area	Impact Behavioral Harassment Harbor Seal (90 dB RMS)[1]	Impact Behavioral Harassment Other Pinnipeds (100 dB RMS)[1]	Vibratory Behavioral Harassment Harbor Seal (90 dB RMS)[1]	Vibratory Behavioral Harassment Other Pinnipeds (100 dB RMS)[1]
Distance to Threshold[1]	620 ft (189 m)	197 ft (60 m)	89 ft (27 m)	26 ft (8 m)
Area Encompassed by Threshold	0.04 sq mi (0.11 sq km)	0.004 sq mi (0.011 sq km)	24,639 sq ft (2,289 sq m)	2,153 sq ft (201 sq m)

dB = decibel; ft = feet; m = meter; RMS = root mean square; sq km = square kilometer; sq mi = square mile

1. Sound pressure levels used for calculations were 112 dB RMS re 20 µPa at 50 feet (15 meters) (Section 3.9.3.3.2) for impact hammer for 36-inch (90-centimeter) steel pile, and 95 dB RMS re 20 µPa at 50 feet (15 meters) for vibratory driver for 36-inch steel pile. All distances are calculated over water.

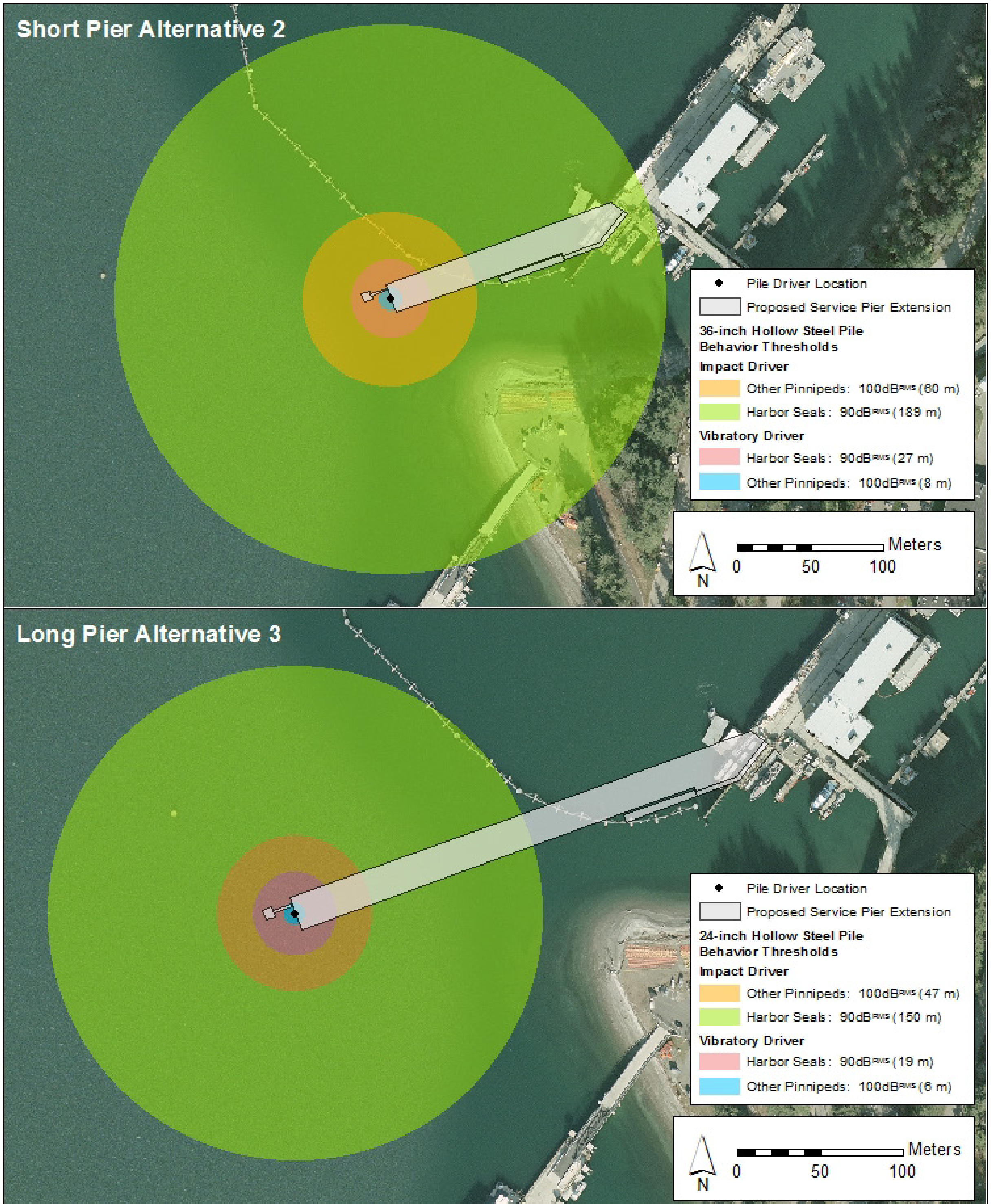


Figure 3.4-5. Representative View of Affected Areas for Marine Mammals due to Airborne Pile Driving Noise during Construction of SPE Alternatives 2 and 3

The distance between the SPE project site and haul-out sites at Delta Pier is 4,800 feet (1,460 meters), which is beyond the airborne behavioral harassment threshold for California sea lion and Steller sea lions. However, harbor seals were observed swimming in the project area during waterfront surveys (Tannenbaum et al. 2009a, 2011a) and may be susceptible to airborne noise disturbance resulting from pile driving. No threshold has been identified for injury to marine mammals due to airborne sound.

CALCULATIONS OF EXPOSURE OF MARINE MAMMALS TO NOISE IMPACTS

The analysis approach in the following section focuses on quantifying potential exposure of marine mammals to project impacts based on their density in the project area and the duration of project activities that may affect these species. The term exposure in this analysis signifies "take" under the MMPA, as detailed in Section 3.4.2.3.2, under Underwater Noise. The following species are included in the analysis because their occurrence in Hood Canal has been confirmed by specific observations during the past decade: harbor seal, California sea lion, Steller sea lion, harbor porpoise, and transient killer whale (see Section 3.4.1 for marine mammal species accounts).

Method of Incidental Taking (MMPA)

Pile driving activities associated with construction of the SPE, as described above, have the potential to disturb or displace marine mammals, but injury is not anticipated given the methods of installation and measures designed to minimize the possibility of injury to marine mammals. Vibratory pile drivers would be the primary method of installation, although they are not expected to cause injury to marine mammals due to the relatively low source levels (166 dB). Also, no impact pile driving of steel pile would occur without a bubble curtain, and pile driving would either not start or be halted if marine mammals approach the shutdown zone. Although the Proposed Action may affect the prey and other habitat features of marine mammals, none of these effects is expected to rise to the level of take under MMPA, as described in the following sections. The ESA-listed Southern Resident killer whale was included in the analysis of indirect effects on its prey base in Section 3.4.2.3.2, under Prey Availability, but is not carried forward in the noise effects analysis because its occurrence has not been confirmed in Hood Canal for 15 years. The humpback whale is not included in the noise effects analysis because they are rarely observed in Hood Canal, and infrequent sightings of the species has shown them occurring at the end of the in-water work window, when pile driving activities would be concluded. Therefore, no noise impacts are expected for Southern Resident killer whale or humpback whale.

Description of Exposure Calculation

The calculations presented here rely on the best data currently available for marine mammal population densities in Hood Canal (Navy 2013). The Navy's database (Navy Marine Species Density Database [NMSDD]) is the overarching database for all Navy projects within its operating areas. The Navy has utilized the NMSDD, in tandem with local observational data, to support several pile driving projects whose applications have been submitted to NMFS. The Northwest region's NMSDD densities were finalized in 2012. The calculations presented in this section rely on NMSDD data for harbor seals and harbor porpoises that occur in Hood Canal (Table 3.4–17). Site-specific abundance data are available from monitoring of Steller sea lions and California sea lions at NAVBASE Kitsap Bangor (see Tables 3.4–18 and 3.4–20, respectively; Navy 2015a). Transient killer whale exposure calculations are described below.

Table 3.4–17. Marine Mammal Species Densities in Hood Canal

Species	Density in Hood Canal[1] animals/sq mi (animals/sq km)	Months Present in Hood Canal
Harbor seal[2]	20.55 (7.93)	Year round
Harbor porpoise	0.38 (0.149)	Potentially year round

Source: Navy 2013

sq km = square kilometer; sq mi = square mile

1. Density is the largest estimate available from fall, summer, and winter estimates. Spring (March 1 through May 31) estimates were not included because the time period is outside the in-water work period.
2. Includes correction for the estimated portion of the harbor seal population that is not hauled out at a given time (London et al. 2012).

Successful implementation of mitigation measures (visual monitoring and the use of shutdown zones) would preclude injury exposures for marine mammals. However, exposures to pile driving noise would result in behavioral disturbance. Results of noise effects exposure assessments should be regarded as conservative overestimates that are influenced by limited occurrence data and the assumption that individuals may be present every day of pile driving.

The method for calculating potential exposures to impact and vibratory pile driving noise includes the following assumptions:

- Each species' population is at least as large as any previously documented highest population estimate.
- Each species would be present in the project area during construction at the start of each day, based on observed patterns of occurrence in the absence of construction. The timeframe for exposures would be 1 potential exposure per individual per 24 hours.
- All piles to be installed would have an underwater noise disturbance distance equal to the noise disturbance distance (ZOI[3]) from the pile that would cause the greatest noise disturbance (i.e., the pile farthest from shore). The underwater ZOI was calculated based on the pile driving method that produces the largest ZOI (i.e., vibratory pile driving). Although some piles would be installed with an impact hammer, the ZOI for an impact hammer would be encompassed by the larger ZOI for the vibratory driver.[4]
- In the absence of site-specific underwater acoustic propagation modeling, the practical spreading loss model was used to determine the ZOI for underwater noise.
- Some type of mitigation (i.e., bubble curtain) would be used for impact pile driving and achieve 8 dB reduction in source levels.

[3] Zone of Influence (ZOI) is the area encompassed by all locations where the sound pressure levels equal or exceed the threshold being evaluated.
[4] Although pile driving noise source levels are higher for impact-driven piles than vibratory-driven piles, the behavioral disturbance criterion for vibratory-driven piles (120 dB RMS) encompasses a much greater area than the criterion for impact-driven piles (160 dB RMS).

For species with density estimates (e.g., harbor seal, harbor porpoise), exposures are estimated by:

Exposure estimate = (n * ZOI)* X days of pile driving activity,

where:

n = density estimate used for each species/season, and
ZOI = noise threshold zone of influence (ZOI) impact area, and
X = number of days of pile driving estimated based on the total number of piles and the estimated number of piles installed per day.

The ZOI impact area is the estimated range of impact on the noise criteria thresholds for both underwater and airborne noise. The distances specified in Tables 3.4–15 and 3.4–16 were used to calculate the overwater areas that would be encompassed within the threshold distances for injury or behavioral harassment. All calculations were based on the estimated threshold ranges using a bubble curtain with 8 dB attenuation as a mitigation measure for impact pile driving. The greatest area affected by construction noise was defined as the calculated distance from SPE pile driving locations to the behavioral harassment threshold (120 dB sound pressure level), or the greatest line-of-sight distance (7.2 miles [11.7 kilometers]) that underwater sound waves could travel from pile driving locations unimpeded by land masses (Figure 3.4–4). The affected area was determined to be 19.3 square miles (50.1 square kilometers) (Table 3.4–15).

The product of n*ZOI was rounded to the nearest whole number before multiplying by the number of pile driving days. If the product of n*ZOI rounds to zero, the number of exposures calculated was zero regardless of the number of pile driving days. The exposure assessment methodology is an estimate of the numbers of individuals exposed to the effects of pile driving activities exceeding NMFS-established thresholds for underwater and airborne noise. Of significant note in these exposure estimates is that (1) implementation of one mitigation method (bubble curtain use during impact pile driving) would result in a quantifiable reduction in exposures of marine mammals to pile driving noise, (2) successful implementation of other mitigation measures such as soft starts is not reflected in exposure estimates, and (3) exposure calculations do not include Level A take because marine mammal monitoring/shutdown implementation would preclude exposure to injurious noise levels. Results from acoustic impact exposure assessments should be regarded as conservative overestimates that are strongly influenced by limited marine mammal population data.

For species with available counts of animals in the project area (Steller and California sea lions), exposures are estimated by:

Exposure estimate = (Abundance) * X days of pile driving activity,

where

Abundance = average monthly maximum counts during the months when pile driving will occur.

SUMMARY OF PROJECT IMPACTS AND ESTIMATED EXPOSURES FOR SPECIES PRESENT IN THE SPE PROJECT AREA

Steller Sea Lion

Steller sea lions are occasionally present in Washington inside waters from early fall to late spring (Jeffries et al. 2000; NMFS 2010) and have been detected in Hood Canal during the period from late September to May (Bhuthimethee 2008, personal communication; Navy 2015a; Table 3.4–18). Most detections of Steller sea lions in Hood Canal have been individuals hauled out on submarines docked at Delta Pier (Navy 2015a).

Although the Navy has determined a density for Steller sea lions in Hood Canal (Navy 2013), when more site-specific data are available it is preferable to use that data to determine the abundance of individuals that may be exposed to noise effects. This is because a density analysis assumes an even distribution of animals, whereas in reality Steller sea lion distribution within the project area is concentrated at Delta Pier. Therefore, the noise exposure calculation for Steller sea lions uses the average maximum monthly abundance of the species during the in-water work window, defined as the average of the monthly maximum number of individuals present during surveys at Delta Pier from July to January during the years 2008 through 2015. The abundance trend for Steller sea lions at Delta Pier has increased since the Navy began monitoring them in November 2008.

Table 3.4–18. Steller Sea Lions Observed at NAVBASE Kitsap Bangor, April 2008–December 2015

	Maximum Number of Steller Sea Lions Observed in Single Survey								
		2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	MAX Average
In-water Work Window July 15 - January 15	July	0	0	0	0	0	0	0	0
	August	0	0	0	0	0	0	0	0
	September	0	0	5	0	0	0	0	1
	October	0	0	4	3	6	9	3	4
	November	4	6	4	5	4	11	13	7
	December	0	3	2	4	4	N/A	7	3
	January	0	2	1	3	N/A	1	6	2
	February	0	0	2	2	2	0	0	1
	March	0	2	2	3	N/A	1	1	2
	April	0	4	6	4	0	2	1	2
	May	0	0	6	3	0	2	0	2
	June	0	0	0	0	N/A	0	0	0
	Average of in-water work window								**2**

Source: Navy 2015a
N/A = no survey was conducted

Exposures to underwater pile driving noise were calculated using the abundance-based formula above, under Description of Exposure Calculation. Table 3.4–19 depicts the number of potential behavioral harassment exposures that are estimated from underwater vibratory and impact pile driving. Using the abundance-based analysis, the most conservative criterion for behavioral harassment (the 120 dB continuous noise harassment threshold), and an average daily abundance of approximately 2 individual Steller sea lions may experience underwater sound pressure levels that would qualify as behavioral harassment on a given day. The noise exposure formula above predicts 250 exposures to underwater noise within the behavioral harassment threshold for vibratory pile installation over the 125 days of pile driving for 36-inch (90-centimeter) steel pile. Over the 36 days of concrete pile driving, the abundance-based formula predicts an additional 72 exposures due to impact pile driving, but the potential exposures calculated this way would be an overestimate because the affected area would be very small (approximately 151 feet [46 meters] from the driven pile) and Steller sea lions would be unlikely to approach active pile driving sites at this distance.

Table 3.4–19. Number of Potential Exposures of Marine Mammals, SPE Alternative 2

Species	Underwater Behavioral Harassment		Airborne Behavioral Harassment
	Steel Piles, Vibratory Pile Driver, All Species (120 dB RMS)	Concrete Piles, Impact Pile Driver, All species, (160 dB RMS)	Steel Piles, Impact Pile Driver Harbor Seal (100 dB RMS), Other Pinnipeds (90 dB RMS)
Steller sea lion	250	72	0
California sea lion	4,500	1,296	0
Harbor seal	49,625	0	0
Harbor porpoise	875	0	N/A
Transient killer whale	180	0	N/A

All underwater sound levels are expressed as dB re 1 μPa; all airborne sound levels are expressed as dB re 20 μPa.
dB = decibel; RMS = root mean square

The airborne exposure calculations assumed that 100 percent of the in-water animals would be available at the surface to be exposed to airborne sound. Sea lions hauled out on submarines at Delta Pier would be beyond the areas encompassed by the airborne noise behavioral harassment threshold for the SPE (Figure 3.4–5) and, therefore, are unlikely to be affected by construction activities. Animals swimming with their heads above the water would potentially be affected by elevated airborne pile driving noise within a small ZOI (197 feet [60 meters]). Given that both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance ZOIs, airborne pinniped takes would be encompassed by underwater exposures, and no additional incidental takes were requested for airborne noise. Therefore, the total number of exposures of Steller sea lions over the entire pile driving period for the SPE project is estimated to be 322 (all underwater).

Steller sea lions are unlikely to be injured by underwater pile driving noise because they are unlikely to be within the injury threshold distance for underwater pile driving noise (16 feet [5 meters] from the driven pile). Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities for the presence of marine mammals (see Mitigation Action Plan, Appendix C for a detailed discussion of mitigation measures), and they would alert work crews when to begin or stop work due to the presence of sea lions in or near the shutdown zones, thereby precluding the potential for injury.

Steller sea lions would most likely avoid waters within the areas affected by above-threshold noise levels during impact pile driving around the SPE project site. Steller sea lions exposed to elevated noise levels could exhibit behavioral changes such as avoidance of the affected area, increased swimming speed, increased surfacing time, or decreased foraging activity. Pile driving would occur only during daylight hours, and therefore would not affect nocturnal movements of Steller sea lions in the water. Most likely, Steller sea lions affected by elevated underwater or airborne noise would move away from the sound source and be temporarily displaced from the affected areas. However, they likely would continue using submarines at Delta Pier as haul-out sites during pile driving, based on evidence cited in Section 3.4.1.2.3 regarding responses of pinnipeds to construction noise including pile driving. Given the absence of any rookeries and only one haul-out area near the project site (i.e., submarines docked at Delta Pier), and infrequent occurrence by a small number of individuals at this site, potential disturbance exposures would have a negligible effect on individual Steller sea lions and would not result in population-level impacts.

The prey base of Steller sea lions includes forage fish and salmonids, which potentially would be less available for predators within the fish injury exposure and behavioral harassment zones (Section 3.3) during the 6-month, in-water construction window. The potential impact on Steller sea lions would be a localized (within the fish behavioral harassment zone), temporary loss of foraging opportunities (during in-water construction) and potential exposure to behavioral harassment as they transit the project area.

California Sea Lion

No regular haul-outs of California sea lions were documented during prior aerial surveys of pinniped populations in Hood Canal (Jeffries et al. 2000) over a decade ago, but the Navy's more recent observations of animals hauled out on submarines and the PSB on NAVBASE Kitsap Bangor indicate that California sea lions are now present in Hood Canal during much of the year. During the in-water construction period (July 15 to January 15), the maximum monthly attendance averaged for each month ranged from 1 to 74 individuals. The largest monthly average (74 animals) during the in-water work window was recorded in November, as was the largest daily count (122) (Table 3.4–20). The likelihood of California sea lions being present at the Bangor waterfront was greatest from October through May, when the frequency of occurrence in surveys was at least 0.80 (i.e., 80 percent of surveys had California sea lions present).

The noise exposure analysis for California sea lions is similar to the approach described above for Steller sea lions. The Navy used the average daily abundance of the species during the in-water work window, defined as the average of the monthly maximum number of individual present during surveys at Delta Pier from July 15 to January 15. From April 2008 through December 2015 the average of the monthly maximum number present during the in-water work window was approximately 36 animals (Table 3.4–20). Using the abundance-based analysis and the most conservative criterion for behavioral harassment (the 120 dB continuous noise harassment threshold), an average of 36 individual California sea lions may experience underwater sound pressure levels on a given day that would qualify as behavioral harassment. Over the 125 days of steel pile driving, the noise exposure formula predicts 4,500exposures to underwater noise within the behavioral harassment threshold for vibratory pile installation. Over the 36 days of concrete pile driving, the abundance-based formula predicts an additional 1,296 exposures due to impact pile driving, but the potential exposures are an overestimate because the ZOI is very small (approximately 151 feet [46 meters] from the driven pile). The total number of exposures over the entire pile driving period for this alternative is estimated to be 5,796 (all underwater) (Table 3.4–19).

Table 3.4–20. California Sea Lions Observed at NAVBASE Kitsap Bangor, April 2008–December 2015

	Maximum Number of California Sea Lions Observed in Single Survey								
		2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	MAX Average
In-water Work Window July 15 - January 15	July	0	0	0	0	3	0	1	1
	August	0	1	3	4	5	0	15	4
	September	12	32	33	14	11	35	44	26
	October	47	44	42	56	70	88	84	62
	November	50	58	42	81	70	122	93	74
	December	27	38	50	64	69	N/A	63	52
	January	4	44	33	43	N/A	48	43	36
	February	28	34	42	48	44	42	32	39
	March	37	40	54	82	N/A	65	55	56
	April	46	51	66	52	32	49	48	49
	May	33	17	54	18	N/A	20	12	26
	June	3	12	17	4	N/A	8	8	9
								Average of in-water work window	**36**

Source: Navy 2015a
N/A = no survey was conducted

Sea lions are unlikely to be injured by pile driving noise because they are unlikely to be within the injury threshold distance for pile driving noise (16 feet [5 meters] from the driven pile). Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities for the presence of marine mammals (see Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures), and they would alert work crews when to begin or stop work due to the presence of sea lions in or near the shutdown zones, thereby precluding the potential for injury.

California sea lions would most likely avoid the waters within the areas affected by above-threshold noise levels during impact pile driving around the SPE project site. Sea lions exposed to elevated noise levels could exhibit behavioral changes such as avoidance of the affected area, increased swimming speed, increased surfacing time, or decreased foraging activity. Pile driving would occur only during daylight hours, and therefore would not affect nocturnal movements of sea lions in the water. Most likely, sea lions affected by elevated underwater or airborne noise would move away from the sound source and be temporarily displaced from the affected areas. However, they may continue using vessels at Delta Pier as haul-out sites during pile driving, based on evidence cited in Section 3.4.1.2.3 regarding responses of pinnipeds to construction noise including pile driving. Given the absence of any rookeries and only one haul-out area near the project site (i.e., submarines at Delta Pier and nearby PSB pontoons), potential disturbance exposures would have a negligible effect on individual California sea lions and would not result in population-level impacts.

The prey base of California sea lions includes forage fish and salmonids, which potentially would be less available for predators within the fish injury exposure and behavioral harassment zones (described in Section 3.3) during the 6-month, in-water construction window. The potential impact on California sea lions would be a localized (within the fish behavioral harassment zone), temporary loss (during in-water construction) of foraging opportunities, and potential exposure to behavioral harassment as they transit the project area.

Harbor Seal

Harbor seals are the most abundant marine mammal in Hood Canal. Jeffries et al. (2003) completed a comprehensive stock assessment of the Hood Canal in 1999 (September 21 between the hours of 3:00 and 4:00 p.m.) and counted 711 harbor seals hauled out. An estimate of the Hood Canal harbor seal population size was based on this survey data and haul-out behavior described by London et al (2012), who calculated an approximate correction factor for the survey count. Using haul-out probability from Figure 4 in London et al. (2012) the correction factor is calculated as follows:

> Approximate probability of an animal to be hauled out during that time frame in that month is 0.20. The inverse of this (1/0.20) provides a correction factor of 5.0. When applied to the survey count data of 711, the correction factor yields a population estimate of 3,555 animals.

Exposures to underwater and airborne pile driving noise were calculated using a density derived from the number of harbor seals that may be present in the water at any one time (80 percent of 3,555 or 2,844 individuals), divided by the area of Hood Canal (138.4 square miles [358.4 square kilometers]) (Jeffries et al. 2003; London et al. 2012). The density of harbor seals calculated in this manner is 20.55 animals/square mile [7.93/square kilometer]). The Navy acknowledges that a uniform density spread out over the Hood Canal is not ideal, and that the density would be higher around haul-out sites such as Dabob Bay and farther south in Hood Canal, which are 10 miles away from Bangor and those Bangor activities. Since the haul-out sites are not located near the Bangor waterfront, density is expected to be much lower near the project area. However, since a detailed geographically stratified density estimate is not currently available, the analysis uses the uniform density to calculate exposures to pile driving noise. Therefore, the exposure estimate for harbor seals presented here is likely a significant overestimate.

The airborne exposure calculations assumed that 100 percent of the in-water injury exposures would be from animals available at the surface to be exposed to airborne sound. Exposures to underwater noise were calculated with the formula in Section 3.4.2.2.2, under Underwater Noise, and the ZOI in Tables 3.4-15 and 3.4–16. Table 3.4–19 depicts the number of behavioral harassment exposures that are estimated from vibratory and impact pile driving both underwater and in-air.

Based on the density analysis of 20.55 individuals/square mile (7.93/square kilometer) and using the most conservative criterion for behavioral disturbance (the 120 dB vibratory harassment threshold with an area of 19.3 square miles [50.1 square kilometers]), up to 397 individual harbor seals may experience sound pressure levels on a given day that would qualify as behavioral harassment. The estimated number of individuals exposed per day accounts for approximately

10 percent of the estimated population, and as noted above is likely a significant overestimate of potential exposures. Thus, not all animals in the population would be expected to be exposed to the activities at Bangor but only a subset of the population that may travel through or haul-out on manmade structures near the waterfront. Furthermore, the behavioral harassment does not appear to be biologically significant based on observations from waterfront surveys conducted by the Navy (Navy 2015a): (1) harbor seals are always present in Bangor waters and occasionally use manmade structures (underside of piers, ladders in the water, wavescreen, floating oil boom, etc.) as haulouts; and (2) pupping occurs from the northern end to the southern end of the waterfront.

Over the 125 days of pile driving of 36-inch (90-centimeter) steel pile, the noise exposure formula above predicts 49,625 exposures to noise within the behavioral harassment threshold for vibratory pile installation. Zero exposures to underwater noise were calculated within the injury threshold (with an area of 850 square feet [79 square meters]). Over the 36 days of concrete pile driving, the noise exposure formula predicts zero exposures due to impact pile driving within the behavioral harassment threshold (with an area of 0.003 square miles [0.007 square kilometers]). Therefore, the total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 49,625 (all underwater) (Table 3.4–19).

The airborne exposure calculations assumed that 100 percent of the in-water animals would be available at the surface to be exposed to airborne sound. Animals swimming with their heads above the water would potentially be affected by elevated airborne pile driving noise within a small ZOI (620 feet [189 meters]). Given that both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance ZOIs, pinniped takes would already be encompassed by underwater exposures and no additional takes were requested for airborne noise exposures.

Harbor seals would most likely avoid waters within the areas affected by above-threshold noise levels during impact pile driving around the SPE project site. They are unlikely to be injured by pile driving noise because they are unlikely to be within the injury threshold distance for pile driving noise (16 feet [5 meters] from the driven pile). Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities for the presence of marine mammals (see Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures), and would alert work crews when to begin or stop work due to the presence of harbor seals in or near the shutdown zone, thereby precluding the potential for injury.

The prey base of harbor seals includes forage fish and salmonids, which would be less available for predators within the fish injury exposure and behavioral harassment zones (described in Section 3.3) during the 6-month, in-water construction window. The potential impact on harbor seals would be a localized (within the fish behavioral harassment zone), temporary loss of foraging opportunities (during in-water construction) and potential exposure to behavioral harassment as they transit the project area.

Harbor Porpoise

Harbor porpoise may be occasionally present in Hood Canal year round and conservatively are assumed to use the entire area. The Navy conducted boat surveys of the waterfront area from

July to September 2008 (Tannenbaum et al. 2009a) and November 2009 to May 2010 (Tannenbaum et al. 2011a). During one of the surveys a single harbor porpoise was sighted in May 2010 in the deeper waters in the vicinity of EHW-1. Overall, these nearshore surveys indicated a low occurrence of harbor porpoise within waters adjacent to the base. Surveys conducted during the TPP indicate that the abundance of harbor porpoises within Hood Canal in the vicinity of NAVBASE Kitsap Bangor is greater than anticipated from earlier surveys and anecdotal evidence (HDR 2012). During these surveys, while harbor porpoise presence in the immediate vicinity of the base (i.e., within 0.6 mile [1 kilometer]) remained low, harbor porpoise were frequently sighted within several kilometers of the base, mostly to the north or south of the project area, but occasionally directly across from the proposed EHW-2 project site on the far side of Toandos Peninsula. These surveys reported 38 individual harbor porpoise sightings on tracklines of specified length and width, resulting in a density of 0.149 individuals/square kilometer.

The density used in the underwater sound exposure analysis was 0.149 animals/square kilometer (Navy 2013). Exposures to underwater pile driving noise were calculated using the formula in Section 3.4.2.3.2, under Underwater Noise, and the ZOI in Table 3.4–17. Table 3.4-19 depicts the number of potential behavioral harassment exposures that are estimated from underwater vibratory and impact pile driving.

Based on the density analysis of 0.38 individuals/square mile (0.149/square kilometer) (Navy 2013) and using the most conservative criterion for behavioral disturbance (the 120 dB vibratory harassment threshold with an area of 19.3 square miles [50.1 square kilometers]), up to 7 individual harbor porpoises may experience sound pressure levels on a given day that would qualify as behavioral harassment due to vibratory pile driving. Over the 125 days of pile driving of 36-inch (90-centimeter) steel pile, the noise exposure formula above predicts 875 exposures to noise within the behavioral harassment threshold for vibratory pile installation. Zero exposures to underwater noise were calculated within the injury threshold (with an area of 21,022 square feet [1,953 square meters]). Over the 36 days of 18-inch (45-centimeter) concrete pile driving, the density-based formula predicts zero exposures due to impact pile driving within the behavioral harassment threshold (with an area of 0.003 square miles [0.007 square kilometers]). Therefore, the total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 875 (Table 3.4–19).

Harbor porpoise that are exposed to pile driving noise could exhibit behavioral reactions such as avoidance of the affected area. Harassment from underwater noise impacts is not expected to be significant because it is estimated that only a small number of harbor porpoise would ever be present in the project area. Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities (see Mitigation Action Plan, Appendix C for a detailed discussion of mitigation measures) for the presence of marine mammals, and they would alert work crews when to begin or stop work due to the presence of harbor porpoise in or near the shutdown zones, thereby reducing the potential for injury.

Transient Killer Whale

Transient killer whales are rarely present in Hood Canal. In 2003 and 2005, groups of transient killer whales (6 to 11 individuals per event) visited Hood Canal to feed on harbor seals and remained in the area for significant periods of time (59 to 172 days) between the months of January and July (London 2006). These whales used the entire expanse of Hood Canal for feeding. No other confirmed sightings of transient killer whales in Hood Canal were reported.

Even though transient killer whales are rare in Hood Canal and an applicable density value is not available, the Navy calculated potential exposures for SPE in the event that a small group may occur within the SPE behavioral disturbance ZOI. For transient killer whales, there have only been two documented time periods of occurrence within Hood Canal and, therefore, a reliable density estimate is not available.

Take estimates were calculated based on the in-water work associated with the construction of SPE. Exposures to underwater pile driving were calculated using the second equation described in the *Description of Exposure Calculation* (page 3.4-68) where the exposure estimate was determined by multiplying the group size times the number of days transient killer whales would be anticipated in the Hood Canal during pile driving activities.

West Coast transient killer whale mean group size in the Salish Sea was 4 individuals during the period from 1987–1993 (mode = 3 individuals) (Baird and Dill 1996). More recently, during the period from 2004–2010, mean group size appears to have increased to 5 individuals (mode = 4 individuals) (Houghton et al. 2015). According to Houghton unpublished data, the most commonly observed group size in Puget Sound (specifically south of Admiralty Inlet) from 2004–2010 data was 6 whales (mode = 6, mean = 6.88) (Houghton 2012, personal communication).

Based on the two documented residence times transient killer whales remained in Hood Canal (59 to 172 days between the months of January and July), NMFS concluded that whales could be exposed to behavioral disturbance due to pile driving noise for 30 days (NMFS 2014). The 30 day estimate reasonably assumes that the whales would not remain in the area for the typical residence time due to the harassing stimuli.

Using this rationale, 180 potential exposures of transient killer whales are estimated (6 animals times 30 days of exposure). Based on this analysis, the Navy requests Level B incidental takes for behavioral harassment of 180 killer whales. Animals of any age or sex could be exposed. Any exposures are anticipated to be short in duration as animals transit through the ZOI during vibratory pile driving.

Transient killer whales that are exposed to pile driving noise could exhibit behavioral reactions such as avoidance of the affected area. Harassment from underwater noise impacts is not expected to be significant because it is estimated that only a small number of transient killer whales would ever be present in the project area. Marine mammal observers would monitor shutdown and disturbance zones during pile driving activities (see Mitigation Action Plan, Appendix C, for a detailed discussion of mitigation measures) for the presence of marine mammals, and they would alert work crews when to begin or stop work due to the presence of transient killer whales in or near the shutdown zones, thereby reducing the potential for injury.

OPERATION/LONG-TERM IMPACTS FOR SPE ALTERNATIVE 2

PREY AVAILABILITY

SPE Alternative 2 would increase the length of the existing pier by 540 feet, permanently displacing a small area (0.045 acre [0.018 hectare]) of deeper water benthic habitat. Given the water depth, the overwater structures would have a minor effect on biological productivity in the larger area affected by shading (approximately 1 acre [0.41 hectare]) (Section 3.2.2.3.2). Moreover, these impacts would occur in deeper water habitat and be highly localized to the immediate vicinity of the pier. Therefore, habitat degradation and barriers for fish in the project area would not result in a significant change in the prey base for marine mammals, as discussed in Section 3.3.2.3.2. Increased artificial lighting at the SPE may affect prey availability, depending on the species, for marine mammals. Some fish such as sand lance, an important forage fish, may be attracted by artificial lighting, which may in turn attract predators, including marine mammals, and facilitate predation on these prey species. Thus, localized changes to the prey base for some marine mammals are possible but these changes cannot be quantified with available information.

NOISE AND VISUAL DISTURBANCE

Cetaceans are unlikely to be present in the waters affected by the Service Pier but pinnipeds may swim through the area. These species are highly mobile and accustomed to utilizing the waters around manmade structures on the Bangor waterfront; therefore, they would not be significantly affected by the presence of this in-water barrier and the associated levels of human activity. Increased vessel traffic would occur with this alternative, but the vessels would be slow moving and unlikely to result in collisions with pinnipeds. Underwater noise levels would increase with increased vessel traffic but would not rise to the injury level. Pinnipeds that utilize the Bangor waterfront have habituated to vessel traffic noise and may avoid the immediate vicinity of disturbing sound levels.

The potential for transits of Navy vessels, including submarines, to affect marine mammals was addressed in the Northwest Training and Testing EIS (Navy 2015b), which is incorporated here by reference. That EIS found that Navy vessels would pass near marine mammals only on an incidental basis. Marine mammals exposed to a passing Navy vessel may not respond at all, or they may exhibit a short-term behavioral response such as avoidance or changing dive behavior. Due to the infrequency of Navy vessel traffic, marine mammals would not be anticipated to experience chronic disturbance from Navy activities. Short-term reactions to vessels would not be likely to disrupt major behavioral patterns or to result in serious injury to any marine mammals. Acoustic masking may occur due to vessel sounds, but the potential is low for submarines, which generate less sound during transit than other vessels. Acoustic masking may prevent an animal from perceiving biologically relevant sounds during the period of exposure, potentially resulting in missed opportunities to obtain resources. Regarding collisions with marine mammals, SSN submarines, which would be on the surface during transits, would have lookouts posted to detect and avoid marine mammals at the surface.

Operation of SPE Alternative 2 would include increased noise and visual disturbance from human activity and artificial light. Under existing conditions, the Bangor waterfront produces an environment of complex and highly variable noise and visual disturbance for marine mammals. Steller and California sea lions haul out on manmade structures and harbor seals regularly forage in the nearshore and deeper waters along the Bangor waterfront in close proximity to ongoing operations. Although future levels of human activity at the larger Service Pier would be greater than existing levels, due to docking two additional submarines at the pier, most individual marine mammals are likely to habituate to the post-construction activity levels, as they have habituated to activity levels at other developed portions of the waterfront. Thus, no additional MMPA take is expected with operation of the Service Pier under Alternative 2.

Maintenance of the SPE would include routine inspections, repair, and replacement of facility components as required (but no pile replacement). These activities could affect marine mammals through noise impacts and increased human activity and vessel traffic. However, noise levels would not be appreciably higher than existing levels elsewhere at the Bangor industrial waterfront, to which marine mammals appear to have habituated. Measures would be employed (Section 3.1.1.2.3) to avoid discharge of contaminants to the marine environment. Therefore, maintenance would have negligible impacts on marine mammals.

California sea lions, Steller sea lions, and harbor seals haul out on docked submarines at Delta Pier and the pontoons that support the existing PSB. They may haul out on submarines docked at the Service Pier in the future because they habituate to human activity in the vicinity of attractive haul-out sites. The shoreline in the project area is not used for hauling out by any pinniped species under existing conditions, and it is unlikely that pinnipeds would haul out on the shoreline in the vicinity of the Service Pier in the future.

3.4.2.3.3. SPE Alternative 3: Long Pier

SPE Alternative 3 would increase the length of the existing pier by 975 feet (297 meters), or almost twice the length of the SPE under Alternative 2. The number of piles and pile driving days would be greater for Alternative 3 than for Alternative 2, thereby increasing the duration of elevated underwater and airborne noise levels due to pile driving. Long-term operations of the SPE would be similar to Alternative 2 with insignificant consequences for marine mammal populations.

CONSTRUCTION OF SPE ALTERNATIVE 3

Marine mammals are expected to avoid disturbed areas due to increased vessel traffic, noise and human activity, increased turbidity, and potential difficulty in finding prey. General concerns over construction period impacts, including water quality, vessel traffic, prey availability, and construction noise, are the same as for SPE Alternative 2, but overall SPE Alternative 3 would have greater and longer-lasting impacts on marine mammals in the project area.

Water Quality

A larger seafloor area (6.6 acres [2.7 hectares]) would be disturbed by construction of SPE Alternative 3, which would cause increasing turbidity levels and suspended sediments compared to Alternative 2 (3.9 acres [1.6 hectares]) (Table 3.2–5) (Section 3.1.2.3.3). Similar to Alternative 2, water quality impacts under Alternative 3 would be temporary and localized within the construction corridor (Section 3.1.2.3.3). Construction-period impacts are not expected to exceed water quality standards. Therefore, no direct impacts on marine mammals are expected due to water quality effects of SPE construction under Alternative 3.

VESSEL TRAFFIC

The same levels of vessel traffic including barge and tug trips (average 6 round trips per month) would be required over more pile driving days for construction of Alternative 3 (205 days) compared to Alternative 2 (161 days). Thus, SPE Alternative 3 would increase overall disturbance levels for marine mammals in the project vicinity and potentially displace them for longer periods of time. However, the affected area would be limited to the project vicinity and, relative to the wide distribution of marine mammal species in inland water, would not affect population sizes or overall distribution.

PREY AVAILABILITY

Impacts of construction on prey availability for fish-eating marine mammals would be similar under both SPE alternatives. Similar to Alternative 2, the greatest impacts on prey species during construction of the SPE project would result from resuspension of sediments, localized turbidity, and behavioral disturbance due to pile driving noise. However, because the area affected under Alternative 3 (6.6 acres [2.7 hectares]) is greater than under Alternative 2 (3.9 acres [1.6 hectares]), the magnitude of the impact under Alternative 3 would be greater. The affected area under either alternative would be limited to the construction footprint. Relative to the wide distribution of marine mammals and their prey resources in inland waters, Alternative 3 would not affect population size or overall distribution of these species.

Construction of Alternative 3 would expose fish populations to potential injury and behavioral disturbance due to underwater pile driving noise (Section 3.3.2.3.3). The time period for behavioral disturbance of fish populations would be greater for Alternative 3 compared to Alternative 2 because a more pile-driving days would be required (205 pile driving days with Alternative 3 compared to 161 pile driving days with Alternative 2). Fish potentially would be disturbed by pile driving noise resulting from operation of vibratory and impact rigs within 7,068 feet (2,154 meters) of impact pile driving and 178 feet (54 meters) of vibratory pile driving, but may actually avoid a much smaller area (Section 3.3.2.3.3).

In the long term, a larger pier footprint would shade a larger area of benthic habitats under Alternative 3 compared to Alternative 2. However, relative to the wide distribution of marine mammal species and their prey resources in inland marine waters, effects of Alternative 3 on prey availability would not amount to a significant impact on marine mammal populations. Both alternatives may indirectly affect Southern Resident killer whales through effects on their prey populations, but the project's effect on the species' prey base would be minimal. Therefore, the ESA effect determination for construction activities under Alternative 3 is "may affect, not likely to adversely affect" Southern Resident killer whales. The project would have no effect on critical habitat for Southern Resident killer whales because no critical habitat has been designated in Hood Canal.

Underwater Noise

Underwater and airborne pile driving and heavy equipment noise levels at any given time during construction would be similar for both SPE alternatives and either alternative would involve in-water pile driving during two in-water construction seasons. The analysis of underwater pile driving noise effects is similar to that described in Section 3.4.2.3.2, with the exception of the source levels used in the exposure calculations. Vibratory pile driving of 24-inch (60-centimeter) steel piles would produce noise levels of approximately 161 dB RMS re 1 μPa at 33 feet (10 meters) from the pile. Impact pile driving of 24-inch steel piles using a single-acting diesel impact hammer would produce average RMS noise levels of 185 dB RMS re 1 μPa at 33 feet, while using a bubble curtain reduces noise levels by 8 dB. Other mitigation measures, including a soft-start approach for pile driving operations and marine mammal monitoring and shutdown zones during pile driving, are described in the Mitigation Action Plan (Appendix C). The project would also require pile driving of 18-inch (45-centimeter) square concrete piles. The source level for this pile driving is 170 dB RMS re 1 μPa at 33 feet (Appendix D). All of the concrete piles would be installed with an impact hammer. A bubble curtain would not be used for installation of concrete piles because the source level at 33 feet is lower than the injury impact thresholds for marine mammals (180 dB RMS for cetaceans and 190 dB RMS for pinnipeds) (Table 3.4–14). Most of the energy in pile driving sound underwater is contained in the frequency range 25 Hz and 1.6 kHz, with the highest energy densities between 50 and 350 Hz (Reyff et al. 2002). In some studies, underwater pile driving noise has been reported to range up to 10 kHz with peak amplitude below 600 Hz (Laughlin 2005).

The areas encompassed by these threshold distances within the SPE Alternative 3 project area are shown in Table 3.4–21, and a representative scenario of areas affected by above-threshold noise levels is shown in Figure 3.4-6. The representative areas in Figure 3.4–6 depict effects related to operation of a pile driver at one location at the seaward end of the SPE, but pile driving would occur along the entire length of the pier during the course of project construction. Only one impact pile driver would operate at a time. Table 3.4–21 shows the ZOIs affected by pile driving at this representative location. Placement of pile driving rigs at other locations along the SPE alignment would generate above-threshold noise levels in slightly different areas.

With a properly functioning bubble curtain in place on the impact hammer rig, construction of SPE Alternative 3 would likely result in noise-related injury to pinnipeds and cetaceans within 16 feet (5 meters) and 72 feet (22 meters) from a driven pile, respectively (Table 3.4–21). Injury exposure to intense underwater noise could consist of PTS or other tissue damage. However, marine mammals are unlikely to be injured by pile driving noise at these short distances because the high level of human activity and vessel traffic would cause them to avoid the immediate construction area. Cetaceans in particular are unlikely to swim this close to manmade structures. In addition, marine mammal monitoring during construction (Mitigation Action Plan, Appendix C, Section 4.2) would preclude exposure to injury from pile driving noise.

Table 3.4–21. Calculated Maximum Distance(s) to the Underwater Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Current Noise Thresholds, SPE Alternative 3

Affected Area	Impact Injury Pinnipeds (190 dB RMS)[1]	Impact Injury Cetaceans (180 dB RMS)[1]	Impact Behavioral Harassment Cetaceans & Pinnipeds (160 dB RMS)[1]	Vibratory Behavioral Harassment Cetaceans & Pinnipeds (120 dB RMS)[2]
24-inch (60-centimeter) Steel Piles				
Distance to Threshold[1]	16 ft (5 m)	72 ft (22 m)	1,522 ft (464 m)	3.4 mi (5.4 km)
Area Encompassed by Threshold	850 sq ft (79 sq m)	16,372 sq ft (1,521 sq m)	0.21 sq mi (0.53 sq km)	9.6 sq mi (24.8 sq km)
18-inch (45-centimeter) Concrete Piles				
Distance to Threshold[3]	<2 ft (<1 m)	7 ft (2 m)	151 ft (46 m)	N/A
Area Encompassed by Threshold	Negligible	Negligible	0.003 sq mi (0.007 sq km)	N/A

dB = decibel; ft = feet; m = meter; RMS = root mean square; sq ft = square feet; sq km = square kilometer; sq m = square meter; sq mi = square mile

1. Bubble curtain assumed to achieve 8 dB reduction in sound pressure levels during impact pile driving. Sound pressure levels used for calculations were: 185 dB re 1 μPa at 33 feet (10 meters) for impact hammer with bubble curtain and 161 dB re 1 μPa for vibratory driver for 24-inch (60-centimeter), hollow steel pile. All sound levels are expressed in dB RMS re 1 μPa.
2. Calculated area is greater than actual sound propagation through Hood Canal due to intervening land masses. Thus, 3.4 miles (5.4 kilometers) is the greatest line-of-sight distance from pile driving locations unimpeded by land masses.
3. Sound pressure levels used for calculations were 170 dB re 1 μPa at 33 feet (10 meters) for impact hammer without bubble curtain.

Behavioral disturbance due to impact pile driving is calculated at approximately 1,522 feet (464 meters) from the driven pile, resulting in an affected area of approximately 0.21 square mile (0.53 square kilometer) around the driven pile. Marine mammals within this area would be susceptible to behavioral harassment during impact pile driving operations. The calculated distance for the behavioral harassment threshold due to vibratory installation is approximately 3.4 miles (5.4 kilometers), but intervening land masses would truncate the propagation of underwater pile driving sound from a driven pile (Figure 3.4–6). The area encompassed by the truncated threshold distance is approximately 9.6 square miles (24.8 square kilometers) around the pile drivers (Figure 3.4–6). Marine mammals within this area would be susceptible to behavioral harassment due to vibratory pile driving operations.

The number of pile driving days would be greater for Alternative 3 (155 days of pile driving for steel pile and 50 days for concrete pile compared to 125 days for steel pile, and 36 days for concrete pile for Alternative 2). A comparison of the number of exposures for marine mammals for Alternatives 2 and 3 are shown in Table 3.4–22. For simplicity, this comparison includes only the exposure thresholds for which exposures greater than zero were calculated or adjusted. Representative views of areas within the ZOIs for behavioral harassment due to underwater pile driving noise for Alternative 3 are shown in Figure 3.4–6.

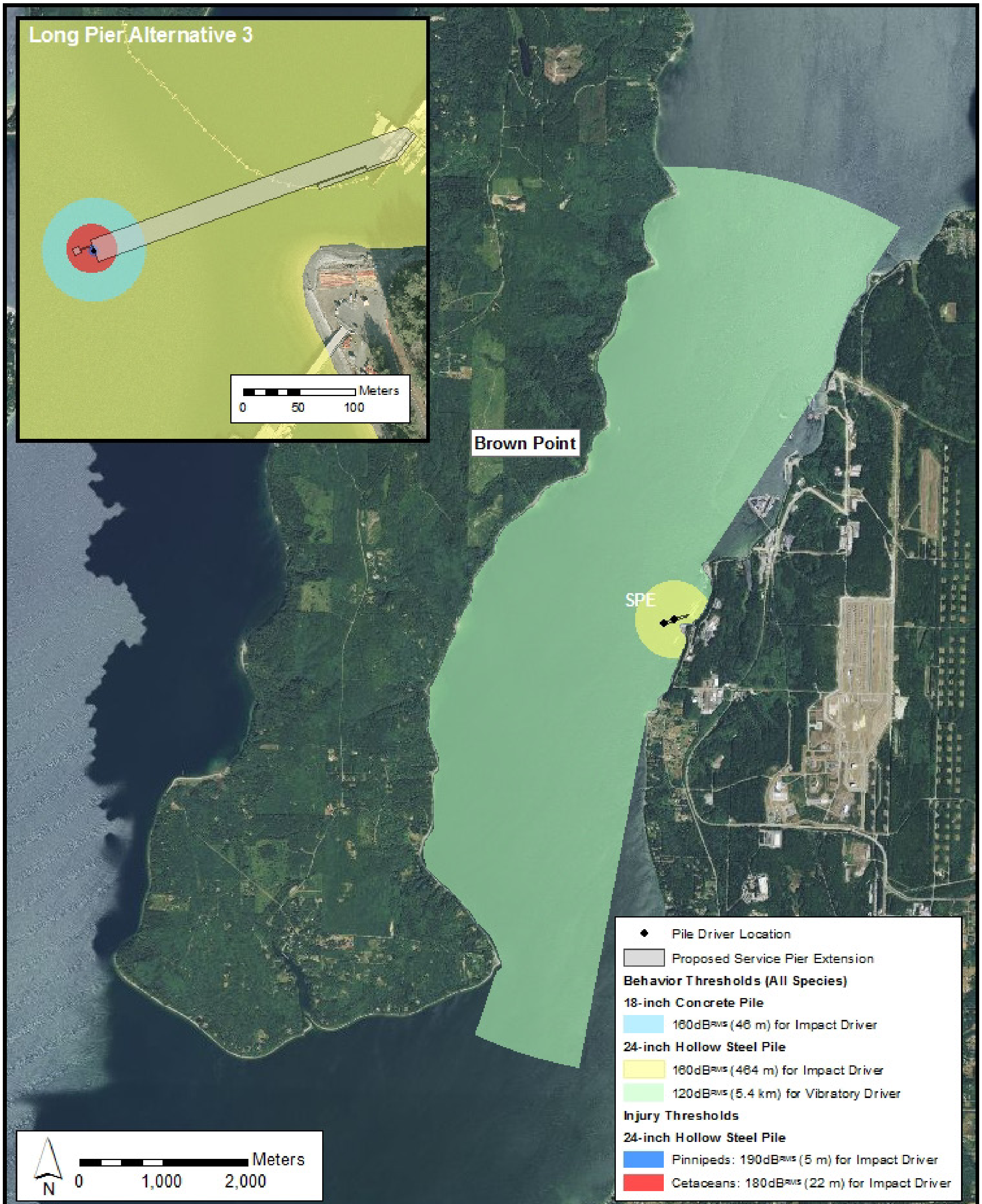


Figure 3.4-6. Representative View of Affected Areas for Marine Mammals due to Underwater Pile Driving Noise during Construction of SPE Alternative 3

Table 3.4–22. Comparison of Potential Exposures for All Marine Mammal Species during the In-Water, Pile-Driving Season (Mid-July to Mid-January), SPE Alternatives 2 and 3

Species	Alternative 2 – Underwater Behavioral Harassment			Alternative 3 – Underwater Behavioral Harassment		
	Steel piles, Vibratory Pile Driver (120 dB RMS)	Concrete Piles, Impact Pile Driver, (160 dB)	Total	Steel piles, Vibratory Pile Driver (120 dB RMS)	Concrete Piles, Impact Pile Driver, (160 dB)	Total
Steller sea lion	250	72	322	310	100	410
California sea lion	4,500	1,296	5,796	5,580	1,800	7,380
Harbor seal	49,625	0	49,625	30,535	0	30,535
Harbor porpoise	875	0	875	620	0	620
Transient killer whale	180	0	180	180[1]	0	180

dB = decibel; RMS = root mean square

AIRBORNE NOISE

Construction of SPE Alternative 3 would result in increased airborne noise in the vicinity of the construction site, as discussed in Section 3.9.3.3. The highest noise source levels would be associated with impact pile driving (500 24-inch [60-centimeter] steel support piles and 160 18-inch [45-centimeter] concrete fender piles). The worst-case pile driving source level (for 24-inch steel piles) is estimated to be 110 dB RMS re 20 µPa (unweighted) at 50 feet (15 meters) from the pile for an impact hammer, and 92 dB RMS re 20 µPa (unweighted) at 50 feet from the pile for vibratory pile driving (Section 3.9.3.2.2). The dominant airborne noise frequencies produced by pile driving are between 50 and 1,000 Hz (WSDOT 2013). No airborne source levels were available for 18-inch (45-centimeter) concrete piles. Modeled distances to airborne thresholds would likely be considerably smaller for concrete piles than for steel piles.

The airborne exposure calculations assumed that 100 percent of the in-water animals would be available at the surface to be exposed to airborne sound. Sea lions hauled out on submarines at Delta Pier would be beyond the areas encompassed by the airborne noise behavioral harassment threshold for SPE Alternative 3 (Figure 3.4–5) and, therefore, are unlikely to be affected by construction activities. Airborne impact pile driving noise for the SPE would likely result in behavioral harassment to harbor seals at a distance of 492 feet (150 meters) and to other pinnipeds (California sea lions and Steller sea lions) at a distance of 154 feet (47 meters) (Table 3.4–23). Vibratory pile driving noise would likely result in behavioral harassment to harbor seals at a distance of 62 feet (19 meters) and to other pinnipeds at a distance of 20 feet (6 meters) (Table 3.4–23). The areas encompassed by these threshold distances are shown in Table 3.4–23 and a representative scenario of areas affected by above-threshold airborne noise levels for an impact pile driving rig is shown in Figure 3.4–5. Other areas would be included in the above-threshold noise areas if the analysis was performed for pile driving rigs at other locations on the SPE structure. Similar to SPE Alternative 2, given that both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance ZOIs, any airborne pinniped takes would already be encompassed within underwater exposures.

Table 3.4–23. Calculated Maximum Distances in Air to Marine Mammal Noise Thresholds due to Pile Driving and Areas Encompassed by Noise Thresholds, SPE Alternative 3

Affected Area	Impact Behavioral Harassment Harbor Seal (90 dB RMS)[1]	Impact Behavioral Harassment Other Pinnipeds (100 dB RMS)[1]	Vibratory Behavioral Harassment Harbor Seal (90 dB RMS)[1]	Vibratory Behavioral Harassment Other Pinnipeds (100 dB RMS)[1]
Distance to Threshold[1]	492 ft (150 m)	154 ft (47 m)	62 ft (19 m)	20 ft (6 m)
Area Encompassed by Threshold	0.03 sq mi (0.07 sq km)	0.003 sq mi (0.007 sq km)	12,076 sq ft (1,134 sq m)	1,385 sq ft (129 sq m)

dB = decibel; ft = feet; m = meter; RMS = root mean square; sq km = square kilometer; sq mi = square mile

1. Sound pressure levels used for calculations were 110 dB RMS re 20 μPa at 50 feet (15 meters) (Section 3.9.3.3.2) for impact hammer for 24-inch (690-centimeter) steel pile, and 92 dB RMS re 20 μPa at 50 feet (15 meters) for vibratory driver for 24-inch steel pile. All distances are calculated over water.

SUMMARY OF PROJECT IMPACTS AND ESTIMATED EXPOSURES FOR SPECIES PRESENT IN THE SPE PROJECT AREA

Steller Sea Lion

Using the abundance-based analysis and the most conservative criterion for behavioral harassment (the 120 dB continuous noise harassment threshold), an average daily abundance of 2 individual Steller sea lions may experience underwater sound pressure levels that would qualify as behavioral harassment on a given day. The noise exposure formula above predicts 310 exposures to underwater noise within the behavioral harassment threshold for vibratory pile installation over the 155 days of pile driving for 24-inch (60-centimeter) steel pile. Zero exposures are expected to occur from underwater noise within the injury threshold (with an area of 850 square feet [79 square meters]). Over the 50 days of concrete pile driving, the abundance-based formula predicts an additional 100 exposures due to impact pile driving, but the potential exposures calculated this way would be an overestimate because the affected area would be very small (approximately 151 feet [46 meters] from the driven pile) and Steller sea lions would be unlikely to approach active pile driving sites at this distance.

The airborne exposure calculations assumed that 100 percent of the in-water animals would be available at the surface to be exposed to airborne sound. Animals swimming with their heads above the water would potentially be affected by elevated airborne pile driving noise within a small ZOI (154 feet [47 meters]). Given that both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance ZOIs, pinniped takes would already be encompassed by underwater exposures, and no additional takes were requested for airborne noise exposures. The total number of exposures over the entire pile driving period for this alternative is estimated to be 410 (all underwater) (Table 3.4–22).

California Sea Lion

Using the abundance-based analysis and the most conservative criterion for behavioral harassment (the 120 dB continuous noise harassment threshold), an average of 36 individual California sea lions may experience underwater sound pressure levels on a given day that would qualify as behavioral harassment. Over the 155 days of steel pile driving, the noise exposure formula predicts 5,580 exposures to underwater noise within the behavioral harassment threshold for vibratory pile installation. Zero exposures are expected to occur from underwater noise within the injury threshold (with an area of 850 square feet [79 square meters]). Over the 50 days of concrete pile driving, the abundance-based formula predicts an additional 1,800 exposures due to impact pile driving, but the potential exposures are an overestimate because the ZOI is very small (approximately 151 feet [46 meters] from the driven pile).

The airborne exposure calculations assumed that 100 percent of the in-water animals would be available at the surface to be exposed to airborne sound. Animals swimming with their heads above the water would potentially be affected by elevated airborne pile driving noise within a small ZOI (154 feet [47 meters]). Given that both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance ZOIs, pinniped takes would already be encompassed by underwater exposures and no additional takes were requested for airborne noise exposures. The total number of exposures over the entire pile driving period for this alternative is estimated to be 7,380 (all underwater) (Table 3.4-22).

Harbor Seal

Based on the density analysis of 20.55 individuals/square mile (7.93/square kilometer) and using the most conservative criterion for behavioral disturbance (the 120 dB vibratory harassment threshold with an area of 9.6 square miles [24.8 square kilometers]), up to 197 individual harbor seals may experience sound pressure levels on a given day that would qualify as behavioral harassment. The estimated number of individuals exposed per day accounts for approximately 5.5 percent of the estimated population, and as noted above is likely a significant overestimate of potential exposures. Thus, not all animals in the population would be expected to be exposed to the activities at Bangor but only a subset of the population that may travel through or haul-out on manmade structures near the waterfront. Furthermore, the behavioral harassment does not appear to be biologically significant based on observations from waterfront surveys conducted by the Navy (Navy 2015a): (1) harbor seals are always present in Bangor waters and occasionally use manmade structures (underside of piers, ladders in the water, wavescreen, floating oil boom, etc.) as haulouts; and (2) pupping occurs from the northern end to the southern end of the waterfront.

Over the 155 days of pile driving of 24-inch (60-centimeter) steel pile, the noise exposure formula above predicts 30,535 exposures to noise within the behavioral harassment threshold for vibratory pile installation. Zero exposures to underwater noise were calculated within the injury threshold (with an area of 850 square feet [79 square meters]). Over the 50 days of concrete pile driving, the noise exposure formula predicts zero exposures due to impact pile driving within the behavioral harassment threshold (with an area of 0.003 square miles [0.007 square kilometers]).

The airborne exposure calculations assumed that 100 percent of the in-water animals would be available at the surface to be exposed to airborne sound. Animals swimming with their heads above the water would potentially be affected by elevated airborne pile driving noise within a small ZOI (492 feet [150 meters]). Given that both the vibratory and impact airborne ZOI is encompassed within the larger underwater disturbance ZOIs, pinniped takes would already be encompassed by underwater exposures and no additional takes were requested for airborne noise exposures. Therefore, the total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 30,535 (all underwater) (Table 3.4–22).

Harbor Porpoise

Based on the density analysis of 0.38 individuals/square mile (0.149/square kilometer) (Navy 2013) and using the most conservative criterion for behavioral disturbance (the 120 dB vibratory harassment threshold with an area of 9.6 square miles [24.8 square kilometers]), up to 4 individual harbor porpoises may experience sound pressure levels on a given day that would qualify as behavioral harassment. Over the 155 days of pile driving of 24-inch (60-centimeter) steel pile, the noise exposure formula above predicts 620 exposures to noise within the behavioral harassment threshold for vibratory pile installation. Zero exposures to underwater noise were calculated within the injury threshold (with an area of 16,372 square feet [1,521 square meters]). Over the 50 days of 18-inch (45-centimeter) concrete pile driving, the density-based formula predicts zero exposures due to impact pile driving within the behavioral harassment threshold (with an area of 0.003 square miles [0.007 square kilometers]). Therefore, the total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 620 (Table 3.4–22).

Transient Killer Whale

Exposures to underwater pile driving were calculated using the second equation described in the *Description of Exposure Calculation* (page 3.4-68) where the exposure estimate was determined by multiplying the group size times the number of days transient killer whales would be anticipated in the Hood Canal during pile driving activities.

West Coast transient killer whale mean group size in the Salish Sea was 4 individuals during the period from 1987–1993 (mode = 3 individuals) (Baird and Dill 1996). More recently, during the period from 2004–2010, mean group size appears to have increased to 5 individuals (mode = 4 individuals) (Houghton et al. 2015). According to Houghton unpublished data, the most commonly observed group size in Puget Sound (specifically south of Admiralty Inlet) from 2004–2010 data was 6 whales (mode = 6, mean = 6.88) (Houghton 2012, personal communication).

Based on the two documented residence times transient killer whales remained in Hood Canal (59 to 172 days between the months of January and July), NMFS concluded that whales could be exposed to behavioral disturbance due to pile driving noise for 30 days (NMFS 2014). The 30 day estimate reasonably assumes that the whales would not remain in the area for the typical residence time due to the harassing stimuli.

Using this rationale, 180 potential exposures of transient killer whales are estimated (6 animals times 30 days of exposure). Based on this analysis, the Navy requests Level B incidental takes for behavioral harassment of 180 killer whales. Animals of any age or sex could be exposed. Any exposures are anticipated to be short in duration as animals transit through the ZOI during vibratory pile driving.

OPERATION/LONG-TERM IMPACTS FOR SPE ALTERNATIVE 3

The long-term operational impacts of SPE Alternative 3 would be qualitatively similar to those described for Alternative 2 but the magnitude of impacts would be greater for Alternative 3, with the exception of underwater noise exposures from pile driving. With the use of a smaller steel pile size (24-inch [60-centimeter]), the ZOI is smaller for SPE Alternative 3 and therefore results in less exposures.

SPE Alternative 3 would increase the length of the existing pier by 975 feet (297 meters), permanently displacing a larger area of deeper water benthic habitat than Alternative 2, and potentially affecting a small amount of habitat supporting prey species. Given the water depth at the SPE site, shading by the overwater structures would have a minor effect on biological productivity (see Section 3.2.2.3.2). Similar to Alternative 2, impacts on the prey base for some marine mammals are not expected to be significant, but these changes cannot be quantified with available information. Marine mammals are wide-ranging and have extensive foraging habitat available in Hood Canal, relative to the foraging area that might be impacted by operation of the SPE. Localized changes in prey availability are possible under Alternative 3 but are expected to be insignificant. The Mitigation Action Plan (Appendix C) describes the marine habitat mitigation that the Navy would undertake as part of the Proposed Action. This habitat mitigation would compensate for impacts of the Proposed Action to marine habitats and species that might indirectly affect the marine mammal prey base.

Impacts of increased vessel traffic and vessel noise from Alternative 3 would be similar to the impacts described for Alternative 2 because the number of submarines berthed at the enlarged Service Pier would be the same. Cetaceans are unlikely to frequent the area, and pinnipeds that utilize the Bangor waterfront have habituated to vessel traffic noise and may avoid the immediate vicinity of disturbing sound levels.

Operation of the larger Service Pier would include increased noise and visual disturbance from human activity and artificial light. Similar to impacts of Alternative 2, most pinnipeds are likely to habituate to the post-construction activity levels, as they have habituated to activity levels at other developed portions of the waterfront. Thus, no additional MMPA take is expected with operation of the larger Service Pier.

Maintenance of the SPE would include routine inspections, repair, and replacement of facility components as required (but no pile replacement). These activities could affect marine mammals through noise impacts and increased human activity and vessel traffic. However, noise levels would not be appreciably higher than existing levels elsewhere at the Bangor industrial waterfront, to which marine mammals appear to have habituated. Measures would be employed (Section 3.1.1.2.3) to avoid discharge of contaminants to the marine environment. Therefore, maintenance for the SPE would have negligible impacts on marine mammals.

3.4.2.3.4. Summary of Impacts for SPE Project Alternatives

Impacts on marine mammals during the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.4–24.

Table 3.4–24. Summary of SPE Impacts on Marine Mammals

Alternative	Environmental Impacts on Marine Mammals
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	*Construction:* Direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability due to extension of pier by 540 feet (165 meters). Construction noise (primarily due to pile driving) sufficient to exceed NMFS disturbance thresholds. Construction disturbance due to in-water work would occur over two seasons, including a total of 161 days of pile driving. *Operation/Long-term Impacts:* Minor indirect impacts on prey species due to loss and degradation of benthic habitat; increased human activity, vessel traffic, and noise.
	MMPA: The Proposed Action would expose marine mammal species in the area to noise levels that would result in behavioral disturbance. No injurious exposures to noise are expected due to the use of vibratory pile driving as the primary pile installation method, the small size of the injury zone from impact pile driving, and monitoring of the injury zone so that a shutdown would occur if a marine mammal approaches the zone. *ESA:* Effect determination for the humpback whale (based on infrequent occurrence) and Southern Resident killer whale is "may affect, not likely to adversely affect"; and "no effect" on Southern Resident killer whale critical habitat."
SPE Alternative 3: Long Pier	*Construction:* Direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability due to extension of pier by 975 feet (297 meters) compared to 540 feet (165 meters) with the short pier for Alternative 2. Construction noise (primarily due to pile driving) sufficient to exceed NMFS disturbance thresholds. Construction disturbance due to in-water work would occur over two seasons, including a total of 205 days of pile driving compared to 161 days for Alternative 2. *Operation/Long-term Impacts:* Minor indirect impacts on prey species due to loss and degradation of benthic habitat; increased human activity, vessel traffic, and noise.
	MMPA: The Proposed Action would expose marine mammal species in the area to noise levels that would result in behavioral disturbance. No injurious exposures to noise are expected due to the use of vibratory pile driving as the primary pile installation method, the small size of the injury zone from impact pile driving, and monitoring of the injury zone so that a shutdown would occur if a marine mammal approaches the zone. *ESA:* Effect determination for the humpback whale (based on infrequent occurrence) and Southern Resident killer whale is "may affect, not likely to adversely affect"; and "no effect" on Southern Resident killer whale critical habitat.
Mitigation: Marine mammals would be monitored during all pile installation activities of the SPE project, and shutdown procedures would be implemented if any marine mammal enters the injury threshold zone for pile driving. Please see Appendix C (Mitigation Action Plan) for more detailed mitigation measures. A detailed marine mammal monitoring plan would be developed in consultation with NMFS.	
Consultation and Permit Status The Navy submitted an IHA application to NMFSHQ for the construction of the SPE project on November 24, 2014, and issued a supplement to the application in June 2015. The Navy will continue its consultation with NMFSHQ in order to obtain an IHA for the SPE preferred alternative. The Navy consulted with the NMFS West Coast Region Office on the Southern Resident killer and humpback whale under the ESA, submitted a Biological Assessment on March 10, 2015, and submitted a revised Biological Assessment on June 10, 2015. ESA consultation with NMFS is ongoing.	

ESA = Endangered Species Act; IHA = Incidental Harassment Authorization; MMPA = Marine Mammal Protection Act; NMFS = National Marine Fisheries Service

3.4.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

The LWI structures and SPE piles would affect availability of forage fish, salmonids, and other marine fish consumed by marine mammals (Section 3.3). Visual disturbance due to barge and other vessel traffic during concurrent construction of both projects may inhibit use of the project sites by marine mammals that frequent nearshore waters, such as harbor seals and sea lions, thereby reducing the area available for foraging, resting, and transiting along the waterfront.

Pile driving for the two projects would result in the combined number of exposures of marine mammals to underwater noise levels that exceed behavioral harassment thresholds shown in Table 3.4–25. The ranges shown in Table 3.4–25 account for differences between the individual LWI and SPE alternatives. These exposures would occur over a total of four in-water work seasons.

Table 3.4–25. Combined Noise Exposures for all Marine Mammal Species for the LWI and SPE Projects

Species	Underwater Vibratory Behavioral Threshold (120 dB)		
	Steel Piles	Concrete Piles*	Total
Steller sea lion	250 – 470 (LWI-3+SPE-2) – (LWI-2+SPE-3)	72 – 100 (SPE-2) – (SPE-3)	322–570
California sea lion	4,500 – 8,460 (LWI-3+SPE-2) – (LWI-2+SPE-3)	1,296 – 1,800 (SPE-2) – (SPE-3)	5, 796–10,260
Harbor seal	30,535 – 67,705 (LWI-3+SPE-3) – (LWI-2+SPE-2)	0	30,535–67,705
Harbor porpoise	620 – 1,195 (LWI-3+SPE-3) – (LWI-2+SPE-2)	0	620-1,195
Transient killer whale	180 – 360 (LWI-3+SPE2/3) – (LWI-2+SPE-2/3)	0	180-360
Total	**35,835–77,720**	**1,296–1,800**	**37,131–79,520**

dB = decibel

Note: * This project would not contribute exposures to concrete pile driving because neither LWI alternative would include concrete piles.

3.5. MARINE BIRDS

Major groupings of marine birds that occur on NAVBASE Kitsap Bangor include shorebirds, wading birds, marine waterfowl, raptors, and seabirds (Table 3.5–1), which use the waters in and around the LWI and SPE project sites. Marine birds use manmade structures on the marine waterfront and trees along the shoreline for perching, resting, and (for a few species) nesting, but in general the focus is on marine habitats and food resources. Marine bird species may also use upland areas, as discussed in Section 3.6. Marbled murrelets are the only ESA-listed bird (Table 3.5–2), present in the marine environment on NAVBASE Kitsap Bangor.

3.5.1. Affected Environment

3.5.1.1. EXISTING CONDITIONS

Shorebirds and marine waterfowl are most abundant along the Bangor waterfront during the winter months and migration periods (Table 3.5–1). However, several species such as killdeer, spotted sandpiper (shorebirds), great blue heron, Canada geese, and dabbling duck species (waterfowl) are present year round. In particular, the shallow waters at the outfall of Devil's Hole near the south LWI project site are frequented by these species. Seabirds (certain gull and tern species) and diving-pursuit birds (such as cormorant species and pigeon guillemot) also occur year round. The marine environment on NAVBASE Kitsap Bangor (including the LWI project sites) provides habitat for foraging, loafing, social interaction, nesting, and brood rearing. Two fish-eating raptor species may be present near the LWI and SPE project sites: bald eagles are year-round residents and ospreys are summer residents on the Bangor waterfront. These species are discussed in Section 3.6.

Habitats near the LWI and SPE project sites that are used by marine birds include estuarine habitat, intertidal and subtidal zones of the nearshore marine, and marine deeper water habitat, as described below. Marine birds also use manmade structures, such as piers and piles associated with overwater structures including EHW-1.

3.5.1.1.1. MARINE BIRD HABITAT

ESTUARIES

Three locations along the Bangor waterfront have year-round freshwater output and are considered estuarine habitat: (1) outflows from Devil's Hole (the south LWI project site; 0.6 mile [1 kilometer] northeast of the SPE site), (2) outflows from Cattail Lake (approximately 1 mile [1.6 kilometers] north of the north LWI project site), and (3) outflows from Hunter's Marsh (approximately 1,200 feet [366 meters] from the north LWI project site). The productive nearshore habitat within estuaries and associated eelgrass beds that are commonly present in estuarine habitat provide foraging opportunities for marine waterfowl and seabirds that frequent the nearshore (Table 3.5–3). Food resources used by marine birds in estuarine habitat range from small schooling fish to invertebrates and marine vegetation (Johnson and O'Neil 2001).

Table 3.5–1. Marine Bird Groupings and Families at the Bangor Waterfront

Marine Bird Grouping	Marine Bird Families	Season(s) of Occurrence	Preferred Habitats	Preferred Prey
Shorebirds and Wading Birds	Plovers, sanderlings, dowitchers, sandpipers, yellowlegs, and phalaropes Great blue heron	• Killdeer: year round • Spotted sandpiper: summer • Phalaropes: during migration • Great blue heron: year round • All other species: winter and during spring and/or fall migration	• Shorebirds: Intertidal zone, mudflats, beaches • Great blue heron: shoreline, shallow marine and freshwater	• Shorebirds: marine worms, insect larvae, aquatic insects • Great blue heron: crustaceans, small fishes
Marine Waterfowl	Diving ducks (goldeneye, scoters, bufflehead), mergansers, grebes, loons, dabbling ducks (mallard, wigeon), and geese	• Canada goose, red-necked and hooded mergansers, and some dabbling ducks: year round • Surf and white-winged scoters: winter and in non-breeding flocks during summer • All other species: winter and/or during migration (spring and/or fall migration)	• Canada goose, mergansers, dabbling ducks: marine and freshwater shorelines, eelgrass beds, and shallow water • Scoters, goldeneyes: marine nearshore and deeper water, near piles • Grebes, loons: marine nearshore and deeper water	• Canada goose: vegetation • Mergansers: small fishes • Dabbling ducks: marine and freshwater vegetation, freshwater and marine larvae, aquatic and terrestrial insects • Scoters, goldeneyes: molluscs, barnacles, crustaceans, other invertebrates, small fishes • Grebes, loons: small fishes
Seabirds	Pursuit divers: auklets, murres, murrelets, guillemots, and cormorants Surface feeders: gulls and terns	• Gulls: glaucous-winged gulls: year round; Ring-billed gull: year round; mew gull: winter, migrant; Bonaparte's gull: fall and spring migrant; other species: winter • Terns: Caspian terns: summer; common tern: fall migrant • All other species: year round	• Pursuit divers: marine nearshore and deeper water • Surface feeders (gulls, terns): shoreline, marine nearshore, and deeper water	• Pursuit divers: small fishes, invertebrates, zooplankton • Surface feeders: small fishes, molluscs, crustaceans, garbage, carrion

Sources: Smith et al. 1997; Opperman 2003; Larsen et al. 2004; Wahl et al. 2005; WDFW 2005

Table 3.5–2. Federally Listed Threatened Marine Bird Species in Hood Canal

Wildlife	Federal Listing	Critical Habitat	Critical Habitat at Base
Marbled murrelet	Threatened *57 FR 45328, October 1, 1992*	Designated *61 FR 26256 May 24, 1996* Proposed revision *71 FR 53838 September 12, 2006*	No; closest critical habitat is forest lands west and south from Dabob Bay

FR = Federal Register

Table 3.5–3. Marine Habitats Used by Marine Birds in Hood Canal

Habitat Type		Habitat Values	Characteristic Species
Estuaries		Estuarine habitat has value for foraging, loafing, social interaction, and brood-rearing activities for a variety of marine waterfowl and seabirds.	Killdeer, sandpiper species, glaucous-winged gull, other gull species, raptors, great blue heron
Nearshore Marine	**Intertidal Zone**	Intertidal habitat has value for foraging activities of shorebirds and gulls, in addition to nesting habitat for breeding shorebirds (killdeer).	
	Subtidal Zone	Subtidal habitat has value for foraging, loafing, social interaction, and brood-rearing activities for a variety of marine waterfowl and seabirds.	Common merganser, Barrow's goldeneye, common goldeneye, American wigeon, surf scoter, white-winged scoter, bufflehead, various grebes, loons, cormorants, pigeon guillemot, marbled murrelet, Canada goose, glaucous-winged gull, raptors, and mallard
Marine Deeper Water		Deeper water habitat has value for foraging, loafing, and social interactions of marine waterfowl and seabirds.	Surf scoter, white-winged scoter, Barrow's goldeneye, common goldeneye, double-crested and pelagic cormorants, pigeon guillemot, marbled murrelet, and glaucous-winged gull
Manmade Structures		Manmade structures have value for roosting activities of select seabirds, and foraging of marine waterfowl and seabirds on the underwater piles of structures.	*Roosting:* Glaucous-winged gull, other gull species, pigeon guillemot, and double-crested and pelagic cormorants, great blue heron *Foraging:* Pigeon guillemot, scoters, goldeneyes, and grebes

Sources: Johnson and O'Neil 2001; Agness and Tannenbaum 2009b

NEARSHORE MARINE HABITAT

INTERTIDAL ZONE

The intertidal zone near the LWI and SPE project sites provides food resources for a variety of shorebirds as well as gulls (Table 3.5–3). The amount of intertidal habitat available varies throughout the day with tidal fluctuation. Food sources from intertidal mudflats occur in the upper intertidal zone, and food sources from shellfish and invertebrates occur in the intermediate intertidal zone. Food resources for shorebirds include molluscs, crustaceans, amphipods, worms, and aquatic insects, among other resources.

Subtidal Zone

Marine waterfowl and seabirds use the subtidal zone of nearshore marine habitat for foraging, loafing (resting on water), social interaction, and potentially for brood-rearing (Table 3.5–3). Food resources for marine birds in the nearshore marine habitat include small fish (e.g., juvenile salmonids, Pacific sand lance, and Pacific herring), crustaceans, molluscs, amphipods, aquatic insects, aquatic invertebrates, and plant material such as eelgrass (Johnson and O'Neil 2001).

MARINE DEEPER WATER HABITAT

Marine deeper water habitat at and near the LWI and SPE project sites is used by marine waterfowl and seabirds for foraging, loafing, and social interaction (Table 3.5–3). Food resources in this habitat primarily include small schooling fish, which are distributed spatially and temporally across deeper water habitat (Hunt 1995). Marine waterfowl can also occur in deeper waters; however, for some species of marine waterfowl, food resources such as plant material and aquatic insects can be more plentiful in the nearshore environment. Fewer marine bird species use deeper marine habitat in the summer than in the winter (Johnson and O'Neil 2001).

MANMADE STRUCTURES

Marine birds use buoys, piers, and piles on NAVBASE Kitsap Bangor as day roosts, perching sites, and nesting sites (Agness and Tannenbaum 2009b). Wharves along the waterfront such as EHW-1 provide underwater substrate for an assemblage of invertebrates such as molluscs, worms and crustaceans, and algal communities that attach to the wharf structures. For example, piles create structure for species typically found in shallower waters or benthic environments and, therefore, can attract marine bird species that forage on these types of prey (Table 3.5–3).

3.5.1.1.2. Federally Endangered or Threatened Birds

MARBLED MURRELET

Status and Population

The marbled murrelet was listed in 1992 as threatened in California, Oregon, and Washington under the ESA (57 FR 45328) (Table 3.5–2). Primary causes of the species' decline include direct mortality from oil spills, by-catch in gillnet fisheries, and loss of nesting habitat (61 FR 26256). Critical habitat for nesting was designated for the marbled murrelet in 1996 (61 FR 26256) and was revised in 2011, but the revised critical habitat did not include military lands (76 FR 61599). NAVBASE Kitsap Bangor is not within designated marbled murrelet critical habitat (61 FR 26256; 71 FR 53838). Designated critical habitat closest to Hood Canal includes forestlands west and south from Dabob Bay, which is within flight distance of the Bangor waterfront (less than 52 miles [84 kilometers]) for breeding murrelets (61 FR 26256).

WDFW has initiated winter at-sea surveys in Washington inland marine waters including Hood Canal through a cooperative agreement with the Navy. The survey effort includes the Bangor shoreline, among other Hood Canal primary sampling units within Stratum 3[1], and is scheduled from 2012/2013 through 2016. The survey method uses a stratified sampling approach to derive density estimates within each stratum. The primary sampling unit in which the Bangor waterfront is located – PSU 39 – was surveyed from October 2013 – February 2014, with the following results expressed as the number of birds detected per kilometer transect length sampled (Table 3.5-4).

Table 3.5–4. 2013–2014 Marbled Murrelet Encounter Rates (PSU 39)

Replicate	Timing	Birds / km transect sampled
1	3 Oct 2013 – 1 Nov 2013	0.529
2	13 Nov 2013 – 17 Dec 2013	0.523
3	1 Jan 2014 – 14 Feb 2014	0.059
Average		0.37

Source: Pearson and Lance 2014
km = kilometer

The global model indicated an estimate of 186 individual birds for the Stratum encompassing NAVBASE Kitsap Bangor between October 2013 and February 2014 (Pearson and Lance 2014). The population estimate for Puget Sound and the Strait of Juan de Fuca in 2013 (Zone 1) was 4,395 birds (95 percent confidence interval = 2,275 – 6,740 birds) with a -3.88 percent (standard error = 1.73 percent) average annual rate of decline for the 2001–2013 period (p = 0.0499) (Pearson et al. 2014).

Marbled murrelets occur year round in Puget Sound and Hood Canal, although their flock size, density, and distribution vary by season (Nysewander et al. 2005; Falxa et al 2008). Observations of marbled murrelets on NAVBASE Kitsap Bangor have been documented since 2007. Marbled murrelets were observed opportunistically during the course of shoreline fish and sediment surveys conducted in spring/summer 2007 and during systematic at-sea surveys of marine birds and mammals conducted in summer 2008 and winter/spring 2009–2010 (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b, 2011b). These observations included eight sightings of marbled murrelet pairs during April and May 2007, and seven sightings of pairs and individuals in November 2009 and April 2010. An individual in juvenile plumage was observed under EHW-1 in September 2008.

The Navy conducted marbled murrelet monitoring in January 2009 during the installation of five steel piles near the southern end of the Bangor waterfront (Navy 2009b). During each of the five pile driving days, one to eight marbled murrelets were frequently observed within 3,280 feet

[1] The Stratum 3 designation is specific to the studies being conducted in cooperation with the Navy; the area in which NAVBASE Kitsap Bangor is located for overall population estimate studies (reference Falxa et al. 2014) is Stratum 2.

(1,000 meters) of pile driving, and intermittent sightings of 12 to 31 murrelets were recorded. No marbled murrelet sightings occurred within the potential injury zone for underwater pile driving noise. Only the September 2008 sighting was in proximity to existing pier structures; other sightings were in nearshore and deeper waters greater than 1,800 feet (549 meters) from any shoreline structure. Marbled murrelet surveys conducted during the TPP (late September to late October 2011) did not detect any murrelets within or in close proximity to the WRA (including the EHW-2 project area), although murrelets were detected elsewhere in Hood Canal (Hart Crowser and HDR 2012). One marbled murrelet was detected in nearshore waters in the vicinity of the north LWI project site (Tannenbaum et al. 2009b). No marbled murrelet observations have been reported in the vicinity of the south LWI project site. Marbled murrelets have been detected occasionally in deeper water in the vicinity of the SPE project site (Navy 2009b; Tannenbaum et al. 2011b).

During the most recent monitoring effort at the NAVBASE Kitsap, Bangor waterfront (July 16, 2013, to February 15, 2014) in support of EHW-2 construction, no marbled murrelets were observed (Pearson and Lance 2014). Collectively, monitoring observations at NAVBASE Kitsap, Bangor suggest that the WRA is not commonly utilized by murrelets or other diving seabirds. This may be due in part to the high levels of disturbance associated with the EHW-2 construction activity, coupled with the already high levels of noise and vessel traffic in the WRA that are part of routine Navy security and operational activities, some of which occur 24 hours a day (e.g., security boat traffic). Agness et al. (2008) similarly concluded that vessel traffic caused significant declines in nearshore densities of Kittlitz’s murrelets, a species closely related to marbled murrelets, in Glacier Bay, Alaska. In contrast, noise and disturbance levels outside of the WRA in portions of Hood Canal and Dabob Bay are generally lower, and both marbled murrelets and diving seabirds appear to be much more common based on observations during the TPP when observers monitored baseline bird populations in these areas (Hart Crowser and HDR 2012).

BEHAVIOR AND ECOLOGY

Murrelets use the marine environment in Hood Canal for courtship, loafing, and foraging (USFWS 2010). In this area, nesting is asynchronous between late April and early September (McShane et al. 2004). During the breeding season, this species tends to forage in well-defined areas along the shoreline in relatively shallow marine waters (Strachan et al. 1995). Murrelets typically forage in pairs during the summer, with single birds occurring less often (Strachan et al. 1995). During the pre-basic (post-breeding season) molt, which occurs from July through November, murrelets are essentially flightless for up to two months (Nelson 1997) and must select foraging sites that provide adequate prey resources within swimming distance (Carter 1984; Carter and Stein 1995). During the non-breeding season, which occurs from September through April, murrelets typically disperse and are found farther from shore (Strachan et al. 1995). The winter flock size averages four birds (USFWS 2010). Murrelets forage at all times of the day and in some cases at night (Strachan et al. 1995). Prey species in Washington coastal and inland waters have not been well documented, but include sand lance, anchovy, immature Pacific herring, shiner perch, and small crustaceans (especially euphausiids) (review by Burkett 1995). Invertebrates are a primary prey source in the non-breeding season, whereas fish are a source year round.

Marbled murrelets nest solitarily in trees with features typical of coniferous old-growth (stand age from 200 to 250 years old trees with multi-layered canopy). Although old-growth forest is the preferred habitat for nesting, this species also is known to nest in mature second-growth forest with trees as young as 180 years old (Hamer and Nelson 1995). WDFW Priority Habitat Species maps do not indicate the presence of marbled murrelet nests in the upland areas including and adjacent to NAVBASE Kitsap Bangor (WDFW 2010b). Although forest stand inventories on NAVBASE Kitsap Bangor indicate that stands are typically less than 110 years old, some relict old-growth trees can be found near Devil's Hole, and a small old-growth stand has been located at the northern portion of the base (International Forestry Consultants 2001; Jones 2010a, personal communication).

3.5.1.1.3. Other Marine Birds

The following discussion provides an overview of the marine bird groupings that occur in the vicinity of the LWI project site, including marine bird families, relative occurrence, habitat requirements, and food resources. Section 3.5.1.1.2 provides information on endangered, threatened, and protected species that occur near the project site. Appendix A provides a complete listing of all birds known or expected to occur on NAVBASE Kitsap Bangor and includes information on seasons of occurrence.

MIGRATORY BIRDS

Most of the marine bird species occurring near the LWI and SPE project sites are present during spring and fall migration or the winter months, including marine waterfowl and seabirds (Appendix A). Six species recognized by USFWS as species of concern could occur in the project area, including the Caspian tern, yellow-billed loon, pelagic cormorant, western grebe, lesser yellowlegs, and short-billed dowitcher (USFWS 2008). (See Appendix A for more information on these species.) Of these species, pelagic cormorants have been documented from Christmas bird counts (Kitsap Audubon Society 2008) and summer surveys (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b). The species does not breed in the vicinity.

SHOREBIRDS AND WADING BIRDS

Shorebirds occurring at or near the LWI and SPE project sites are mainly present during winter and/or migration periods, depending on species life history (Table 3.5–1). Exceptions include killdeer, which are present year round, and spotted sandpiper, a summer resident and potential breeder on NAVBASE Kitsap Bangor. Shorebirds primarily rely on resources on NAVBASE Kitsap Bangor for foraging during the non-breeding season when over-wintering or as a stopover during spring and fall migrations (for species such as phalaropes) (Buchanan 2004). Both killdeer and spotted sandpiper nest close to water (Opperman 2003) and may nest on the shoreline near the project sites. Shorebirds focus on intertidal habitat for all foraging activities (Johnson and O'Neil 2001). Many shorebird species (e.g., plovers, sanderlings, sandpipers, and dowitchers) forage in intertidal mudflats or on beaches near the shoreline for polychaete and oligochaete worms, insect larvae, and aquatic insects (Buchanan 2004). Other food sources for shorebirds include amphipods, copepods, crustaceans, and molluscs. Shorebirds rest or sleep (roost) in a variety of location-dependent habitats. Some roosting habitats used by shorebirds include salt flats adjacent to intertidal foraging areas, higher elevation sand beaches, fields, or grassy areas near intertidal foraging areas. Roost sites occasionally include piles, log rafts, floating docks, or other floating structures when natural roost sites are limited (Buchanan 2004). Shorebird detections were infrequent during at-sea surveys of the Bangor waterfront, with the exception of flocks of dunlin and western sandpiper that used sections of the PSB in deeper water as resting sites during winter months in 2010 (Tannenbaum et al. 2011b).

Great blue herons are wading birds that forage on fish, amphibians, and aquatic invertebrates in wetlands, streams, and marine shorelines in Washington (Quinn and Milner 2004). They are year-round residents in low-elevation areas of western Washington, breeding in colonies (rookeries) that are typically located near a body of water. Great blue herons are observed foraging, resting, and flying along the Bangor shoreline throughout the year (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b, 2011b). In 2008, three new nests were constructed on a lightning tower at EHW-1, at least two of which had chicks during summer 2008 marine wildlife surveys (Tannenbaum et al. 2009b). The tower does not appear to have been used by nesting great blue herons since 2008. A great blue heron rookery with 10 nests was discovered in mid-April 2013 in the vicinity of the proposed SPE parking lot, but the nests were abandoned by the end of May. Since the site was abandoned early in the season it would not warrant protection under the Navy's management criteria for heron nesting sites on NAVBASE Kitsap Bangor.

MARINE WATERFOWL

Most marine waterfowl species only occur at the Bangor waterfront during the winter and migrate north for their breeding season. However, common and hooded mergansers, Canada geese, and some dabbling duck species (mallard, gadwall, and northern shoveler) can be found near the LWI project sites year round. Of these species, only Canada geese and merganser have been sighted regularly during summer months (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b). Surf and white-winged scoters primarily occur in winter, but also can occur in summer (Opperman 2003; Tannenbaum et al. 2011b), although sightings are less common during summer months (Agness and Tannenbaum 2009b). Marine waterfowl primarily forage in the nearshore environment, including near manmade structures (such as EHW-1), but are also found in deeper marine waters (Agness and Tannenbaum 2009b). The primary food resources of marine waterfowl include molluscs, crustaceans, and plant material. Other secondary food sources of marine waterfowl in the nearshore area of the LWI project sites are aquatic larvae and invertebrates. In the Puget Sound region, eelgrass beds are important foraging zones for dabbling ducks (American wigeon and mallard) (Lovvorn and Baldwin 1996). Mergansers, such as the common merganser, nest close to water in rock crevices, tree cavities, or under tree roots (Opperman 2003) and may nest along the shoreline habitat near the LWI project sites during summer. Marine waterfowl also rest on shore and in the intertidal zone (Agness and Tannenbaum 2009b). Summer surveys of marine waterfowl on the Bangor shoreline did not reveal any evidence of local breeding, that is, nest sites or chicks (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b).

SEABIRDS

Two primary groupings of seabirds occur near the LWI project sites: surface-feeding and pursuit-diving. In addition, the parasitic jaeger is a predatory seabird that may occur in the vicinity of NAVBASE Kitsap Bangor during fall migration (late September to early October) in pursuit of small birds such as common terns, which are also in migration during this time

(Opperman 2003). Depending on individual species life history, surface-feeding seabirds may be present in the vicinity of NAVBASE Kitsap Bangor during different seasons. Glaucous-winged gulls occur year round (Hayward and Verbeek 2008), but other gull species only occur during part of the year (Table 3.5–1 and Appendix A). Glaucous-winged gulls breed at established colonies, with the closest colony to the LWI project site located approximately 30 miles (48 kilometers) to the northwest at Protection Island (Hayward and Verbeek 2008). Caspian terns disperse from nesting colonies after the breeding season ends in June or July and may occur in the vicinity of the LWI project sites from April to August. Gulls and terns in the vicinity forage on small schooling fish (e.g., Pacific herring, Pacific sand lance, and juvenile salmonids), which are visible from the water surface in the nearshore marine and deeper water habitats. Additional forage resources taken opportunistically by gulls include objects gleaned at the water surface, garbage on shore or inland, scavenged carrion, and small birds and eggs. Gulls can also forage in the intertidal zone; for example, gulls can feed on molluscs by dropping a mollusc from the air to break the shell on the beach or other hard surface, such as EHW-1.

Pursuit-diving seabirds can occur year round in the vicinity of the LWI project sites; however, numbers of some species are greater during winter months (e.g., pelagic cormorant, common murre, and pigeon guillemot). Cormorants such as the double-crested cormorant nest in colonies along the outer coast of Washington; however, non-breeding double-crested cormorants are found year round on NAVBASE Kitsap Bangor, and pelagic cormorants are also occasionally present. Cormorants typically roost on buoys and other structures at the waterfront in groups of 10 or more individuals, the majority of which are juveniles (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b, 2011b).

With the exception of the pigeon guillemot, seabirds such as the common murre and rhinoceros auklet do not nest near the Bangor waterfront (Wilson and Manuwal 1986; Ainley et al. 2002; Agness and Tannenbaum 2009b). Non-breeding common murres can occur year round. In general, however, common murres are most abundant in inland waters of Washington during the winter (Johnson and O'Neil 2001), whereas rhinoceros auklets are more common during the summer (Johnson and O'Neil 2001; Opperman 2003). Pigeon guillemots were frequently observed during spring/summer surveys of the NAVBASE Kitsap shoreline and infrequently in winter. Common murres and rhinoceros auklets were not detected during these surveys.

Pursuit-diving seabirds are found in nearshore and marine deeper waters near the project site, where they dive to capture prey underwater. These seabirds are also found near manmade structures, such as EHW-1, where algal and invertebrate communities (which provide additional forage resources) have become established on underwater piles. Primary forage resources of these seabirds include small schooling fish and other nearshore fish, such as Pacific sand lance and Pacific herring (Vermeer et al. 1987). The pigeon guillemot forages opportunistically on a more general diet of epibenthic fish and invertebrates compared to some other pursuit-divers, such as the common murre (Vermeer et al. 1987). Additional forage resources of pursuit-diving marine birds include zooplankton and aquatic invertebrates.

MARINE BIRDS AT THE LWI AND SPE PROJECT SITES

Great blue herons have been observed at the outlet of Devil's Hole in the vicinity of the south LWI project site and have been detected in smaller numbers in the vicinity of the north LWI and

SPE project sites. Several heron pairs have nested on a lightning tower at EHW near the north LWI project site in the past (2008), but this is not a recurring rookery location (Tannenbaum et al. 2009b, 2011b). No shorebird concentrations have been detected in the vicinity of the LWI project sites.

Most marine waterfowl species tend to concentrate in the vicinity of manmade structures on the Bangor waterfront, including EHW-1 near the north LWI project site (Tannenbaum et al. 2009b, 2011b). The most abundant marine waterfowl species detected near the project site include Barrow's goldeneye, surf scoter, and bufflehead. The south LWI project site appears to have fewer occurrences of marine waterfowl, with the exception of American wigeon.

Merganser species and Barrow's goldeneye are the most abundant species that congregate in the vicinity of the Service Pier, and pigeon guillemots and various gull species congregate in the vicinity of the north LWI and SPE proposed project sites (Tannenbaum et al. 2009b, 2011b).

3.5.1.2. MARINE BIRD HEARING AND VOCALIZATION

Diving birds (e.g., loons, pelicans, some ducks, terns, and cormorants) may not hear well under water, compared to other (non-avian) terrestrial species, based on adaptations that protect their ears from pressure changes (Dooling and Therrien 2012). Common murres (*Uria aalge*) were deterred from gillnets by acoustic transmitters emitting 1.5 kHz pings at 120 dB re 1 µPa; however, there was no significant reduction in rhinoceros auklet (*Cerorhinca monocerata*) bycatch in the same nets (Melvin et al. 1999). Stemp (1985) found no effect of seismic survey activity on the distribution and abundance of seabirds, and Parsons (in Stemp 1985) reported that shearwaters with their heads underwater were observed within 100 feet (30 meters) of seismic sources (impulsive sounds) and did not respond[2].

Data relevant to the auditory capabilities of bird species are either from studies of vocalizations or audiometric recordings done in-air. These data generally suggest that birds hear best at frequencies between about 1 and 5 kHz, with the most sensitive frequency in the range of 2 to 3 kHz (Dooling 1980, 1982, 2002; review in Dooling and Popper 2007). In-air data for marine birds is limited but generally matches that reported for other bird species. For instance, Woehler (2002) presented data on the hearing capabilities of six penguin species based on their vocalization behavior. The frequency range for all species was between 400 and 8,000 Hz. The upper limit of in-air hearing in all birds is generally limited to the mid-frequency bandwidth due to the anatomical morphology of their middle ear. Saunders et al. (2000) determined that the presence of a single columella rather than the three ear bones found in mammals generally limits hearing in most avian species to a maximum of approximately 10 kHz. No auditory information exists for the marbled murrelet; however, murrelet vocalizations have been recorded for adults and nestlings, with adult calls ranging from approximately 4 to 7 kHz and nestling begging calls from 2 to 11 kHz (Nelson 1997).

[2] Effects of seismic survey underwater sound cannot be compared directly to effects of pile driving, particularly in shallow waters where sound propagation differs from that in deeper waters generally studied in seismic surveys.

3.5.1.3. CURRENT REQUIREMENTS AND PRACTICES

ENDANGERED SPECIES ACT

The ESA is discussed under the fish resource, Section 3.3.1.4.1.

MIGRATORY BIRD TREATY ACT

The MBTA (16 USC 703 et seq.) and EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, protect migratory birds from harm, except as permitted by USFWS for purposes such as banding, scientific collecting, taxidermy, falconry, depredation control, and other regulated activities such as game bird hunting. Harm includes actions that "result in pursuit, hunting, taking, capture, killing, possession, or transportation of any migratory bird, bird part, nest, or egg thereof."

3.5.2. Environmental Consequences

3.5.2.1. APPROACH TO ANALYSIS

The evaluation of impacts on marine birds considers the importance of the resource (i.e., legal, recreational, ecological, or scientific); the proportion of the resource affected relative to its occurrence in the region; the particular sensitivity of the resource to project activities; and the duration of environmental impacts or disruption.

The primary impacts on marine birds from construction of the LWI and SPE would be associated with water quality changes (turbidity) in nearshore habitats, noise associated with impact and vibratory pile driving, construction vessel traffic, visual disturbance, and changes in prey availability. In particular, pile driving noise during the construction period has the potential to disrupt marine bird nesting, foraging, and resting in the vicinity of the LWI and SPE. The range to effect for construction noise for each Alternative is described in the following sections. Other impacts on marine birds, such as changes in prey availability, are anticipated to be highly localized to the construction area.

3.5.2.2. LWI PROJECT ALTERNATIVES

3.5.2.2.1. LWI ALTERNATIVE 1: NO ACTION

There would be no activities related to construction or operations that would disturb marine birds in the project area under the No Action Alternative. Therefore, this alternative would have no impacts on marine birds.

3.5.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

Construction of the LWI under this Alternative has the potential to impact marine birds primarily through underwater and airborne noise generated by pile driving, visual disturbance due to construction activity and vessels, and temporary localized effects within the construction area on prey availability.

CONSTRUCTION OF LWI ALTERNATIVE 2

The primary impacts on marine birds from construction of LWI Alternative 2 would be associated with temporary water quality changes (turbidity) in nearshore habitats, noise associated with pile driving and other construction equipment, temporarily increased construction vessel traffic and intermittent changes in prey availability (benthic community and forage fish), and visual disturbance from the presence of construction workers and equipment during the in-water construction period.

WATER QUALITY

Construction of the LWI would temporarily resuspend sediments into the water in the project area due to installation of piles and steel plate anchors for the mesh barrier, anchoring of barges and tugs, relocation of PSB buoys, and work vessel movements, as discussed in Section 3.1.2.2.2. Water quality would be impacted because bottom sediments would be temporarily resuspended and spread up to approximately 130 feet (40 meters), as described in Section 3.1.2.2.2.

A maximum of 13.1 acres (5.3 hectares) of benthic habitat may be temporarily disturbed within the construction footprint. Resuspended sediments would increase turbidity periodically during in-water construction activities, but turbidity is expected to be localized within the construction zone and temporary during the course of project construction. Metals and organic contaminants that may be present in sediments could also become suspended in the water column in the construction impact zone, but these contaminants are within the sediment quality guidelines listed in Section 3.1.1.1.3. Water quality could also be impacted by stormwater discharges (contaminant loading), and spills (contaminant releases). However, construction-period conditions are not expected to exceed water quality standards, and mitigation measures for the protection of marine water quality and the seafloor would be implemented to minimize impacts (Mitigation Action Plan, Appendix C).

Bird species that prey on fish and benthic organisms may be impacted if resuspended sediments obscure their prey. However, increased turbidity would be limited to the area immediately around driven piles. BMPs and current practices would be implemented to minimize impacts on water quality, such as deploying an oil boom if a spill were to occur, and implementing procedures to remove contaminants (Appendix C). Marine birds would be unlikely to enter the contained area during periods of construction activity due to the pile driving noise, vessel movement, and human presence during the in-water construction window. Some birds may enter the area during breaks in activity, when turbidity due to pile driving would be low. Therefore, impacts on marine birds due to changes in water quality during construction are expected to be minor.

VESSEL TRAFFIC

Vessel movements have the potential to affect marine birds by visual or physical disturbance, or noise (review in Piatt et al. 2007). Responses to disturbance also vary with environmental factors such as habitat types, tides, time of day, and weather (review in Agness 2006). Responses to vessel disturbance are species-specific, and it is likely that both airborne and underwater noise and visual presence of vessels play a role in prompting reactions from marine birds. The probability and significance of vessel and marine bird interactions is dependent on several factors including numbers, types, and speeds of vessels; duration and spatial extent of activities; and the presence/absence and density of marine birds. In general, large, loud, or fast boats appear to have greater impacts than smaller, quieter boats (Piatt et al. 2007).

Behavioral changes in response to vessel presence can include avoidance reactions, alarm/startle responses, temporary abandonment of resting sites, and other behavioral and stress-related changes, such as altered swimming speed, flight, diving, altered direction of travel, and changes in feeding activity, vocalizations, and resting behavior. For example, studies of vessel disturbance and murrelet species (including marbled murrelet) in Alaska, British Columbia, and Washington showed that murrelet counts were negatively correlated with vessel traffic, fewer birds made foraging dives, more birds made avoidance dives, and more birds flew off the water compared to undisturbed focal groups (Kuletz 1996; Speckman et al. 2004; Agness 2006; unpublished data reviewed in Piatt et al. 2007). Boat distance and speed had an effect on reactions by marbled murrelets (review in Piatt et al. 2007). On average, murrelets reacted (by diving or flying) to approaching boats at 130 feet (40 meters) when boat speed was greater than 16 knots, but flushed on average at 92 feet (28 meters) when boat speed was less than 7 knots.

Marine birds on NAVBASE Kitsap Bangor encounter vessel traffic associated with daily operations, maintenance, and security monitoring along the waterfront. During construction of the LWI, several additional vessels would operate in the project area, including one pile driving barge with a crane, one supply barge, one tug boat, and work skiffs. Construction activity involving vessel traffic may occur over 24 months, but the greatest activity levels would be associated with pile driving (up to 80 days during one in-water work season). Sixteen total round trips of barges are expected for the duration of the project (Table 2–1). At any given time, there would be no more than two tugs and six smaller boats, plus barges, present in the construction area. The powered vessels would operate at low speeds within the relatively limited construction zone and access routes during the in-water construction period. Tugs would be employed primarily to bring barges to and from the project area and to position them, which generally involves low speeds. Small boats used to ferry personnel or for monitoring would likewise be operating at slow speeds.

The increased boat traffic associated with in-water construction activities may displace some marine birds if they are in the LWI construction area. As described in Section 3.5.1.1, seabirds and waterfowl would be most abundant types of birds in the project area during the in-water work period, but the effect on breeding marine birds would be negligible because most species do not breed in the vicinity of the project area. Most marine bird species that occur along the Bangor waterfront appear to have habituated to high levels of vessel traffic, based on surveys of developed areas such as Delta Pier, Marginal Pier, and the Service Pier (Tannenbaum et al. 2009b, 2011b). Thus, although some individuals may be disturbed by increased construction-period vessel traffic in the project area, overall impacts would be temporary and intermittent.

PREY AVAILABILITY

The prey base for marine waterfowl includes vegetation, molluscs, and crustaceans and for seabirds includes juvenile salmonids, forage fish, and invertebrates. As described in Section 3.3.1.1, fish species and groups that occur in the LWI project area include forage fish (Pacific sand lance, surf smelt, Pacific herring) and juvenile salmonids (juvenile Chinook salmon, coho salmon, and steelhead; and cutthroat trout) (Bhuthimethee et al. 2009). As described in Section 3.2.1.1, a number of benthic invertebrate species are abundant and diverse at the LWI project sites. These nearshore resources offer suitable prey for most of the marine birds that have been documented in Hood Canal and the Bangor waterfront, but available information is not sufficiently detailed to support a comparison of these sites with other known or potential foraging sites in inland waters.

Some of the prey species, including forage fish and juvenile salmonids have been identified in beach seine surveys (SAIC 2006; Bhuthimethee et al. 2009) and are particularly vulnerable to project impacts because they migrate, feed, shelter, or spawn in the nearshore environment. The greatest impacts on prey species during construction would result from nearshore benthic habitat displacement, resuspension of sediments, localized turbidity within the construction zone, creation of physical barriers to fish migration in nearshore waters, and behavioral disturbance due to pile driving noise. Anchoring of construction barges, propeller wash, pile driving, and installation of anchor plates could locally displace or disturb nearshore benthic habitats and increase turbidity. All of these actions may indirectly impact marine birds by reducing their invertebrate and vertebrate prey base, as discussed in detail in Sections 3.2.2.2.2 and 3.3.2.2.2, respectively. Construction of the pile-supported pier may temporarily reduce biological productivity and quality of benthic habitat used by prey species. Potential construction impacts on benthic habitats would be proportional to the size of the construction zone (up to 100 feet [30 meters] of the proposed LWI structures). Construction of LWI Alternative 2 may potentially displace or disturb up to 13.1 acres (5.3 hectares) of benthic habitat used by invertebrate prey species. Potential impacts to forage fish from underwater noise are detailed in Section 3.3.

VISUAL DISTURBANCE

Visual disturbance would also impact use of the construction area by marine bird species, which have variable levels of tolerance for disturbance. Species including bald eagles, osprey, and great blue herons that are intolerant of visual disturbance while foraging may be impacted during construction at shoreline foraging areas in the vicinity (Watson and Pierce 1998; Quinn and Milner 2004; Eissinger 2007). Birds that depart during construction activities may return to the area following a decrease in activity, such as evening or early morning hours before work commences and when activities are completed. Due to the large size of the Bangor waterfront area and the surrounding Hood Canal, alternative foraging and resting areas are present that would minimize the potential effects of visual disturbance during construction.

CONSTRUCTION AND PILE DRIVING NOISE

The following analysis of underwater noise under LWI Alternative 2 focuses on criteria and guidelines used by the USFWS to determine effects on the ESA-listed marbled murrelet. The analysis estimates the areas that would be encompassed by these criteria based on pile driving noise source levels and propagation of sound through the project area.

Average underwater noise levels measured along the Bangor waterfront are elevated over ambient conditions at undeveloped sites due to waterfront operations, but are within the minimum and maximum range of measurements taken at similar environments within Puget Sound (see Appendix D). In 2009, the average broadband ambient underwater noise levels were measured at 114 dB re 1 μPa between 100 Hz and 20 kHz (Slater 2009). Peak spectral noise from industrial activity was noted below the 300 Hz frequency, with maximum levels of 110 dB re 1 μPa noted in the 125 Hz band. In the 300 Hz to 5 kHz range, average levels ranged between 83 and 99 dB re 1 μPa. Wind-driven wave noise dominated the background noise environment at approximately 5 kHz and above, and ambient noise levels flattened above 10 kHz. Underwater ambient noise measurements taken at EHW-1 (approximately 1,500 feet [450 meters] from the north LWI and 5,900 feet [1,800 meters] from the south LWI) during the TPP project in 2011 ranged from 112.4 dB re 1 μPa RMS between 50 Hz and 20 kHz at mid depth to 114.3 dB at deep depth (Illingworth & Rodkin 2012).

Increased vessel activity and barge-mounted construction equipment such as cranes and generators would temporarily elevate underwater noise levels in the project vicinity. Noise from tugs associated with barge movement would produce intermittent noise levels of approximately 142 dB re 1 μPa at 33 feet (10 meters). These noise levels are typical of an industrial waterfront where tugs, barges, and other vessels are in operation, and consistent with noise levels experienced daily by marine birds under existing conditions in the vicinity of the Bangor waterfront.

Under LWI Alternative 2, up to 54 24-inch (60-centimeter) steel pipe piles would be driven at the north site location, and 202 24-inch steel pipe piles (120 of which would be installed temporarily) would be driven at the south site. An additional 15 36-inch (90-centimeter) piles (abutment piles) and 5 24-inch piles (abutment stair piles) would be driven on shore (in the dry) at the north site, and 16 36-inch piles and 5 24-inch piles would be driven on shore at the south site. Piles would be installed primarily with a vibratory driver, with additional proofing of piles by an impact hammer only if needed. Driving would occur over a maximum of 80 days between July 15 and January 15 during the first year of construction.

Details on selection of proxy source levels for acoustic modeling and sound transmission loss calculations are presented in Appendix D, as is a discussion of the use of a bubble curtain to attenuate noise from impact driving of steel piles. Source levels used to estimate the ranges to effect for marbled murrelets are detailed in Table 3.5-5.

Sound from impact pile driving may be detected above the average background noise levels at any location in Hood Canal with a direct acoustic path (i.e., line-of-sight from the driven pile to receiver location). Intervening land masses would block sound propagation outside of the pathways.

The USFWS identified threshold criteria for marbled murrelets for determining injury exposure to underwater pile driving noise as 208 dB SEL re 1 μPa^2-sec for barotrauma injury and 202 dB SEL re 1 μPa^2-sec for auditory injury (Table 3.5-6). Since the criterion for auditory injury was the lower of the two thresholds, it is used to assess injurious impacts on the marbled murrelet from impact pile driving.

In estimating the potential effects to marbled murrelets from noise generated by impact proofing, the acoustic model assumes 200 strikes per pile with up to 10 piles being proofed per day for the cumulative range to effect. However, the actual number of piles being driven in a given day, and the number of strikes per pile, may be significantly lower than what was modeled.

Table 3.5–5. Source Levels (unattenuated) for Impact Proofing and Vibratory Pile Driving - LWI Alternative 2

Underwater		
Pile Size / Type	**dB SEL re: 1 μPa^2 sec @ 33 feet (10 meters)**	
24-inch (60-centimeter) steel pipe	181	
Airborne		
Pile Size / Type	**dBA RMS re: 20 μPa @ 50 feet (15 meters)**	
	Impact	Vibratory
24-inch steel pipe	100	89
36-inch (90-centimeter) steel pipe	100	96

dB=decibel; re 1 μPa = referenced at 1 micropascal; sec = second; SEL= sound exposure level

Table 3.5–6. Calculated Ranges to Effect - LWI Alternative 2

	Underwater Noise		Airborne Noise
	Barotrauma Injury 208 dB SEL[1]	Auditory Injury 202 dB SEL[1]	Masking
Distance to Threshold	24 ft (7 m)	61 ft (19 m)	138 ft (42 m)
Area Encompassed by Threshold[2]	1,836 sq ft (171 sq m)	11,690 sq ft (1,134 sq m)	59,829 sq ft (5,512 sq m)

dB=decibel; ft = feet; m = meter; μPa = micropascal; SEL= sound exposure level (re 1 μPa^2-sec); sq ft = square feet; sq m = square meter

1. All SEL values assume 2,000 strikes per day. Bubble curtain assumed to achieve an 8 dB reduction in sound pressure levels (or SPLs).
2. Areas encompassed by threshold are the same for the north and south LWI sites

Further, when the model applies the 208 or 202 dB re 1 μPa^{2}sec SEL injury thresholds it assumes marbled murrelets are remaining underwater within the range to effect during the entirety of active impact proofing. In other words, an individual bird would have to be underwater constantly within the calculated range during all impact proofing, with the maximum number of piles installed, and all piles requiring proofing with the maximum number of strikes, in order to accumulate energy from every impact strike. Because these assumptions are physiologically impossible for marbled murrelets, and represent an extreme worst-case scenario regarding pile driving methods and numbers, the practical range to effect would be significantly smaller than those listed in Table 3.5-6 and illustrated in Figure 3.5-1.

Marbled murrelets are unlikely to be injured by pile driving noise at these short distances because the high level of human activity and vessel traffic would cause them to avoid the immediate construction area. Further, impact proofing would be halted if a marbled murrelet is observed within 61 feet (19 meters) of the pile being driven (Appendix C). All pile driving would begin 2 hours after sunrise and cease 2 hours before sunset to minimize effects on foraging marbled murrelets during the nesting season.

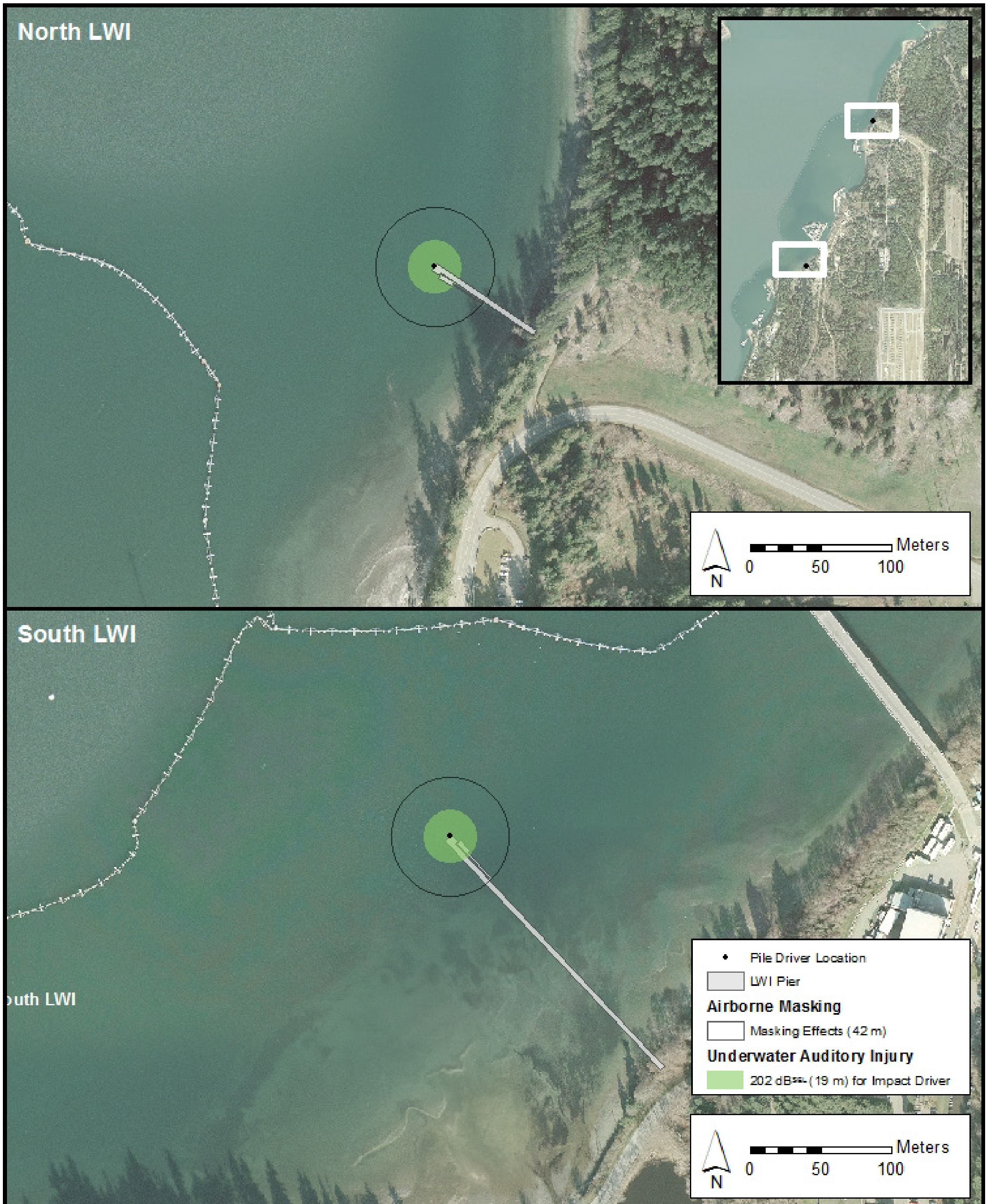


Figure 3.5-1. Representative View of Affected Areas for Marbeled Murrelet due to Underwater and Airborne Pile Driving Noise during Construction of LWI Alternative 2

PHYSIOLOGICAL AND BEHAVIORAL IMPACTS OF NOISE

PHYSIOLOGICAL EFFECTS

Temporary changes in physiology (e.g., stress, reproductive hormone levels) (Blickley et al. 2012; Sanyal et al. 2013) and behavior (e.g., avoidance, foraging, vocalization, attention) (Shen 1983; Bowles 1995) may occur, but are expected to be temporary and consistent with those experienced during exposure to other natural and anthropogenic stressors in an area with a high level of activity such as Hood Canal. Research suggests that bird populations in urban environments can rebound very shortly after even large-scale, extremely noisy events (Payne et al. 2012). During construction of the offshore wind farm Egmond aan Zee in the Netherlands, observers reported that birds (mainly gulls and terns) passing by the activity area did not show a noticeable reaction to pile driving noise (Leopold and Camphuysen 2009). Further, potential for these effects is expected to decrease rapidly with distance from the source of the noise, particularly if topography or vegetation attenuates the signal (WSDOT 2014).

The source levels for airborne noise from pile driving (Table 3.5-5) would be well below those known to cause injury to birds in laboratory situations. Studies of captive birds indicate that long-term exposure to high levels (≥ 93 dBA) of non-impulsive noise (e.g., vibratory pile driving) or to multiple impulses over 125 dBA can cause temporary threshold shifts (Dooling and Popper 2007). However, birds may recover auditory function even after repeated exposure to elevated sound levels (Corwin and Cotanche 1988; Niemiec et al. 1994), and noise resulting from pile driving and other construction activities would be temporary and intermittent during the course of the day.

BEHAVIORAL EFFECTS

Behavioral responses to sound are highly variable and context-specific. For each potential behavioral change, the magnitude of the change ultimately determines the severity of the response. A number of factors may influence an animal's response to noise, including its previous experience; auditory sensitivity; biological and social status, including age and sex; and the behavioral state and activity at the time of exposure. Characteristics of the noise, such as duration and whether the sounds start suddenly or gradually, play a role in determining an animal's response. There is anecdotal evidence of underwater pile driving effects on marine birds. Construction-period monitoring at the Hood Canal Bridge, approximately 22 miles (35 kilometers) from NAVBASE Kitsap Bangor, described a pigeon guillemot that appeared to be distressed and initially unable to fly following underwater exposure to impact pile driving at a distance of approximately 225 feet (69 meters) (Entranco and Hamer Environmental 2005). Foraging marbled murrelets observed during the same project flushed at the onset of pile driving but eventually habituated to pile driving noise.

For birds in the immediate vicinity of the construction activities, behavioral responses to construction noise could include flushing, temporary interruptions of foraging or other behaviors, increased stress hormone levels, changes in vocalization patterns, or avoidance of the activity area (Wasser et al. 1997; Remage-Healey and Romero 2000, 2001; Romero and Remage-Healey 2000; Ronconi and St. Clair 2002; Weimerskirch et al. 2002; Penna and Zúñiga 2014). Energy expenditures due to avoidance of elevated sound pressure levels may increase. Conversely, if small fish are killed or injured as a result of pile driving, foraging birds may be attracted to the work area to feed on them in spite of the noise levels (Cooper 1982). Even without the attractant of stunned or killed fish, birds could continue to forage close to the study area and be exposed to noise from pile driving and extraction. For example, monitoring work at the Hood Canal Bridge in Washington demonstrated that marbled murrelets would continue to dive and forage within 984 feet (300 meters) of active pile driving operations (Entranco and Hamer Environmental 2005), indicating that foraging birds may habituate to such noise.

The summer/fall, pre-basic molt condition (July to November), during which murrelets are essentially flightless, would overlap with the in-water construction season for the LWI. During the pre-basic molt period, marbled murrelets would be less able to withdraw quickly from the project area when suddenly exposed to sound at injury or disturbance levels and could dive underwater to avoid the disturbance. However, visual monitoring before the start of pile driving would minimize the likelihood of this occurring.

HABITUATION

Habituation is a response that occurs when an animal's reaction to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok et al. 2003/2004). Animals are most likely to habituate to sounds that are predictable and unvarying. The opposite process is sensitization—when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. Behavioral state or differences in individual tolerance levels may affect the type of response as well. For example, animals that are resting may show greater behavioral change in response to disturbing noise levels than animals that are highly motivated to remain in an area for feeding (Richardson et al. 1995; National Research Council 2003; Wartzok et al. 2003/2004). Indicators of disturbance may include sudden changes in the animal's behavior or avoidance of the affected area. Species occurring in the vicinity of the LWI project area may have habituated to noise (Brown et al. 2012) from year-round active military activities.

AIRBORNE NOISE

There are no criteria or guidelines for exposure of ESA-listed species such as marbled murrelet to injury from elevated airborne sound. Marine birds would potentially be disturbed by airborne noise associated with construction of the LWI under Alternative 2. Activities that would generate elevated noise levels could include excavation for the abutments, pile driving for the abutments, in-water pile driving, road construction, placement of armor rock, and other uses of heavy equipment. The highest airborne noise levels over water (100 dBA RMS re: 20 μPa at 50 feet [15 meters]) would be associated with impact proofing of steel piles (Table 3.5-5). Airborne noise from vibratory driving is estimated to be 96 dBA RMS re: 20 μPa at 50 feet (15 meters) from the pile being installed. The dominant airborne noise frequencies produced by pile driving are between 50 and 1,000 Hz (WSDOT 2013), which are within the frequency range detected by marine birds.

In addition to pile driving, other LWI construction activities and equipment would generate lower noise levels that are comparable to ambient levels elsewhere along the Bangor waterfront where ongoing operations use trucks, forklifts, cranes, and other equipment (Section 3.9.3.2). Construction equipment for the LWI project would include backhoes, bulldozers, loaders, graders, trucks, and cranes. Activities that would generate elevated noise levels could include excavation for the abutments; construction of the pier deck and fence, and stairways; and road construction and other uses of heavy equipment. Average noise levels are expected to be in the 60 to 68 dBA range, consistent with urbanized or industrial environments where equipment is operating and similar to the range of noise measured on Delta Pier (Navy 2010). Operation of non-pile driving, heavy construction equipment would produce airborne noise levels ranging from 78 to 90 dBA at 50 feet (15 meters) (WSDOT 2013). In the absence of pile driving noise and with simultaneous operation of two types of heavy equipment, the maximum construction noise level is estimated to be 94 dBA at a distance of 50 feet (Section 3.9), but this noise level would be intermittent.

MASKING

Another potential effect of airborne noise from impact pile driving may be masking of vocalizations (Vargas-Salinas and Amézquita 2014). Natural and artificial sounds can disrupt behavior by auditory masking, or interfering with an animal's ability to detect and interpret other relevant sounds, such as communication signals (Wartzok et al. 2003/2004). Masking occurs when both the signal and masking sound have similar frequencies and either overlap or occur very close to each other in time. A signal is very likely to be masked if the noise is within a certain "critical bandwidth" around the signal's frequency and its energy level is similar or higher (Holt et al. 2009). Additional factors influencing masking are the temporal structure of the noise and the behavioral and environmental context in which the signal is produced. Continuous noise is more likely to mask signals than intermittent noise of the same amplitude; quiet "gaps" in the intermittent noise allow detection of signals which may not be detectable during continuous noise (Brumm and Slabbekoorn 2005). Noise from pile driving could cause masking if it disrupts communication and other hearing-dependent behavior. The USFWS has developed criteria and guidelines for evaluating the exposure of marbled murrelets to non-injurious acoustic masking due to elevated airborne noise levels (USFWS 2013c). Airborne noise-related thresholds have not been established for other marine bird species that occur on the waterfront, such as scoter species, pigeon guillemots, goldeneye species, cormorants, and grebes.

Based on the finding of the Marbled Murrelet Hydroacoustic Science Panel II (SAIC 2012), which was tasked with evaluating non-injurious thresholds for pile driving noise, the USFWS determined that airborne acoustic masking due to impact pile driving may affect foraging marbled murrelets. Marbled murrelets typically perform foraging dives in pairs and are highly vocal when they are above the surface (Strachan et al. 1995). On the water's surface, birds typically stay within 100 feet (30 meters) of their partners during foraging bouts. This behavior is thought to play a role in foraging efficiency, and therefore airborne noise that masks their vocalizations has the potential to affect foraging success (Carter and Sealy 1990; Strachan et al. 1995).

Unlike other noise effects criteria and guidelines established for injury and behavioral disturbance, the distance from a pile driving source within which communications would be masked is dependent on ambient noise levels and therefore is site-specific. The expert science panel (SAIC 2012) developed methods to calculate masking distances for impact pile driving projects and applied the procedure to sample cases using ambient and pile driving source data from the TPP (Illingworth & Rodkin 2012) on the Bangor waterfront. Under typical conditions on the waterfront, the maximum distance within which pile driving noise for a 24-inch

(60-centimeter) steel pile is expected to compromise communication between foraging murrelets, assuming the birds are no more than 100 feet (30 meters) apart, would be 138 feet (42 meters) (Table 3.5-6). Acoustic monitoring during EHW-2 construction (Illingworth & Rodkin 2013) indicated that average airborne source levels during impact driving of 36-inch (90-centimeter) steel piles were the same as, and in some cases lower than, 24-inch (60-centimeter) steel piles. Therefore, the masking distance for 24-inch steel piles would pertain to all pile sizes installed under Alternative 2. Representative scenarios of areas encompassed by masking effects are shown in Figure 3.5–1. Similar to the depiction of underwater injury zones, the airborne effects zones would vary depending on the placement of pile driving rigs along the LWI alignments. The USFWS (2013c) has provided guidance on evaluating the significance of airborne masking effects for pile driving projects. "Typical" pile driving projects involve:

- Installation of 24-inch or 36-inch (60- or 90-centimeter) steel piles,
- Use of vibratory pile drivers,
- Use of impact pile drivers for proofing only, and
- Adherence to a 2-hour timing restriction (i.e., no pile driving 2 hours after sunrise and 2 hours before sunset during the breeding season).

Typical pile driving projects would not result in measurable effects on marbled murrelets because the use of impact hammers is intermittent and of short duration, the two-hour timing restriction protects murrelets during their most active foraging periods, and murrelet vocalizations are adapted to overcome the effects of ambient noise (USFWS 2013c). Other considerations in determining whether a project may be atypical would include the project timing, location, and number of piles. The calculated range in which masking could occur for marbled murrelets is listed in Table 3.5-6. The potential for masking effects due to pile driving would be minimized by implementing a marbled murrelet monitoring plan (Appendix C), which would provide for halting impact pile driving while murrelets are present within the masking zone for airborne noise. Masking effects cease immediately when the masking noise stops. .

No recently used nest sites are known from the project area that would be affected by airborne construction noise, including marbled murrelet nesting habitat and nests of marine bird species. Relative to size of available habitat, the area affected by airborne construction noise is negligible.

SUMMARY OF IMPACTS

Nearshore waters in the vicinity provide foraging habitat and prey species for marbled murrelets, and they have been observed in the area during the months of the proposed in-water construction window. They appear to be most abundant during the winter (USFWS 2010); that is, during the proposed in-water construction window for pile driving.

Marbled murrelets are expected to avoid the immediate vicinity of project activities because of construction activities. If individuals were to occur, they would be expected in very small numbers because they have never been observed regularly in the area. Murrelets occurring in the vicinity may have habituated to pile driving and other construction noise, and measurable effects of exposure to noise in this location are not anticipated.

Based on the conservative assumptions used in the sound propagation model to determine the distance to the injurious underwater noise thresholds, the low likelihood of occurrence in the project area, and the protective measures being implemented during construction (Appendix C), any impacts to marbled murrelets would be insignificant and discountable. Potential indirect effects such as temporary alterations to prey base (Section 3.3) would be minor, and no population-level impacts would occur, and the species' overall fitness would not be affected.

Therefore, the ESA effect determination for construction activities under LWI Alternative 2 is "may affect, not likely to adversely affect" marbled murrelets. There would be "no effect" on critical habitat for murrelets.

Direct and indirect impacts on other bird species would be similar to those described for marbled murrelets. While it is likely that most marine birds would avoid the immediate vicinity of the construction site, especially while pile driving is taking place, it is possible that some individuals may habituate sufficiently to occur in the vicinity. Some mitigation measures designed to protect marbled murrelets (e.g., daily time restrictions for pile driving) would protect MBTA-protected seabird species as well as the marbled murrelet from exposure to construction noise. Migratory marine birds are widespread throughout Puget Sound in winter months, but the area affected by the LWI would be limited and would not impact marine bird populations overall.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 2

PREY AVAILABILITY

LWI Alternative 2 would create a nearshore barrier to the movements of marine biota that would be 280 feet (85 meters) long at the north location and 730 feet (223 meters) long at the south location. Marine birds are highly mobile and their movements would not be significantly affected by the presence of the in-water barrier. The mesh would be a high visibility material that is not directly comparable to fishing nets but rather would be more like a semi-flexible grate with fairly wide partitions between the mesh openings. Therefore, diving birds would be expected to readily avoid the mesh and are unlikely to become entangled in it.

The LWI may indirectly affect marine birds by temporarily changing their prey base (primarily fish and invertebrates). The main impact of LWI Alternative 2 on the benthic organisms would be the permanent loss of nearshore habitat due to installation of steel piles and anchor plates. The LWIs and abutment stair landings would permanently displace approximately 0.14 acre (0.06 hectare) of nearshore soft-bottom benthic habitat at the north and south locations. The overwater structures would shade a small area of benthic habitat (approximately 0.0029 acre [0.0012 hectare] of full shading) (Section 3.2.2.2.2). However, shading impacts on biological productivity of sessile benthic invertebrates in this area would be minor due to its small size. A potential beneficial effect may occur by facilitating predation by marine birds. The piles and mesh would create a physical barrier to movements of juvenile salmonids and forage fish (Section 3.3.2.2.2) in the nearshore environment, causing them to hesitate at the mesh and/or migrate around the seaward ends of the piers. These fish may be more vulnerable to avian predators. Adult salmonids are less dependent on nearshore habitats than juveniles and are more mobile, but they may congregate at the seaward ends of the LWI, where they would be more exposed to avian (eagle or osprey) predation. Moreover, installation of additional piles for the

LWI pier would result in an increase in hard-surface benthic habitat for encrusting species, which has the potential to benefit waterfowl and seabirds that forage on these resources.

Prey populations would not be significantly impacted by the construction and future operation of Alternative 2. Operations impacts of the LWI would be limited to the small area including and adjacent to the structures. The Mitigation Action Plan (Appendix C) describes the marine habitat mitigation actions that the Navy would undertake as part of the Proposed Action. This habitat mitigation action would compensate for impacts of the Proposed Action to marine habitats and species.

NOISE AND VISUAL DISTURBANCE

Operation of the LWI may result in a minor increase in potential noise and visual disturbance from human activity and artificial light. Under existing conditions, the Bangor waterfront produces an environment of complex and highly variable noise and visual disturbance for marine birds. Some marine bird species, such as pigeon guillemots, waterfowl species, and seabirds including gulls and cormorants, forage and loaf in marine waters and manmade structures at working piers and wharves on NAVBASE Kitsap Bangor (Agness and Tannenbaum 2009b). Because future operations of the LWI would not exceed existing levels, most individual marine birds are likely to habituate to the post-construction activity levels as they have to activity levels at other developed portions of the waterfront. Operation of the LWI would be unlikely to impact future use of the MSF pier by nesting pigeon guillemots because the north LWI is over one mile from the LWI (1.6 kilometers) away and noise levels attenuated by distance and physical features such as buildings and trees would be less than ambient noise at the MSF at this distance.

Maintenance of the LWI would include routine inspections, cleaning, repair, and replacement of facility components as required (not including pile replacement). These activities could affect marine birds through noise impacts. However, noise levels are not expected to be appreciably higher than existing levels elsewhere along the Bangor waterfront, to which marine birds appear to have habituated. Therefore, maintenance would have negligible impacts on marine birds.

Effects of long-term operations of the LWI on prey availability, noise, and visual disturbance are not expected to measurably affect marine bird behaviors, including resting, foraging, and breeding, on the Bangor waterfront.

Therefore, the ESA effect determination for operation of LWI Alternative 2 is "may affect, not likely to adversely affect" marbled murrelets. There would be "no effect" on critical habitat for the species.

3.5.2.2.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

LWI Alternative 3 would modify the existing PSB system to extend across the intertidal zone and attach to concrete abutments at the shoreline, but there would not be a pile-supported pier as proposed under Alternative 2. As described in Chapter 2, no piles would be installed in the water, and nearshore barriers to movement of marine biota would be much less than under Alternative 2. LWI Alternative 3 would include the same concrete abutments described for LWI Alternative 2, as well as observation posts, such that marine birds could be exposed to airborne pile driving noise for these structures, all of which would be installed from the shoreline in the dry. Long-term operations of the LWI under Alternative 3 would result in some potential indirect effects on prey species, although the consequences for marine bird populations are likely to be insignificant.

CONSTRUCTION OF LWI ALTERNATIVE 3

Marine birds are expected to avoid the construction areas because of increased vessel traffic and noise and human activity. General construction period impacts, including those to water quality, vessel traffic, prey availability, and construction noise, would be similar to LWI Alternative 2, but overall Alternative 3 would have fewer and shorter-duration impacts on marine birds. Additionally, Alternative 3 would require no in-water pile driving, thus eliminating the potential for marbled murrelets to be exposed to injurious noise levels.

The following sections describe how construction would affect the abundance and distribution of marine birds present or potentially on NAVBASE Kitsap Bangor, and compare the effects of LWI Alternative 3 with effects of LWI Alternative 2.

WATER QUALITY

Tug and barge operations and placement of PSB buoy anchors would resuspend contaminants that may be present in sediments and increase turbidity levels, as discussed in Section 3.1.2.2.3. A smaller seafloor area (up to 12.7 acres [5.2 hectares]) may be disturbed under LWI Alternative 3 compared to Alternative 2 (approximately 13.1 acres [5.3 hectares]). Similar to Alternative 2, water quality effects of Alternative 3, including seafloor disturbance, would be temporary and localized within the construction zone, and construction-period impacts are not expected to result in violations of water quality standards. Measures for the protection of marine water quality and the seafloor would be implemented to minimize impacts (Mitigation Action Plan, Appendix C).

Because suspended sediment and contaminant concentrations would be low and highly localized to the immediate construction area, no impacts on marine birds are expected due to changes in water quality during construction. Considering the wide distribution of marine birds in inland marine waters, water quality changes due to LWI Alternative 3 would be negligible.

VESSEL TRAFFIC

Vessel movements associated with construction of the LWI under Alternative 3 have the potential to impact marine birds directly by accidentally striking or disturbing individuals. Construction activity involving vessel traffic may occur over 12 months. However, because no in-water piles would be installed with Alternative 3, lower levels of vessel traffic including barge and tug trips would be required (3 total round trips for barges under Alternative 3 compared to 80 days of pile driving with 16 total round trips under Alternative 2). Thus, LWI Alternative 3 would result in lower overall disturbance levels for marine birds in the project vicinity and would likely displace them for shorter periods of time. The affected area for both alternatives would be limited to the project vicinity and inconsequential relative to the wide distribution of marine bird populations in inland waters.

PREY AVAILABILITY

Construction of Alternative 3 could displace and degrade benthic habitats and marine vegetation used by prey populations for foraging and refuge, and also potentially affect marine bird foraging success due to increased turbidity. Impacts of LWI construction on prey availability for fish-eating marine birds under Alternative 3 are described in Section 3.3 and impacts on benthic organisms are described in Section 3.2. The amount of foraging and refuge habitat supporting prey populations that would be lost or degraded during project construction would be smaller for Alternative 3 (12.7 acres [5.2 hectares]) than for Alternative 2 (13.1 acres [5.3 hectares]) (Table 3.2–8). Under Alternative 3, there would be reduced (relative to Alternative 2) barriers to fish movements in the nearshore because no pier/mesh barrier system would be installed with this alternative, and there would be no in-water pile driving and related disturbance of fish. Thus, adverse behavioral responses of fish populations to project construction would be reduced under Alternative 3. Under Alternative 3, less habitat for benthic organisms would be lost or degraded during construction because there would be no pile and mesh barrier installation.

While project construction may temporarily alter the prey base of marine birds that occur in the immediate project vicinity, in the overall context of the range occupied by marine bird populations in Hood Canal and inland marine waters, the area affected by Alternative 3 is too small to represent meaningful impacts on population numbers and distribution.

NOISE

As described in Section 2.1.1.3.3, Alternative 3 would require pile driving for the LWI abutments. A total of 15 36-inch (90-centimeter), 15 24-inch (60-centimeter), and up to 12 30-inch (76-centimeter) hollow steel piles would be driven at the north LWI site, all of which would be driven in the dry using a land-based pile driving rig. The same number of steel piles would be driven in the dry at the south LWI site, with the exception that 16, rather than 15, 36-inch piles would be installed. Piles would be driven using vibratory and impact drivers as required. Unlike the pile-supported pier under Alternative 2, no in-water pile driving would be required for Alternative 3, and the total number of driven piles would be substantially fewer (85 land-installed piles for Alternative 3 compared with 136 permanent in-water piles, 120 temporary in-water piles, and 41 land-installed piles for Alternative 2). Exposure of marine birds to pile driving noise would be limited to airborne noise impacts from Alternative 3, and the duration of the exposure would be substantially shorter. Up to 30 days of pile driving would be required for construction of Alternative 3 compared to 80 days of pile driving for Alternative 2.

Under LWI Alternative 3, the range in which potential masking may occur for marbled murrelets would be the same as LWI Alternative 2 (Table 3.5-6). Representative views of the areas encompassed by this range are shown in Figure 3.5–2 for the north and south LWI locations. The affected areas under Alternative 3 are limited to the nearshore zone, which is typically not frequented by foraging or resting marbled murrelets. Therefore, no murrelets are likely to be exposed to adverse airborne noise-related effects. Moreover, the Navy would actively avoid masking effects due to pile driving by implementing a marbled murrelet monitoring plan (Appendix C), which would provide for halting impact pile driving while murrelets are present within the masking zone for airborne noise. All pile driving would cease if a marbled murrelet were observed within or entering the masking zone for airborne pile driving.

Figure 3.5-2. Representative View of Affected Areas for Marbled Murrelet due to Airborne Pile Driving Noise during Construction of LWI Alternative 3

Airborne sound due to other construction equipment would be similar to the levels described for non-pile driving construction noise under Alternative 2. Average noise levels are expected range from 60 to 68 dBA, consistent with urbanized or industrial environments where equipment is operating and similar to the range of noise measured on Delta Pier (Navy 2010). Operation of heavy construction equipment (excluding pile drivers) would produce airborne noise levels ranging from 78 to 90 dBA at 50 feet (15 meters) (WSDOT 2013). In the absence of pile driving noise and with simultaneous operation of two types of heavy equipment, the maximum construction noise level is estimated to be 94 dBA at a distance of 50 feet (Section 3.9), but this noise level would be intermittent.

As discussed above for Alternative 2 (Section 3.5.2.2.2), Alternative 3 would meet the characteristics of a "typical" pile driving project as defined by the USFWS (2013c) for the purposes of evaluating masking effects on marbled murrelets. Alternative 3 is not expected to have measurable effects on the species.

Therefore, the ESA effect determination for construction activities under LWI Alternative 3 is "may affect, not likely to adversely affect" marbled murrelets. There would be "no effect" on critical habitat for the species.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 3

LWI Alternative 3 would modify the existing PSB system to extend across the intertidal zone and attach to concrete abutments at the shoreline, and the pile-supported pier and in-water mesh proposed under Alternative 2 would not be constructed. Most of the habitat displacement under Alternative 3 would result from pontoons of the PSB repeatedly grounding and scouring in nearshore benthic habitat. Alternative 3 would permanently displace or disturb a smaller area of soft-bottom benthic habitat (0.06 acre [0.025 hectare]) than Alternative 2 (0.14 acre [0.06 hectare]), thereby affecting a smaller amount of habitat supporting benthic prey species.

Shading of benthic habitat would be reduced under Alternative 3 compared to Alternative 2 with minor effects on benthic community productivity. Thus, the LWI footprint under Alternative 3 would be smaller and would pose no barrier to movement of marine biota. Opportunities for marine birds to prey on fish migrating around the seaward ends of the piers under Alternative 2 would not occur with Alternative 3. Installation of additional piles under Alternative 2 would increase hard-surface benthic habitat for encrusting species, which are prey for some waterfowl and seabirds, but since fewer piles would be installed under Alternative 3, the potential benefits to marine birds would be less likely than under Alternative 2. Similar to Alternative 2, impacts on the prey base for marine bird species are expected to be minor, but these changes cannot be quantified with available information. Marine birds are wide-ranging and have extensive foraging habitat available in Hood Canal relative to the foraging area that might be impacted by operation of the LWI. Localized changes in prey availability within the construction zone are possible under Alternative 3 but are expected to be negligible. The Mitigation Action Plan (Appendix C) describes the marine habitat compensatory mitigation that the Navy would undertake as part of the Proposed Action. The habitat mitigation would compensate for impacts of the Proposed Action on marine habitats and species that might indirectly affect the marine bird prey base.

Operation and maintenance of the LWI under Alternative 3 would include increased noise and visual disturbance from human activity and artificial light, similar to Alternative 2. However, disturbance levels would not be appreciably higher than existing levels to which marine birds appear to have habituated elsewhere at the Bangor waterfront. Direct and indirect effects of project operations on marine birds would be negligible, and no population level impacts are anticipated.

Therefore, the ESA effect determination for operation of LWI Alternative 3 is "may affect, not likely to adversely affect" marbled murrelets. There would be "no effect" on critical habitat for the species.

3.5.2.2.4. SUMMARY OF LWI IMPACTS

Impacts on marine mammals during the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.5-7.

Table 3.5–7. Summary of LWI Impacts on Marine Birds

Alternative	Environmental Impacts on Marine Birds
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Pier	*Construction:* Potential direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability due to installation of pile-supported pier. Construction noise (primarily due to pile driving) may exceed USFWS underwater injury and airborne masking thresholds for marbled murrelet, but would be intermittent and temporary. Construction disturbance due to in-water work would occur over one season, including a total of 80 days of pile driving. *Operation/Long-term Impacts:* Indirect impacts on prey species due to loss and degradation of benthic habitat, and barriers to migratory fish. Increased hard-surface benthic habitat may benefit marine birds that consume encrusting invertebrates.
	ESA: Effect determination for the marbled murrelet is "may affect, not likely to adversely affect" with "no effect" on critical habitat for the species.
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* Potential direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability, airborne construction noise (primarily due to impact pile driving) sufficient to exceed the USFWS airborne masking threshold. Construction disturbance due to in-water work would occur over one season, including a total of 30 days of pile driving, compared to 80 days for Alternative 2. *Operation/Long-term Impacts:* Indirect impacts on prey species due to loss and degradation of benthic habitat, but no barriers to migratory fish, in contrast to Alternative 2. Increased hard-surface benthic habitat may benefit marine birds that consume invertebrates.
	ESA: Effect determination for the marbled murrelet is "may affect, not likely to adversely affect" with "no effect" on critical habitat for the species.
Mitigation: Marbled murrelets would be monitored during impact pile installation activities of the LWI project within the airborne masking and underwater injury zones, and shutdown procedures would be implemented if any marbled murrelet enters the injury zone or the masking zone for impact pile driving. Appendix C (Mitigation Action Plan) details mitigation measures.	
Consultation and Permit Status: The Navy consulted with the USFWS Washington Fish and Wildlife Office on the marbled murrelet under the ESA. A Biological Assessment (BA) was submitted to USFWS in March 2015, and a revised BA was submitted in June 2015. In a concurrence letter dated March 4, 2016, USFWS stated that LWI project impacts to marbled murrelets are discountable.	

ESA = Endangered Species Act; USFWS = U.S. Fish and Wildlife Service

3.5.2.3. SPE PROJECT ALTERNATIVES

3.5.2.3.1. SPE ALTERNATIVE 1: NO ACTION

There would be no activities related to construction or operations that would disturb marine birds in the project area under the No Action Alternative. Therefore, this alternative would have no impacts on marine birds.

3.5.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

Construction of the SPE would directly impact marine birds primarily through underwater and airborne noise generated by pile driving, visual disturbance due to construction activity and vessels, and temporary localized effects on prey availability within the construction zone. Indirect impacts could result from localized changes in the benthic prey (Section 3.2) and forage fish communities (Section 3.3). Impacts on marine birds from operation of this alternative are anticipated to be highly localized. Marine birds are wide-ranging and have a large foraging habitat available in Hood Canal, relative to the foraging area that might be impacted by operation of the SPE, and long-term impacts resulting from the Proposed Action would be minor.

CONSTRUCTION OF SPE ALTERNATIVE 2

Impacts on marine birds from construction of SPE Alternative 2 may include temporary water quality changes (turbidity) in nearshore habitats, noise associated with pile driving and other construction equipment, increased construction vessel traffic, changes in prey availability (benthic community and forage fish), and visual disturbance from the presence of construction workers and equipment during the in-water construction period.

Construction-related activities may disturb foraging marine birds because the number of vessels, including barges, and workers in the area would increase. However, birds occurring in the area may have habituated to anthropogenic stressors based on the ongoing military activities at the NAVASE Kitsap Bangor waterfront. Impacts on marine birds would occur when birds are foraging underwater at the same time that underwater noise is being generated by impact, and to a lesser extent vibratory, pile driving; but the simultaneous occurrence of underwater foraging and pile driving would be limited in time, scope, and intensity. Birds resting or foraging on the surface of the water, the shoreline, or manmade structures could also be exposed to airborne pile driving noise. Mitigation measures described in Appendix C, Section 5.0, would reduce the likelihood of adverse impacts on marbled murrelets, and would also benefit other marine bird species.

WATER QUALITY

Construction of the SPE would temporarily resuspend sediments in the project area due to anchoring of barges and tugs, installation of piles, and work vessel movements, as described in Section 3.1.2.3.2. Water quality would be impacted because bottom sediments would be temporarily resuspended and may spread up to 130 feet (40 meters) as described in Section 3.1.2.3.2. Up to 3.9 acres (1.6 hectares) of benthic habitat may be temporarily disturbed within the construction footprint. Potential impacts to marine birds due to changes in water quality are as detailed in Section 3.5.2.2.2 for LWI Alternative 2.

VESSEL TRAFFIC

During construction of the SPE, several additional vessels would operate in the project area, including one to two pile driving barges, one to two support barges, one tug boat, and two work skiffs. Six round trip barge transits per month are expected for the duration of the project (Table 2–2). At any given time, there would be no more than two tugs and six smaller boats, plus barges, present in the construction area. Construction activity involving vessel traffic may occur over 24 months, but the greatest activity levels would be associated with pile driving (up to 161 days over two in-water work seasons). The powered vessels would operate at low speeds within the relatively limited construction zone and access routes during the in-water construction period. Tugs would be used primarily to bring barges to and from the project area and to position them, which generally involves low speeds. Small boats used to ferry personnel or for monitoring would likewise be operating at slow speeds.

Potential impacts to marine birds due to vessel traffic during construction of SPE Alternative 2 are as detailed in Section 3.5.2.2.2 for LWI Alternative 2. Most marine bird species that occur along the Bangor waterfront appear to have habituated to high levels of vessel traffic, based on surveys of developed areas such as Delta Pier, Marginal Pier, and the Service Pier (Tannenbaum et al. 2009b, 2011b). Thus, although some individuals could be disturbed by increased construction-period vessel traffic in the project area, they probably would continue to frequent the project area during periods when vessel traffic is low.

PREY AVAILABILITY

The prey base for marine waterfowl includes vegetation, molluscs, and crustaceans, and for seabirds includes juvenile salmonids, forage fish, and invertebrates. As described in Section 3.3.1.1, fish species and groups that occur in the deeper-water SPE project area include some forage fish (e.g., Pacific sand lance and Pacific herring) and salmonids (juvenile Chinook salmon, coho salmon, and steelhead; and cutthroat trout) (Bhuthimethee et al. 2009). As described in Section 3.2.1.1, benthic invertebrate species characteristic of deeper water are present at the SPE project site. This portion of the Bangor shoreline has a steep subtidal grade, lacks flat bottom benthic habitat, and has no nearby freshwater nutrient input of the type that can contribute to higher abundance and diversity where these inputs occur. Potential impacts to marine birds due to temporary changes in prey availability during SPE Alternative 2 are as detailed in Section 3.5.2.2.2 for LWI Alternative 2.

Under Alternative 2, construction of the SPE may temporarily disturb up to 3.9 acres (1.6 hectares) of soft-bottom benthic habitat used by prey species. Mitigation efforts (Appendix C) would minimize potential impacts to prey communities. While localized effects of project construction may affect the prey base of marine birds that occur in the project vicinity, in the overall context of the Hood Canal marine bird populations, the impacts to prey availability would be minor.

VISUAL DISTURBANCE

Visual disturbance would also impact use of the construction area by marine bird species, which have variable levels of tolerance for disturbance. Birds that depart during construction activities may return to the area following a decrease in activity, such as evening or early morning hours before work commences and when activities are completed. Due to the large size of the Bangor waterfront area and the surrounding Hood Canal, alternative foraging and resting areas are present that would minimize the potential effects of visual disturbance during construction.

The Navy and USFWS Washington Fish and Wildlife Office have identified potential marbled murrelet nesting habitat in the stand of conifer forest that would be the site of the proposed parking lot, utilities, laydown area, and road improvements for the SPE project. Eight trees with a total of 10 platforms appear to be marginally suitable for nesting (Harke 2013, personal communication). The parking lot and other facilities would occupy approximately 7 acres (2.8 hectares) and would be located within the outline depicted in Figure 3.5–3. Up to 4 additional acres (1.6 hectares) may be cleared for a laydown area and other construction-related disturbance and revegetated with native species following construction. The Navy, through early coordination with USFWS, is minimizing impacts on marbled murrelet potential nesting habitat in the conifer stand on this site. The original parking lot design was situated farther north in the conifer stand to avoid impacts on a newly established heron rookery (subsequently abandoned) in the southeast corner of the proposed parking lot area. The original location was the site of several potential marbled murrelet nesting platforms. During a site visit on June 19, 2013, USFWS requested that the Navy avoid this potential nesting habitat and relocate the proposed parking area to the southwest corner of the site within an old orchard. The proposed design has incorporated the USFWS request to minimize impacts on the conifer stand, but a small portion of the conifer stand (<4 acres) including four potential nest trees may be removed. In addition, tree removal would not be conducted during the marbled murrelet breeding season of April 1 through September 23.

CONSTRUCTION AND PILE DRIVING NOISE

Underwater noise conditions at the NAVBASE Kitsap Bangor waterfront are detailed in Section 3.5.2.2.2 for LWI Alternative 2. Approximately 50 24-inch (60-centimeter), and 230 36-inch (90-centimenter), steel pipe support piles would be driven over 125 days during the first in-water work window to support the pier extension. 105 18-inch (45-centimeter) square concrete piles that would serve as fender piles would be driven over 36 days during the second in-water work window. Most steel piles would be driven with a vibratory driver, and an impact hammer would be used to proof piles, if necessary. Concrete piles would be driven by impact hammer only. Source levels for acoustic modeling under SPE Alternative 2 (Table 3.5-8) resulted in the calculated ranges to effect detailed in Table 3.5-9 and Figure 3.5-4.

Sound from impact pile driving would be detected above the average background noise levels at any location in Hood Canal with a direct acoustic path (i.e., line-of-sight from the driven pile to receiver location). Intervening land masses would block sound propagation outside of these pathways. Mitigation measures for underwater pile driving noise, including a bubble curtain, and marbled murrelet monitoring during pile driving, are described in Appendix C.

Figure 3.5-3. Proposed SPE Parking Lot Area

Table 3.5–8. Source Levels (unattenuated) for Impact Pile Driving - SPE Alternative 2

Underwater	
Pile Size / Type	**dB SEL — re: 1μPa^2 sec @ 33 feet (10 meters)**
36-inch (90-centimeter) steel pipe	181
18-inch (45-centimeter) square concrete	159
Airborne	
Pile Size / Type	**dBA RMS — re: 20 μPa @ 50 feet (15 meters)**
36-inch steel pipe	100
18-inch square concrete	

dB=decibel; re 1 μPa = referenced at 1 micropascal; SEL= sound exposure level

Table 3.5–9. Calculated Ranges to Effect - SPE Alternative 2

	Underwater Noise		**Airborne Noise**
	Barotrauma Injury 208 dB SEL	**Auditory Injury 202 dB SEL**	**Masking**
36-inch (60-centimeter) — Steel Piles			
Distance to Threshold[1]	24 ft (7 m)	61 ft (19 m)	138 ft (42 m)
Area Encompassed by Threshold	1,836 sq ft (171 sq m)	11,690 sq ft (1,134 sq m)	59,829 sq ft (5,542 sq m)
18-inch (45-centimeter) — Concrete Piles			
Distance to Threshold[2]	4 feet (1 meter)	9 feet (3 meters)	138 ft (42 m)
Area Encompassed by Threshold	28 sq ft (3 sq m)	314 sq ft (28 sq m)	59,829 sq ft (5,542 sq m)

dB = decibel; ft = feet; m = meter; SEL= sound exposure level (re 1 μPa^2-sec); sq ft = square feet; sq m = square meter

1. SEL values assume 2,000 strikes per day. Bubble curtain assumed to achieve an 8 dB reduction in sound pressure levels.
2. SEL values assume 3,000 strikes per day; no bubble curtain would be used during impact driving of concrete piles.
3. Available data are insufficient to estimate an accurate masking zone for 18-inch concrete piles; however, it is expected to be smaller than the zone assumed for 36- or 24-inch steel piles. Therefore, the sound levels for 36-inch steel piles were used as a proxy for 18-inch concrete piles as a conservative assumption in the acoustic model.

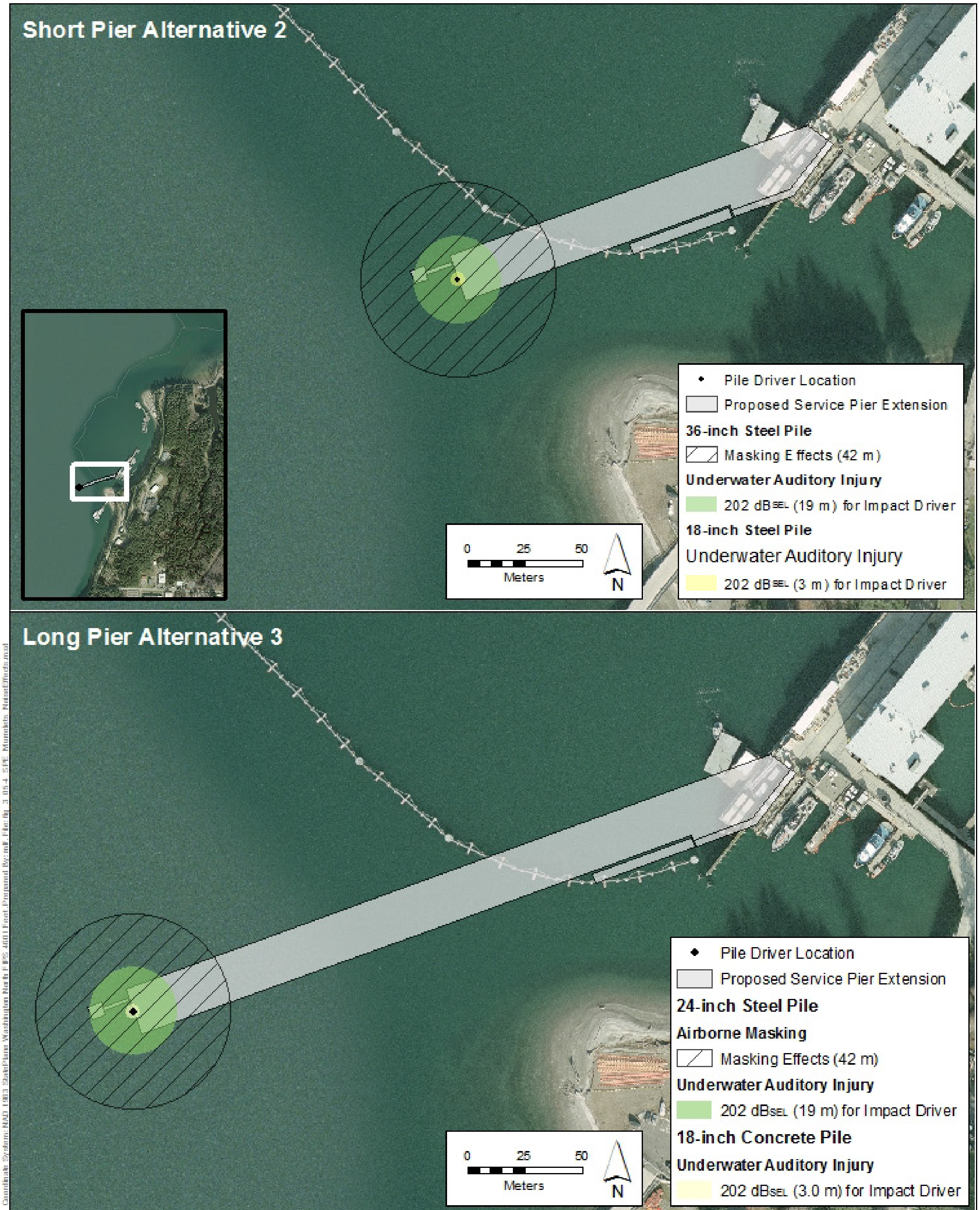


Figure 3.5-4. Representative View of Affected Areas for Marbled Murrelets due to Underwater and Airborne Pile Driving Noise during Construction of SPE Alternatives 2 and 3

PHYSIOLOGICAL AND BEHAVIORAL IMPACTS OF NOISE

Because 36- and 24-inch (90- and 60-centimeter) steel piles may be installed interchangeably during the first in-water work window under SPE Alternative 2, the largest source level (i.e., for 36-inch steel piles) is assumed for analysis. The model assumes up to 200 strikes may be required to proof steel piles, and up to 300 strikes would be required to fully install concrete piles. Up to 10 piles may be installed on any day of active pile driving. The potential physiological and behavioral impacts of noise, including habituation, to seabirds are described in Section 3.5.2.2.2 under LWI Alternative 2.

AIRBORNE NOISE

Similar to LWI Alternative 2, marine birds would potentially be disturbed by airborne noise associated with construction of SPE Alternative 2. The highest airborne noise levels over water would be associated with impact proofing of steel piles (Table 3.5-8). Airborne noise from vibratory driving is estimated to be 96 dBA RMS re: 20 μPa at 50 feet (15 meters) from the pile being installed. No vibratory driving of concrete piles would occur during the second in-water work window. The dominant airborne noise frequencies produced by pile driving are between 50 and 1,000 Hz (WSDOT 2013), which are within the frequency range detected by marine birds.

In addition to pile driving, other SPE construction activities and equipment would generate lower noise levels that are comparable to ambient levels elsewhere along the Bangor waterfront where ongoing operations use trucks, forklifts, cranes, and other equipment (Section 3.9.3.2). Construction equipment for the SPE project would include backhoes, bulldozers, loaders, graders, trucks, and cranes. Activities that would generate elevated noise levels could include construction of the pier extension deck, construction of the Pier Services and Compressor Building, and other uses of heavy equipment. Average noise levels are expected to be in the 60 to 68 dBA range, consistent with urbanized or industrial environments where equipment is operating and similar to the range of noise measured on Delta Pier (Navy 2010). Operation of non-pile driving, heavy construction equipment would produce airborne noise levels ranging from 78 to 90 dBA at 50 feet (15 meters) (WSDOT 2013). In the absence of pile driving noise and with simultaneous operation of two types of heavy equipment, the maximum construction noise level is estimated to be 94 dBA at a distance of 50 feet (Section 3.9), but this noise level would be intermittent; this level is consistent with the typical ambient noise at an industrial waterfront.

MASKING

Masking is introduced in Section 3.5.2.2.2 under LWI Alternative 2. As with underwater noise, the method of calculating masking distance is detailed in Appendix D. Under typical conditions on the waterfront, the maximum distance within which pile driving noise for a 24-inch (60-centimeter) steel pile is expected to compromise communication between foraging murrelets, assuming the birds are no more than 100 feet (30 meters) apart, would be 138 feet (42 meters) (Table 3.5-9). Representative scenarios of areas encompassed by masking effects are shown in Figure 3.5-4. As described in Appendix C, the masking zone would be monitored and pile driving halted if a marbled murrelet is observed. Masking effects cease immediately when the masking noise stops. Therefore, the potential for impact to marbled murrelets from masking is minimal.

Summary of Potential Impacts

Nearshore waters in the vicinity provide foraging habitat and prey species for marbled murrelets, and they have been observed in the area during the months of the proposed in-water construction window. They appear to be most abundant during the winter (USFWS 2010); that is, during the proposed in-water construction window for pile driving.

Marbled murrelets are expected to avoid the immediate vicinity of project activities because of construction activities. If individuals were to occur, they would be expected in very small numbers because they have never been observed regularly in the area. Murrelets occurring in the vicinity may have habituated to pile driving and other construction noise, and measurable effects of exposure to noise in this location are not anticipated.

Based on the conservative assumptions used in the sound propagation model to determine the distance to the injurious underwater noise thresholds, the low likelihood of occurrence in the project area, and the protective measures being implemented during construction (Appendix C), any impacts to marbled murrelets would be insignificant and discountable. No population-level impacts would occur, and the species' overall fitness would not be affected.

Therefore, the ESA effect determination for construction activities under SPE Alternative 2 is "may affect, not likely to adversely affect" marbled murrelets. There would be "no effect" on critical habitat for the species.

Direct and indirect impacts on other bird species would be similar to those described for marbled murrelets. While it is likely that most marine birds would avoid the immediate vicinity of the construction site, especially while pile driving is taking place, it is possible that some individuals may habituate sufficiently to occur in the vicinity. Some mitigation measures designed to protect marbled murrelets (e.g., daily time restrictions for pile driving and no tree removal during the breeding season) would protect MBTA-protected seabird species as well as the marbled murrelet from exposure to construction noise and habitat disturbance. Migratory marine birds are widespread throughout Puget Sound in winter months, but the area affected by the SPE would be limited and would not impact marine bird populations overall.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 2

Prey Availability

SPE Alternative 2 would increase the length of the existing pier by 540 feet [165 meters], permanently displacing a small area (approximately 0.045 acre [0.018 hectare]) of deeper water soft-bottom benthic habitat that is used by prey populations. This would result in indirect effects on marine birds primarily in terms of their prey base. Installation of additional piles would increase hard-surface benthic habitat for encrusting species, which would benefit waterfowl and seabirds that forage on these resources. Given the water depth, the overwater structures would have a minor effect on biological productivity of sessile benthic organisms (Section 3.2.2.3.2). Moreover, these impacts would be highly localized to the immediate vicinity of the pier. Therefore, habitat degradation and barriers for fish and invertebrates in the project area would not result in a significant change in the prey base for marine birds. Increased lighting at the SPE may affect prey availability, depending on the species, for marine birds. Some fish such as sand lance, an important forage fish species, may be attracted by artificial lighting, which may in turn attract predators and facilitate predation on these fish. Thus, localized changes to the prey base for some marine birds are possible but these changes cannot be quantified with available information.

NOISE AND VISUAL DISTURBANCE

Underwater and airborne noise levels may increase slightly from two additional submarines that would berth at the enlarged Service Pier. Marine birds that utilize the Bangor waterfront are assumed to have habituated to vessel traffic noise.

Under existing conditions, the Bangor waterfront produces an environment of complex and highly variable noise and visual disturbance for marine birds. Marine birds perch on manmade structures and forage and rest in the nearshore and deeper waters along the Bangor waterfront in close proximity to ongoing operations. Future operations of the larger Service Pier would be greater than existing levels due to an increase in submarine use of the pier. In general, however, most individual marine birds are likely to habituate to the post-construction activity levels, as they have habituated to activity levels at other developed portions of the Bangor waterfront.

Maintenance of the larger Service Pier would include routine inspections, repair, and replacement of facility components as required (but no pile replacement). These activities could affect marine birds through noise impacts and increased human activity and vessel traffic. However, noise levels would not be appreciably higher than current conditions at the Bangor industrial waterfront, to which many marine birds appear to have habituated. Therefore, maintenance activities would have negligible impacts on marine birds.

Impacts of long-term operations of the larger Service Pier on prey availability, noise, and visual disturbance are expected to be minor, with no species or population-level changes to marine bird behavior or fitness.

Therefore, the ESA effect determination for operation of SPE Alternative 2 is “may affect, not likely to adversely affect” marbled murrelets. There would be “no effect” on critical habitat for the species.

3.5.2.3.3. SPE ALTERNATIVE 3: LONG PIER

SPE Alternative 3 would increase the length of the existing pier by 975 feet (297 meters), or almost twice the length of the SPE under Alternative 2. The number of piles and pile driving days would be greater for Alternative 3 than for Alternative 2, thereby increasing the duration of elevated underwater and airborne noise levels due to pile driving. Long-term operations of the SPE would be similar to Alternative 2 with no major consequences for marine bird populations.

CONSTRUCTION OF SPE ALTERNATIVE 3

Marine birds are expected to avoid the project area due to increased human activity. General concerns over construction period impacts, including water quality, vessel traffic, prey availability, and construction noise, are similar to those described for SPE Alternative 2, but overall SPE Alternative 3 would have slightly greater and longer-duration impacts on marine birds in the project area due to the larger size of the pier. The following sections describe the quantitative differences between the impacts of the two alternatives on marine birds.

WATER QUALITY

A larger seafloor area (6.6 acres [2.7 hectares]) would be disturbed by pile driving and other construction for SPE Alternative 3 compared to Alternative 2 (3.9 acres [1.6 hectares]), thereby increasing turbidity levels and suspended sediments (Section 3.1.2.3). Impacts on visibility at the project site, which could affect marine bird foraging success, would be greater for Alternative 3 than for Alternative 2. The disturbance in the affected area would be temporary and limited to the construction corridor associated with pile driving and construction-period impacts are not expected to exceed water quality standards. Compared to the wide distribution of marine bird species in inland waters, water quality changes due to the SPE project would not significantly affect marine bird populations or overall distribution.

VESSEL TRAFFIC

A similar number of barge trips would be required for construction of both SPE alternatives (six round trips per month). However, because a larger number of piles would be installed for SPE Alternative 3 (500 24-inch [60-centimeter] steel piles and 160 18-inch [45-centimeter] concrete piles versus 230 36-inch [90-centimeter] steel piles, 50 24-inch steel piles, and 105 18-inch concrete piles for Alternative 2), Alternative 3 would increase overall disturbance levels for marine birds in the project vicinity for longer periods of time (205 days of pile driving under Alternative 3 compared to 161 days under Alternative 2). The affected area would be limited to the project vicinity and, relative to the wide distribution of marine bird species in inland waters, vessel traffic changes due to the SPE project would not affect population size or overall distribution.

PREY AVAILABILITY

Impacts of construction on prey availability for fish-eating marine birds would be similar under both SPE alternatives. However, because the area affected by Alternative 3 (6.6 acres [2.7 hectares]) would be greater than for Alternative 2 (3.9 acres [1.6 hectares) for Alternative 3), the magnitude of the impact under Alternative 3 would be greater. The affected area under either alternative would be limited to the footprint of the larger pier and adjacent to the area subject to construction disturbance. Relative to the wide distribution of marine bird species and the prey resources in inland waters, SPE Alternative 3 would not alter population size or overall distribution.

Construction of Alternative 3 may expose fish to potential injury or behavioral disturbance due to underwater pile driving noise (Section 3.3). The time period for behavioral disturbance of fish populations would be greater for Alternative 3 than for Alternative 2 because a larger number of piles would be installed and more pile driving days (161 days under Alternative 2 compared to 205 days under Alternative 3) would be required, as described above for vessel traffic.

However, compared to the wide distribution of marine bird species and their prey resources in inland marine waters, the small area affected by construction of Alternative 3 on prey availability would not result in a significant impact on marine bird populations or distribution, including the ESA-listed marbled murrelet.

NOISE

As described for Alternative 2, underwater and airborne noise associated with impact proofing of steel piles may cause the greatest impacts on marine birds occurring in the project area during construction of the SPE. The acoustic modeling approach is described in Appendix D. Both SPE Alternatives would require two in-water pile driving seasons, but the number of pile driving days would be greater for SPE Alternative 3 (155 days for installation of steel piles and 50 days for installation of concrete piles compared to 125 days for steel piles and 36 days for concrete piles with Alternative 2). Thus, the overall noise-related impacts of Alternative 3 would be slightly greater than those of Alternative 2. Ranges to effect for SPE Alternative 2 are detailed in Table 3.5-9. The proxy source level for 36- and 24-inch steel piles is 181 dB SEL re: 1 μPa. Therefore, the resulting ranges to effect are the same. Representative views of the ZOIs for underwater injury and in-air masking for SPE Alternative 3 are shown in Figure 3.5–4.

SUMMARY OF POTENTIAL IMPACTS

Marbled murrelets are expected to avoid the immediate vicinity of project activities because of construction activities. If individuals were to occur, they would be expected in very small numbers because they have never been observed regularly in the area. Murrelets occurring in the vicinity may have habituated to pile driving and other construction noise, and measurable effects of exposure to noise in this location are not anticipated.

Based on the conservative assumptions used in the sound propagation model to determine the distance to the injurious underwater noise thresholds, the low likelihood of occurrence in the project area, and the protective measures being implemented during construction (Appendix C), any impacts to marbled murrelets would be insignificant and discountable. No population-level impacts would occur, and the species' overall fitness would not be affected.

Therefore, the ESA effect determination for construction activities under SPE Alternative 3 is "may affect, not likely to adversely affect" marbled murrelets. There would be "no effect" on critical habitat for the species.

Direct and indirect impacts on other bird species would be similar to those described for marbled murrelets. While it is likely that most marine birds would avoid the immediate vicinity of the construction site, especially while pile driving is taking place, it is possible that some individuals may habituate sufficiently to occur in the vicinity. Some mitigation measures designed to protect marbled murrelets (e.g., daily time restrictions for pile driving and no tree removal during the breeding season) would protect MBTA-protected seabird species as well as the marbled murrelet from exposure to construction noise and habitat disturbance. Migratory marine birds are widespread throughout Puget Sound in winter months, but the area affected by the SPE would be limited and would not impact marine bird populations overall.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 3

The long-term operational impacts of SPE Alternative 3 would be qualitatively similar to those described for SPE Alternative 2. Alternative 3 would permanently displace a slightly smaller area (0.043 acre [0.017 hectare]) of deeper water, soft-bottom benthic habitat than Alternative 2 (0.045 acre [0.018 hectare]), potentially affecting a small amount of habitat supporting benthic prey species.

Given the water depth at the SPE site, shading by the overwater structures would have a minor impact on benthic community productivity (Section 3.2.2.3.2). Similar to SPE Alternative 2, the impacts on the prey base for marine birds are not expected to be significant, but these changes cannot be quantified with available information. Marine birds are wide-ranging and have extensive foraging habitat available in Hood Canal, relative to the foraging area that would be impacted by operation of the SPE. Localized changes in prey availability are possible under Alternative 3, but are expected to be discountable.

Impacts of increased vessel traffic and vessel noise would be similar to the impacts described for SPE Alternative 2 because the number of submarines berthed at the enlarged Service Pier with Alternative 3 would be the same. As described for Alternative 2, most individual marine birds occurring in the vicinity would be assumed to have habituated to the post-construction activity levels, as they have habituated to activity levels at other developed portions of the waterfront.

Maintenance of the larger Service Pier would include routine inspections, repair, and replacement of facility components as required (but no pile replacement). These activities could affect marine birds through noise impacts and increased human activity and vessel traffic. However, noise levels would not be appreciably higher than existing levels elsewhere at the Bangor industrial waterfront, to which marine birds appear to have habituated. Measures would be employed (Section 3.1.2.3.2) to avoid discharge of contaminants to the marine environment. Therefore, maintenance activities would have negligible impacts on marine birds.

Impacts of long-term operations of the Service Pier on prey availability, noise, and visual disturbance are expected to be minor, with no species or population-level changes to marine bird behavior or fitness.

Therefore, the ESA effect determination for operation of SPE Alternative 3 is “may affect, not likely to adversely affect” marbled murrelets. There would be “no effect” on critical habitat for the species.

3.5.2.3.4. SUMMARY OF IMPACTS FOR SPE PROJECT ALTERNATIVES

Impacts on marine birds during the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.5-10.

Table 3.5–10. Summary of SPE Impacts on Marine Birds

Alternative	Environmental Impacts on Marine Birds
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	*Construction:* Direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability due to extension of pile-supported pier. Construction noise (primarily due to pile driving) may exceed USFWS underwater injury and airborne masking thresholds for marbled murrelet, but would be intermittent and temporary. Construction disturbance due to in-water work would occur over 2 seasons, including a total of 161 days of pile driving. *Operation/Long-term Impacts:* Indirect impacts on prey species due to loss and degradation of benthic habitat; direct impacts (displacement during periods of high activity) due to increased vessel traffic, operations noise, and visual disturbance. Increased hard-surface benthic habitat may benefit marine birds that consume encrusting invertebrates.
	ESA: Effect determination for the marbled murrelet is "may affect, not likely to adversely affect" with "no effect" on critical habitat for the species.
SPE Alternative 3: Long Pier	*Construction:* Direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability due to extension of the pile-supported pier. Construction noise (primarily due to pile driving) sufficient to exceed USFWS injury and masking thresholds for marbled murrelet. Construction disturbance due to in-water work would occur over 2 seasons, including a total of 205 days of pile driving. *Operation/Long-term Impacts:* Slightly greater potential indirect impacts on prey species due to loss and degradation of larger benthic habitat area, direct impacts (displacement during periods of high activity) due to increased vessel traffic, operations noise, and visual disturbance.
	ESA: Effect determination for the marbled murrelet is "may affect, not likely to adversely affect" with "no effect" on critical habitat for the species.
Mitigation: Marbled murrelets would be monitored during impact pile installation activities of the SPE project within the airborne masking and underwater injury zones, and shutdown procedures would be implemented if any marbled murrelet enters the injury zone or the masking zone for impact pile driving. Appendix C (Mitigation Action Plan) details mitigation measures. Tree removal would not occur during the marbled murrelet breeding season (April 1 through September 23) and would be in a manner protective of all migratory birds.	
Consultation and Permit Status: The Navy consulted with the USFWS Washington Fish and Wildlife Office on the marbled murrelet under the ESA. A Biological Assessment (BA) was submitted to USFWS in March 2015, and a revised BA was submitted in June 2015. In a concurrence letter dated March 4, 2016, USFWS stated that SPE project impacts to marbled murrelets are discountable.	

ESA = Endangered Species Act; USFWS = U.S. Fish and Wildlife Service

3.5.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

The LWI structures and SPE piles may alter local availability of marine bird prey (Sections 3.2, Marine Vegetation and Invertebrates, and 3.3, Fish). Visual disturbance due to barge and other vessel traffic during concurrent construction of both projects may inhibit use of the project sites by marine birds that frequent nearshore waters, such as marine waterfowl, seabirds, wading birds, shorebirds, and raptors, potentially reducing the area available for foraging, resting, and transiting along the waterfront. Monitoring of the injury and masking zones during impact pile driving at the LWI and SPE sites would minimize the likelihood of exposure of marbled murrelets to injurious noise levels and auditory masking. The combined impacts of the LWI and SPE projects on marine birds are summarized below in Table 3.5–11.

Table 3.5–11. Summary of Combined LWI/SPE Impacts for Marbled Murrelets and Other Marine Birds

Resource	Combined LWI/SPE Impacts
Marbled Murrelets and Other Marine Birds	The combined impacts of the LWI and SPE projects on marbled murrelets and other marine birds may include minor alterations of prey availability, visual disturbance, and exposure to elevated noise levels underwater (for diving birds) and in the air, including up to 285 days of pile driving over four in-water work seasons. Indirect impacts on prey species due to loss and degradation of benthic habitat; direct impacts (displacement during periods of high activity) due to increased vessel traffic, operations noise, and visual disturbance. Increased hard-surface benthic habitat may benefit marine birds that consume encrusting invertebrates.

Up to 80 days of in-water pile driving may be required for construction of the LWI structures, and up to 205 days may be required for the SPE, depending on the alternative, for a total of up to 285 days of in-water pile driving. Once construction is completed, underwater noise during operations would return to levels similar to existing conditions. Construction of the two projects would not overlap; therefore, concurrent or overlapping noise impacts would not occur.

3.6. TERRESTRIAL BIOLOGICAL RESOURCES

The overall upland environment of NAVBASE Kitsap Bangor includes typical low-elevation western Washington terrestrial vegetation, terrestrial wildlife, and freshwater wetlands and streams. The following sections describe general upland conditions throughout the entire base, as appropriate, and conditions present at the specific LWI and SPE upland project areas where upland elements of the projects would be located, as well as impacts on these resources that would be expected to result from implementation of these projects.

3.6.1. Affected Environment

3.6.1.1. EXISTING CONDITIONS

The overall upland environment of NAVBASE Kitsap Bangor is a mixture of typical second growth forest stands; open, brushy areas; and developed areas. Much of the land has been retained in a more or less natural state, resulting in high-quality natural resources such as wetlands, surface water and groundwater, and forest communities. These high-quality habitat conditions support a diverse population of plant, fish, and wildlife species, as described below.

3.6.1.1.1. VEGETATION AND HABITATS

Information on NAVBASE Kitsap Bangor vegetation communities, including the upland project area, was obtained in the course of forest resource surveys (International Forestry Consultants 2001), wetland surveys (Johnson Controls 1992; Brown and Tannenbaum 2009), terrestrial and wetland surveys (Pentec 2003), wildlife habitat surveys (Tannenbaum and Wallin 2009), and cultural resources surveys (HRA 2011). These reports include maps and lists of plant species found at surveyed sites. Based on a review of the USFWS Endangered Species Program list of 2013, no federally listed threatened or endangered plant species have been identified or are likely to occur on NAVBASE Kitsap Bangor (USFWS 2013a). Four primary land cover types occur in the upland environment on NAVBASE Kitsap Bangor: (1) forest; (2) brush and shrubland; (3) wetlands, streams, and open water; and (4) developed areas including building complexes, paved industrial areas, lawns, landscaping, and mowed rights-of-way and open grass areas (Table 3.6–1). With the exception of wetlands, which are described in Section 3.6.1.1.3, these cover types, as well as invasive and noxious weeds, are described below.

FOREST

Approximately 68 percent of the NAVBASE Kitsap Bangor upland area, including most of the undeveloped area along the waterfront, is composed of forests. Most forest stands are dominated by coniferous trees, including Douglas-fir, western red cedar, western hemlock, grand fir, shore pine, and western white pine (Table 3.6–1). The forest understory consists primarily of conifer seedlings, evergreen shrubs, ferns and other shade-tolerant plants, lichen, and moss species. Canopy closure in coniferous forest stands averages 70 to 100 percent. Most forest stands on NAVBASE Kitsap Bangor are second growth, that is, stands that have regrown following a major disturbance, most commonly timber harvest prior to Navy acquisition of the lands.

Table 3.6–1. Vegetation Cover Types in the Upland Environment on NAVBASE Kitsap Bangor

Cover Type	Approximate Acreage	Description
Forest	4,888 (68.4%)	**Conifer Forest:** Trees, primarily Douglas-fir (*Pseudotsuga menziesii*), western hemlock (*Tsuga heterophylla*), western redcedar (*Thuja plicata*), western white pine (*Pinus monticola*), shore pine (*Pinus contorta var. contorta*), Sitka spruce (*Picea sitchensis*), madrone (*Arbutus menziesii*), and grand fir (*Abies grandis*), with an understory of conifer seedlings and salal (*Gaultheria shallon*), sword fern (*Polystichum munitum*), Oregon grape (*Mahonia nervosa*), rhododendron (*Rhododendron macrophyllum*), and huckleberry (*Vaccinium ovatum*). **Deciduous Forest:** Trees, primarily red alder (*Alnus rubra*), bigleaf maple (*Acer macrophyllum*), and black cottonwood (*Populus trichocarpa*), with an understory of salmonberry (*Rubus spectabilis*), oceanspray (*Holodiscus discolor*), and herbaceous species that include sword fern, rough horsetail (*Equisetum hyemale*), and giant horsetail (*Equisetum telmateia*). Other species found in second-growth deciduous forest include the non-native Himalayan blackberry (*Rubus discolor*) and native Pacific blackberry (*Rubus ursinus*), holly (*Ilex aquifolium*), and colonial bentgrass (*Agrostis capillaris*). **Mixed Forest:** This includes both coniferous and deciduous trees and understory vegetation.
Wetlands, Streams, and Open Waters:	Included in Forest and Brush and Shrubland acreage	Described in Section 3.6.1.1.3
Brush and Shrubland	314 (4.4%)	Native plants include salmonberry, Oregon grape, salal, and oceanspray, as well as herbaceous species that include sword fern, rough horsetail, and giant horsetail. Non-native shrub species include Himalayan blackberry, Pacific blackberry, English holly, and colonial bentgrass.
Developed Areas, including lawn, landscaping, mowed rights-of-way	1,947 (27.2%)	Roads, parking lots, buildings, and other structures. Includes athletic fields, mowed areas such as road rights-of-way, and native and landscaped grass and shrub areas adjacent to developed facilities.
Total	7,149 (100%)	

Source: Navy Region NW Geographic Information System (GIS) data layers

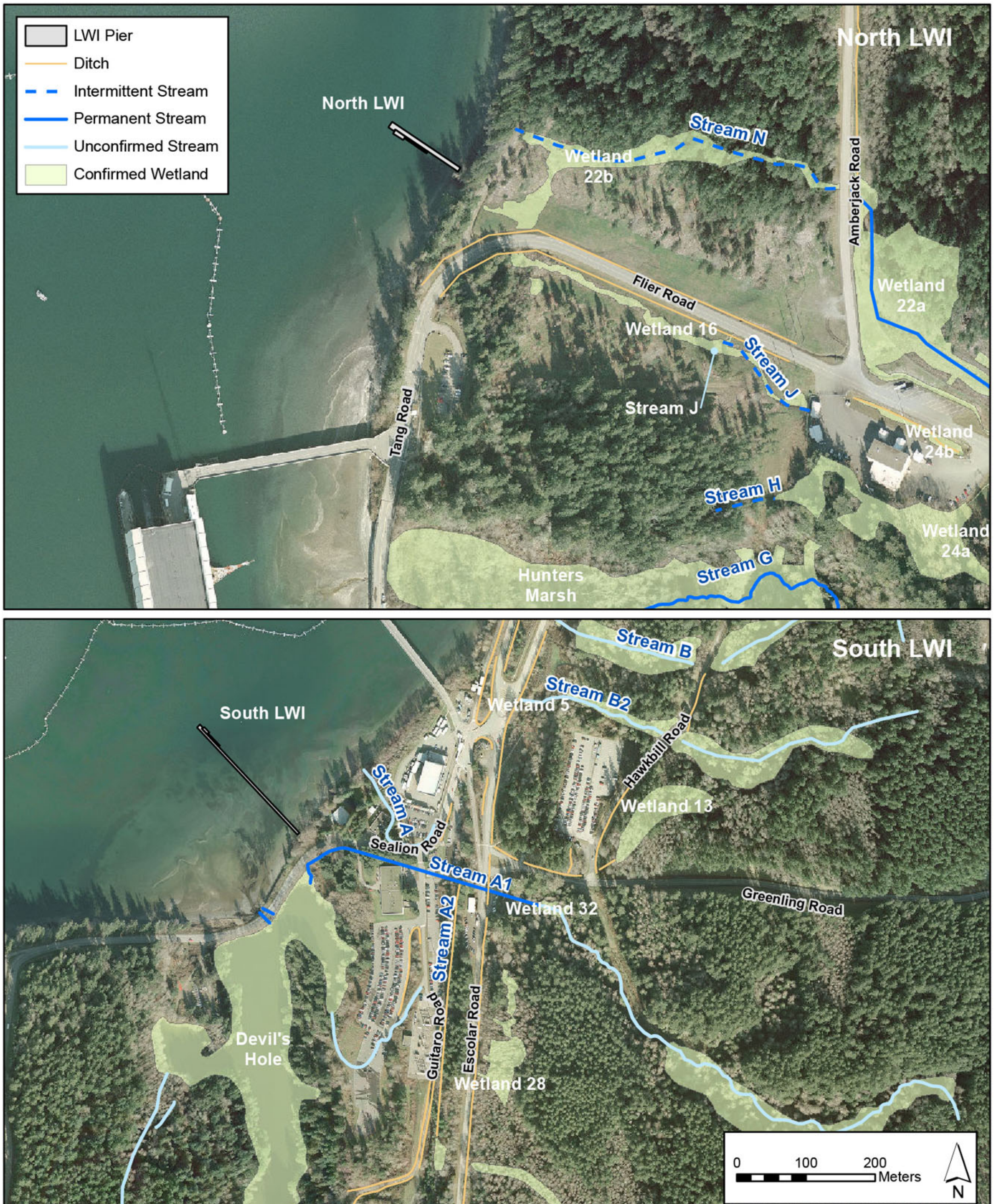
TERRESTRIAL VEGETATION AND HABITATS IN THE VICINITY OF THE LWI PROJECT SITES

The north LWI project site is near a shoreline bluff where a forested strip runs parallel to Tang Road. The forest strip is mixed forest with dominant tree species of Douglas-fir and red alder. Also along the bluff are some unvegetated areas that appear to be natural, likely caused by slides in steep portions of the bluff. This zone is used for perching by raptors and other birds that forage along the shoreline, including bald eagles and kingfishers. It may also provide nesting opportunities for songbirds. Invasive species, including Himalayan blackberry and Scotch broom, are present along the roadside; however, cover of these species was low (up to 3 percent) (International Forestry Consultants 2001). For security purposes, the Navy clears, thins, and maintains a 350-foot (107-meter) zone on both sides of Flier Road. The first 100 feet (30 meters) is maintained free of all trees and undergrowth. In the outer 250 feet (76 meters), trees are thinned and undergrowth is removed by mowing. East of Tang Road, wetlands and their associated streams (Wetlands 16 and 22b and Streams J and N) are present near the north LWI project site, but their value for wildlife is limited because they have been cleared of vegetation (Figure 3.6–1). The wetlands are within the security zone, but some herbaceous/grassy vegetative cover is likely to develop that may provide habitat for amphibians.

Terrestrial vegetation closest to the south LWI project site includes two small patches of trees and a patch of shrubs (primarily non-native Himalayan blackberry) between the shoreline and the north side of Sealion Road. Devil's Hole is approximately 250 feet (76 meters) south of the south LWI project site and is separated from the shoreline by Sealion Road. Devil's Hole is surrounded by coniferous, mixed, and deciduous forests, dominated by Douglas-fir and red alder. The average forest age is 67 to 77 years old, which is slightly older than the average age of forest stands in the waterfront area. Some of the oldest and largest conifers on NAVBASE Kitsap Bangor occur at the south edge of Devil's Hole farthest from the waterfront. Invasive species, including Himalayan blackberry, Scotch broom, and English ivy, cover approximately 5 percent of the area surrounding Devil's Hole and Himalayan blackberry thickets are present along the roadside near the south LWI.

Shoreline vegetation in the vicinity of the south LWI provides perch sites for raptors and other birds and cover for a variety of wildlife species that forage on the shoreline. Devil's Hole and the adjacent shoreline provide high-quality habitat for many wildlife species, such as raptors and carnivores. Otter and mink have been observed crossing Sealion Road from the small Devil's Hole lake to the estuary. Bald eagles, kingfishers, and great blue herons regularly forage in the shallow waters of the area.

Devil's Hole is surrounded on three sides by mature forest stands (Section 3.6.1.1.1) that provide good quality habitat for many wildlife species such as black-tailed deer, small mammals, and songbirds. With the exception of the shoreline adjacent to Sealion Road, forest stands around the lake are relatively undisturbed, which is likely to attract forest-dwelling wildlife species. Emergent or lake fringe wetland is very limited along the lakeshore, offering little habitat for amphibians.



Sources:Pacific Northwest Georeadiness Center RSIMS; Brown and Tannenbaum 2009

Figure 3.6–1. Streams and Wetlands near the LWI Project Sites

TERRESTRIAL VEGETATION AND HABITATS IN THE VICINITY OF THE SPE PROJECT SITE

Vegetation cover at terrestrial sites on the shoreline potentially affected by the SPE project is a combination of forest, shrubs and grassland, and disturbed areas dominated by invasive and non-native shrubs and grasses typical of disturbed shoreline areas of NAVBASE Kitsap Bangor. Dominant tree species include Douglas-fir, red alder, western red cedar, and western hemlock. This habitat is used for perching by raptors and other birds that forage along the shoreline, including bald eagles and kingfishers.

Vegetation at the SPE upland parking lot site east of Sealion Road consists primarily of lowland second growth conifer forest dominated by Douglas-fir, western red cedar, and western hemlock.

The forest understory consists of shade-tolerant conifer seedlings, evergreen shrubs, deciduous shrubs, and ferns. The forest provides good quality habitat for many wildlife species such as black-tailed deer, small mammals, and songbird species. Wetlands in the general vicinity (Section 3.6.1.1.3) are very small but provide habitat for amphibians, reptiles, songbirds, and small mammals. The unnamed stream was classified as potentially perennial and fish-bearing (Anchor QEA 2013) and may provide habitat for aquatic invertebrates. Devil's Hole (with wildlife habitats as described above for the LWI project sites) lies over a low ridge east of the SPE project site.

The site of the proposed parking lot and laydown area for the SPE project includes an abandoned homestead-era orchard approximately 6.4 acres (2.6 hectares) in size located on the corner of Sturgeon Street and Sealion Road (Figure 3.6–2). The orchard consists of old fruit trees associated with a former homestead site and an understory of native and invasive shrub and herbaceous species. A small isolated wetland, described in Section 3.6.1.1.3, was identified at the edge of the orchard (Figure 3.6–2).

3.6.1.1.2. WETLANDS

According to scientists, wetlands are transitional habitats that occur between upland and aquatic environments where the water table is at or near the surface of the land or where the land is covered by shallow water that may be up to 6 feet (2 meters) deep. Wetlands are dominated by plants that can tolerate various degrees of flooding or saturated soils. Freshwater habitats with flowing or deep water, such as rivers, streams, lakes, and ponds, are often closely associated with wetlands. In general, wetlands provide several benefits including flood and stormwater control, baseflow support for streams and groundwater, erosion and shoreline protection, water quality improvement, and support for natural biological systems and wildlife habitat (Hruby 2004).

NAVBASE Kitsap Bangor includes two main watersheds, defined as major surface water drainages separated by topographic divides. The drainages at the base include five sizable perennial streams that enter Hood Canal (part of the northern Hood Canal watershed) and two tributaries of Clear Creek that flow to the southeast and enter into Dyes Inlet (part of the Clear Creek watershed). Some of the perennial streams pass through small lakes or wetlands before discharging into Hood Canal. Most of the wetlands on NAVBASE Kitsap Bangor are palustrine type, emergent, forested, or scrub/shrub wetlands (as defined by Cowardin et al. 1979) that are less than 1 acre (0.4 hectare) in size (Johnson Controls 1992; Navy 2001; Pentec 2003; Brown and Tannenbaum 2009; Anchor QEA 2013).

Sources: Pacific Northwest Georeadiness Center RSIMS; Brown and Tannenbaum 2009; Anchor QEA 2013

Figure 3.6–2. Streams and Wetlands near the SPE Upland Project Area

Wetlands in the project areas were mapped using USACE formal delineation methods (USACE 2010) (Figure 3.6–1, Figure 3.6–2), described using the Cowardin Classification System (Cowardin et al. 1979), and given functional ratings using the WDOE Wetland Rating System (Table 3.6–2) (Hruby 2004).

WETLANDS IN THE VICINITY OF THE LWI PROJECT SITES

Wetlands that occur in the vicinity of the north and south LWI project sites are listed in Table 3.6–3 and described below. Streams in the vicinity of the LWI project sites are also described below. Devil's Hole is the only wetland in the vicinity of the LWI project sites that is included on the National Wetlands Inventory (USFWS 2013b).

Table 3.6–2. WDOE 2004 Wetland Rating System

Category	Description
I	Category I wetlands are those that (1) represent a unique or rare wetland type, or (2) are more sensitive to disturbance than most wetlands, or (3) are relatively undisturbed and contain ecological attributes that are impossible to replace within a human lifetime, or (4) provide a high level of functions. In western Washington the following types of wetlands are Category I: estuarine wetlands larger than 1 acre, Natural Heritage wetlands, mature and old-growth forested wetlands, wetlands in coastal lagoons, and wetlands that perform many functions very well.
II	Category II wetlands are difficult, though not impossible, to replace and provide high levels of some functions. These wetlands occur more commonly than Category I wetlands but still need a relatively high level of protection. Category II wetlands in western Washington include estuarine wetlands, interdunal wetlands, and wetlands that perform functions well.
III	Category III wetlands are (1) wetlands with a moderate level of functions and (2) interdunal wetlands between 0.1 and 1 acre in size. These wetlands have been disturbed in some ways, and are often less diverse or more isolated from other natural resources in the landscape than Category II wetlands.
IV	Category IV wetlands have the lowest levels of functions and are often heavily disturbed. These are wetlands that should be able to be replaced and in some cases be able to be improved.

Source: Hruby 2004

Table 3.6–3. Wetlands in the Vicinity of the LWI and SPE Project Sites

Wetland Name	Acres (Hectares)	Juris-dictional	Wetland Rating Category	Description
Wetland 22b	1.3 (0.5)	Yes	III	Palustrine, forested, emergent marsh, seasonally flooded
Wetland 31 (Devil's Hole)	20 (8.1)	Yes	III	Lacustrine, permanently flooded; palustrine, scrub/shrub, emergent marsh, seasonally flooded
Orchard Wetland	0.06 (0.02)	No	IV	Palustrine, forested, scrub/shrub, emergent marsh, saturated

Sources: Brown and Tannenbaum 2009; MacKenzie and Jones 2013

NORTH LWI PROJECT SITE

There are no wetlands or other waters of the U.S. within the limits of construction of the LWI project sites. Wetlands in the vicinity of the north LWI project site outside of the limits of construction include Wetland 22b, which is within 50 feet (15 meters) of the north LWI project site and is separated from the immediate construction site by Tang Road (Figure 3.6–1).

Wetland 22b is located west of Amberjack Avenue and is associated with intermittent Stream N, which receives drainage from Wetland 22a via a culvert under Amberjack Avenue. *Stream N* flows westerly from Amberjack Avenue to a culvert under Tang Road near the Hood Canal shoreline. Wetland 22b is approximately 1.3 acres (0.5 hectare) and is narrow at the eastern end near Amberjack Avenue and widens toward the west. The upstream half of Wetland 22b supports a natural conifer forest overstory and shrub/herbaceous understory. The downstream half of the wetland and its buffers were cleared of all understory and most trees during 2008. Some scattered small red alders and western red cedars remain in the canopy of the wetland area, but the understory will be maintained in a low grassland/herbaceous condition. Wetland 22b is a Category III wetland because, although portions are disturbed and the wetland provides low value for hydrologic and water quality functions, the wetland is over 1 acre (0.4 hectare) in size and supports a diversity of vegetation types (emergent marsh and forested wetlands) that provide moderate habitat for wildlife.

SOUTH LWI PROJECT SITE

Devil's Hole is a manmade lake located approximately 250 feet (76 meters) southeast of the south LWI project site (Figure 3.6–1) that was created in the 1940s when the Navy modified Sealion Road. Two streams (*Stream A1* and *A2*) flow through culverts and empty into the northwest corner of Devil's Hole, in the vicinity of the south LWI project site. Devil's Hole supports open-water habitat with a narrow band of emergent lake fringe wetland vegetation at the northern edge of the lake, in the vicinity of the south LWI project site. Devil's Hole is a Category III wetland because it is a large water body with moderate water quality, hydrologic, and habitat functions. It is surrounded by intact upland forest buffer except for the vicinity of Sealion Road.

WETLANDS IN THE VICINITY OF THE SPE PROJECT SITE

The *Orchard wetland* was identified by Navy staff in the vicinity of the limits of construction of the proposed SPE upland parking lot site (Figure 3.6–2, Table 3.6–3). The wetland is located at the edge of the orchard adjacent to Sturgeon Street. Including a 30-foot (9-meter) buffer zone, it occupies approximately 0.28 acres (0.11 hectares). The wetland is depressional, apparently captures either surface or shallow subsurface flow from the abutting orchard, and lacks surface discharge. It appears to be highly impacted by historic agricultural land uses. Wetland vegetation consists of a sparse grass-dominated herbaceous layer (slough sedge and reed canary grass) and a tree canopy dominated by red alder.

Thirteen small wetlands (one 0.83-acre [0.34-hectare] wetland and 12 wetlands less than 0.09 acre [0.036 hectare]) and one unnamed perennial stream were identified in the general vicinity of the upland SPE project area and were formally delineated (Anchor QEA 2013) (Figure 3.6–2). All of these features lie uphill from the SPE project site; therefore, they do not receive drainage from the SPE project upland site. The wetland buffer zone that is closest to the SPE project site is more than 650 feet (198 meters) away and the unnamed stream at its closest reach is more than 1,800 feet (549 meters) from the proposed upland waterfront support facility. Since none of these wetlands, their associated buffers, or hydrologic connections lie within areas potentially disturbed by the SPE project, they were not carried forward in the analysis.

3.6.1.1.3. THREATENED, ENDANGERED, AND SENSITIVE SPECIES

Based on review of USFWS lists of ESA terrestrial plant and wildlife species that occur in Kitsap County, no federally listed terrestrial plant or wildlife species have been identified or are likely to occur on NAVBASE Kitsap Bangor (USFWS 2013a). Other sensitive species and species of concern are described in Section 3.6.1.1.4.

3.6.1.1.4. WILDLIFE

Terrestrial wildlife resources include the mammals, birds, amphibians, and reptiles that live in the area and their associated habitats. None of the freshwater bodies potentially affected by the Proposed Action contain fish. Therefore, freshwater fish are not addressed in this EIS.

The species described in this section include many mammals, birds (including migratory species), amphibians, reptiles, and nuisance/pest species. The main land cover types on NAVBASE Kitsap Bangor provide suitable habitat for a number of different wildlife species and include forest, brush and shrubland, wetlands, streams, and open water; marine shoreline; and developed areas.

WILDLIFE SPECIES

Terrestrial wildlife (game species, non-game mammals, birds, amphibians, and reptiles) in the vicinity of the LWI and SPE project areas are typical of forest-dwelling species that occur on NAVBASE Kitsap Bangor as a whole (Table 3.6–4). The occurrence, habitat use, and other natural history information of these species are discussed below. Appendix A provides a complete listing of all wildlife species known or expected to occur on NAVBASE Kitsap Bangor.

MIGRATORY BIRD SPECIES AND BIRDS OF CONSERVATION CONCERN

Most of the terrestrial bird species occurring on NAVBASE Kitsap Bangor are protected under the MBTA (see Section 3.6.1.2.4), with the exception of introduced species such as rock pigeon and European starling (Section 3.6.1.1.2). Six terrestrial migratory bird species that occur or are likely to occur on NAVBASE Kitsap Bangor are considered birds of conservation concern by the USFWS: bald eagle, peregrine falcon, rufous hummingbird, olive-sided flycatcher, willow flycatcher, and purple finch (USFWS 2008). The state of Washington lists the great blue heron as a priority species for site specific management with a focus on nesting colonies. This species is discussed in Section 3.5.

Table 3.6–4. Wildlife Groupings and Representative Species on NAVBASE Kitsap Bangor

Wildlife Group	Representative Species	Season(s) of Occurrence
Game Species	Black-tailed deer, black bear, cougar, and game birds (i.e., grouse and quail species)	Year round
Non-Game Mammals	Carnivores: river otter, mink, ermine (weasel), coyote, raccoon, red fox, and bobcat Small mammals: shrews, moles, mice, squirrels, rats, mountain beavers, beavers, and rabbits Bats: *Myotis* species, hoary bat, and big brown bat	Year round
Non-Game Birds	Raptors: osprey, bald eagle, red-tailed hawk, owls, and other birds of prey Woodpeckers: pileated woodpecker, downy woodpecker, red-breasted sapsucker Songbirds: sparrows, swallows, warblers, kinglets, chickadees, finches, wrens, and others Wading birds and waterfowl: great blue heron, Canada goose	Year round: great blue heron, bald eagle, woodpeckers, finches, chickadees, red-tailed hawk, crows, jays, sparrows Summer resident: osprey and migratory songbirds (e.g., swallows, warblers, flycatchers, Swainson's thrush) Winter resident: northern harrier, fox sparrow, golden-crowned sparrow, ruby-crowned kinglet Spring and/or fall migrant: sharp-shinned hawk, peregrine falcon, ruby-crowned kinglet, and most summer resident species listed above
Amphibians	Red-legged frog, Pacific tree frog, salamander species Introduced: bullfrog	Year round
Reptiles	Northwestern and common garter snakes and northern alligator lizard	Year round

Sources: Storm and Leonard 1995; Adams et al. 1999; Johnson and O'Neil 2001; Opperman 2003; Jones et al. 2005

BALD EAGLES

The bald eagle was delisted from the ESA on August 8, 2007 (72 FR 37346). However, it remains protected under both the MBTA and the Bald and Golden Eagle Protection Act (16 USC 668-668a); the latter prohibits the taking, possession of, or commerce in bald and golden eagles. Bald eagles in the Pacific Northwest include resident birds and winter migrants that breed farther north. Migration patterns in general are timed to track the availability of spawning salmonids (Buehler 2000). Many resident eagles in the Pacific Northwest migrate in late summer, when juveniles and adults move north up the coast to meet salmon runs in Alaska. At the end of these salmon runs in late fall, Alaskan and Pacific Northwest eagles move south along the coast following salmon runs. Adults reach wintering grounds in Pacific Northwest states in November or December, followed by juveniles in January (Buehler 2000). Eagles that breed in more northern latitudes return to their breeding grounds during spring migration from January to March, depending on food resources and weather conditions.

Near Hood Canal and the Bangor waterfront, bald eagles nest along the shoreline of Dabob Bay on the Bolton Peninsula and along the shoreline of Quilcene Bay, west of Dabob Bay, in Hood Canal. Bald eagles have been observed feeding, perching or roosting, and bathing on NAVBASE Kitsap Bangor year round (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b, 2011b). A bald eagle nest near the KB Dock was monitored in 2014 (Navy 2014b). A pair of adult bald eagles was observed at the nest from March through August 2014. However, the condition of the nest deteriorated during the summer and no juveniles were documented. This nest is approximately 1,200 feet (370 meters) south of the LWI project site and 3,200 feet (975 meters) north of the SPE project site. A bald eagle nesting territory is present within 7,200 feet (2,195 meters) of the north LWI project site (WDFW 2010b). This territory contains two nests (WDFW 2010b). Five known bald eagle territories are located on the Toandos Peninsula across Hood Canal from NAVBASE Kitsap Bangor (WDFW 2010b).

GAME SPECIES

The Columbian black-tailed deer is a common, year-round resident on NAVBASE Kitsap Bangor that is seen in most habitat types at the base, but is most common in forested areas (SAIC staff field observations, 2005 to 2009). Black-tailed deer are herbivores and browse on a variety of grasses, forbs, shrubs, and trees (Raedeke and Taber 1983).

Two cougar sightings were reported in 2010 at the upper base, and there have been numerous black bear sightings at the lower base (Jones 2010b, personal communication). Cougars prey on black-tailed deer and smaller mammals in forested and adjacent habitats. Black bears are omnivorous foragers eating plants, berries, and small mammals in the understory of forest, grassland, brush, and shrubland habitats.

Five species of game birds are likely to occur on NAVBASE Kitsap Bangor (Appendix A) including two native species, ruffed and blue grouse. Other game bird species were introduced to the region for the purpose of recreational hunting, including quail species (California and mountain quail) and the ring-necked pheasant (Johnson and O’Neil 2001). Habitats used by game birds include forest, shrubland, and grasslands, depending on the species. These game birds consume primarily plant material, including seeds and berries (Taber and Raedeke 1983).

NON-GAME MAMMALS

Carnivores, or predatory mammals, are found in most habitats on NAVBASE Kitsap Bangor, where they pursue small mammal and avian prey or other food resources. In addition to larger carnivores (black bear and cougar), smaller carnivores include raccoons, weasel, bobcat, coyote, mink, and river otter. River otters are considered to be specialists in aquatic habitats, including the marine shoreline, where they forage in shellfish beds and beaches for molluscs, fish, and crustaceans. Coyote and raccoons also frequent the marine shoreline, where they forage on shellfish, crustaceans, and fish (Tannenbaum et al. 2009b; SAIC staff field observations, 2005 to 2009). Small mammals, including vole, mice, rat, squirrel, and rabbit species, occur in habitats with appropriate food and shelter resources, such as forest understory, grasslands, and brush and shrublands (Johnson and O’Neil 2001). Bat species often forage over open-water habitats with productive insect resources, as well as in forested habitats, forest edges, and open areas (Johnson and O’Neil 2001). Some bat species use forest habitat for maternity colonies and diurnal roosts (e.g., hoary bat and silver-haired bat), whereas other bat species prefer to roost in caves, crevices, or old buildings (*Myotis* spp. and big brown bat) (Johnson and Cassidy 1997).

Non-Game Birds

A variety of terrestrial birds occur on NAVBASE Kitsap Bangor, some of which are year-round residents and some of which are migratory (Table 3.6–4 and Appendix A). Migratory land birds spend only part of the year on NAVBASE Kitsap Bangor for nesting, as winter residents, or as short-term, stopover species during migration (Johnson and O'Neil 2001). Songbirds and other small birds are found in most habitats on NAVBASE Kitsap Bangor, depending on the species. Summer resident migratory songbirds include insect-eating species such as flycatchers, swallows, and warblers that breed in forested habitat and in shrubby growth. This cover type provides the greatest structure for nesting habitat in proximity to food resources (Larsen et al. 2004; Wahl et al. 2005). Year-round resident species include corvids (crows and jays), wrens, most sparrows, finches, and chickadees.

Woodpecker species are year-round residents that inhabit forested habitat, where they use downed wood, snags, and live trees with decay for foraging on insects, such as ants and other invertebrates, and for cavity nesting (Johnson and O'Neil 2001). Raptor species (birds of prey) occurring on NAVBASE Kitsap Bangor include bald eagles, red-tailed hawks, osprey, falcon species (in migration), turkey vulture, and several owl species. Raptor species use all habitats at the base including the marine shoreline. Bald eagles are discussed above. Except for bald eagles, there are no known active raptor nests in the vicinity of the project. Most of the bird species that occur on NAVBASE Kitsap Bangor are considered migratory under the MBTA, although in this region many individuals, including some songbird species, owls, bald eagles, red-tailed hawks, herons, some gull species, and others do not engage in long-distance migrations. Exceptions to the MBTA are introduced species. Migratory birds that are seasonally present on NAVBASE Kitsap Bangor include numerous neotropical songbirds occurring as summer residents; migratory raptors occurring as winter residents, summer residents, or during fall and/or spring migration; and numerous waterfowl and shorebird species that are present in various seasons (Appendix A).

Amphibians

Amphibians on NAVBASE Kitsap Bangor are likely to include pond/wetland-breeding species (northwestern salamander, rough-skinned newt, Pacific tree frog, red-legged frog, and long-toed salamander) (Johnson and O'Neil 2001; Jones et al. 2005). Bullfrog, an introduced species, is also likely to be present. A terrestrial-breeding species, the western red-backed salamander, may also be present. Other amphibians that may occur at the base include ensatina, western toad, Olympic torrent salamander, coastal giant salamander, and coastal tailed frog. Pond-breeders require quiet waters and suitable aquatic vegetation to support egg attachment (Johnson and O'Neil 2001). Terrestrial breeders require moist sites, such as seeps, crevices, or large logs, within forested stands for breeding. Outside of the breeding season, amphibians on NAVBASE Kitsap Bangor primarily use forest and riparian areas. During winter, most of the amphibian species in the area enter a state of semi-hibernation in underground terrestrial retreats or in the bottom of ponds.

REPTILES

Four species of snakes, two lizards, and two turtles potentially occur on NAVBASE Kitsap Bangor (Storm and Leonard 1995) (Appendix A). One of the turtles, the slider, is an introduced species now distributed throughout freshwater habitats of the Pacific Northwest. Whereas some reptile species potentially occurring on NAVBASE Kitsap Bangor prefer open areas, such as clearcuts or grassland (western fence lizard), others prefer forest habitat (northern alligator lizard), and many are commonly found near freshwater (garter snake species, rubber boa) or in freshwater (western painted turtle). During winter, most of the reptile species in the area hibernate underground.

NUISANCE SPECIES

A number of wildlife species, including European starlings, rock pigeons, ravens, gulls, mice, bats, raccoons, squirrels, and moles, were identified in the *FY 2004 Naval Base Kitsap Bangor Pest Management Plan* (Navy 2004b) as pest species in situations where they occur in structures or interact adversely with humans. This plan describes a variety of methods used to control these species as required primarily for health reasons. Starlings and pigeons are not protected by the MBTA and therefore can be controlled with humane methods, which on NAVBASE Kitsap Bangor include routinely destroying starling nests when found and using netting and other methods to control rock pigeons and their use of waterfront structures. Mammals are prevented from entering buildings by various exclusion measures, or they may be trapped and relocated.

3.6.1.2. CURRENT REQUIREMENTS AND PRACTICES

3.6.1.2.1. REQUIREMENTS AND PRACTICES RELATED TO VEGETATION

NAVBASE Kitsap Bangor manages its forest lands and vegetation in compliance with federal law and regulation, EOs, and DoD and Navy guidance. This includes mandated cooperation with other federal agencies such as USFWS, NMFS, and WDFW. Applicable laws include the Sikes Act Improvement Act (P.L. 86-797 as amended, 16 USC 670(a) et seq.: Conservation Programs on Military Installations); the ESA; the Forest Resources Conservation and Shortage Relief Act (1990); the CWA; the MBTA; and the Noxious Weed Control Act of 1974 (7 USC 2801–2814, January 3, 1975, as amended in 1988 and 1994). EOs pertaining to Navy lands include EO 11990 (wetlands protections) and EO 13112 (combating the introduction of nonindigenous microbial, animal and plant species). DoD and Navy guidance documents directing forest and land management include the *Memorandum on Implementation of Ecosystem Management in the DOD* (1994); DOD Instruction 4715.3 *Environmental Conservation Program* (1996); *Memorandum on Implementation of Sikes Act Improvement Act: Updated Guidance* (2002); Chief of Naval Operations Instruction 5090.1D CH-1 *Environmental Readiness Program Manual* (2014); Naval Facilities Engineering Command *Real Estate Operations and Natural Resources Management Procedure Manual* (P-73); and the *Guidelines for Preparing, Revising and Implementing Integrated Natural Resources Management Plans for Navy Installations* (2003). Pursuant to the Sikes Act, the Navy prepared an Integrated Natural Resources Management Plan (Navy 2001) providing policy goals for land use on NAVBASE Kitsap Bangor.

The Navy is the steward of the lands within NAVBASE Kitsap Bangor and is responsible for managing the forest resource, including timber harvest, conservation, utilization, and enhancement, while maintaining the environmental conditions consistent with the military mission. Timber harvest is an ongoing activity on NAVBASE Kitsap Bangor. Annual harvests over the past five years have generally been less than 100 acres (40 hectares) and conducted exclusively for military construction land clearance.

3.6.1.2.2. Requirements and Practices Related to Wildlife

The ESA (16 USC 1531 et seq.), the MBTA (16 USC 703 et seq.), EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, and the Bald and Golden Eagle Protection Act (16 USC 668) protect certain wildlife species, as discussed in Section 3.6.1.2.4. Other applicable requirements are in the Sikes Act Improvement Act (P.L. 86-797 as amended, 16 USC 670(a) et seq.: Conservation Programs on Military Installations). The Navy would avoid knowingly impacting bald eagles and other migratory birds, including nest sites during construction and operation of the LWI and SPE projects.

3.6.1.2.3. Requirements and Practices Related to Wetlands

Waters of the U.S., including wetlands and navigable waters, are regulated by USACE under Section 404 of the CWA of 1972. EO 11990, *Protection of Wetlands*, directs federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of waters of the U.S., and to avoid new construction in wetlands wherever there is a practicable alternative. NAVBASE Kitsap Bangor complies with requirements of the CWA and EO 11990 by ensuring there would be no net loss of wetlands at the base, implementing mitigation of wetland impacts, and requiring that any activity within a jurisdictional wetland area be permitted by USACE, subject to nationwide exemptions. WDOE regulates waters of the state, including wetlands, under RCW 90.48, Washington State Water Pollution Control Act, and Section 401 of the CWA.

Wetlands under federal jurisdiction are delineated according to the USACE *Wetlands Delineation Manual* (Environmental Laboratory 1987) and the Western Mountains and Valleys Regional Supplement ("Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region [Version 2.0]") (USACE 2010). USACE's definition of a wetland requires that an area meet criteria for each of three wetland parameters: (1) hydrophytic vegetation, (2) wetland hydrology, and (3) hydric soils (Environmental Laboratory 1987). USACE relies on the WDOE 2004 Wetland Rating System for Western Washington (Hruby 2004) (Table 3.6–2) to assign a functional value to a wetland. This system evaluates wetlands in terms of their hydrologic (flood control), water quality, and habitat functions. Wetlands are classified into four categories, with Category I performing the highest value wetland functions and Category IV providing the lowest value functions (Table 3.6–2) (Hruby 2004).

The CZMA requires that federal actions that have reasonably foreseeable effects on coastal users or resources must be consistent to the maximum extent practicable with the enforceable policies of approved state coastal management programs. Activities and development impacting coastal resources that involve the federal government are evaluated through a process called federal consistency, in which the proponent agency is required to prepare a CCD for concurrence from the affected state.

Neither project would impact any wetlands. The LWI shoreline abutments described in Section 2.1.1 would require construction below the MHHW line. Placement of fill in the intertidal zone is regulated under the CWA, and a USACE permit under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act would be required. The Navy submitted a JARPA to the USACE for the LWI project, seeking a jurisdictional determination for waters of the U.S. affected by the project and a Section 404 permit application for work within affected waters. Construction in the coastal zone is also regulated by the CZMA. In accordance with the CZMA, the Navy submitted a CCD to WDOE for the LWI project. When the SPE project is programmed and scheduled, the Navy will submit a JARPA to the USACE and a CCD to WDOE for the SPE project.

3.6.1.2.4. Requirements and Practices Related to Threatened, Endangered, and Sensitive Species

The ESA (16 USC 1531 et seq.) protects fish, wildlife, and plant species that are listed as threatened or endangered in the United States or elsewhere. Based on a review of the USFWS Endangered Species Program list of 2013, no federally listed threatened or endangered terrestrial wildlife species or critical habitats have been identified or are likely to occur on NAVBASE Kitsap Bangor (USFWS 2013a). Marbled murrelets, a marine bird species, are addressed in Section 3.5. The Navy would consult with the USFWS Washington Fish and Wildlife Office, as appropriate, in the event that federally listed terrestrial wildlife species are detected in the project area.

The MBTA (16 USC 703 et seq.) and EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, protect migratory birds from harm, except as permitted by USFWS for purposes such as banding, scientific collecting, taxidermy, falconry, depredation control, and other regulated activities such as game bird hunting. Harm includes actions that "result in pursuit, hunting, taking, capture, killing, possession, or transportation of any migratory bird, bird part, nest, or egg thereof." Bald eagles are protected under both the MBTA and the Bald and Golden Eagle Protection Act (16 USC 668), which prohibits the taking of bald eagles through pursuit, shooting, poison, killing, trapping, collecting, disturbance, or transportation.

3.6.1.2.5. Best Management Practices and Current Practices

BMPs and current practices, described in Section 3.7.1.2, would avoid or minimize impacts of the proposed projects on terrestrial vegetation; wetlands; threatened, endangered, and sensitive species; and wildlife, soils, and aquatic resources. Specifically, BMPs and current practices would be implemented to control erosion and runoff following removal of vegetation and earthwork at the SPE upland facility site. Similarly, vegetation removal and excavation in the LWI abutment areas adjacent to the marine shoreline would require BMPs and current practices to minimize and avoid impacts originating in the upland environment. Erosion at the construction staging area would be minimal, but BMPs would be employed as needed to control erosion and sedimentation. BMPs and current practices include the following: diversion berms and interceptor ditches on both sides of the roadways, sediment traps outfitted with rock check dams and stand pipes, straw bale barriers on the sides of roads, erosion control blankets or turf reinforcement mats, and silt fences along the sides of roads. Water-spraying on soil would be used to control dust generation during earthmoving and hauling activities. Plastic coverings or spraying water on the stockpiled, excavated material would be used to minimize windblown dust. Any fluid spills or leakage from vehicles onto soil would be handled in accordance with a spill response plan.

3.6.2. Environmental Consequences

3.6.2.1. APPROACH TO ANALYSIS

The evaluation of impacts on terrestrial resources considers both direct and indirect effects of construction and operation of the LWI and SPE projects. Potential direct effects include removal or disturbance of vegetation, wetlands, and wildlife habitat; fragmentation of wildlife habitat; barriers to wildlife movements; and noise and other disturbance-related effects on wildlife populations in the project area. Potential indirect impacts include the introduction of non-native plants into areas disturbed by construction.

3.6.2.2. LWI PROJECT ALTERNATIVES

3.6.2.2.1. LWI ALTERNATIVE 1: NO ACTION

With the No Action Alternative, the LWI would not be constructed, overall operations would not change from current levels, and no impacts on terrestrial vegetation, terrestrial wildlife, or wetlands would occur.

3.6.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

CONSTRUCTION

VEGETATION

Upland construction of the north and south LWI project sites would include clearing of vegetation, grading, excavation, filling, and concrete work for the abutments, stairs, and associated utilities.

Staging Area

The proposed staging area near the intersection of Archerfish and Seawolf Roads (Figure 2–1) is 5.4 acres (2.2 hectares) in size and is highly disturbed due to past use as a staging area for other projects. Approximately half of the site is gravel and would be used for staging for the LWI project. The other half is a sloped, revegetated area that would not be affected by LWI staging. Therefore, there would be no impacts on vegetation at the staging area.

LWI Shoreline Abutments

Approximately 1.1 acre (0.44 hectare) of land supporting forested and shrub vegetation adjacent to the shoreline would be disturbed during construction of the north and south LWI locations (Figure 3.6–1). Vegetation that would be disturbed for the north and south LWI abutments is located in narrow strips that are largely isolated from intact habitat by roads and vegetation clearing that supports the EHW missile haul route. Construction BMPs for earthwork and hauling activities would support slope stability, and prevent erosion and runoff to adjacent habitats. Therefore, erosion and sedimentation impacts are not anticipated. These measures are described fully in Section 3.7.2.2.2.

Together, the two abutments would create 0.12 acre (0.048 hectare) of new impervious surface. Additional areas (0.1 acre [0.04 hectare]) would be converted to permanent pervious surface such as gravel pathways. A total of 0.86 acre (0.35 hectare) would be revegetated with native species after construction is completed.

WETLANDS

No wetland impacts are anticipated due to construction of the north and south LWIs under LWI Alternative 2.

THREATENED AND ENDANGERED SPECIES

No impacts on ESA-listed terrestrial species would occur under LWI Alternative 2.

WILDLIFE

Visual and audible disturbance leading to avoidance of areas with human activity may alter use of the project area by bird species, which have variable levels of tolerance for disturbance. Species that are intolerant of disturbance while nesting, resting, or foraging may be impacted during construction through increased potential for visual disturbance, increased vehicle and small boat traffic, and construction noise at the project sites (Watson and Pierce 1998; Quinn and Milner 2004; Eissinger 2007).

Construction noise would increase primarily due to airborne pile driving, as described in Section 3.9.3. Additional construction noise would result from the use of heavy equipment for earth moving and excavation; an auger drill rig for pile installation at the shoreline abutments; cranes, concrete saws or jackhammers; and vehicle traffic; but these noise levels would be lower than pile driving noise levels (see Section 3.9.3.2 for noise level details). In particular, extensive dump truck traffic would be required for construction of the LWI abutments, which would increase traffic noise from the LWI project sites along roadways to the upper base. Maximum noise levels from equipment operating concurrently may be as high as 94 dBA intermittently, but on the average noise levels would range from 60 to 68 dBA, similar to other locations where heavy equipment is in operation on a daily basis on the Bangor waterfront. Construction noise would last for about 24 months but pile driving would occur for no more than 80 days during the first year.

Terrestrial wildlife species could be disturbed by elevated noise levels during construction, but there are no current established thresholds for airborne noise-related disturbance. Typical ambient daytime noise levels on the waterfront average 64 dBA although intermittent peak noise can be greater (Section 3.9.2). Under this Alternative, the loudest construction noise (impact pile driving) produces 100 dBA at 50 feet (15 meters) from the source (Table 3.9–3). This noise would attenuate more rapidly in the presence of vegetation than it would over water. Based on information presented in Section 3.9.3.3, pile driving noise would attenuate to 64 dBA within approximately 2,500 feet (760 meters) from an impact driver. Pile driving would be intermittent and performed largely with a vibratory driver, which produces lower noise levels. The most conservative estimated duration of impact proofing would range from roughly 1.5 to 2 hours; actual impact proofing may take less time or not be required on an active driving day. Thus, under the worst-case scenario, forest-dwelling wildlife in the vicinity of the LWI project sites would experience elevated noise levels due to pile driving for only a portion of the day. Use of heavy construction equipment would contribute to disturbance of terrestrial wildlife species within a shorter distance of the construction sites, but would be in operation more frequently during the construction period.

The impacts of construction on upland wildlife species depend largely upon the habitat uses of these animals within the probable zone of disturbance, especially during their breeding seasons, typically from late February through August, depending on the species. Terrestrial wildlife species are expected to respond to airborne noise in ways similar to marine wildlife, including habituation and sensitization, as described in Sections 3.4 and 3.5. Noise might temporarily displace some terrestrial wildlife during construction, whereas other species may become habituated to noise and visual disturbances and would remain in the general vicinity. Highly mobile species including game species, non-game birds, and small carnivores are expected to avoid the construction sites during periods of high activity, which would be limited to daylight hours during the 24-month construction period. However, the upland area directly affected by the LWI project has limited value as wildlife habitat for these mobile species as well as less mobile species (small mammals, amphibians, and reptiles), and therefore construction period disturbance would not affect many individuals. Although some individual disturbance may occur, population level impacts are not expected.

Bald eagles detected during marine bird surveys on NAVBASE Kitsap Bangor (Tannenbaum et al. 2009b, 2011b) were probably the resident pairs that use nests located in the Vinland neighborhood north of the base and the nest south of Devil's Hole. This species is territorial during the breeding season and forages locally. Territories of bald eagles with nests on relatively straight shorelines on Puget Sound typically contained about 0.93 miles (1.5 kilometers) of shoreline on each side of the nest (Watson and Pierce 1998), and this area is used for foraging.

Responses of bald eagles to noise and visual disturbance vary greatly depending on habituation, location, individual tolerance levels, and the stage of their annual nesting cycle. Watson and Pierce (1998) found that vegetative screening and distance were the two most important factors determining the impact of visual disturbances for bald eagles. Nesting birds are most sensitive to disturbance early in the nesting cycle, which begins in late winter for bald eagles (Watson and Pierce 1998). The nest closest to the north LWI is over 7,200 feet (2,195 meters or 1.36 miles) away, with screening vegetation present. Bald eagles were observed at a nest near the KB docks in 2014 (Navy 2014b) but this nest deteriorated during the summer and no chicks were detected. This nest is approximately 1,200 feet (366 meters or 0.22 mile) from the proposed LWI south location, at which distance airborne impact pile driving noise is expected to attenuate to background sound levels at the Bangor waterfront in the absence of pile driving (Section 3.9.2.1). If eagles were to utilize this nest location in the future, they are not expected to be impacted by construction noise.

Bald eagles foraging on the shoreline would also be susceptible to disturbance due to construction. The USFWS (2003) determined that elevated noise levels from impact pile driving at a dock in Port Angeles could disrupt the normal feeding behavior of adult bald eagles within approximately 2,600 feet (792 meters) of the dock site. Bald eagles have been observed foraging on the shoreline approximately 1,800 feet (549 meters) north of the north LWI site (Tannenbaum et al. 2009b). There is no effective screening from pier construction along this shoreline; thus, bald eagles may avoid foraging during periods of high construction activity within this area. However, undisturbed foraging habitat would be available within the territory. No incidental takes of bald eagles are anticipated.

OPERATION/LONG-TERM IMPACTS

Operation of the LWI would not require additional ground disturbance or vegetation clearing, but may increase the potential for noise and visual disturbance to wildlife present in adjacent forest due to human activity. The abutments, piers, and grate barriers could alter wildlife movement along the marine shoreline, affecting terrestrial species such as raccoon, deer, bear, and river otter that use the shoreline for foraging or as a travel corridor. The LWI abutments would be continuously illuminated at a low level, with relatively limited impacts on the movements of nocturnal animals. Maintenance of the LWI could result in short-term, localized disturbance of wildlife.

The 20 towers on the LWI piers may be used as perches for birds such as gulls and crows, but they would have no wires strung to or from them so the potential to affect birds in flight would be negligible. Since the towers would be only 40 feet (12 meters) tall and completely exposed to view, it is unlikely that they would be used by nesting birds. Nests of most bird species that occur at NAVBASE Kitsap Bangor would be protected under the MBTA while they are in active use (i.e., eggs or chicks are present) but could be removed subsequently.

3.6.2.2.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

CONSTRUCTION

The upland features of LWI Alternative 3 would be very similar to those of Alternative 2. The only difference would be the addition of two 30-foot towers. These two towers would be located within existing developed areas adjacent to the proposed shoreline abutments and so would not result in the loss of any additional habitat. The observation posts would be constructed at the base of the shoreline bluffs and would not affect terrestrial vegetation. The observation post to be installed on Marginal Wharf would require installation of a cable from an upland hub to the wharf, but this cable would be trenched entirely through an existing paved road and no new ground disturbance or vegetation impacts would occur. The number of pile driving days would be fewer for Alternative 3 (up to 30 vs. up to 80). Therefore, the impact of Alternative 3 construction on terrestrial biological resources, e.g., disturbance of wildlife species, would be substantially less than described above for Alternative 2.

OPERATION/LONG-TERM IMPACTS

Operation of LWI Alternative 3 would be the same as Alternative 2 except that Alternative 3 would include installation of two towers adjacent to the abutments and have no over-water towers. The abutment towers are likely to be used as perches by birds, but unlikely to be used for nesting, as noted for Alternative 2. Any actively used nests that are built on the towers would be protected by the MBTA but may be removed once birds have fledged. The LWI abutments would be continuously illuminated at a low level, with relatively limited effects only on the movements of nocturnal animals. The towers would have no wires strung to or from them so potential to affect birds in flight is negligible. Therefore, the impacts from operation of Alternative 3 would be very similar to those from operation of Alternative 2.

3.6.2.2.4. Summary of LWI Impacts

Impacts on terrestrial vegetation, wetlands, and terrestrial wildlife associated with the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.6–5.

Table 3.6–5. Summary of LWI Impacts on Terrestrial Biological Resources

Alternative	Environmental Impacts on Terrestrial Biological Resources
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Pier	**Construction***:* Impacts on 1.1 acre (0.44 hectare) of upland vegetation (from abutment construction). Permanent loss of 0.21 acre (0.087 hectare) of vegetation; revegetation of 0.86 acre (0.35 hectare). Pile driving noise impacts on wildlife during one in-water construction season and other equipment noise during a total 24 months of construction (80 days of pile driving). Potential disturbance of bald eagles that may forage in the vicinity. **Operation:** Slightly increased noise and visual disturbance due to human activity at LWI, lighting, and vehicle movements in upland project area and shoreline. Increased isolation of terrestrial habitat encompassed within WSE due to lack of shoreline connectivity to adjacent habitat.
LWI Alternative 3: PSB Modifications (Preferred)	**Construction:** Same as Alternative 2. Impacts on 1.1 acre (0.44 hectare) of upland vegetation (from abutment construction). Permanent loss of 0.21 acre (0.087 hectare) of vegetation; revegetation of 0.86 acre (0.35 hectare). Pile driving noise impacts on wildlife during one in-water construction season and other equipment noise during a total 24 months of construction (30 days of pile driving). Potential disturbance of foraging activity of the bald eagle pair that nests near the south LWI site **Operation:** Similar to Alternative 2. Slightly increased noise and visual disturbance due to human activity at LWI, lighting, and vehicle movements in upland project area and shoreline. Increased isolation of terrestrial habitat encompassed within WSE due to lack of shoreline connectivity to adjacent habitat.
Mitigation: BMPs and current practices to reduce and minimize impacts on terrestrial vegetation and wetland resources are described in Section 3.6.1.2.	
Consultation and Permit Status: No consultation is required for upland vegetation impacts. The Navy submitted a request for water quality certification (through the JARPA process) and a CCD to WDOE, as well as an application for a permit under CWA Section 404 to the USACE through the JARPA process. The Navy will consult with the USFWS Washington Fish and Wildlife Office in the event that any ESA-listed terrestrial wildlife species is detected on NAVBASE Kitsap Bangor and potentially affected by the project. The Navy has determined that the Proposed Action would not result in incidental takes of bald or golden eagles under the Bald and Golden Eagle Protection Act or adversely affect migratory birds under the MBTA. Therefore, no consultation under these acts was requested. Alternative 3 is the Least Environmentally Damaging Practicable Alternative according to the CWA Section 404(b)(1) guidelines.	

BMP = best management practices; CCD = Coastal Consistency Determination; ESA = Endangered Species Act; MBTA = Migratory Bird Treaty Act; USFWS = U.S. Fish and Wildlife Service; WDOE = Washington Department of Ecology; WSE = Waterfront Security Enclave

3.6.2.3. SPE PROJECT ALTERNATIVES

3.6.2.3.1. SPE ALTERNATIVE 1: NO ACTION

Under the No Action Alternative, the SPE would not be constructed, overall operations would not change from current levels, and no impacts on terrestrial vegetation, terrestrial wildlife, or wetlands would occur.

3.6.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

CONSTRUCTION

VEGETATION

Construction of the SPE would result in permanent removal of approximately 7 acres (2.8 hectares) of existing second-growth forest vegetation and orchard for the sites of a new parking lot and other project elements (Figure 3.6–2). The forest is contiguous with a larger forested zone on NAVBASE Kitsap Bangor. The orchard pre-dates development of NAVBASE Kitsap Bangor by the Navy and was part of a homestead on the site. The Navy determined that the orchard would not be eligible as a National Register of Historic Places site (Leidos et al. 2014) and requested concurrence from the State Historic Preservation Officer (SHPO) on this finding. Genetic analysis and field identification of the trees determined that the fruit varieties present are heirloom varieties that were widely available around 1900 and are still readily available. Another approximately 4 acres (1.6 hectares) would be temporarily disturbed (vegetation removed) during construction. The timber value of the removed vegetation would be returned to the Navy at present market value. Removal of vegetation and disturbance of soil on the site could result in erosion, runoff, or discharge of fluids from vehicles or equipment onto the site or adjacent undisturbed vegetation communities. Construction BMPs for earthwork and hauling activities would control slope stability, erosion, and runoff to protect the adjacent habitats. These measures are described fully in Section 3.7.1.2.

All clearing and timber sales for construction would be done in accordance with an approved NAVBASE Kitsap Bangor forest management plan. Following construction, revegetation of the temporarily disturbed area would proceed using a mix of native plant material including shrubs, herbaceous plants, and tree seedlings or saplings. Regular maintenance, including planting and seeding desirable native plant species, mowing, weeding, and erosion control would minimize the establishment or spread of invasive plants to exposed soils on the site. The revegetation site would be managed after completion of the project consistent with the forest management plan to avoid establishment of invasive or noxious weeds, and promote restoration of natural habitat values, and prevent establishment of weed species in the adjacent intact forest.

WETLANDS

The SPE project would not impact the orchard wetland because it is excluded from the proposed construction area (Figure 3.6–2). The 30-foot (9-meter) buffer zone would preserve wetland and buffer zone vegetation, and construction-period BMPs (Section 3.7.1.2) would prevent runoff into the buffer zone and wetland.

THREATENED AND ENDANGERED SPECIES

No impacts on ESA-listed terrestrial species would occur under SPE Alternative 2.

WILDLIFE

Construction would result in the permanent loss of approximately 7 acres (2.8 hectares), and temporary loss of 4 acres (1.6 hectares) of wildlife habitat. The area encompassed by the proposed parking lot is good-quality wildlife habitat and resident individuals would be permanently displaced, although the temporarily disturbed area would be revegetated with native plant species that would eventually provide wildlife habitat. The revegetated area would develop a shrub/small tree-dominated community within several years of planting. Construction noise and potential impacts to wildlife are introduced above under LWI Alternative 2, and apply to SPE Alternative 2. As discussed in Section 3.5, tree removal would be conducted outside of the marbled murrelet breeding season (April 1 through September 23). Tree removal between September 24 and March 30 would be protective of all migratory birds.

Bald eagles have been observed foraging on the shoreline at the outlet of Devil's Hole, approximately 3,200 feet (975 meters) from the SPE project site (Tannenbaum et al. 2009b). Given the distance and presence of vegetative screening between the SPE project site and this foraging site, SPE construction would probably not affect bald eagle use of the foraging site. However, bald eagles may avoid the shoreline near the SPE project site, because of construction-related noise and disturbance.

Bald eagles at NAVBASE Kitsap Bangor are discussed under LWI Alternative 2. Due to the distance (3,200 feet [975 meters]) between the nest documented in 2014 (Navy 2014b) and the SPE project site, airborne impact pile driving noise is expected to attenuate to existing ambient levels. Impacts to bald eagles using this nest site are not expected. Similar to the LWI project site, bald eagles are expected to avoid the shoreline near the SPE project during pile driving activity. No incidental takes of bald eagles are anticipated.

Lighting at construction sites can deter use by many nocturnal wildlife species. Construction would occur during normal daytime hours, but some additional lighting may be used on the construction sites at night, which is likely to affect use by wildlife. Given that the construction areas would be cleared of vegetation and occupied by equipment and materials, additional construction lighting at night would not contribute greatly to the overall impacts on wildlife.

OPERATION/LONG-TERM IMPACTS

Operation of the enlarged Service Pier and upland support facility and parking lot would not require additional ground disturbance or vegetation clearing, but could increase the noise and visual disturbance to wildlife present in adjacent forest habitat due to human activity, such as operations staff walking through the area or driving vehicles. The new support facilities would promote human access into areas that are adjacent to relatively undisturbed forested habitat, potentially increasing disturbance to wildlife. Additional night lighting along the extended Service Pier and increased activity may be avoided by most terrestrial wildlife species. Maintenance of the Service Pier could result in short-term, localized disturbance of wildlife.

3.6.2.3.3. SPE Alternative 3: Long Pier

The upland construction and operations of SPE Alternative 3 would be the same as Alternative 2. Therefore, the terrestrial biological impacts of Alternative 3 would be largely the same as those of Alternative 2. The only notable difference is that Alternative 3 would entail a maximum of 205 days of in-water pile driving, compared to 161 days for Alternative 2. Therefore, the potential impacts of pile driving noise on terrestrial wildlife would be slightly longer in duration, but not of greater intensity, for SPE Alternative 3.

3.6.2.3.4. Summary of SPE Impacts

Impacts on terrestrial vegetation, wetlands, and terrestrial wildlife associated with the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.6–6.

Table 3.6–6. Summary of SPE Impacts on Terrestrial Biological Resources

Alternative	Environmental Impacts on Terrestrial Biological Resources
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	**Construction:** Permanent loss of 7 acres (2.8 hectares) and temporary loss of 4 acres (1.6 hectares) of forest vegetation and wildlife habitat. Pile-driving noise impacts on wildlife during two in-water construction seasons and other equipment noise during a total 24 months of construction (161 days of pile driving). Some potential for disturbance of foraging by bald eagles. **Operation:** Increased noise and visual disturbance due to human activity at Service Pier, lighting, and vehicle movements in upland project area and shoreline.
SPE Alternative 3: Long Pier	**Construction:** Permanent loss of 7 acres (2.8 hectares) and temporary loss of 4 acres (1.6 hectares) of forest vegetation and wildlife habitat. Pile driving noise impacts on wildlife during two in-water construction seasons and other equipment noise during a total 24 months of construction (205 days of pile driving). Some potential for disturbance of foraging by bald eagles. **Operation:** Increased noise and visual disturbance due to human activity at Service Pier, lighting, and vehicle movements in upland project area and shoreline.
Mitigation: Area temporarily disturbed by construction would be revegetated with native species. BMPs and current practices to reduce and minimize impacts on terrestrial vegetation and wetland resources are described in Section 3.6.1.2.	
Consultation and Permit Status: No consultation is required for upland vegetation impacts. The Navy will submit a request for water quality certification (through the JARPA process) and a CCD to the WDOE. The Navy has submitted a BA and consulted with the USFWS Washington Fish and Wildlife Office on ESA-listed marbled murrelet and will consult on any other ESA-listed terrestrial wildlife species that may be detected on NAVBASE Kitsap Bangor and potentially affected by the project. The Navy has determined that the Proposed Action would not result in incidental takes of bald or golden eagles under the Bald and Golden Eagle Protection Act or adversely affect migratory birds under the MBTA. Therefore, no consultation under these acts was requested. Alternative 2 is the Least Environmentally Damaging Practicable Alternative according to the CWA Section 404(b)(1) guidelines.	

BMP = best management practice; ESA = Endangered Species Act; MBTA = Migratory Bird Treaty Act; USFWS = U.S. Fish and Wildlife Service

3.6.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

3.6.2.4.1. VEGETATION

Together the LWI and SPE (both alternatives) projects would result in permanent clearing of approximately 7.2 acres (2.9 hectares) of forest and shrub vegetation. Approximately 4.9 acres (2 hectares) may also be disturbed temporarily during construction and revegetated with native species.

3.6.2.4.2. WILDLIFE

Together, the LWI and SPE projects would result in the permanent loss of approximately 7.2 acres (2.9 hectares) of forested and shrub wildlife habitat, including the homestead orchard proposed as a parking lot for the Service Pier. An additional 4.9 acres (2 hectares) of similar wildlife habitat would be temporarily disturbed, but revegetated with native species following construction. Pile driving and other construction noise may disturb wildlife during the construction periods (a total of four years). The construction periods for the two projects would not overlap; therefore, concurrent or overlapping noise impacts would not occur. Construction at the south LWI could disturb bald eagles foraging in areas with a direct line of sight to the project location, and the SPE project could extend this disturbance for two additional years.

3.6.2.4.3. WETLANDS

Neither the LWI nor the SPE would result in impacts on wetlands.

3.7. GEOLOGY, SOILS, AND WATER RESOURCES

Geologic resources include the soil, rock, and upland sediment that are present at or near the surface of the project area. These materials occur naturally in place or as a result of grading and filling. Geologic resources include lithologic types, slope stability, soil moisture, erosion, and any previous modification to the land surface. Geologic resources may be affected by water at or near the surface, by lack of vegetation, and by other outside influences such as earthquakes and manmade modifications to the land that cause movement and instability of geologic materials. Because interactions between geologic materials and water are so critical, geology and soils issues overlap with surface water and groundwater resources, and are thus included together in this section.

Surface water and groundwater resources include standing and moving water at the surface, all shallow subsurface water, and any utilized (pumped) groundwater on NAVBASE Kitsap Bangor. Surface water includes streams, ponds, wetlands, retention ponds, stormwater collection structures (e.g., ditches), seepage, and interactions with waters of Hood Canal. These surface water bodies may be naturally occurring, modified by humans, or initially constructed by humans. A large number of factors affect surface water and groundwater resources, including precipitation, watershed dynamics, impervious surfaces, stream gradients, vegetation, water quality, recharge and discharge, aquifer characteristics, and pumping of aquifers. In addition, spills of petroleum products and hazardous substances can adversely impact surface water and groundwater quality. Interactions with Hood Canal include runoff and sedimentation, coastal flooding, and tsunami events. Hood Canal water resources considerations are discussed in more detail in Section 3.1.

3.7.1. Affected Environment

3.7.1.1. EXISTING CONDITIONS

The geologic conditions described include topography, geology, geologically hazardous areas, and soils. The geology of the Bangor waterfront is typical of shorelines around Puget Sound and Hood Canal, with steep bluffs rising several hundred feet from the marine waters and merging into uplands with a more gradual slope. The underlying geologic conditions are the result of periodic episodes of glaciation, where the advance and retreat of glaciers have laid down successive layers of sediments alternating between dense till layers and other fine- and coarse-grained layers of sediments. Interglacial deposits tend to consist of fine-grained sediments. These glacial and interglacial deposits are more than 1,200 feet (366 meters) thick, overlying bedrock. Surface soils at the NAVBASE Kitsap Bangor upland area are highly variable, depending upon the nature of the underlying sediments. A majority of the base consists of a gravelly, sandy loam soil developed from glacial till, which is a common near-surface geologic material. Potential geologic hazards include areas of slope instability and erosion potential, as well as general seismic hazards.

3.7.1.1.1. Geologic Overview

The Hood Canal basin is a glacially carved fjord with steep flanks rising abruptly to elevations of more than 200 feet (61 meters) above mean sea level (MSL). Further inland on the Kitsap Peninsula, slopes are moderate and many upland areas are nearly flat. Maximum elevations on NAVBASE Kitsap Bangor are nearly 500 feet (150 meters) above MSL (USGS 2002, 2003).

The Kitsap Peninsula is underlain by a thick accumulation of glacial and non-glacial sediments in a sequence of alternating coarse- and fine-grained deposits that partially fill the regional north-south bedrock depression referred to as the Puget Sound Lowland. The glacial deposits consist principally of outwash sand and gravel, lacustrine silt and clay, and till. The non-glacial sediments consist largely of fine-grained floodplain deposits, but in some areas may also contain sand and gravel characteristic of alluvial fans (Kahle 1998; USGS 2003).

GEOLOGIC CONDITIONS WITHIN THE LWI UPLAND PROJECT AREAS

The north LWI upland project area is largely covered by glacial till referred to as Vashon till (Qvt) (Figure 3.7–1). This glacial till consists of very dense, pebbly, silty sand containing 10 to 20 percent clay. Thickness of the till in this area is typically 10 to 100 feet (3 to 30 meters). Till extends down essentially to the beach level. Beach deposits consist of sand and gravel with organic material. In the shoreline bluff, till is underlain by Vashon glacial advance outwash (Qva), which is a well-sorted deposit of sand and gravelly sand, with localized lenses of fine-grained material. In the general vicinity of the LWI upland project areas, the outwash is typically less than 100 feet (30 meters) thick and present at elevations between approximately 150 and 300 feet (46 and 91 meters) MSL, above the tops of the waterfront bluff. The geologic layer below the outwash consists principally of Vashon glacio-lacustrine (Qvgl) deposits of silt, clayey silt, and very fine sand. These glacial lake deposits are exposed in the waterfront bluff and stream valleys at elevations between approximately 75 and 150 feet (23 and 46 meters) MSL. In the lower 75 feet (23 meters) of the bluff are pre-Vashon (older) deposits of interbedded sand, gravel, clay, silt, and peat (Kahle 1998; USGS 2003; Shannon & Wilson 2012).

The shoreline area adjacent to the south LWI upland project area includes silty sand of the Vashon recessional outwash, plus alluvium, and fill material (together mapped as Qal), including beach deposits of silty gravelly sand and organic material. Higher inland elevations consist of Qvt, Qvgl, and Qva (in that order) trending east, away from the shoreline (Figure 3.7–1).

GEOLOGIC CONDITIONS WITHIN THE SPE UPLAND PROJECT AREA

Similar to the north LWI upland project area, the SPE upland project area is largely covered by Qvt (Figure 3.7–2). Thickness of the till in this area is typically 10 to 100 feet (3 to 30 meters), and the upper few feet of weathered till is composed of silty sand or gravel. The till is underlain by Qva, similar to that at the LWI upland area (Kahle 1998; USGS 2003; Shannon & Wilson 2013).

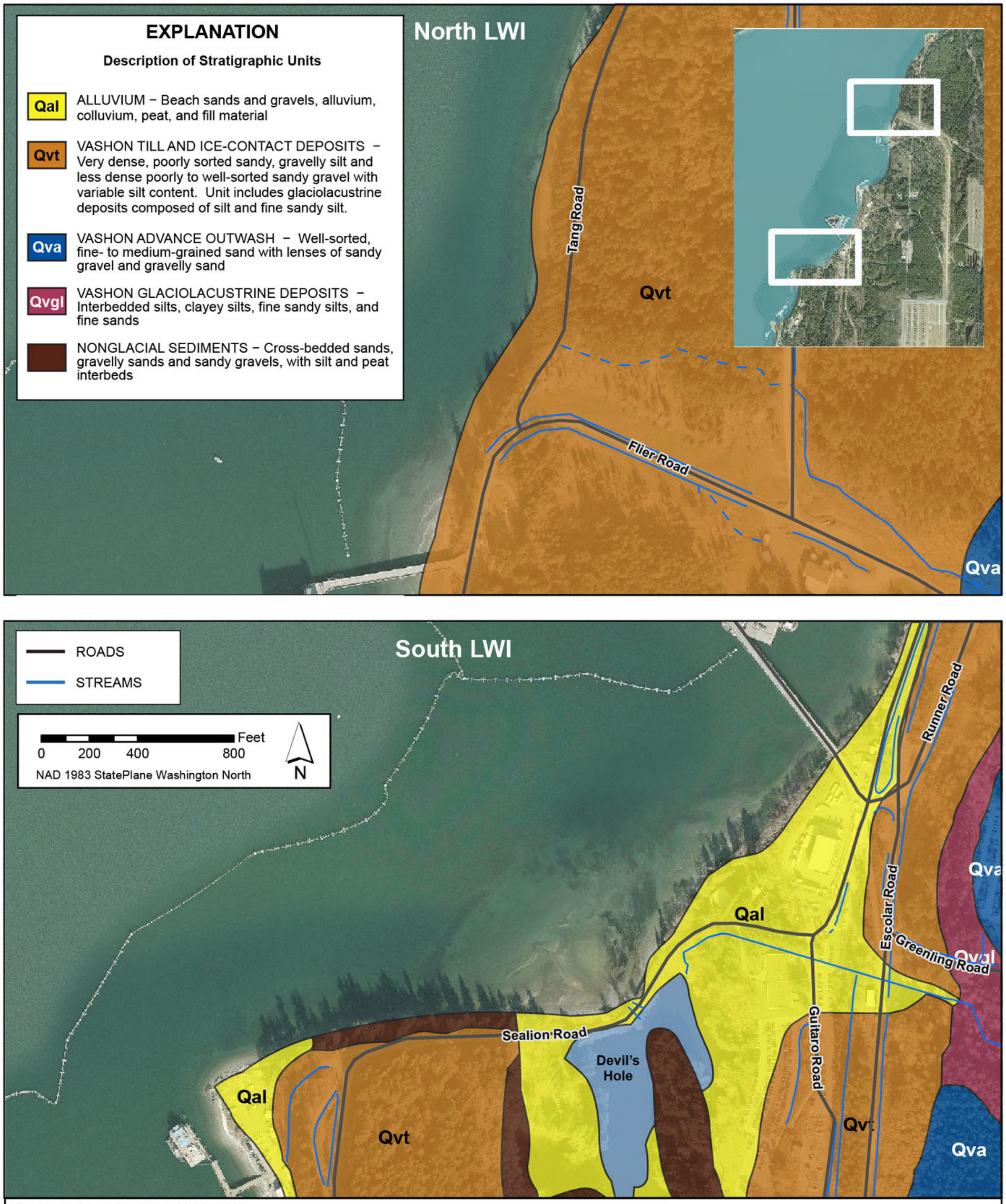
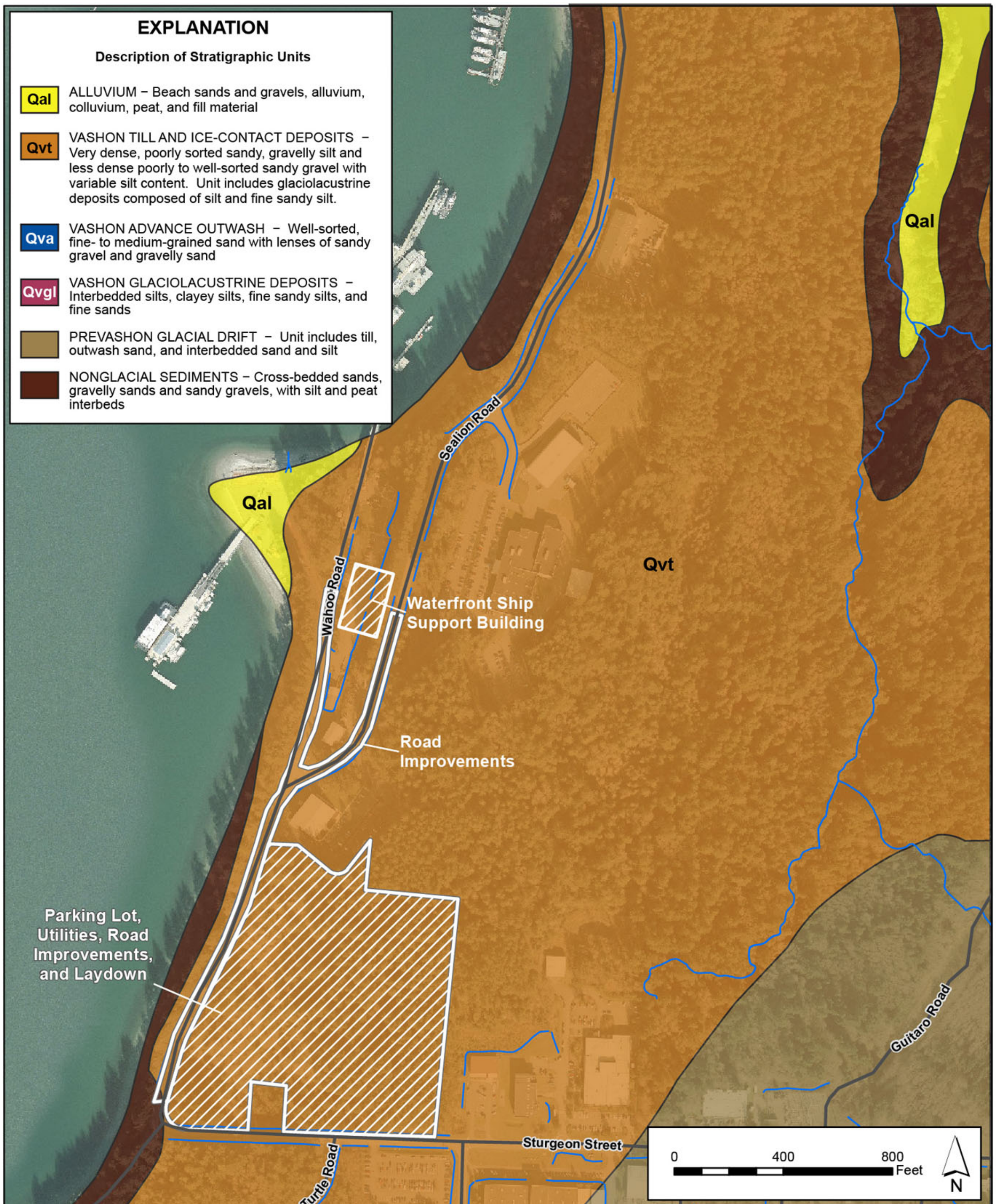


Figure 3.7–1. Surficial Geology of NAVBASE Kitsap Bangor in the LWI Upland Project Areas



Geology information from: Kahle 1998

Figure 3.7–2. Surficial Geology of NAVBASE Kitsap Bangor in the SPE Upland Project Area

3.7.1.1.2. SOILS OVERVIEW

Four primary categories of soil types occur within the NAVBASE Kitsap Bangor upland area:

(1) Upland soils that are developed from Qvt typically consist of a gravelly, sandy loam (20 to 40 inches [51 to 102 centimeters] thick) overlying a dense hardpan layer. These soils have a variable permeability and may support perched water during winter months. Perched water flows laterally and discharges in depressions and streams and through seeps along hillsides and road cuts. These soils are designated as Alderwood and Poulsbo series soils.

(2) In many of the larger stream cuts and near bluff tops, soils are developed from Qva sediments that consist of loamy sand. These soils are deep and tend to be well drained because of their sand-rich texture. In the NAVBASE Kitsap Bangor upland area, these coarse-grained soils are designated as Indianola soils.

(3) Soils developed from Qvgl sediments consist of silt loam and silty clay loam up to 60 inches (150 centimeters) thick. This soil has a relatively low permeability, perches water during the winter months, and also supports wetlands. Lateral flows along platy clay layers occur during the wet months and slopes as low as 8 to 15 percent on this soil type are thus prone to slippage. These fine-grained soils are designated as Kitsap soils.

(4) Soils developed on steeper slopes along bluffs and stream valleys typically overlie Qva, Qvgl, and older deposits. These soils have variable characteristics and are prone to instability due to their steepness and local presence of clay. These soils are designated as Indianola-Kitsap complex, with slopes of 45 to 70 percent. In addition to these four listed soil types, other undifferentiated soils include those along streams, in marshes or lakes, and on beaches (Qal) (Soil Conservation Service 1980).

3.7.1.1.3. SLOPE STABILITY HAZARD AREAS

Chapter 19.400 of the Kitsap County Code defines areas of high geologic hazard as those with slopes greater than or equal to 30 percent and mapped as either unstable or unstable with landslides. Areas of moderate geologic hazard are defined as those with unstable slopes less than 30 percent or those with an intermediate stability designation, or slopes of 15 percent or greater with springs or groundwater seepage.

Detailed mapping of areas with high potential for slope instability or erosion has not been performed within the boundaries of NAVBASE Kitsap Bangor. Mapping conducted as part of the Coastal Zone Atlas of Washington (WDOE 2009) investigated areas to the north and south of the base, with designations of unstable and intermediate stability, plus local areas of recent landslides. A recent evaluation of Kitsap County landslides, using light detection and ranging laser survey techniques, identified three noticeable landslides on NAVBASE Kitsap Bangor (McKenna et al. 2008). Two of these are located approximately halfway between the north and south LWI upland project areas, along the north side of the stream that trends east of Marginal Wharf. The other landslide area is located on the southeast side of Cattail Lake, about 5,000 feet (1,500 meters) northeast of the north LWI upland project area. These three landslides appear to be situated on moderate to steep slopes within Qvgl silt-clay deposits (Kahle 1998). Kahle also observed that well-developed slump blocks (rotated soil areas similar to landslides) are present along the shoreline near Delta Pier, located approximately 1,000 feet (300 meters) north of the south LWI project site, and near the EHW-1 structure, located approximately 1,500 feet (460 meters) south of the north LWI project site.

The presence of these landslides is consistent with results of slope stability modeling displayed in a WDNR online map, which predicted that areas on NAVBASE Kitsap Bangor lying along the Hood Canal bluffs and along incised stream channels would be expected to exhibit moderate or high slope instability (WDNR 2009).

SLOPE STABILITY CONDITIONS AT THE LWI PROJECT SITES

The bluff along the waterfront area at the north LWI project site is designated in the WDNR slope stability model as having mostly medium to high slope instability. As such, this area may be prone to landslides and erosion. However, this analysis is based solely on slope steepness, without soil type and other factors considered. The shoreline adjacent to the north LWI project site is characterized by localized steep slope (bluffs) gradients, ranging between 30 and 100 percent slope (Figures 3.7–3 and 3.7–4). Moderate to gentle slopes and stream valleys are present in the upland areas above the bluff.

The waterfront area at the south LWI project site is designated in the WDNR slope stability model as ranging up to moderate slope instability. This area is characterized by slope gradients ranging between 15 and 60 percent slope, with generally more stable areas in comparison to the north LWI project site.

The geotechnical report for the north and south LWI project sites indicated that these areas have a low risk for seismic-induced slope instability (Shannon & Wilson 2012).

SLOPE STABILITY CONDITIONS AT THE SPE PROJECT SITE

The upland areas near the onshore components of the SPE project site are characterized by low to moderate average slopes, which slope westward toward Hood Canal (Figures 3.7–5 and 3.7–6). The proposed Waterfront Ship Support Building site is slightly steeper than the proposed parking structure site. These areas are designated in the WDNR slope stability model as mostly low slope instability, but locally up to moderate instability. The geotechnical report for the SPE project site indicated that this area has a low risk of seismic-induced slope instability (Shannon & Wilson 2013).

3.7.1.1.4. SEISMICITY

Western Washington is recognized as a seismically active region. Faults within the Puget Sound Lowland are capable of producing earthquakes with Richter magnitudes of 7.0 to 7.7. Even larger earthquakes (magnitude 8 to 9) are predicted due to offshore deep subduction faulting. NAVBASE Kitsap Bangor lies between two major fault zones that have been active in the recent geological past: the Seattle Fault (active within the last 1,100 years) and the South Whidbey Island Fault (active within the last 2,500 years). These and other regional faults are capable of large-magnitude earthquakes that could affect structures and slope stability in the project area, including inducement of landslides and other forms of mass wasting (Kitsap County Department of Emergency Management 2004; Bourgeois and Martin 2008).

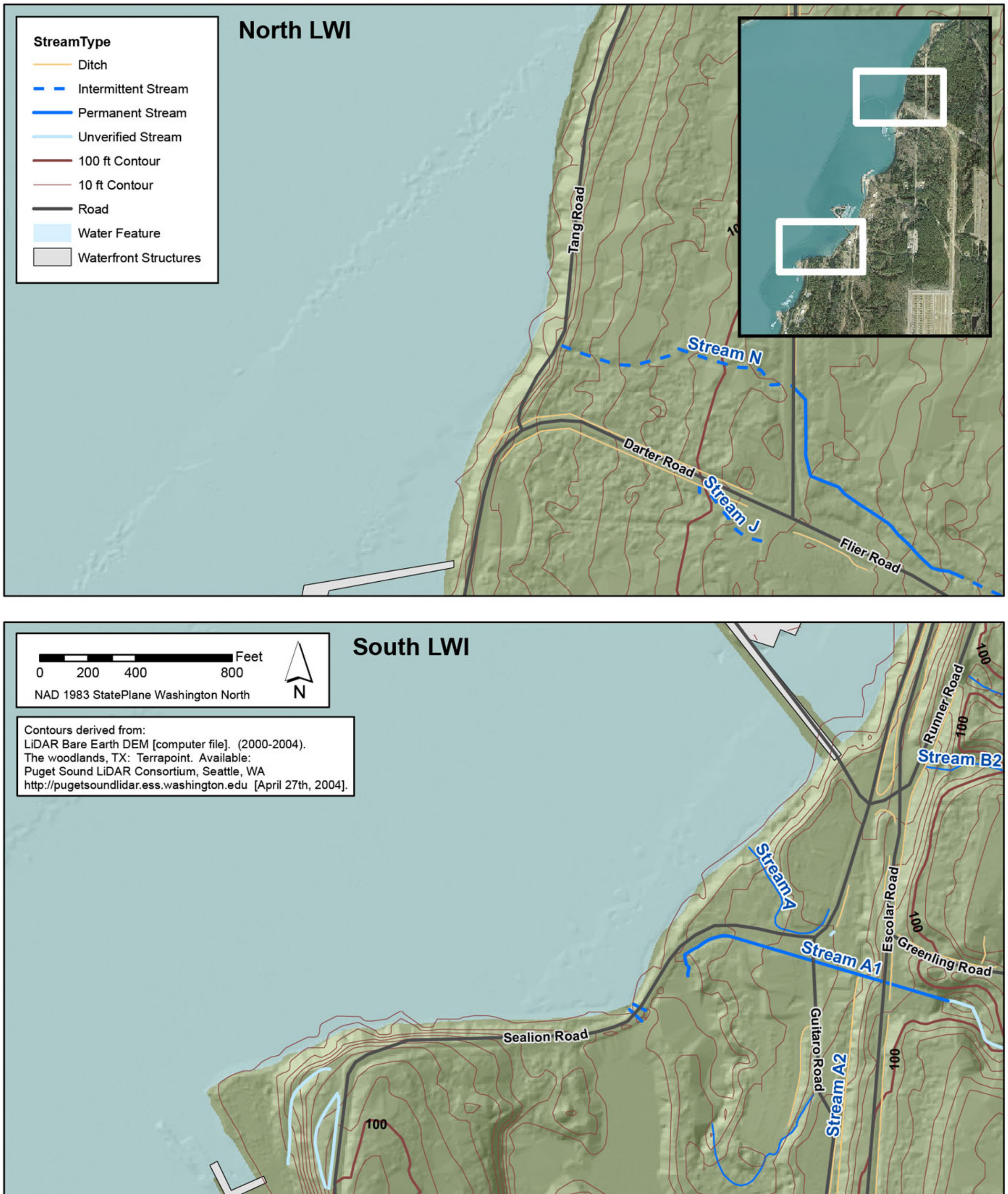


Figure 3.7–3. Topography in the LWI Project Area

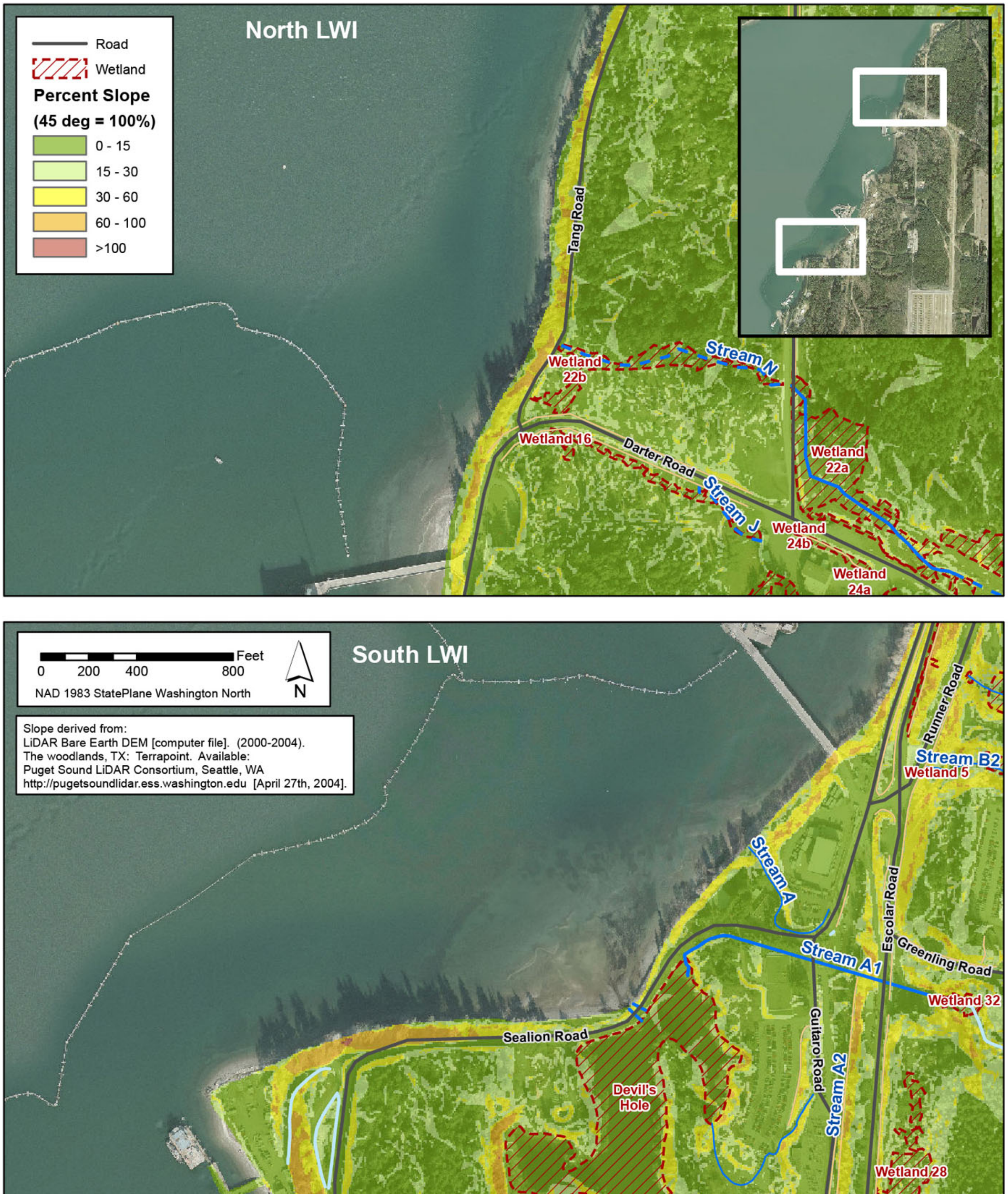


Figure 3.7–4. Surface Water Features and Slope near the LWI Project Sites

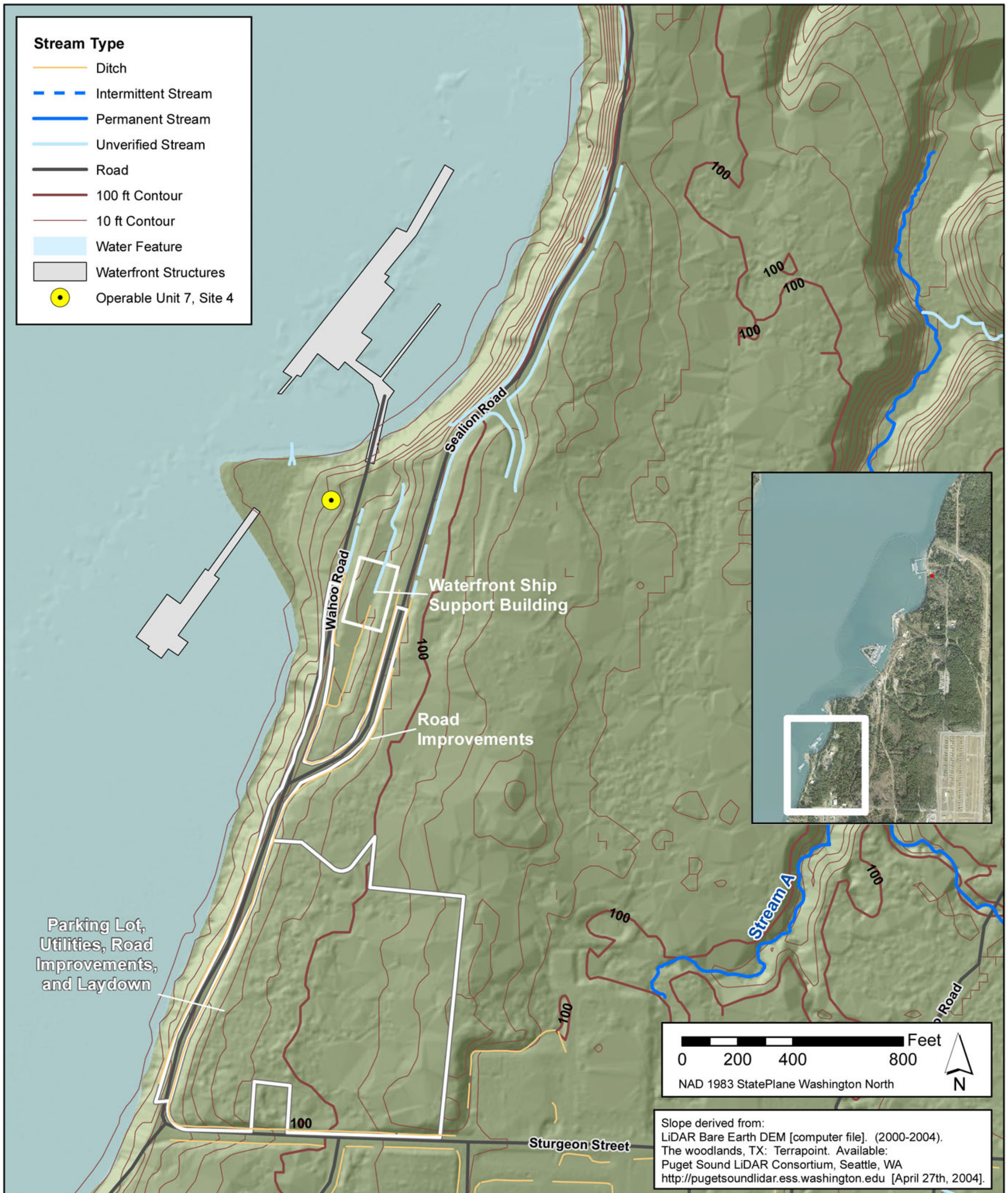


Figure 3.7–5. Topography in the SPE Project Area

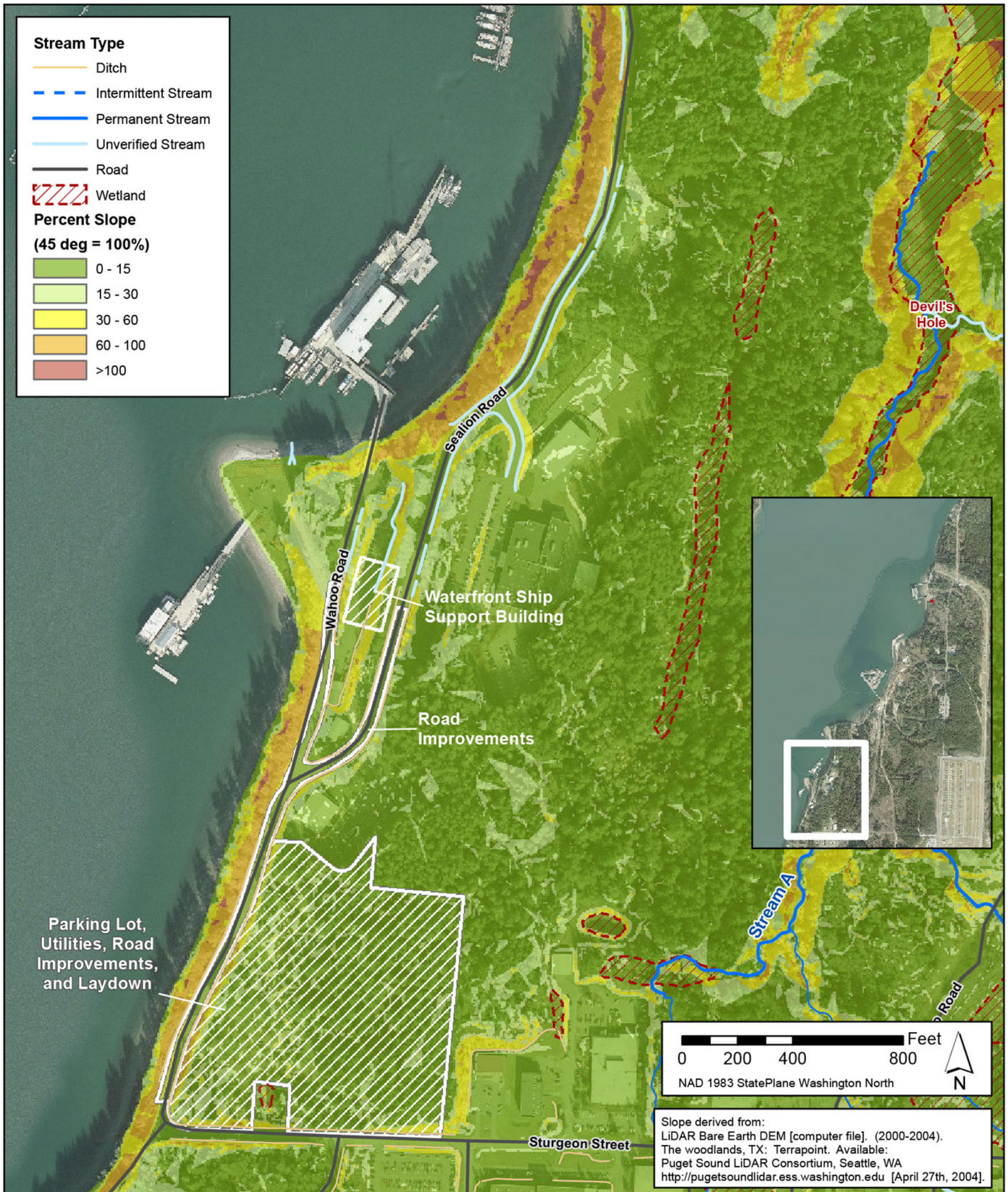


Figure 3.7–6. Surface Water Features and Slope near the SPE Project Site

The U.S. Geological Survey (USGS) has developed a series of seismic hazard maps that describe the likelihood that earthquake shaking of varying degrees will occur in a given area. On NAVBASE Kitsap Bangor, predicted peak horizontal ground acceleration (PGA) with a 2 percent probability of exceedance in 50 years is 0.50 to 0.60 g (gravitational acceleration). Predicted ground acceleration with a 10 percent probability of exceedance in 50 years is 0.30 to 0.35 g. For reference, a PGA of 0.10 g is the approximate threshold for damage to older structures or structures not made to resist earthquakes (USGS 2008).

SEISMICITY AT THE LWI PROJECT SITES

Based on Kitsap County mapping of ground-shaking amplification during an earthquake, the north LWI upland project area is classified as Site Class C to D (on a scale of B to F, where B is neutral and subsequent letters have increasing amplification of ground shaking). This suggests that seismic ground shaking in the north LWI upland project area would be considered to have modest amplification based on near-surface geology. Furthermore, the liquefaction susceptibility for the project area soils is considered to be very low to low, indicating that surface soils would have a low probability of liquefying and losing strength during an earthquake (Palmer et al. 2004).

The south LWI upland project area is classified as Site Class D to E, and the liquefaction susceptibility for the project area soils is considered moderate to high. This indicates that surface soils would have a much higher probability of liquefying and losing strength during an earthquake (than in north LWI project area), based on the soil type and shallow groundwater conditions. The geotechnical report for the north and south LWI project sites indicated that these areas have a low risk of liquefaction and other seismic instability (Shannon & Wilson 2012).

SEISMICITY AT THE SPE PROJECT SITE

Based on Kitsap County mapping of ground-shaking amplification during an earthquake, the project area is classified as Site Class C and Site Class C to D. This suggests that seismic ground shaking in the SPE upland project area would be considered to have modest amplification based on near-surface geology. Furthermore, the liquefaction susceptibility and related seismic instability for project area soils is considered to be very low to low, indicating that surface soils would have a low probability of liquefying and losing strength during an earthquake (Palmer et al. 2004; Shannon & Wilson 2013).

TSUNAMI HAZARDS

A potential exists for tsunami hazards within Hood Canal along the Bangor waterfront. Historical evidence for possible past tsunami activity is found in sand deposits above sea level along southern Hood Canal. These and other potential tsunami events would be initiated by seismic and/or landslide activity into the canal. The anticipated maximum height of tsunami inundation in Hood Canal is unknown. For comparative purposes, historical landslides in Puget Sound have generated tsunami waves of known heights. An earthquake-induced subaerial landslide in the Tacoma Narrows produced a tsunami that reached 6 to 8 feet (1.8 to 2.4 meters) in height. Two underwater landslides near Olympia and Tacoma generated tsunami waves of 10 to 15 feet (3 to 5 meters) in height (Palmer 2001; Kitsap County Department of Emergency Management 2004; Bourgeois and Martin 2008). The overall potential for a tsunami to occur on NAVBASE Kitsap Bangor is considered very small (Moffatt & Nichol 2011). A large earthquake generated in the offshore tectonic zone would not produce a significant tsunami event in Hood Canal due to the attenuation of wave energy as the wave travels from the Strait of Juan de Fuca and turns into the protected waters of Hood Canal (Gottlieb 2010).

3.7.1.1.5. SURFACE WATER

Precipitation and seepage are the sources of surface water for the upland areas on NAVBASE Kitsap Bangor. Kitsap County has a temperate maritime climate, with annual precipitation averaging approximately 50 inches (127 centimeters) per year. The total annual snowfall is approximately 16 inches (41 centimeters). Most precipitation falls during late fall and winter (Kitsap County Department of Emergency Management 2004).

WATERSHEDS

NAVBASE Kitsap Bangor includes two main watersheds, defined as major surface water drainages separated by topographic divides. The drainages at the base include five sizable perennial streams that enter Hood Canal (part of the northern Hood Canal watershed), and two tributaries of Clear Creek that flow to the southeast and enter into Dyes Inlet (part of the Clear Creek watershed). By including smaller streams on the base that are usually perennial, a total of 15 streams are enumerated, with drainage basins for these streams varying from 0.03 to 3.7 square miles (0.08 to 9.6 square kilometers). Recorded stream flows range from 0.01 to 4.0 cubic feet (0.0003 to 0.11 cubic meters) per second. Three of the perennial streams pass through small lakes or marsh areas before discharging into Hood Canal: Cattail Lake, Hunter's Marsh, and Devil's Hole. Altogether, the base includes four lakes and ponds, and three larger marshes (May 1997).

STREAMS AND WETLANDS WITHIN THE LWI UPLAND PROJECT AREAS

The north LWI upland project area lies entirely within the Hood Canal watershed. Intermittent Stream N is located at this project area and Wetland 22b is located along Stream N between Tang Road and Amberjack Avenue. Intermittent Stream J and Wetland 16 are located about 500 feet (150 meters) south of the project area (Figures 3.7–3 and 3.7–4). Biological aspects of wetlands on NAVBASE Kitsap Bangor are described in more detail in Section 3.6.

Stream N is intermittent near the shore and becomes perennial about 1,000 feet (300 meters) inland to the east. Stream N drains Wetlands 22a and 22b and flows westerly from Amberjack Avenue through a culvert under Tang Road to Hood Canal. Wetland 22b, which is seasonally flooded, is approximately 1.3 acres (0.53 hectare) and is narrow at the eastern end near Amberjack Avenue and widens going westerly. Stream J (a short drainage) and surrounding Wetland 16 (0.6 acre [0.24 hectare]) are parallel to the south edge of Flier Road. Water reaches these features from culverts under an adjacent building and parking lot on the south side of Flier Road at the intersection with Amberjack Avenue, and from Wetland 24b, which is seasonally flooded (Brown and Tannenbaum 2009).

The south LWI upland project area lies about 250 feet (75 meters) north of the Devil's Hole and drainage. Nearby streams include Stream A, which may discharge into Hood Canal where the south LWI interface structure would be located; permanent Stream A1, which discharges into the north end of Devil's Hole; and intermittent Stream A2, which also discharges into the north end of Devil's Hole (Figures 3.7–3 and 3.7–4).

Most of Stream A is within a roadside ditch, but the primary source of water appears to be from a natural seep (Wetland 13). Water also flows into this stream as runoff from roads and parking lots in the vicinity. Stream A1 is a larger natural stream that flows from the north side of Escolar Road, then enters a very long culvert under buildings, parking lots, and roads, and resurfaces within a roadside drainage along Sealion Road before emptying into Devil's Hole (Brown and Tannenbaum 2009). Stream A2 originates at a ponded wetland fed by a natural stream, flows north through a forested area between an abandoned railroad grade and tracks parallel to the west bank of Escolar Road, then joins the culvert that carries Stream A1 toward Devil's Hole. Devil's Hole is a manmade lake (from earlier road construction) that is permanently flooded. It is a large water body with moderate water quality, hydrologic, and habitat functions.

STREAMS AND WETLANDS WITHIN THE SPE UPLAND PROJECT AREA

There is one main stream course in the general vicinity of the SPE upland project area, Devil's Hole Creek (Figures 3.7–5 and 3.7–6). The creek drains from south to north, discharging into Devil's Hole. The main stream channel and major tributaries are located more than 700 feet (210 meters) east of the closest proposed SPE construction area, the parking lot. The entire SPE upland project area drains westward and northward, largely through a series of roadside ditches (see Stormwater Management, below).

A small wetland, approximately 3,200 square feet in size (0.07 acre), is located south of the proposed SPE parking lot area (Figure 3.7–6). This wetland appears to have no surface inflow or drainage (see Section 3.6).

WATER QUALITY

Surface water monitoring in the overall Hood Canal watershed is performed on an ongoing basis by Kitsap County Health District (2005) and WDOE (2008b). However, with the exception of Kitsap County performing periodic sampling for fecal coliform, no other monitoring of streams is known to take place on NAVBASE Kitsap Bangor.

FLOODPLAINS / FREQUENTLY FLOODED AREAS

The Hood Canal shoreline below an elevation of 10 feet (3 meters) MSL is identified as a zone of coastal flooding. The waterfront shoreline area is designated by the Federal Emergency Management Agency (FEMA) as an A1-30 zone. This area is subject to flooding during a 100-year flood, which indicates that it has a 1 percent chance of flooding annually and a 26 percent chance of flooding in 30 years (National Flood Insurance Program 1980). The upland portions of the base are not mapped for flood hazard areas but are unlikely to contain any flood hazard areas based on the topography and similarity to areas adjacent to the base that are not mapped as flood hazards.

WATER SUPPLY

None of the surface water bodies described in this section is used as a potable water source. Potable water on NAVBASE Kitsap Bangor is provided by four deep groundwater supply wells. Wells for other purposes, including standby wells, are also maintained on the base (Parametrix 1994b).

STORMWATER MANAGEMENT

STORMWATER MANAGEMENT WITHIN THE LWI UPLAND PROJECT AREAS

As discussed previously (Streams and Wetlands within the LWI Upland Project Areas), surface water runoff from the LWI upland project areas drains via streams and wetlands to Hood Canal (north LWI project site) and to Hood Canal and Devil's Hole (south LWI project site). However, a stormwater retention pond has been constructed at the north LWI upland area for the Waterfront Security Enclave project. This manmade pond is located south of the north LWI abutment and is used to collect stormwater runoff from Flier Road and other adjacent impervious surfaces. However, this stormwater pond is not a part of the LWI project and would not be affected by it.

STORMWATER MANAGEMENT WITHIN THE SPE UPLAND PROJECT AREA

Surface water from the roadway south of the SPE upland project area (Sturgeon Street) drains west and north through ditches and the existing storm drain system. This stormwater is discharged to Hood Canal in the area north of Sturgeon Street. Stormwater in the areas along Sealion Road and Wahoo Road, in the vicinity of the proposed Waterfront Ship Support Building, also drains via roadside ditches and discharges to Hood Canal. In addition to runoff directly associated with the upland drainage basin, current runoff from the Service Pier is collected and pumped to a retention pond in the Devil's Hole drainage basin (located 600 feet [180 meters] northeast of the proposed laydown area). After retention, this stormwater runoff drains through Devil's Hole Creek and discharges through an outfall into Hood Canal (Navy 2009a). These discharges are regulated by the MSGP and the NAVBASE Kitsap Bangor industrial activity SWPPP.

3.7.1.1.6. GROUNDWATER

Groundwater beneath the NAVBASE Kitsap Bangor upland area occurs in a series of aquifers composed of permeable sand and gravel layers separated by layers of less permeable deposits of silt, sand, and clay. The uppermost aquifer is situated within Qva deposits, and is overlain by low-permeability Qvt (Figure 3.7–7). The Qva aquifer is typically 10 to 150 feet (3 to 46 meters) thick, and the water table occurs at depths of 60 to 80 feet (18 to 24 meters) below the land surface in upland areas; however, in lower-elevation areas along Hood Canal, in wetlands, and along some of the deeply incised stream channels, the water table is present at or near the land surface. In addition, perched water may exist at shallow depths on top of low-permeability layers, such as Qvt and Qvgl deposits. Some groundwater discharge in the form of springs and seeps is known to occur in the area, most commonly near the base of the Qva unit (Kahle 1998; USGS 2003).

Six groundwater wells, which are not used for drinking water, are located approximately 0.25 mile (0.4 kilometer) east of the north LWI upland project area. The wells extend to depths between 38 and 92 feet (12 and 28 meters), or elevations of 30 to 85 feet (9 to 26 meters) MSL (Kahle 1998).

The NAVBASE Kitsap Bangor upland area is located in zones of both groundwater recharge and discharge, as schematically depicted by the flow arrows in Figure 3.7–7. The direction of horizontal groundwater flow in the shallower aquifers beneath the upland area is westward, approximately perpendicular to the shoreline, discharging into Hood Canal or streams that drain to the canal. Groundwater is recharged by precipitation and infiltration in higher elevation areas on the eastern portion of the upland area. Estimated long-term average recharge to the shallow aquifers on NAVBASE Kitsap Bangor typically ranges from 8 to 10 inches (20 to 25 centimeters) per year. Groundwater discharge takes place on the western, lower elevation portions of the upland area and within Hood Canal (Parametrix 1994b; Kahle 1998; USGS 2002, 2003).

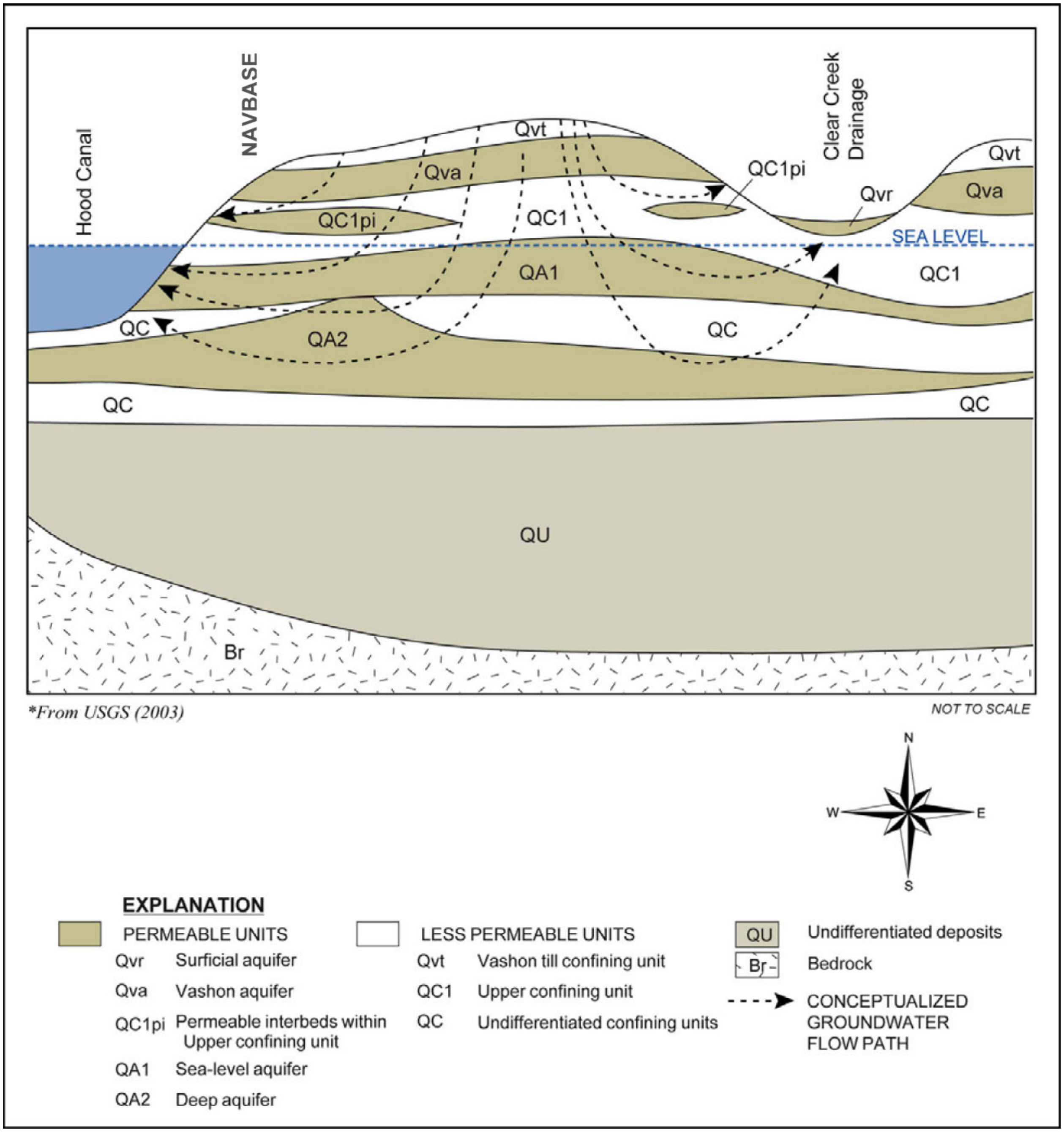


Figure 3.7–7. Conceptual Model of Hydrologic Conditions on NAVBASE Kitsap Bangor

Groundwater quality data are not available for the specific project areas. However, these areas are not located near known sources of groundwater contamination or any CERCLA operable units (OUs). The nearest groundwater-contaminated sites are known as Site A within OU 1 (where groundwater remediation is ongoing), the Bangor Ordnance Disposal site, which is located 1 mile (1.6 kilometers) northeast of the north LWI upland project area; and Site F within OU 2, the Former Wastewater site, which is located about 2.5 miles (4 kilometers) southeast of the south LWI upland project area (USGS 2002; Navy 2005).

3.7.1.2. CURRENT REQUIREMENTS AND PRACTICES

Project activities on NAVBASE Kitsap Bangor involving the disturbance or contamination of soils may be subject to regulatory authority or guidelines at the federal and state levels. Applicable laws and regulations are concerned with the effect of soil erosion and sedimentation, instability, contamination, and the placement of fill into wetlands and other surface water bodies. Laws pertinent to degradation of the soil primarily address contamination of soil by hazardous or toxic materials, associated risk to human health and the environment, and subsequent soil cleanup. The following section summarizes components of these regulations that pertain to NAVBASE Kitsap Bangor and this project.

CERCLA AND MTCA

CERCLA, also commonly known as Superfund, was enacted to address abandoned or uncontrolled hazardous waste sites. The law has subsequently been amended by SARA and is implemented by the *National Oil and Hazardous Substances Contingency Plan* (see Section 3.1 under Regulatory Compliance for further discussion). CERCLA is administered by the USEPA and provides for site identification and listing on the NPL. Sites on NAVBASE Kitsap Bangor have been listed on the NPL because of contamination associated with a number of hazardous waste sites on the base. Under EO 12580, the Navy is the lead agency for investigation and cleanup of contaminated sites on NAVBASE Kitsap Bangor. CERCLA provides for state participation, and WDOE is the lead regulatory agency for contaminated sites on NAVBASE Kitsap Bangor. The MTCA is the state regulation (WAC 173-340) that addresses the identification, investigation, and cleanup of hazardous waste sites in Washington.

In January 1990, the Navy, USEPA, and WDOE entered into a Federal Facilities Agreement for the study and cleanup of possible contamination on NAVBASE Kitsap Bangor. Studies conducted at the base identified a number of contaminated waste sites that were subsequently combined into eight OUs within the Bangor NPL site. None of the contaminated sites is located within the LWI upland project areas; the nearest site (OU 4 Site C-West) is approximately 0.5 mile (0.8 kilometer) southeast of the north LWI upland project area. OU 7 Site 4 is located approximately 0.9 mile (1.4 kilometers) southwest of the south LWI project area, above Carlson Spit near the location of the proposed Waterfront Ship Support Building for the SPE upland project area (Figure 3.7–5). The OU 7 risk assessment concluded that conditions at Site 4 pose no unacceptable risks to human health (under an unrestricted use scenario) or the environment. The OU 7 ROD declared that no remedial action (and no institutional controls or monitoring) is required for these sites/areas (URS 1996; Navy 2005). OU 6 Site D is a former ordnance disposal area in the west-central portion of the base, located just east of Devil's Hole Creek and wetlands. However, Site D is not within the SPE upland project area and is not a concern for this study.

STATE AND COUNTY SHORELINE POLICIES

Shoreline-related activities on NAVBASE Kitsap Bangor, including modification of potentially unstable soils, are considered to meet CZMA consistency through application of the policies and regulations of the Kitsap County SMP (Kitsap County Code, Title 22). Hood Canal has been designated by the state as a Shoreline of Statewide Significance (Code Chapter 22.300.145). As a result, the SMP seeks to enhance and protect water resources in the Hood Canal Watershed, including all lands and activities that affect drainage of water into the canal or its tributaries. This includes minimizing erosion and sedimentation and protecting soil resources.

The Kitsap County Code for geologically hazardous areas is based on that used by the USGS, WDNR, and WDOE (Canning 2001; WDOE 2009). Although the County Code has no direct applicability to Navy projects in a regulatory context, because of its basis, it can be used as a guideline for environmental evaluations and for meeting the goals of the SMP. The hazards pertaining to construction that affect the geologic stability and erosion of sloping land are covered by the County Code under Chapter 19.400, “Geologically Hazardous Areas.” The geologically hazardous areas are designated based on percent slope, mapping or determination of stability zones, soil types, and groundwater seepage (Kitsap County Code).

Project activities on NAVBASE Kitsap Bangor involving groundwater and non-marine surface waters are subject to regulatory authority at the federal and state level. Section 3.1 addresses regulations pertaining to the waters of Hood Canal.

CLEAN WATER ACT

The Federal Water Pollution Control Act Amendments of 1972, as amended in 1977 and 2002 and commonly known as the Clean Water Act (33 USC 1251), established regulations for discharges of pollutants into waters of the U.S. The CWA contains the requirements to set water quality standards for all contaminants in surface waters. The following text highlights CWA sections that are pertinent to upland and shoreline surface waters, followed by other regulatory requirements.

Administered by USACE, Section 404 applies to the discharge of dredged or fill material into navigable waters of the U.S., including USACE jurisdictional streams. A Section 404 permit is required for project activities that involve filling, clearing, or grading in USACE Section 404-regulated streams.

Activities that require compliance with Section 404 of the CWA must also obtain a Section 401 water quality certification from WDOE. Issuance of a certification means that WDOE anticipates that the project will comply with state water quality standards and other aquatic resource protection requirements. The water quality certification covers both construction and operation of a project. Conditions of the certification become conditions of the Section 404 permit.

Section 402 regulates wastewater discharges into surface water. Section 402 is implemented by the NPDES program. The USEPA has regulatory authority for NPDES for federal facilities in Washington State, including NAVBASE Kitsap Bangor.

A NPDES Construction Stormwater General Permit is required for construction activities that disturb 1 acre (0.4 hectare) or more and may result in a discharge of stormwater to surface waters of the state, including storm drains, ditches, wetlands, creeks, rivers, lakes, and marine waters. The permit requires construction site operators to prepare a SWPPP and to install and maintain erosion and sediment control measures to prevent soil, nutrients, chemicals, and other harmful pollutants from being washed by stormwater runoff into surface water bodies. An NPDES permit is required for the discharge of wastewater into surface waters through a conveyance system (e.g., an outfall). During construction of the LWI and SPE upland project facilities, stormwater runoff would be handled in accordance with an NPDES Construction General Permit. A SWPPP would be developed, following guidance in WDOE's *Stormwater Management Manual for Western Washington* (WDOE 2014) and utilizing EPA's *NPDES General Permit for Discharges from Construction Activities* (USEPA 2012). The SWPPP would specify which BMPs would be implemented during construction and operation to limit erosion and contaminant discharges, including sedimentation, to upland water bodies and Hood Canal.

Industrial stormwater discharges on NAVBASE Kitsap Bangor are covered under EPA's 2015 MSGP. Stormwater runoff discharges would also be covered under the MSGP. This permit may include limits on the quantity and quality of discharge, as well as requirements for monitoring the effluent and its receiving water (Navy 2009a).

Spill Prevention, Control, and Countermeasures (SPCC) regulations (40 CFR 112) are intended to protect water quality from releases of petroleum products. The regulations apply to facilities that store or use more than 1,320 gallons (4,997 liters) of petroleum products (inclusive of amounts stored in all drums, tanks, and operating equipment containing 55 gallons [208 liters] or more). These regulations are administered by the USEPA and require that an SPCC plan be developed and that secondary containment be provided for containers and tanks. The regulations would apply to project components that use or store petroleum products.

Section 303(d) requires the identification of surface water bodies that do not meet applicable CWA quality standards and the development of a cleanup plan, known as a TMDL. No freshwater bodies within the NAVBASE Kitsap Bangor upland area appear on the most recent 303(d) list (WDOE 2013b,c). However, some areas of Hood Canal near NAVBASE Kitsap Bangor are on the 303(d) list for low dissolved oxygen levels (Section 3.1.1.1.2).

In addition to the CWA, two other federal regulations apply to upland and shoreline surface waters: the Energy Independence and Security Act of 2007 (EISA) and the CZMA.

Energy Independence and Security Act of 2007 (EISA), Section 438

The EISA of 2007 (Public Law 110-140) is an Act of Congress concerning the energy policy of the United States. Section 438 of the Act requires federal development projects with a footprint exceeding 5,000 square feet (465 square meters) to "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to temperature, rate, volume, and duration of flow." According to the USEPA guidance on implementing Section 438 of the Act (USEPA 2009a), the intent of Section 438 is to "require federal agencies to develop and redevelop applicable facilities in a manner that maintains or restores stormwater runoff to the maximum extent technically feasible" and to "replicate the pre-development hydrology to protect and preserve both the water resources on site and those downstream." Pre-development site hydrology can be maintained by retaining rainfall on site through infiltration, evaporation/transpiration, and reuse.

COASTAL ZONE MANAGEMENT ACT

The CZMA requires that federal actions that have reasonably foreseeable effects on coastal users or resources must be consistent to the maximum extent practicable with the enforceable policies of approved state coastal management programs. Activities and development impacting coastal resources that involve the federal government are evaluated through a process called federal consistency, in which the proponent agency is required to prepare a CCD for concurrence from the affected state.

WASHINGTON STATE WATER POLLUTION CONTROL ACT (RCW 90.48)

The state water quality standards are defined in the Washington State Water Pollution Control Act and implemented in WAC 173-201A. The regulation establishes water quality standards for surface waters of the state of Washington consistent with public health and public enjoyment of the waters and the propagation and protection of fish, shellfish, and wildlife. WDOE's *Stormwater Management Manual for Western Washington* (WDOE 2014) provides generic and technical guidance on measures to control the quantity and quality of stormwater runoff from development projects for compliance with CWA permit conditions as well as EISA Section 438.

CONSULTATION AND PERMIT COMPLIANCE STATUS

No consultations or permits are required for geology and soils; however, consultation and permitting actions are being undertaken with respect to aquatic resources. The Navy submitted a JARPA to USACE and other regulatory agencies, requesting permits under CWA Sections 401, 402, and 404 for the LWI project. These requirements are covered in more detail in Section 3.6.1.2.3. Construction in the coastal zone is also regulated by the CZMA. In accordance with the CZMA, the Navy submitted a CCD to WDOE for the LWI project. When the SPE project is programmed and scheduled, the Navy will submit an application for permits under the CWA for the SPE project to USACE and WDOE and a CCD to WDOE.

BEST MANAGEMENT PRACTICES AND CURRENT PRACTICES

The following BMPs and current practices would be implemented to control runoff and siltation and minimize impacts on surface water:

- A SWPPP will be implemented for construction and operation.
- Measures to control stormwater will include installation of a temporary runoff capture and discharge system and installation of temporary siltation barriers, such as straw wattles, below the excavation/construction zone.

- During clearing, grading, and maintenance, the following will be employed as needed to control erosion and sedimentation: possible use of benched surfaces, down drain channels, diversion berms and ditches, erosion control blankets or turf reinforcement mats, plastic coverings, silt fences and check dams, and straw bales.
- Water-spraying on soil will be used to control dust generation during earthmoving and hauling activities.
- Following construction, areas disturbed by construction and not occupied by new impervious surface will be revegetated with native species. Areas within the WSE cleared areas will be revegetated with grass seed mix and maintained as per WSE requirements.
- Gravel will be installed at construction area access points to prevent tracking of soil onto paved roads.
- Additional BMPs will be implemented to control runoff and siltation and minimize impacts to surface water per the *Stormwater Management Manual for Western Washington* (WDOE 2014).

3.7.2. Environmental Consequences

3.7.2.1. APPROACH TO ANALYSIS

The evaluation of impacts on geologic resources considers whether geologic materials would become unstable under proposed conditions, whether erosion and sedimentation in water bodies would occur, whether excavation and transport of soil would adversely affect water or land environments, and whether soil contamination would increase or spread.

The evaluation of impacts on surface water and groundwater considers whether surface water bodies would be physically modified, whether the surface water or aquifer quality would be degraded, whether additional stormwater runoff would require handling, whether discharge or recharge between the surface and groundwater would be affected, and whether flooding or tsunami events would affect the area. Surface water degradation includes runoff that causes erosion, turbidity, and sedimentation. Surface water impacts would be gauged by compliance with state water quality standards, including measures of turbidity.

3.7.2.2. LWI PROJECT ALTERNATIVES

3.7.2.2.1. LWI ALTERNATIVE 1: NO ACTION

Under the LWI No Action Alternative, the LWI structures and PSBs would not be constructed. There would be no construction or operation-related activities that would directly or indirectly result in ground disturbance or erosion affecting soils or water resources. Therefore, there would be no impact on geology, soils, or water resources due to the LWI No Action Alternative.

3.7.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

CONSTRUCTION

Construction activities and facilities at the north and south LWI project sites would include a contractor staging area, ground clearing, excavation, filling, and concrete work for the LWI abutment and utilities. No construction activities are anticipated to occur in the upland area away from the project sites as part of the Proposed Action. Road access to the north LWI project site already exists via Flier Road and Tang Road. Road access to the south LWI project site was constructed as part of the WSE project. Only localized nonpermanent access roads would be needed during construction, and these would be revegetated with native species upon completion.

Clearing and grading for vegetation removal and excavation for abutment construction would disturb soils and create the potential for erosion and runoff during storm events. Soil types in the north and south LWI upland project areas would not be highly erosive. However, temporary and long-term controls of soil erosion and runoff would be in place as BMPs for earthmoving and hauling activities. Construction BMPs for clearing, grading, hauling, maintenance, and other activities such as utility work would be employed as needed to control erosion and sedimentation. These measures include the following: diversion berms and interceptor ditches on both sides of the roadways, sediment traps outfitted with rock check dams and stand pipes, straw bale barriers on the sides of roads, erosion control blankets or turf reinforcement mats, and silt fences along the sides of roads. Water-spraying on soil would be used to control dust generation during earthmoving and hauling activities. Any potential fluid spills or leakage from vehicles onto soil would be cleaned up immediately, in accordance with the spill response plan.

The potential impacts on the intertidal environment from earthmoving and hauling activity would include erosion and runoff from the abutment excavation area and the lower part of the paved access roads. The abutment areas and access roadways are adjacent to the shoreline. Temporary and long-term controls of soil erosion and runoff would be in place as BMPs for earthmoving and hauling activities, as listed above for the access road, to protect the intertidal environment.

Construction of the both LWI abutments would disturb approximately 1.1 acre (0.44 hectare) of land and would require excavation of approximately 6,245 cubic yards (4,775 cubic meters) of soil and fill of 6,966 cubic yards (5,326 cubic meters). The staging area for both LWI construction sites would be a 5.4-acre (2.2-hectare) site near the intersection of Archerfish and Seawolf Roads (Figure 2–1), which is not near the LWI project sites. This highly disturbed site has been used in staging for other construction projects and, therefore, is not counted in the totals above. The staging area would be used for storing construction equipment, tools, and vehicles as well as for stockpiling excess soil, if needed. Soil may be segregated at the staging area, depending on origin. This staging area is not adjacent to streams or wetlands. The construction staging area is situated on soils underlain by Qvt, consisting of sandy, gravely silt. This material is expected to be moderately well-drained and prone to minor perching water. Similar to above, the staging area is not located in an area of known landsliding, slumping, or other erosive elements. Erosion during usage of the construction staging area would be minimal, and BMPs would be employed as needed to control erosion and sedimentation, as listed above, and to provide additional protection of streams and wetlands in the vicinity. Plastic coverings or spraying water on the stockpiled, excavated material would be used to minimize windblown dust.

Together, the two abutments would create 0.12 acre (0.048 hectare) of new impervious surface, plus an additional 0.1 acre (0.04 hectare) of permanent pervious surface such as aggregate pathways. The abutment stair landings would lie below the intertidal zone as represented by MHHW, and construction would require excavation below MHHW. Abutment work would be conducted at low tide and therefore "in the dry." Beach contours would be returned to pre-construction conditions following construction. To allow construction of the LWI abutments, shoreline soil would be excavated to an approximate 45 degree slope down to the MHHW at each project site. The excavated soil would be hauled off site and temporarily stockpiled in the staging area. Temporary erosion controls and BMPs would be utilized to prevent erosion and runoff from the excavated area and to protect the intertidal environment. Once the abutments are built, mechanically stabilized earth would be used to fill the gap from the excavated shoreline. If the excavated material meets compaction requirements, it would be used for backfill on the landward side of the new abutments. Material that cannot be used would be replaced with new backfill material that would be brought on site. Clearing, grading, excavation, filling, and hauling of this material would have the potential to cause soil erosion and sedimentation. However, the access road and stormwater BMPs discussed below would minimize offsite impacts.

No hazardous waste sites or other contaminated soil have been identified in or near the LWI upland project areas (Navy 2005). Therefore, no known impacts exist as a result of handling contaminated soil. SPCC regulations would require that secondary containment be provided for containers and tanks used to store petroleum products, which would also be protective of potential spills in the construction staging area.

Clearing and grading of land in the north and south LWI upland project areas for construction purposes and vehicle travel would disturb soils and create the potential for runoff to cause increased turbidity and sedimentation in nearby drainages and in the intertidal environment. In the north LWI upland project area, intermittent Stream N lies to the north of the project activities and would not be directly affected by them. In the south LWI upland project area, construction activities could potentially affect Stream A, which discharges into Hood Canal near where the abutment structure would be located. Permanent Stream A1, which discharges into Devil's Hole, is away from the project site and is not anticipated to be affected by construction of the abutment. During construction, BMPs would be implemented along the access roads and in the staging area to control runoff and sedimentation and to minimize the impact on surface water, per the *Stormwater Management Manual for Western Washington* (WDOE 2014). A SWPPP would be developed for this purpose and to specify other procedures to protect surface water bodies. Measures to control stormwater could include installation of a temporary runoff capture and discharge system and installation of temporary siltation barriers, such as straw wattles, below the excavation/construction zone. Any potential fluid spills or leakage from vehicles or equipment onto soil would be handled in accordance with Navy spill response plans.

Construction BMPs would be implemented to prevent indirect impacts on wetlands. BMPs for surface drainage, such as culverts and weep pipes, may be necessary to allow surface water flow and to divert any seepage. BMPs for clearing, grading, and maintenance would be employed as needed to control erosion and sedimentation, including the possible use of benched surfaces, down drain channels, diversion berms and ditches, erosion control blankets or turf reinforcement mats, plastic coverings, silt fences and check dams, and straw bales.

Construction of the LWI abutments at each site would require excavation of sediment/soil at and near the beach. BMPs for earthmoving and hauling activities, as listed above, would be implemented to reduce impacts in the intertidal environment. Based on the above analysis and utilization of BMPs and other measures in the SWPPP, potential construction impacts on geology, soils, and water resources for intertidal and upland activities would be minimal.

Construction and the slight increase in impermeable surface area in the LWI upland project areas near the shore would not impact groundwater recharge, as most of this area lies in a groundwater discharge zone. The relatively small footprint of the impervious abutment would also not affect groundwater recharge. The BMP and SPCC controls discussed above would be protective of water quality for dissolved constituents, and groundwater quality would not be impacted by construction activities. No groundwater contaminant plumes have been identified in the LWI upland project areas.

OPERATION/LONG-TERM IMPACTS

After construction of the LWI abutments is complete, the areas that were cleared of vegetation for access to the abutment sites would be revegetated and periodically maintained, as described in Section 3.6.1.2. The revegetation of the area surrounding the roadway and the construction of the abutment would protect against erosion or other soil movement in this vicinity. Stormwater structures and utilities for permanent facilities would be operated using BMPs to prevent soil erosion and any surface water contamination. Drainage structures along the margins of the access roads would remain in place to control runoff. Maintenance of the upland LWI abutment structures would include routine inspections, repair, replacement of facility components, as required, and maintenance of vegetation, but no significant construction activities. Thus, potential long-term impacts on geology, soils, and water resources in the staging area, the abutment areas, and the area surrounding the access roads due to long-term operation of Alternative 2 would be minimal.

The initial LWI design considered a predicted seismic ground acceleration for both 50 percent and 10 percent probabilities of exceedance in 50 years (PGAs of 0.17 g and 0.34g). Considering the low liquefaction and related seismic instability potential, the impact on LWI structures due to seismic risk would be low (Shannon & Wilson 2012).

The upland area of the LWI facilities lies above the base flood elevation of 10 feet (3 meters) that is defined for the adjacent Hood Canal shoreline (National Flood Insurance Program 1980) and would not be impacted by coastal flooding. Although tsunami impact heights are uncertain for Hood Canal, a maximum of 10 to 15 feet (3 to 5 meters) might be expected, which could potentially cause erosion or minor damage to the LWI upland facilities depending on tidal levels (Section 3.7.1.1.4, under Tsunami Hazards). However, the anchored and reinforced concrete LWI abutment structure near the water would be designed to withstand high water-level situations and would not be expected to be impacted by a tsunami or flooding (see also Section 3.1.1.1.1, under Bathymetric Setting). In addition, the overall potential for a tsunami to occur on NAVBASE

Kitsap Bangor is considered very small (Gottlieb 2010; Moffatt & Nichol 2011). Therefore, potential long-term impacts on the intertidal zone associated with the abutment, which would protect against erosion or other soil movement, would be minimal.

3.7.2.2.3. LWI Alternative 3: PSB Modifications (Preferred)

For geology, soils, and water resources, upland features of Alternative 3 are similar to those of Alternative 2. The two onshore observation posts would not increase the total area disturbed beyond that described for Alternative 2. Installation of the third observation post on Marginal Wharf would involve trenching through existing roadway; no new area would be disturbed. Implementation of BMPs would prevent adverse impacts. Impacts on these resources from long-term operation would be the same for both alternatives.

3.7.2.2.4. Summary of LWI Impacts

Impacts on geology, soils, and water resources associated with the construction and operation phase of the LWI project alternatives, along with mitigation measures and consultation and permit status, are summarized in Table 3.7–1.

Table 3.7–1. Summary of LWI Impacts on Geology, Soils, and Water Resources

Alternative	Environmental Impacts on Geology, Soils, and Water Resources
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Piers	*Construction:* Temporary disturbance of a total of 1.1 acre (0.44 hectare). This temporary disturbance would be due to site clearing, grading, hauling, excavation and filling. There would be potential for soil erosion, runoff to surface water, and sedimentation. Construction BMPs used to control erosion and sedimentation to protect surface waters and intertidal area. Stormwater BMPs and SWPPP would be used to protect surface waters including wetlands. Permanent disturbance of shoreline geology and soils to construct abutment including excavation and filling. Abutment work would be conducted at low tide and therefore “in the dry.” Beach contours would be returned to pre-construction conditions following construction. Construction BMPs would minimize erosion and sedimentation, and final design would stabilize and protect shoreline from erosion, flooding, and tsunamis. Potential impacts on geology, soils, and water resources in the intertidal and upland areas from construction would be minimal. *Operation/Long-term Impacts:* Construction staging area and areas that were disturbed for access to the abutment sites would be revegetated and periodically maintained. Minimal new impervious surfaces totaling 0.12 acre (0.048 hectare). The revegetation of the area surrounding the temporary access roadway and the construction of the abutment would protect against erosion or other soil movement in this vicinity. Drainage structures along the access roads would remain in place to control runoff, and stormwater utilities and BMPs would handle soil erosion and surface water contamination. Maintenance of the upland LWI abutment structures would include routine inspections, repair, replacement of facility components, as required, and maintenance of vegetation, but no significant construction activities. Design of structures would consider seismic impacts. Potential impacts on geology, soils, and water resources in the intertidal and upland areas from long-term operations would be minimal.

Table 3.7–1. Summary of LWI Impacts on Geology, Soils, and Water Resources (continued)

Alternative	Environmental Impacts on Geology, Soils, and Water Resources
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* Same as Alternative 2. Temporary disturbance of a total of 1.1 acre (0.44 hectare) of soils. This temporary disturbance would be due to site clearing, grading, hauling, excavation, and filling. There would be potential for soil erosion, runoff to surface water, and sedimentation. Construction BMPs used to control erosion and sedimentation to protect surface waters and intertidal area. Stormwater BMPs and SWPPP would be used to protect surface waters including wetlands. Permanent disturbance of shoreline geology and soils to construct abutment including excavation and filling. Abutment work would be conducted at low tide and therefore "in the dry." Beach contours would be returned to pre-construction conditions following construction. Construction BMPs would minimize erosion and sedimentation, and final design would stabilize and protect shoreline from erosion, flooding, and tsunamis. Potential impacts on geology, soils, and water resources in the intertidal and upland areas from construction would be minimal. *Operation/Long-term Impacts:* Same as Alternative 2. Areas that were disturbed for access to the abutment sites would be revegetated and periodically maintained. Minimal new impervious surfaces totaling 0.12 acre (0.048 hectare). The revegetation of the area surrounding the temporary access roadway and the construction of the abutment would protect against erosion or other soil movement in this vicinity. Drainage structures along the access roads would remain in place to control runoff, and stormwater utilities and BMPs would handle soil erosion and surface water contamination. Maintenance of the upland LWI abutment structures would include routine inspections, repair, replacement of facility components, as required, and maintenance of vegetation, but no significant construction activities. Design of structures would consider seismic impacts. Potential impacts on geology, soils, and water resources in the intertidal and upland areas from long-term operations would be minimal.
Mitigation: With implementation of the proposed BMPs and current practices, and permitting requirements, construction of the LWI Alternative would not adversely affect geology, soils, and water resources, and additional mitigation measures would not be necessary.	
Consultation and Permit Status No consultations or permits are required for Geology and Soils. The Navy submitted a JARPA to USACE and other regulatory agencies, requesting permits under CWA Sections 401, 402, and 404. Alternative 3 is the Least Environmentally Damaging Practicable Alternative according to the CWA Section 404(b)(1) guidelines. In accordance with the CZMA, the Navy submitted a CCD to WDOE for construction in the coastal zone.	

BMP = best management practice; CCD = Coastal Consistency Determination; CWA = Clean Water Act; CZMA = Coastal Zone Management Act; JARPA = Joint Aquatic Resources Permit Application; sq ft = square foot; sq m = square meter; SWPPP = Stormwater Pollution Prevention Plan; USACE = U.S. Army Corps of Engineers; WDOE = Washington Department of Ecology

3.7.2.3. SPE PROJECT ALTERNATIVES

3.7.2.3.1. SPE ALTERNATIVE 1: NO ACTION

Under the SPE No Action Alternative, the SPE and upland structures would not be constructed. There would be no construction or operation-related activities that would directly or indirectly result in ground disturbance or erosion affecting soils or water resources. Therefore, there would be no impact on geology, soils, or water resources due to the SPE No Action Alternative.

3.7.2.3.2. SPE Alternative 2: Short Pier (Preferred)

CONSTRUCTION

Offshore construction activities and facilities at the SPE project site may include in-water extension of the Service Pier, a pier crane, and addition of a Pier Services and Compressor Building on the pier. No shoreline construction is proposed. Onshore or upland construction activities and facilities would include a contractor staging (laydown) area, ground clearing, excavation, filling, road work, concrete work for the Waterfront Ship Support Building, and a 421-car parking lot.

All new SPE facilities would be built to meet requirements of the WDOE *Stormwater Management Manual for Western Washington* (WDOE 2014) and EISA. Upland clearing and grading for vegetation removal and development of building, parking, and road facilities would disturb soils and create the potential for erosion and runoff during storm events. The parking lot and construction laydown area for the SPE project would be located within a vegetated area and would require clearing. A total of approximately 11 acres (4.5 hectares) would be cleared for this alternative. Of this total, 7 acres (2.8 hectares) would be permanently occupied by the new paved parking lot and road improvements. Approximately 2 acres (0.8 hectare) would be temporarily disturbed for development of the laydown area, while an additional 2 acres (0.8 hectare) would be temporarily disturbed for general construction purposes; these 4 acres (1.6 hectares) would be revegetated with native forest species following construction. The new parking lot would require removal of approximately 11,100 cubic yards (8,490 cubic meters) of top soil, followed by a cut-to-fill quantity of approximately 14,500 cubic yards (11,100 cubic meters). Road improvements would require removal of approximately 22,230 cubic yards (17,000 cubic meters) of soil. Construction of the Waterfront Ship Support Building and some road work would require installation of retaining walls. Roadside utility improvements along Sealion Road and Sturgeon Street would include installation of duct banks for communication and stormwater piping.

Soil types in the SPE upland project area would not be highly erosive. However, temporary and long-term controls of soil erosion and runoff would be in place as BMPs for earthmoving and hauling activities. Construction BMPs for clearing, grading, hauling, maintenance, and other activities would be employed as needed to control erosion and sedimentation. These measures include: diversion berms and interceptor ditches on both sides of the roadways, sediment traps outfitted with rock check dams and stand pipes, straw bale barriers on the sides of roads, erosion control blankets or turf reinforcement mats, and silt fences along the sides of roads. Water-spraying on soil would be used to control dust generation during earthmoving and hauling activities during dry periods. Any potential fluid spills or leakage from vehicles onto soil would be cleaned up immediately, in accordance with the spill response plan. Therefore, potential impacts on geology resources for this alternative during upland construction would be minimal.

The construction laydown/staging area at the SPE project site would be located east of the proposed parking lot, while the SPE and new parking lot construction are undertaken. The laydown area would be used for storing construction equipment, tools, materials, and vehicles as well as for stockpiling excess soil, if needed. Soil may be segregated at the laydown area, depending on origin. After the SPE and the new parking lot construction are completed, the

Waterfront Ship Support Building would be constructed at the site of the existing parking lot. This proposed building site has a slightly steeper slope than the proposed parking structure location, but would be constructed entirely on the pre-existing parking lot, which would minimize site clearing and potential soil erosion. These sites are all situated on soils underlain by Qvt, consisting of sandy, gravely silt (Figure 3.7–2). This material is expected to be moderately well-drained. The proposed upland facilities would not be located in areas of known landsliding, slumping, or other erosive elements, to the extent practicable. Erosion during development would be minimal, and BMPs would be employed as needed to control erosion and sedimentation, as listed above, and more specifically to protect streams and wetlands. Plastic coverings or spraying water on the stockpiled, excavated material would be used to minimize windblown dust.

One potentially hazardous waste site, OU 7 Site 4, with possible ordnance disposal at Carlson Spit, was identified near the SPE upland project area (URS 1996; Navy 2005) (Figure 3.7–5). However, the OU 7 risk assessment concluded that conditions at Site 4 pose no unacceptable risks to human health (under an unrestricted use scenario) or the environment, and no remedial action was required. Therefore, no known impacts exist as a result of handling contaminated soil. SPCC regulations would require that secondary containment be provided for containers and tanks used to store petroleum products, which would also be protective of potential spills in the construction staging area. Therefore, potential impacts on soil resources for this alternative during upland construction would be minimal.

Clearing and grading of land in the SPE upland project area for construction purposes and vehicle travel would disturb soils and create the potential for runoff to cause increased turbidity and sedimentation in nearby drainages and in the intertidal environment. During construction, BMPs would be implemented along the access roads and in the laydown area to control runoff and sedimentation and to minimize the impact on surface water, per the *Stormwater Management Manual for Western Washington* (WDOE 2014). A SWPPP would be developed for this purpose and to specify other procedures to protect surface water bodies. Measures to control stormwater could include installation of a temporary runoff capture and discharge system and installation of temporary siltation barriers, such as straw wattles, below the excavation/construction zone. Any potential fluid spills or leakage from vehicles or equipment onto soil would be cleaned up immediately, in accordance with Navy spill response plans. Stormwater runoff from the existing Service Pier would continue to be collected in the collection system and pumped to the retention pond in the Devil's Hole drainage basin (Navy 2009a).

Construction BMPs would be implemented to prevent indirect impacts on wetlands. BMPs for surface drainage, such as culverts and weep pipes, may be necessary to allow surface water flow and to divert any seepage. BMPs for clearing, grading, and maintenance would be employed as needed to control erosion and sedimentation, including the possible use of benched surfaces, down drain channels, diversion berms and ditches, erosion control blankets or turf reinforcement mats, plastic coverings, silt fences, check dams, and straw bales. Therefore, potential impacts on surface water resources for this alternative during upland construction would be minimal.

Construction and the increase in impermeable surface area in the SPE upland project area near the shore would not impact groundwater recharge, as most of this area lies in a groundwater discharge zone. The BMP and SPCC controls discussed above would be protective of water quality for dissolved constituents, and groundwater quality would not be impacted by construction activities. No groundwater contaminant plumes have been identified in the SPE upland project area.

OPERATION/LONG-TERM IMPACTS

Currently, stormwater runoff from the Service Pier is collected and pumped to an existing retention pond in the Devil's Hole drainage basin. Under Alternative 2, this conveyance would continue as before, but stormwater runoff from the SPE would be collected in a trench drain on the pier, treated with an on-pier canister system, and discharged to Hood Canal. This system would operate to treat potential contaminants resulting from routine vehicle use on the pier extension, and would be designed to meet the basic treatment requirements of the WDOE Stormwater Management Manual for Western Washington, and then discharged in accordance with an NPDES permit. In addition, SPCC regulations would require that secondary containment be provided for containers and tanks used to store petroleum products on the SPE and the Pier Services and Compressor Building, which would also be protective of potential spills in the area. Therefore, potential long-term impacts on the intertidal zone associated with the SPE and facilities under this alternative would be minimal.

Any SPE upland project construction areas that would be cleared of vegetation and not developed would be revegetated and periodically maintained, as described in Section 3.6.1.2. The revegetation of areas surrounding new roadways and the parking lot and in the temporary laydown area would protect against erosion or other soil movement in this vicinity. Stormwater structures and utilities for permanent facilities would be operated using BMPs to prevent soil erosion and any surface water contamination. Drainage structures along the margins of the access roads would remain in place to control runoff, and new stormwater conveyance structures would be installed in the parking lot area. The design of the new SPE parking areas, roadways, and building site would follow the DoD's United Facilities Criteria guidelines for low-impact development and would include water quality enhancements and onsite infiltration to the greatest extent feasible. The parking lot would be subdivided into three drainage areas, and would be terraced and graded so that runoff would sheet-flow into landscape areas between the parking rows. These landscape areas would be designed as bioretention trenches, with amended soil placed in the upper layers to filter stormwater and underdrains at the trench bottoms to collect water that cannot infiltrate. The underdrains would convey excess water to the lower edges of the parking lots and would utilize level spreaders that allow sheet flow into the existing forest. During very large storm events, an emergency overflow system would bypass the level spreaders and connect to the roadside ditch along Sealion Road, which discharges to Hood Canal. Maintenance of these storm drain structures would include routine inspections, repair, replacement of components, as required, and maintenance of vegetation, but no significant construction activities.

The initial design for SPE onshore structures considered a predicted seismic ground acceleration for both 10 percent and 2 percent probabilities of exceedance in 50 years (PGAs of 0.31 and 0.53g). The initial design for SPE beach and pier structures considered a seismic predicted ground acceleration for both 50 percent and 10 percent probabilities of exceedance in 50 years (PGAs of 0.11 g and 0.31 g). Considering the low liquefaction and related seismic instability potential, the impact on LWI structures due to seismic risk would be low (Shannon & Wilson 2013).

Facilities in the SPE upland area lie above the base flood elevation of 10 feet (3 meters) that is defined for the adjacent Hood Canal shoreline (National Flood Insurance Program 1980) and would not be impacted by coastal flooding. Although tsunami impact heights are uncertain for Hood Canal, a maximum of 10 to 15 feet (3 to 5 meters) might be expected, which could potentially cause erosion or minor damage to the SPE upland Waterfront Ship Support Building and the emergency generator facility, depending on tidal levels (Section 3.7.1.1.4, under Tsunami Hazards). However, the overall potential for a tsunami to occur at NAVBASE Kitsap Bangor is considered very small (Gottlieb 2010; Moffatt and Nichol 2011). Thus, potential impacts on geology, soils, and water resources in the upland parking lot and access road, and the area surrounding the Waterfront Ship Support Building and emergency generator facility, due to long-term operation of SPE Alternative 2, would be minimal.

3.7.2.3.3. SPE Alternative 3: Long Pier

CONSTRUCTION

The offshore construction activities and facilities for SPE Alternative 3 would consist of similar structures and construction and operation activities as for SPE Alternative 2, except that a longer extension would be constructed for the Service Pier and the wave attenuation system would be connected to the end of the pier instead of located under it. This difference in design and construction may affect the potential marine and airborne noise resource impacts, but potential impacts on geology, soils, and water resources would be the same as described for SPE Alternative 2.

The upland portion of SPE Alternative 3 would consist of the same structures and construction activities as for SPE Alternative 2. Therefore, potential impacts on geology, soils, and water resources would be the same as described for SPE Alternative 2.

OPERATION/LONG-TERM IMPACTS

The offshore and upland operations activities for SPE Alternative 3 would be essentially the same as for SPE Alternative 2. Therefore, potential impacts on geology, soils, and water resources would be the same as described for SPE Alternative 2.

3.7.2.3.4. Summary of SPE Impacts

Impacts on geology, soils, and water resources associated with the construction and operation phase of the SPE project alternatives, along with mitigation measures and consultation and permit status, are summarized in Table 3.7–2.

Table 3.7–2. Summary of SPE Impacts on Geology, Soils, and Water Resources

Alternative	Environmental Impacts on Geology, Soils, and Water Resources
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	*Construction:* No shoreline construction is proposed. New facilities to be built would meet requirements of WDOE Stormwater Management Manual and EISA. New project elements would occupy 7 acres (2.8 hectares). Additional temporary upland disturbance of soils of approximately 4 acres (1.6 hectares) results from site clearing, grading, hauling, excavation and filling for the parking lot, and the Waterfront Ship Support Building. Potential exists for soil erosion, runoff to surface water, and sedimentation. Construction BMPs and SWPPP used to control erosion and sedimentation to protect surface waters including wetlands and intertidal area. The project construction sites would not be located in areas of known landsliding, slumping, or other erosive elements, to the extent practicable. Potential impacts to geology, soils, and water resources in the upland area from construction would be minimal. *Operation/Long-term Impacts:* Stormwater runoff from the SPE would be collected and treated in an online canister system prior to discharging to Hood Canal in accordance with an NPDES permit. Secondary containment for containers and tanks used to store petroleum products on the SPE and the Pier Services and Compressor Building would be protective of potential spills in the area. Long-term impacts on the intertidal zone would be minimal. Construction sites and areas that were disturbed for access to the construction sites would be revegetated and periodically maintained. New impervious surfaces of approximately 7 acres (2.8 hectares); stormwater BMPs would protect water quality. The revegetation of the area surrounding the new structures would protect against erosion or other soil movement. Drainage structures along the margins of the access roads would remain in place to control runoff, and stormwater utilities and BMPs would handle soil erosion and surface water contamination. Design of structures would consider seismic impacts. Potential impacts on geology, soils, and water resources in the upland area from long-term operations would be minimal.
SPE Alternative 3: Long Pier	*Construction:* Same as Alternative 2. No shoreline construction is proposed. New facilities to be built would meet requirements of WDOE Stormwater Management Manual and EISA. New project elements would occupy 7 acres (2.8 hectares). Additional temporary upland disturbance of soils of approximately 4 acres (1.6 hectares) results from site clearing, grading, hauling, excavation and filling for the parking lot, and the Waterfront Ship Support Building. Potential exists for soil erosion, runoff to surface water, and sedimentation. Construction BMPs and SWPPP used to control erosion and sedimentation to protect surface waters including wetlands and intertidal area. The project construction sites would not be located in areas of known landsliding, slumping, or other erosive elements, to the extent practicable. Potential impacts on geology, soils, and water resources in the upland area from construction would be minimal.

Table 3.7–2. Summary of SPE Impacts on Geology, Soils, and Water Resources (continued)

Alternative	Environmental Impacts on Geology, Soils, and Water Resources
SPE Alternative 3: Long Pier (continued)	*Operation/Long-term Impacts:* Same as Alternative 2. Stormwater runoff from the SPE would be collected and treated in an online canister system prior to discharging to Hood Canal in accordance with an NPDES permit. Secondary containment for containers and tanks used to store petroleum products on the SPE and the Pier Services and Compressor Building would be protective of potential spills in the area. Long-term impacts on the intertidal zone would be minimal. Construction sites and areas that were disturbed for access to the construction sites would be revegetated and periodically maintained. New impervious surfaces of approximately 7 acres (2.8 hectares); stormwater BMPs would protect water quality. The revegetation of the area surrounding the new structures would protect against erosion or other soil movement. Drainage structures along the margins of the access roads would remain in place to control runoff, and stormwater utilities and BMPs would handle soil erosion and surface water contamination. Design of structures would consider seismic impacts. Potential impacts on geology, soils, and water resources in the upland area from long-term operations would be minimal.
Mitigation: With implementation of the proposed BMPs and current practices, and permitting requirements, construction of the SPE Alternative would not adversely affect geology, soils, and water resources, and additional mitigation measures would not be necessary.	
Consultation and Permit Status No consultations or permits are required for Geology and Soils. The Navy will submit a JARPA to USACE and other regulatory agencies, requesting permits under CWA Sections 401 and 402. In accordance with the CZMA, the Navy will submit a CCD to WDOE for construction in the coastal zone.	

BMP = best management practice; CCD = Coastal Consistency Determination; CWA = Clean Water Act; CZMA = Coastal Zone Management Act; EISA = Energy Independence and Security Act; JARPA = Joint Aquatic Resources Permit Application; NPDES = National Pollutant Discharge Elimination System; SWPPP = Stormwater Pollution Prevention Plan; USACE = U.S. Army Corps of Engineers; WDOE = Washington Department of Ecology

3.7.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

Together, the LWI and SPE projects (both alternatives) would result in approximately 4.9 acres (2 hectares) of temporary surface disturbance, although revegetation with native species, stormwater controls, and other BMPs would minimize erosion and other impacts. There would be approximately 7.1 acres (2.9 hectares) of new impervious surface, for which stormwater controls would minimize impacts.

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3.8. LAND USE AND RECREATION

3.8.1. Affected Environment

Land use is the classification of either natural or human-modified activities occurring at a given location. Natural land uses include undeveloped coastlines, forested areas, or other natural open space. Human-modified land uses include developed land (such as residential, commercial, industrial, recreational, or other developed areas). Land uses are often regulated by management plans, policies, regulations, and ordinances (e.g., zoning) that determine the type and extent of land use allowable in specific areas and protect specially designated or environmentally sensitive areas.

3.8.1.1. EXISTING CONDITIONS

Land use surrounding NAVBASE Kitsap Bangor is mostly rural residential with some small pockets of more dense residential development and forest. Land use on NAVBASE Kitsap Bangor is a mix of natural areas and open space, residential and transient housing, industrial facilities, administration offices, and military uses related to support and operations of submarines. The waterfront area consists of wharves, piers, and laydown areas for temporary equipment and construction, in addition to docking facilities. A military security buffer zone (closed to public access) is located across Hood Canal on Toandos Peninsula (Figure 3.8–1). Recreational uses on NAVBASE Kitsap Bangor include pedestrian and bicycle trails and indoor and outdoor facilities (such as gyms, hardcourts, and playfields). Water-based recreation opportunities exist off base and include sea kayaking, fishing, boating, shellfish harvesting, and sightseeing. The Final Kitsap County Comprehensive Plan and Development Regulation Amendments has designated NAVBASE Kitsap Bangor as military land use (Kitsap County 2012a).

3.8.1.1.1. LAND USES

Comprising 7,149 acres, NAVBASE Kitsap Bangor is located approximately 20 miles (32 kilometers) west of Seattle and 3 miles (5 kilometers) northwest of Silverdale, Washington, in Kitsap County (Figure 3.8–1). Land uses surrounding NAVBASE Kitsap Bangor are generally semi-rural with pockets of residential development. Land uses adjacent to the base have been zoned by Kitsap County as Rural Residential (one development unit per 5 acres [2 hectares]), Rural Commercial, Public Facility, and Urban Industrial (Kitsap County 2012b, 2012c). Small unincorporated communities close to NAVBASE Kitsap Bangor include Vinland (located on the northern boundary of NAVBASE Kitsap Bangor) and Olympic View (located southeast of the base and along the coastal area bordering the western base boundary) (Figure 3.8–1). The closest incorporated city near NAVBASE Kitsap Bangor is Poulsbo, about 3 miles (4.8 kilometers) east of the base. Silverdale, which is unincorporated, lies a similar distance south of the base.

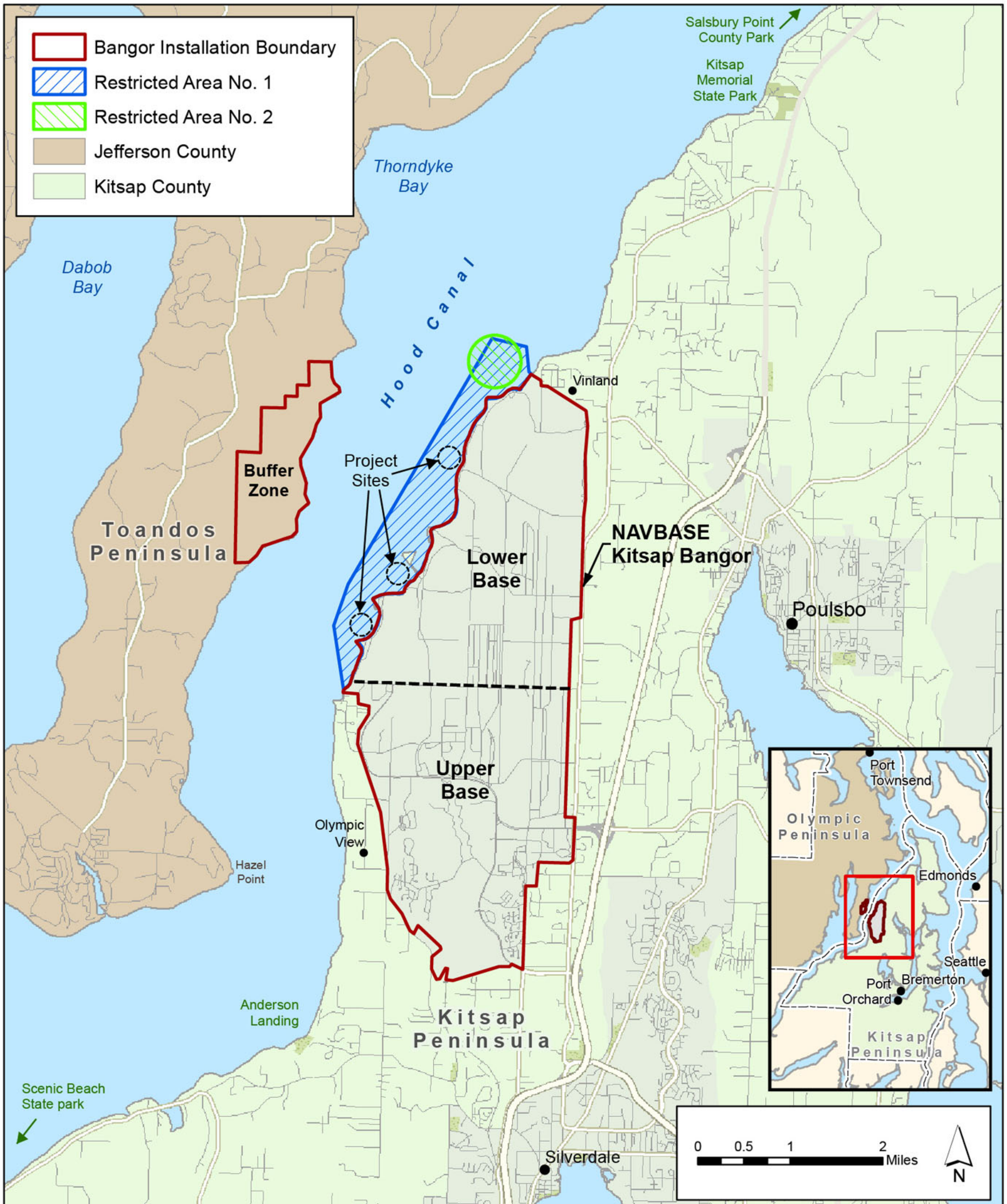

Figure 3.8–1. Communities and Public Use Areas in the Vicinity of NAVBASE Kitsap Bangor

NAVBASE Kitsap Bangor is entirely owned by the federal government and is divided into two major land-use sectors: Lower Base and Upper Base (Figure 3.8–1). The Lower Base contains most of the industrial facilities, the waterfront area, and maintenance and production facilities. The waterfront area at the Lower Base consists of wharves and docking facilities distributed along a 4-mile (6.4-kilometer) section of shoreline. These facilities include the EHW-1, Delta Pier, Marginal Wharf, Carderock Pier, Service Pier, KB Dock, and MSF. Base residential areas are located on Upper Base approximately 4 miles (6.4 kilometers) south of the proposed LWI and SPE structures.

West of the LWI and SPE sites, the Navy owns a 768-acre (311-hectare) buffer strip on the Toandos Peninsula that is closed to public access (Navy 2001) (Figure 3.8–1). The Toandos Peninsula is rural in character, and Jefferson County has designated this buffer zone as Military Reservation. Land use designations surrounding the buffer area are Rural Forest, Commercial Forest, and Rural Residential (one development unit per 5 acres [2 hectares] and one development unit per 20 acres [8 hectares]) (Jefferson County 2005). Washington State Parks manages 10,000 feet (3,048 meters) of shoreline at the southern tip of this peninsula for shellfish harvesting. The shellfish harvesting site is accessed by boat only; there is no upland access.

LAND USES NEAR THE LWI PROJECT SITES

The LWI sites are located along the eastern bank of Hood Canal within the Bangor waterfront (Figure 3.8–1). Hood Canal averages 1.5 miles (2.4 kilometers) in width adjacent to the LWI sites. Several large facilities in the direct vicinity of the LWI project sites are primarily industrial uses, such as the EHW-1, Delta Pier, and Marginal Wharf.

The north LWI project site lies within the north end of the main Bangor industrial waterfront. It is within Naval Restricted Area 1 (Chapter 1, Section 1.1), about 1.3 miles (2.1 kilometers) south of the northern installation boundary.

The south LWI project site lies within the Bangor industrial waterfront and is within Naval Restricted Area 1 about 2.7 miles (4.3 kilometers) south of the northern installation boundary. The south LWI project site is just north of a beach that has been designated for tribal shellfish harvesting. See Section 3.14 for information related to tribal shellfish harvesting.

The planned emphasis for the Lower Base is to directly support TRIDENT mission activities and other industrial-type uses. The existing land uses at the proposed LWI sites are consistent with the land use planning emphasis for this area of the installation (TRIDENT Joint Venture 1975).

LAND USES NEAR THE SPE PROJECT SITE

The SPE project site is located along the eastern bank of Hood Canal within the Bangor waterfront (Figure 3.8–1), approximately 0.6 mile (1 kilometer) north of the southern boundary of the base and 3.3 miles (5.4 kilometers) south of the northern boundary of the base. Areas south of the base are rural residential including the community of Olympic View. The western bank of Hood Canal, directly across from the SPE project site, is designated Rural Forest, Commercial Forest, and Rural Residential land uses (Jefferson County 2005); and the Navy-owned buffer strip on the Toandos Peninsula in Jefferson County (Navy 2001). The SPE project site lies within the Bangor industrial waterfront and Naval Restricted Area 1. Nearby facilities include the Carderock Pier and KB Dock.

3.8.1.1.2. RECREATION

Recreation opportunities have decreased on NAVBASE Kitsap Bangor since 2001 as a result of access restrictions developed for base security. NAVBASE Kitsap Bangor continues to provide some outdoor activities to military personnel, their families, and federal employees associated with the base; however, recreational activities are prohibited at the Lower Base. No hunting is allowed anywhere on base and no public shellfish harvesting is allowed along the Bangor waterfront. NAVBASE Kitsap Bangor is restricted from general public access.

Outside of NAVBASE Kitsap Bangor boundaries, Hood Canal provides water-based activities (such as fishing, sightseeing, shellfish harvesting, and other recreational activities). Sea kayaking and some scuba diving are also increasingly common ways for visitors to enjoy the scenic resources of the coastline. The closest sea kayak trail begins/ends at Kitsap Memorial State Park 5 miles (8 kilometers) north of NAVBASE Kitsap Bangor (Figure 3.8–1), runs north and around Kitsap Peninsula and ends/begins at Poulsbo (North Kitsap Trails Association 2012).

Public recreation areas in the vicinity of NAVBASE Kitsap Bangor include Kitsap Memorial State Park, Scenic Beach State Park (about 8 miles [13 kilometers] south of the base), and Salsbury Point County Park (about 7.4 miles [12 kilometers] north of the base). Currently, Washington State Parks has closed the sport clam and oyster fishing season at Kitsap Memorial and Scenic Beach State Parks until further notice due to the decline of shellfish populations (Washington State Parks 2012a, 2012b). The closest public water access site on the eastern shore of Hood Canal is Anderson Landing, about 3.5 miles (6 kilometers) south of the base (Figure 3.8–1). The closest boat launch is at Salsbury Point County Park, on Kitsap Peninsula just north of Hood Canal Bridge (Kitsap County Parks and Recreation 2011).

A floating security barrier prevents recreational and commercial boater access to the waterfront area of the base. Boaters must remain outside the security fencing and the Naval Restricted Areas (Chapter 1, Section 1.1).

RECREATION NEAR THE LWI PROJECT SITES

The LWI project sites are restricted from general public use as they are within the existing Naval Restricted Area 1. Therefore, there are currently no recreation uses on land near the LWI project sites. Recreational activities on the waters of Hood Canal are discussed above.

RECREATION NEAR THE SPE PROJECT SITE

The SPE project site is currently restricted from general public use as it is within the existing Naval Restricted Area 1. Therefore, there are currently no recreation uses on land near the SPE project site. Recreational activities on the waters of Hood Canal are discussed above.

3.8.1.2. CURRENT REQUIREMENTS AND PRACTICES

Under the doctrine of federal supremacy, the federal government is not subject to local or state land use or zoning regulations unless specifically consented to by Congress. The federal government takes state and local land use plans, guidelines, and ordinances into consideration and cooperates with agencies to avoid conflicts when possible. The applicable federal regulation for land use along the Bangor waterfront is the CZMA. However, the CZMA excludes federally owned and managed areas within the coastal zone, specifically military reservations and installations.

The Navy incorporates sustainable planning practices into facility planning, construction, and operations as required under various environmental laws and EOs. Specifically, Naval Facilities Instruction 11010.45, Regional Planning Instruction — Sustainable Planning, addresses general principles and guidance for sustaining compatible conditions through coordination with neighboring communities. Sustainable planning instructions include various strategies to meet goals embodied in federal laws and EOs and ensure long-term flexibility for supporting mission needs. To the extent practicable, NAVBASE Kitsap Bangor attempts to follow local policies (e.g., the Kitsap County Shoreline Management Master Program) by minimizing adverse impacts on water quality, sediment quality, shellfish, finfish, wildlife, boating, recreational and commercial fishing, public access, scenic vistas, and wetlands.

The Navy *Waterfront Functional Plan, 2009 Update* (Navy 2009c) focuses on waterfront activities and infrastructure in Navy Region Northwest. The plan develops a long-range improvement strategy that addresses operational shortfalls caused by facility inadequacies and reduces infrastructure by identifying excess assets. The LWI and SPE are appropriate infrastructure as described in the Navy *Waterfront Functional Plan*.

In 1975, the Navy prepared a *TRIDENT Support Site Master Plan* (TRIDENT Joint Venture 1975) for NAVBASE Kitsap Bangor "to identify the capital improvement projects necessary to meet mission requirements, and to recommend locations for future development which promote both optimum land utilization and the accomplishment of assigned missions." The plan was guided by objectives for the mission, traffic and circulation, community involvement, physical form, and environmental quality. The proposed plan addresses both the Lower and Upper Base, where a mixture of industrial, administrative, community, and residential uses were occurring, and identifies alternative layouts for arranging functional areas. The proposed plan for the Lower Base is in compliance with the Naval Ordnance Safety and Security Activity and DoD Explosives Safety Board requirements. The plan also contains recommendations and goals for organizing future development and siting new projects on the base. The plan identifies visual integration, provision of desirable buffers between various land uses, recreational amenities, and circulation as needing further consideration.

Pursuant to the Sikes Act, the Navy prepared an INRMP that provides policy goals for land use on NAVBASE Kitsap Bangor (Navy 2001). Land use goals include:

- Maintaining the grounds in an environmentally safe and sensitive manner that complements the military mission,
- Ensuring that multiple land uses are compatible,

- Applying land management practices consistent with the ecosystem management approach, and
- Making land available for non-military productive uses.

The INRMP also directs that future land development should occur in the following order of priority: (1) reconstruction, renovation, and rehabilitation of obsolete facilities; (2) development on previously disturbed grounds and military use areas where intensive development already exists; (3) undisturbed areas contiguous to developed areas; and (4) natural areas.

Aside from the plans and guidelines discussed above, no consultations or permits are required for land use and recreation resources. Noise regulations applicable to the Proposed Actions are discussed in Section 3.9.2.3.

3.8.2. Environmental Consequences

3.8.2.1. APPROACH TO ANALYSIS

The evaluation of impacts on land use considers a proposed action's compatibility with existing land use, adopted land use, and shoreline plans and policies.

The relative importance of land use impacts is based on the level of land use sensitivity in areas affected by the proposed action. In general, land use impacts would be adverse if they would: (1) be inconsistent or noncompliant with applicable land use plans and policies, (2) preclude the viability or use of the existing land, or (3) be incompatible with adjacent or vicinity land use to the extent that public health and safety is threatened.

3.8.2.2. LWI PROJECT ALTERNATIVES

3.8.2.2.1. LWI ALTERNATIVE 1: NO ACTION

Under the No Action Alternative, the LWI project would not be built and overall operations would not change from current levels. Therefore, there would be no impacts on land use and recreation.

3.8.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

Alternative 2 would be consistent with the NAVBASE Kitsap Bangor *TRIDENT Support Site Master Plan* and would not have a direct impact on adjacent land uses or recreation in the community of Vinland, the closest off-base residential area to the Proposed Action. Recreational users in the project vicinity would be affected by construction noise, especially pile driving noise. Noise impacts on residential areas are addressed in Section 3.9.

CONSTRUCTION

LAND USE

Under Alternative 2, construction would have no direct impact on land use. Proposed construction would not displace any adjacent land uses and is compatible with base plans. The commitment of land/water resources is consistent with the *TRIDENT Support Site Master Plan* (TRIDENT Joint Venture 1975) and the *Waterfront Functional Plan* update (Navy 2009c). This project would be consistent with the *TRIDENT Support Site Master Plan* goal of meeting the TRIDENT mission requirements. The staging area for both LWI construction sites would be a 5.4-acre (2.2-hectare) area near the intersection of Archerfish and Seawolf Roads (Figure 2–1), which is not near the LWI project sites. This area has been previously disturbed during earlier construction projects for staging and its use for the LWI project would be consistent with existing land use.

An indirect impact on land use would be noise from pile driving and other construction activities. The land uses with greatest noise impact have a direct line of sight to the impact pile driver and would receive noise levels above local background, including waterfront residences along Thorndyke Bay. However, at no time would vibratory pile driving noise exceed 60 dBA (the maximum daytime allowable noise level specified in WAC 173-3 60-040) at any off-base location. Implementing the mitigation to restrict the duration of construction activities from 10:00 p.m. to 7:00 a.m. would prevent any noise impacts on residential land uses at night.

RECREATION

No public recreational uses occur at either of the LWI project sites and construction would be conducted within Naval Restricted Area 1, which currently restricts public access; therefore, construction of Alternative 2 would have no direct impact on recreational uses or access in the community of Vinland and those that use Hood Canal for recreational activities.

Noise during construction, specifically from pile driving, would diminish qualities of tranquility and solitude that many persons seek while recreating in areas near the base. The noise levels on the western shore of Hood Canal would not exceed WAC-permissible exposure levels for residential areas and, therefore, would not have an adverse noise impact on recreation in this area. In addition, temporary construction noise between 7:00 a.m. and 10:00 p.m. are exempt from noise standards. Pile driving would not occur outside these hours. Those engaging in activities such as boating, scuba diving, kayaking, and fishing on Hood Canal adjacent to the base may be affected by pile driving noise, but the floating security barriers around Restricted Area 1 would prevent recreational users from getting too close to areas with potentially harmful noise levels. Pile driving would occur during the in-water work window starting July 15, during daylight hours, and would take up to 80 working days.

Waterfront construction and military activities are ongoing at NAVBASE Kitsap Bangor. While intermittent elevated noise can be expected during construction, the highest intensity noise would be limited to the immediate vicinity of the construction activities. Recreational divers would not use waters in the project area because of access restrictions associated with the WRA. Divers in waters farther away from the construction areas may experience temporarily elevated noise conditions, but levels are not expected to differ appreciably from the range of noise typically generated in the heavily used waters of Hood Canal.

The base is off limits to the general public, which provides separation between construction noise sources and the recreating public on land. Construction noise would have a localized, direct, and short-term adverse impact on the quality of recreational activities such as fishing, hiking, kayaking, walking along the beach, camping, and bird watching that benefit from quiet settings.

OPERATION/LONG-TERM IMPACTS

Alternative 2 would not change ongoing land uses nor displace any current uses, including recreational uses as the project sites are within an area that currently precludes public access. Indirect impacts such as noise generated by maintenance would be similar to current conditions and thus have no impact on recreation. Because there would be no change in operations, there would be no operational/long-term impacts on land use or recreation from the LWI project. Permanent structures would be consistent with existing structures and surrounding land uses.

3.8.2.2.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

Similar to LWI Alternative 2, Alternative 3 would also be consistent with the NAVBASE Kitsap Bangor *TRIDENT Support Site Master Plan* and would not have a direct impact on adjacent land uses or recreation in the community of Vinland, the closest off-base residential area to the Proposed Action.

CONSTRUCTION

LAND USE

Land use impacts from construction would be similar to those for LWI Alternative 2, except noise impacts would be less for Alternative 3 because of the shorter duration of pile driving (30 days versus 80 days). There would not be adverse noise impacts on residential areas (Section 3.9.3.2). The upland towers, observation posts, shoreline abutments, and upland staging area would be consistent with existing structures and surrounding land uses.

The abutments are the same as for LWI Alternative 2 and therefore would still be constructed and would use the same proposed staging area as for Alternative 2.

RECREATION

Recreational users in the project vicinity would be affected by construction noise, especially pile driving noise. LWI Alternative 3 differs from Alternative 2 in that there would be fewer piles, reduced duration of construction activities, and no in-water pile driving or impacts to scuba divers; therefore, the construction noise impact on recreation would be less than for Alternative 2. Noise impacts on residential areas are addressed in Section 3.9.3.

OPERATION/LONG-TERM IMPACTS

Because there would be no change in operations, there would be no operational/long-term impacts on land use or recreation from the LWI project. Permanent structures would be consistent with existing structures and surrounding land uses.

3.8.2.2.4. SUMMARY OF IMPACTS FOR LWI PROJECT ALTERNATIVES

Impacts on land use and recreation associated with the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.8–1.

Table 3.8–1. Summary of LWI Impacts on Land Use and Recreation

Alternative	Environmental Impacts on Land Use and Recreation
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Pier	*Construction:* Compatible with Navy *Waterfront Functional Plan* and *TRIDENT Support Site Master Plan*; temporary adverse localized noise impacts on recreational areas from pile driving. *Operation/Long-term Impacts:* No impact.
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* Compatible with Navy *Waterfront Functional Plan* and *TRIDENT Support Site Master Plan*; temporary adverse localized noise impacts as pile driving would occur (decrease in noise compared to Alternative 2 with a shorter construction duration and fewer piles, and no underwater noise impacts to scuba divers). *Operation/Long-term Impacts:* No impact.
Mitigation: The Navy would notify the public about upcoming construction activities and noise at the beginning of construction activities. Construction activities would not be conducted during the hours of 10:00 p.m. to 7:00 a.m.; in addition, pile driving would occur only during daylight hours. The Navy would request that the U.S. Coast Guard issue a Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity. Please see Appendix C (Mitigation Action Plan) for more detailed mitigation measures.	
Consultation and Permit Status: No consultations or permits are required.	

3.8.2.3. SPE PROJECT ALTERNATIVES

3.8.2.3.1. SPE ALTERNATIVE 1: NO ACTION

Under the No Action Alternative, the SPE would not be built and overall operations would not change from current levels. Therefore, there would be no impacts on land use and recreation.

3.8.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

Alternative 2 would be consistent with the NAVBASE Kitsap Bangor *TRIDENT Support Site Master Plan* and would not have a direct impact on adjacent land uses or recreation in the community of Olympic View, the closest off-base residential area to the Proposed Action. Recreational users in the project vicinity would be affected by construction noise, especially pile driving noise. Noise impacts are addressed in Section 3.9.

CONSTRUCTION

LAND USE

Under SPE Alternative 2, construction would have no direct impact on land use. Noise during construction, specifically from pile driving, would not exceed WAC-permissible exposure levels for nearby residential areas. In addition, temporary construction noise between the hours of 7:00 a.m. and 10:00 p.m. is exempt from the WAC limitations, and construction would not occur outside those hours. Nevertheless, pile driving noise would be audible in the community of

Olympic View, which would result in a temporary adverse effect on those distant residential areas. Noise levels in residential areas on the western shore of Hood Canal would be substantially lower than levels in Olympic View but would still be audible at times. The duration of pile driving would be no more than 161 days. Noise would be buffered through distance as well as by intervening mature forest and vegetation.

Proposed construction would not displace any adjacent land uses and is compatible with base plans. The commitment of land/water resources is consistent with the *TRIDENT Support Site Master Plan* (TRIDENT Joint Venture 1975) and the *Waterfront Functional Plan* update (Navy 2009c).

An indirect impact on land use would be noise from pile driving and other construction activities. The land uses with greatest noise impact include residential properties on the western shore of Hood Canal with a direct line of sight to the impact pile driver and would receive noise levels above local background. However, at no time would vibratory pile driving noise exceed 60 dBA (the maximum daytime allowable noise level specified in WAC 173-3 60-040). This would also be true when pile driving is occurring simultaneously at both the SPE and LWI project sites. Implementing the mitigation to restrict the duration of construction activities from 10:00 p.m. to 7:00 a.m. would prevent any noise impacts on residential land uses at night.

The potential staging area for construction would be located within the existing parking lot and at the site of the future Waterfront Ship Support Building, both of which are in the existing industrial area on the base.

RECREATION

There are currently no public recreational uses at or near the SPE project site; therefore, construction of SPE Alternative 2 would have no direct impact on recreational uses at or near the site, or on recreational access in the community of Olympic View.

The noise levels on the western shore of Hood Canal would not exceed WAC-permissible exposure levels for residential areas and, therefore, would not have an adverse noise impact on recreation in this area. Those engaging in activities such as boating, scuba diving, kayaking, and fishing on Hood Canal adjacent to the base may be affected by pile driving noise, but the floating security barriers around Naval Restricted Area 1 would prevent recreational users from entering the construction area. Pile driving would occur in daylight hours during two in-water work windows (July 15 to January 15), and would take no more than 161 days.

As described above for LWI Alternative 3, recreational divers are would not use waters in the immediate area because of access restrictions associated with the WRA. Divers in waters farther away from the construction areas may experience temporarily elevated noise conditions, but levels are not expected to differ appreciably from the range of noise typically generated in the heavily used waters of Hood Canal.

The base is off limits to the general public, which provides separation between construction noise sources and the recreating public. Construction noise would have a localized, direct, and short-term adverse impact on the quality of recreational activities such as fishing, hiking, kayaking, walking along the beach, camping, and bird watching that benefit from quiet settings.

OPERATION/LONG-TERM IMPACTS

SPE Alternative 2 would not change ongoing land uses or displace any current uses, including recreational uses. Indirect impacts, such as noise generated by maintenance, would be similar to current conditions and thus have no impact on recreation. The increase in operational activity would not impact land use or recreation in the long term, except that operational noise would be more constant, but not louder, than at present, and typical of general noise levels at this industrial waterfront. See Section 3.10 for a discussion of the impacts of light seen from the community of Olympic View.

3.8.2.3.3. SPE ALTERNATIVE 3: LONG PIER

SPE Alternative 3 differs from Alternative 2 in that the pier extension would be greater to accommodate two submarines berthed in an in-line configuration and the location extends more southwesterly than Alternative 2. Noise impacts on residential areas are addressed in Section 3.9.

CONSTRUCTION

LAND USE

Noise from construction of SPE Alternative 3 would have similar effects on residential areas as Alternative 2, but over a longer period (maximum of 205 days of pile driving as compared to 161 days for Alternative 2) during two in-water construction periods. Proposed construction would not displace any adjacent land uses and would be compatible with base plans.

RECREATION

SPE Alternative 3 would have no impact on access to recreation as the location of Alternative 3 is within an area that currently restricts public access. Recreational users in the project vicinity would be affected by both airborne and underwater construction noise, especially pile driving noise. The noise impacts on persons on the west bank of Hood Canal and on Hood Canal would be the same as Alternative 2, except pile driving would occur over a longer period of time, as the total number of piles would be greater than for Alternative 2. Noise during construction, specifically from pile driving, would diminish qualities of tranquility and solitude that many persons seek while recreating in areas of Hood Canal near the base.

OPERATION/LONG-TERM IMPACTS

Operational impacts would be the same as described above for SPE Alternative 2.

3.8.2.3.4. SUMMARY OF IMPACTS FOR SPE PROJECT ALTERNATIVES

Impacts on land use and recreation associated with the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.8–2.

Table 3.8–2. Summary of SPE Impacts on Land Use and Recreation

Alternative	Environmental Impacts on Land Use and Recreation
SPE Alternative 1: No Action	No impact
SPE Alternative 2: Short Pier (Preferred)	*Construction:* Compatible with Navy *Waterfront Functional Plan* and *TRIDENT Support Site Master Plan*; temporary adverse localized noise impacts on residential and recreational areas from pile driving (total maximum of 161 days). *Operation/Long-term Impacts:* No impact.
SPE Alternative 3: Long Pier	*Construction:* Compatible with Navy *Waterfront Functional Plan* and *TRIDENT Support Site Master Plan*; temporary adverse localized noise impacts on residential and recreational areas from pile driving. Noise from pile driving would last longer than Alternative 2 (total maximum of 205 days). *Operation/Long-term Impacts:* No impact.
Mitigation: The Navy would notify the public about upcoming construction activities and noise at the beginning of construction activities. Construction activities would not be conducted during the hours of 10:00 p.m. to 7:00 a.m.; in addition, pile driving would occur only during daylight hours. The Navy would request that the U.S. Coast Guard issue a Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity. Please see Appendix C (Mitigation Action Plan) for more detailed mitigation measures.	
Consultation and Permit Status: No consultations or permits are required.	

3.8.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

The LWI and SPE projects are localized and would follow the existing designated land use of the area, therefore having no combined impact on the existing land use. In addition, the LWI and SPE projects would minimally add to the density of the existing industrial development of the waterfront area.

Construction schedules for the LWI and SPE projects would not overlap and so would not have additive noise impacts. However, impacts from the two projects combined would extend over a period of up to four years, including up to 285 days of pile driving, compared to two years for each project alone. Each project could result in noise impacts to nearby residential and recreational areas. The most impacted community, Olympic View, would be affected by construction noise from the SPE project only: up to 205 days of pile driving over two years. Noise levels in both residential and recreational areas would not be sufficient to cause injury but could result in disturbance.

3.9. AIRBORNE ACOUSTIC ENVIRONMENT

Noise is defined as unwanted sound or, more specifically, as any sound that (1) is undesirable because it interferes with communication, (2) is intense enough to damage hearing, or (3) is otherwise annoying. Human and wildlife response to sound varies according to the type and characteristics of the noise source, distance between the noise source and the receptor, sensitivity of the receptor, local environmental or atmospheric conditions, and time of day. Sound levels are typically measured in decibels (dB). When discussing noise and humans, noise levels are expressed in terms of A-weighted decibel (dBA), which is a measure of sound energy adjusted for the sensitivities of human hearing, as discussed below. This section discusses airborne noise only. Underwater noise is discussed separately for biological resources in Section 3.3, Section 3.4, and Section 3.5. In addition, a detailed description of underwater sound propagation and airborne noise source levels is provided in Appendix D.

3.9.1. Sound Characteristics

3.9.1.1. SOUND FUNDAMENTALS

Due to wide variations in sound levels, measurements are in dB, which is a unit of measure based on a logarithmic mathematical scale (e.g., a 3 dB increase corresponds to a 100 percent increase in perceived sound). Airborne noise is commonly reported using dBA, which indicates the type of filtering used in the measurement. The purpose for using A-weighted levels is to assess impacts on human receptors and thus is filtered or "shaped" to correspond to how humans hear, in the frequency range of approximately 20 hertz (Hz) to 20 kilohertz (kHz). Sound levels used to assess impacts on wildlife are typically unfiltered. Unfiltered sound pressure levels (or SPLs) are designated as "unweighted." To make comparisons between sound levels, dB sound levels are always referenced to a standard intensity at a standard distance from the source. According to the USEPA (1974), under most conditions, a 5 dB change is necessary for noise increases to be noticeable to humans. Airborne noise levels are expressed in decibels relative to a sound pressure level of 20 micropascals (dB re 20 μPa). Noise is related to the energy level of the sound waves emanating from a source. For many sources, such as construction, the energy level fluctuates over time. To address this variability, sound levels are typically measured as the average energy level over a given time period (Leq metric), which represents the average energy per unit of time that would result in the same total energy over the same time period (one hour is the standard period).

3.9.1.2. SOUND PROPAGATION

Construction noise behaves as a point-source and thus propagates in a spherical manner (that is, equally in all directions) when unobstructed, with a 6 dB decrease in sound pressure level per doubling of distance (WSDOT 2013). Structures, vegetation, and topographic conditions can affect how sound propagates through the air and act to reflect, absorb, or otherwise scatter sound energy. Two specific noise conditions exist at the LWI and SPE project sites, namely propagation over water to the west side of Hood Canal and propagation over heavily vegetated terrain on the east side of Hood Canal. In the first condition, propagation over water is considered a "hard-site" condition (WSDOT 2013); thus, no additional noise reduction factors apply. However, in the second condition two noise reduction factors apply for the topography of the sites. The first of these is a 7.5 dB loss factor per doubling of distance in "soft-site" conditions, wherein normal, unpacked earth is the predominant soil condition. The second factor is a reduction of 10 dB for interposing dense vegetation, e.g., trees and brush, between the noise source and potential receptors. Prevailing atmospheric conditions can also affect how sound propagates in air, including wind speed, direction, air temperature, and humidity; these factors are not accounted for in the present analysis because they are variable.

3.9.1.3. NOISE-RELATED ENVIRONMENTAL STRESSORS

Ambient noise levels are made up of natural and manmade sounds. Natural sound sources include wind and precipitation, water movement such as surf and wind-generated wave noise, and wildlife. Sound levels from these sources are typically low to moderate, but can be pronounced during violent weather events. Sounds from natural sources are not considered undesirable.

The majority of the daily ambient sound on NAVBASE Kitsap Bangor that is considered noise is generated by human activities. These activities include movement of marine vessels and heavy trucks; operation of equipment (such as cranes, forklifts, and other mechanized equipment); various industrial activities occurring at the shoreline and upland facilities; and general traffic.

3.9.2. Affected Environment

3.9.2.1. EXISTING CONDITIONS

Ambient background noise in urbanized areas typically varies from 60 to 70 dBA. Cavanaugh and Tocci (1998) measured typical residential noise at 65 dBA. Noise levels on NAVBASE Kitsap Bangor vary based on location, but the minimum daytime average levels are estimated to average around 65 dBA in the residential and office park areas, as described in the literature (Cavanaugh and Tocci 1998). Residential and office park areas are located more than one mile from the LWI and SPE project sites and are acoustically screened from the project sites by hills and vegetation. Traffic on the roads is expected to produce levels between 60 and 72 dBA during daytime hours (WSDOT 2013); speeds on NAVBASE Kitsap Bangor are limited to 35 to 40 miles per hour (mph) (56 to 64 kilometers per hour, or kph) on arterials and 25 mph (40 kph) on secondary streets.

Under spherical spreading conditions, sound pressure levels from a point source decrease by 6 dB for every doubling of distance from the source (i.e., the sound level at 100 feet [30 meters] from a source would be one half the level at a distance of 50 feet [15 meters]). Thus, the loudest areas on the base would be along the waterfront and at the ordnance handling areas where most of the activity is taking place, such as near EHW-1 and Delta Pier. Airborne noise measurements were taken from October 19–20, 2010, within the waterfront industrial area near the project sites. During this period, daytime noise levels ranged from 60 to 104 dBA, with average values of approximately 64 dBA. Evening and nighttime levels ranged from 55 to 96 dBA, with an average level of approximately 64 dBA. Thus, daytime maximum levels were higher than nighttime maximum levels, but average nighttime and daytime levels were similar (Navy 2010). These measured noise levels are applicable to the LWI and SPE sites, which are located within the industrial waterfront at NAVBASE Kitsap Bangor. Note that an average sound pressure level is equivalent to the single level over the average time period that would contain the same total sound energy as all of the sound levels combined in that time period.

Higher noise levels are produced by a combination of sound sources including heavy trucks, forklifts, cranes, marine vessels, mechanized tools and equipment, and other sound-generating, industrial/military activities. This section discusses airborne noise only, and noise measurements are not corrected for atmospheric factors as described above unless specifically indicated. Modeling of underwater and airborne noise is detailed in Appendix D.

3.9.2.2. SENSITIVE RECEPTORS

A human sensitive noise receptor is defined as a location or facility where people involved in indoor or outdoor activities may be subject to stress or considerable interference from noise. Such locations or facilities often include residential dwellings, hospitals, nursing homes, educational facilities, and libraries. Wildlife noise receptors, including nest sites and mammal haul-out sites, are addressed in Sections 3.4, 3.5, and 3.6. On-base residential areas and daycare facilities are located several miles inland from the proposed project sites, too far to be affected by project-generated noise.

3.9.2.2.1. Sensitive Noise Receptors Near the LWI Project Sites

The nearest sensitive human noise receptors include schools and residences. Vinland Elementary School is located approximately 2 miles (3.2 kilometers) east of the north LWI project site, and Breidablik Elementary School is located approximately 4 miles (6.4 kilometers) northeast of the project site. Other sensitive noise receptors include residences in Vinland located just north of the NAVBASE Kitsap Bangor northern property boundary, approximately 1.5 miles (2.4 kilometers) from the LWI project site and residences on the west side of Hood Canal, notably in the vicinity of Thorndyke Bay, approximately 4 miles (6.4 kilometers) north of the LWI project site. Typical noise levels measured in a small-town residential neighborhood ranged from 43 to 64 dBA, with levels of 52 dBA occurring more than 50 percent of the time (Cavanaugh and Tocci 1998). Vinland and Thorndyke Bay and surrounding areas are predicted to have similar noise characteristics. Recreational users on the eastern side of Toandos Peninsula and on Hood Canal may experience elevated noise levels during construction activities.

3.9.2.2.2. Sensitive Noise Receptors Near the SPE Project Site

The closest receptor to the SPE project site is the community of Olympic View, approximately 0.6 mile (1.0 kilometer) south of the SPE project. Because the SPE site is approximately 1.8 miles (2.9 kilometers) south of the north LWI project site, the sensitive receptors located north of the base (Vinland, the schools, and Thorndyke Bay) are approximately 1.8 miles farther from the SPE project site than from the north LWI project site, as described in the preceding paragraph.

3.9.2.3. CURRENT REQUIREMENTS AND PRACTICES

At the state level, WAC Chapter 173-60 establishes maximum allowable noise levels. Based on land-use characteristics, areas are categorized as Class A, B, or C zones (environmental designations) for the purpose of noise abatement (Table 3.9–1). This regulation applies to noise created on the base that may propagate into adjacent non-Navy properties. Industrial areas, such as along the Bangor waterfront, are considered a Class C zone; commercial and recreational areas are considered a Class B zone; and residential areas are considered a Class A zone.

Table 3.9–1. Washington Maximum Permissible Environmental Noise Levels (dBA Leq)

Noise Source	Receiving Property		
	A – Residential (Day/Night)	B – Commercial	C – Industrial
A – Residential	55/45	57	60
B – Commercial	57/47	60	65
C – Industrial	60/50	65	70

Source: WAC 173-60-040; dBA = A-weighted decibel; Leq = equivalent sound level

Title 10, Section 10.28.040 of the Kitsap County Code limits the maximum permissible environmental noise levels for residential zones. The hours and maximum permissible noise levels are the same as those in WAC Chapter 173-60. Sounds originating from temporary construction sites as a result of construction activity are exempt from these provisions between the hours of 7:00 a.m. and 10:00 p.m.

Washington noise regulations (WAC 173-60-040) limit the noise levels from a Class C noise source that affect a Class A receiving property to 60 dBA (daytime) and 50 dBA (nighttime) (nighttime hours are considered 10:00 p.m. to 7:00 a.m.). However, the state noise rules allow these levels to be exceeded by up to 15 dBA for certain brief periods without violating the limits. In addition, certain activities are exempt from these noise limitations:

- Sounds created by motor vehicles on public roads are exempt at all times, except for individual vehicle noise, which must meet noise performance standards set by WAC 173-60-050;
- Sounds created by motor vehicles off public roads, except when such sounds are received in residential areas;
- Sounds originating from temporary construction activities during all hours when received by industrial or commercial zones and during daytime hours when received in residential zones; and
- Sounds caused by natural phenomena and unamplified human voices.

The WAC does not specify the time duration for temporary construction activities.

3.9.3. Environmental Consequences

3.9.3.1. APPROACH TO ANALYSIS

The evaluation of impacts due to noise considers noise generated by pile driving; both impact hammer and vibratory methods; noise from other construction equipment, including noise due to earthmoving activities; and noise from vessel and boat traffic and construction equipment. Standard noise transmission models are used to estimate dissipation of noise over distance from the expected noise source locations and operating conditions. Noise analyses described herein include differences in site topography and use appropriate noise dissipation factors for noted conditions. Changes in acoustic propagation due to wind, humidity, temperature and other atmospheric factors are not modeled. Appendix D describes the source levels and methodology used to model airborne noise propagation from pile driving.

While the Navy is not subject to local noise ordinances outside installation boundaries, potential impacts from airborne pile driving were analyzed using the WAC 173-60-040 daily allowable noise level of 60 dBA as proxy for ambient noise levels. Leq is the preferred method to describe sound levels that vary over time, resulting in a single decibel value that takes into account the total sound energy over the period of time of interest. Sound levels included in WAC 173-60-040 are assumed to have used an averaging time of 1 hour. Airborne noise levels used for acoustic modeling were measured using 1- and 10-second averaging times for impact and vibratory driving, respectively (Illingworth and Rodkin 2013). Modeling used the higher-impact driving sound levels to conservatively estimate airborne propagation distances. Due to the short duration of each strike, if the given source level is assumed to be constant throughout the hourly Leq period, then the actual Leq achieved will be overestimated, thus, this is a worst-case scenario. Modeled sound levels at the propagation distances described in this section, therefore, overestimate levels that will be reached during actual pile driving and represent a worst-case scenario.

3.9.3.2. LWI PROJECT ALTERNATIVES

Table 3.9-2 details the pile types and numbers, as well as the projected number of days of active driving for each of the LWI Action Alternatives.

Table 3.9–2. Summary of Pile Numbers and Active Driving Days (LWI)

DEIS Alternatives	Size / Type	Number	Number of Days	In-Water Work Window
LWI Alternative 2	24-inch (60-centimeter) steel	54 (north)	80	first
		202 (south)		
	24-inch steel	5 (north) (in the dry)		
		5 (south) (in the dry)		
	36-inch (90-centimeter) steel	15 (north) (in the dry)		
		16 (south) (in the dry)		
LWI Alternative 3 (Preferred Alternative)	24-inch steel	15 (north) (in the dry)	30	first
		15 (south) (in the dry)		
	30-inch (76-centimeter) steel	12 (north) (in the dry)		
		12 (south) (in the dry)		
	36-inch steel	15 (north) (in the dry)		
		16 (south) (in the dry)		

3.9.3.2.1. LWI ALTERNATIVE 1: NO ACTION

The No Action Alternative would not construct or operate the LWI project so there would be no increase in noise-generating activities and no noise impacts.

3.9.3.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

In general, sound pressure levels decrease by a factor of 2 (or 6 dB) for every doubling of distance from the source; thus, the loudest areas on the base would be near the shoreline where most of the activity is taking place, such as near EHW-1 and Delta Pier. Based on recent measurements of aboveground noise taken along the Bangor waterfront, maximum noise in this area is similar to levels observed for common construction equipment.

CONSTRUCTION

Construction of the LWI would involve the use of multiple types of construction equipment, many of which may be operated at the same time. Under LWI Alternative 2, maximum noise levels would be produced when driving piles using barge-mounted cranes and impact hammer pile driving equipment. Most pile driving would occur with a vibratory driver. An impact driver would be used occasionally to proof piles to ensure they are able to bear the design loads. Extensive dump truck traffic is expected during upland construction to move excavated earth and replacement fill. This would increase traffic noise transiting from the LWI project site on the Lower Base to the Upper Base and to local roadways. This noise would not be particularly disruptive to human receptors, due in part to the existing truck traffic on the base and moving in and out of the base. Equipment such as dump trucks, front end loaders, dozers, backhoes, cranes, auger drill rig, and concrete saws or jackhammers are expected to be used at both sites during upland site construction. Use of tugs and work skiffs also is anticipated to support in-water work, and in addition, barge-mounted equipment would be used to install the in-water mesh and steel plate anchors. In the absence of pile driving activity, maximum noise levels produced by construction equipment that might typically be employed at the LWI project site are 90 dBA (USDOT 2006). Presuming multiple sources of noise may be present at one time, maximum combined levels may be as high as 94 dBA. This assumes that multiple, co-located sources combined together would increase noise levels as much as 3 to 4 dB over the level of a single piece of equipment by itself. The resultant sound pressure level (SPL) from n-number of multiple sources is computed with the following relationship using principles of decibel addition:

$$CombinedSPL = 10 \cdot \log_{10}\left(10^{\frac{SPL1}{10}} + 10^{\frac{SPL2}{10}} + \ldots + 10^{\frac{SPLn}{10}}\right)$$

These maximum noise levels are intermittent in nature and not present at all times. Average ambient noise levels are expected to be in the 60 to 68 dBA range, consistent with urbanized or industrial environments where equipment is operating, and similar to the range of noise measured in-situ on Delta Pier in October 2010 (Navy 2010).

Noise propagation was modeled based on three physical environment conditions:

1. Over water, using a 6 dB loss factor per doubling of distance;
2. Over a soft site (e.g., unpaved land), using a 7.5 dB loss factor per doubling of distance; and
3. Over a soft site with dense vegetation, using a 7.5 dB loss factor with a 10 dB reduction

Based on these conditions and the proxy source levels used for acoustic modeling (Table D–8 in Appendix D), the airborne sound environment can be expected to be at ambient conditions at the distances detailed in Table 3.9–3.

Pile driving noise from both impact and vibratory pile driving could exceed allowable noise limits for the Occupational Safety and Health Administration (OSHA) (90 dBA) and Navy Occupational Safety and Health (84 dBA) for an 8-hour period. Personal protective equipment would be required for personnel working in these areas, including personnel working on the water. Personal protective equipment must be capable of reducing the noise exposure to less than 84 dBA, 8-hour time weighted average and less than 140 dB peak sound pressure level for impact or impulse noise.

On-base residential areas would not be affected by pile driving noise due to the intervening distance (4 miles [6.4 kilometers]), terrain, and vegetation (although pile driving may at times be audible above background noise levels). Recreational boaters and kayakers in Hood Canal adjacent to the project sites could be affected by pile driving noise above 60 dBA, although the floating security barrier would prevent recreational users from getting close enough to the pile driver to receive potentially harmful noise levels (84 dBA for 8 hours).

Table 3.9–3. Airborne Impact Pile Driving Noise Propagation Distance to Ambient Conditions (LWI Alternative 2)

Metric	Over Water		Soft Site, No Vegetation		Soft Site, with Vegetation	
	unweighted	A-weighted	unweighted	A-weighted	unweighted	A-weighted
Sound Level (dB RMS) at 50 ft (15 m) from driven pile	110	100	110	100	100	90
Distance to 60 dB RMS (approximate ambient conditions) from driven pile	15,561 ft (4,743 m)	4,921 ft (1,500 m)	4,921 ft (1,500 m)	1,952 ft (595 m)	1,957 ft (597 m)	771 ft (235 m)

dB = decibel; ft = feet; m = meters; RMS = root mean square

Properties with a direct line of sight to the impact pile driver would receive noise levels above local background levels over a distance of approximately 3 miles (4.7 kilometers) assuming a conservative background level of 50 dBA. Waterfront residences on the western shore south of Squamish Harbor, including those along Thorndyke Bay, would receive maximum noise levels less than 60 dBA during impact driving and would not exceed maximum daytime noise levels in WAC 173-60-040. Areas experiencing noise levels above 60 dBA during impact pile driving are shown in Figure 3.9–1. Residents at Vinland, just north of the base property line, may be able to hear impact noise during pile driving, but levels received would be below the expected background noise level of a quiet, residential neighborhood of 50 dBA due to interposing vegetation and terrain.

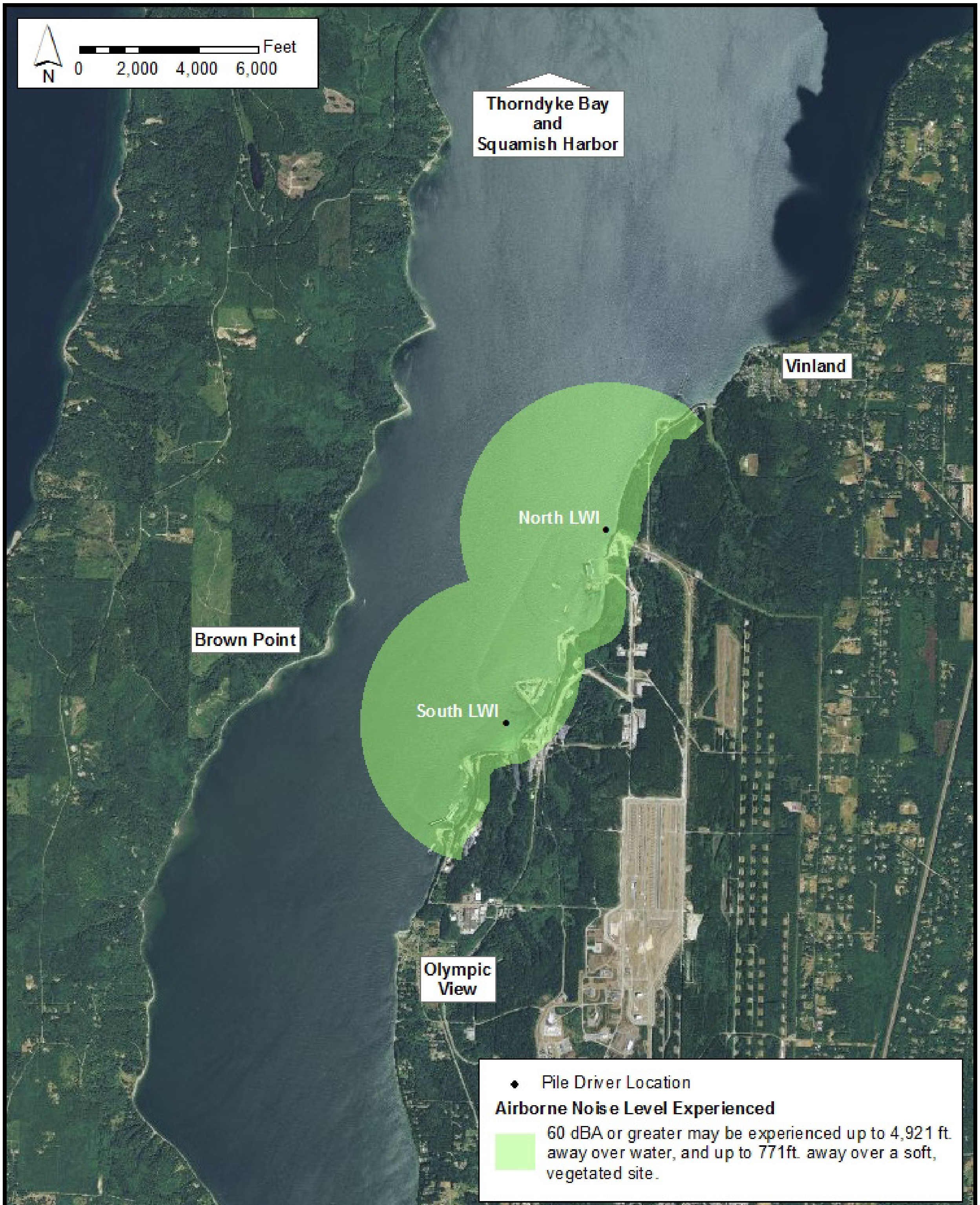

Figure 3.9-1. Areas Experiencing Airborne Noise Levels of 60 dBA or Greater During Impact Pile Driving, LWI Project

Most pile driving activity would occur with a vibratory driver.

Table 3.9–4 details estimated received noise levels during vibratory pile driving activity for the three terrain conditions described above.

Properties within a direct line-of-sight of a vibratory pile driver may hear vibratory pile driving noise above the background noise on a quiet day. However, at no time would vibratory pile driving noise exceed 60 dBA (the maximum daytime allowable noise level specified in WAC 173-60-040) at any off-base location, including Vinland, local schools, or local residents on the western shore of Hood Canal. Kayakers or boaters located in Hood Canal within 1,385 feet (422 meters) of a vibratory pile driver may receive noise levels above 60 dBA but would not receive noise levels sufficient to cause injury (84 dBA for 8 hours).

Table 3.9–4. Airborne Vibratory Pile Driving Noise Propagation Distance to Ambient Conditions (LWI Alternative 2)

Metric	Over Water		Soft Site, No Vegetation		Soft Site, with Vegetation	
	unweighted	A-weighted	unweighted	A-weighted	unweighted	A-weighted
Sound Level (dB RMS) at 50 ft (15 m) from driven pile	92	89	92	89	82	79
Distance to 60 dB RMS (approximate ambient conditions) from driven pile	1,959 ft (597 m)	1,385 ft (422 m)	938 ft (286 m)	712 ft (217 m)	374 ft (114 m)	285 ft (87 m)

dB = decibel; ft. = feet; m = meters; RMS = root mean square

OPERATION/LONG-TERM IMPACTS

Operation of LWI Alternative 2 would result in a modest increase in airborne noise due to in-air noise of waves breaking on in-water structures during times of windy weather, which would be highly localized to areas directly adjacent to the pier and structures. There would be no increase in vessel or vehicle traffic. Therefore, operation of this alternative would not increase airborne noise levels above existing conditions at either LWI site location.

3.9.3.2.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

CONSTRUCTION

Airborne noise levels generated by construction of Alternative 3 would be the same as for Alternative 2, but the duration of noise generation would be less for Alternative 3. Table 3.9-2 details the number and type of piles, as well as the number of active driving days, for LWI Alternative 3. Pile driving noise would extend approximately the same distances inland as for

Alternative 2 (Tables 3.9–3 and 3.9–4), though distances over water may be smaller based on the abutments' proposed shoreline location. General construction noise would occur for approximately two years for both alternatives. Because Alternative 3 does not include construction of a pier, general construction noise, which excludes pile driving noise, would be at lower levels than for Alternative 2. Upland construction for Alternative 3 would be the same as for Alternative 2, so the level and duration of noise from upland construction would be the same for the two alternatives. Construction noise would be audible in adjacent areas of Hood Canal, which are used for recreation, and on the far side of the Canal, but WAC limits would not be exceeded in residential areas.

OPERATION/LONG-TERM IMPACTS

Operation/long-term noise impacts for Alternative 3 would be the same as described above for Alternative 2: minor and very localized.

3.9.3.2.4. SUMMARY OF LWI IMPACTS

Impacts due to airborne noise associated with construction and operation of the LWI project, along with mitigation and consultation and permit status, are summarized in Table 3.9–5.

Table 3.9–5. Summary of LWI Impacts Due to Airborne Noise

Alternative	Environmental Impacts Due to Airborne Noise
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-supported Pier	*Construction:* Pile driving (no more than 80 days) would increase noise levels in residential and recreational areas (with a conservative assumed ambient noise level of 50 dBA) over a line-of-sight distance of approximately 3 miles [4.7 kilometers]. WAC limits would not be exceeded in residential or school areas. Pile driving noise would exceed OSHA and Navy limits at the construction sites, requiring protective equipment. Non-pile-driving noise from typical construction activity would not adversely affect sensitive receptors off NAVBASE Kitsap Bangor. *Operation/Long-term Impacts:* Minor and highly localized to pier and PSBs.
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* Pile driving (no more than 30 days) would increase noise levels in residential and recreational areas (with a conservative assumed ambient noise level of 50 dBA) over a line-of-sight distance of approximately 3 miles [4.7 kilometers]. WAC limits would not be exceeded in residential or school areas. Pile driving noise would exceed OSHA and Navy limits at the construction sites, requiring protective equipment. Non-pile-driving noise from typical construction activity would not adversely affect sensitive receptors off NAVBASE Kitsap Bangor. *Operation/Long-term Impacts:* Minor and highly localized to PSBs.
Mitigation: The Navy would notify the public about upcoming construction activities and noise at the beginning of construction activities. Construction activities would not be conducted during the hours of 10:00 p.m. to 7:00 a.m.; in addition, pile driving would occur only during daylight hours. Appendix C (Mitigation Action Plan) details mitigation measures.	
Consultation and Permit Status: No consultations or permits are required.	

OSHA = Occupational Safety and Health Administration; WAC = Washington Administrative Code

3.9.3.3. SPE PROJECT ALTERNATIVES

Table 3.9–6 details the pile types and numbers, as well as the projected number of days of active driving for each of the LWI Action Alternatives.

Table 3.9–6. Summary of Pile Numbers and Active Driving Days (SPE)

DEIS Alternatives	Size / Type	Number	Number of Days	In-Water Work Window
SPE Alternative 2 (Preferred Alternative)	36-inch (90-centimeter) steel	230	125	first
	24-inch (60-centimeter) steel	50		
	18-inch (45-centimeter) concrete	105	36	second
SPE Alternative 3	24-inch steel	500	155	first
	18-inch concrete	160	50	second

3.9.3.3.1. SPE Alternative 1: No Action

The No Action Alternative would not construct or operate the SPE project so there would be no increase in noise-generating activities and no noise impacts.

3.9.3.3.2. SPE Alternative 2: Short Pier (Preferred)

CONSTRUCTION

The principal source of airborne noise during construction of SPE Alternative 2 would be driving of 36- and 24-inch (90- and 60-centimeter) steel piles, and 18-inch (45-centimeter concrete piles) using a combination of impact and vibratory driving methods. Because sound levels for the smaller concrete piles are expected to be significantly lower than those of the larger steel piles, data for 36-inch steel piles are analyzed under this Alternative, representing the largest anticipated ranges to effect for any type / size of pile driven during the first or second in-water work window. As described above for the LWI, airborne noise propagation was modeled based on three physical environment conditions. Based on these conditions and the proxy source levels used for acoustic modeling (Table D–8 in Appendix D), the airborne sound environment can be expected to be at ambient conditions at the distances detailed in Tables 3.9–7 and 3.9–8, and Figure 3.9–2.

As described above under LWI Alternative 2, pile driving noise from both impact and vibratory pile driving could exceed allowable noise limits for the Occupational Safety and Health Administration (OSHA) (90 dBA) and Navy Occupational Safety and Health (84 dBA) for an 8-hour period. Personal protective equipment would be required for personnel working in these areas, including personnel working on the water. Personal protective equipment must be capable of reducing the noise exposure to less than 84 dBA, 8-hour time weighted average and less than 140 dB peak sound pressure level for impact or pulsed noise.

Residents at Vinland, just north of the base property line, may be able to hear impact noise during pile driving, but levels received would be below the expected background noise level of a quiet, residential neighborhood of 50 dBA due to interposing vegetation and terrain. Properties with a direct line of sight to the pile driver in the community of Olympic View, which is located approximately 0.6 mile (1.0 kilometer) south of the project site, would experience noise levels of approximately 64 dBA from impact pile driving and 60 dBA for vibratory driving. Properties in Olympic View without line of sight to the pile driver would experience lower noise levels. The WAC 173-60-40 permissible noise level for residential areas affected by industrial activities is 60 dBA in the daytime and 50 dBA at night. However, temporary construction noise during the daytime is exempt from these limits. Nevertheless, residents of Olympic View may be able to hear pile driving noise above background levels, and so could be adversely affected. These pile driving impacts would occur for no more than 125 days during normal construction hours over the first in-water work window, and 36 days during the second in-water work window.

Table 3.9–7. Airborne Impact Pile Driving Noise Propagation Distance to Ambient Conditions (SPE Alternative 2)

Metric	Over Water		Soft Site, No Vegetation		Soft Site, with Vegetation	
	unweighted	A-weighted	unweighted	A-weighted	unweighted	A-weighted
Sound Level (dB RMS) at 50 ft (15 m) from driven pile	112	100	112	100	102	90
Distance to 60 dB RMS (approximate ambient conditions) from driven pile	19,521 ft (5,950 m)	4,921 ft (1,500 m)	5,906 ft (1,800 m)	1,952 ft (595 m)	2,297 ft (700 m)	771 ft (235 m)

dB = decibel; ft = feet; m = meters; RMS = root mean square

Table 3.9–8. Airborne Vibratory Pile Driving Noise Propagation Distance to Ambient Conditions (SPE Alternative 2)

Metric	Over Water		Soft Site, No Vegetation		Soft Site, with Vegetation	
	unweighted	A-weighted	unweighted	A-weighted	unweighted	A-weighted
Sound Level (dB RMS) at 50 ft (15 m) from driven pile	95[1]	96[1]	95	96	85	86
Distance to 60 dB RMS (approximate ambient conditions) from driven pile	2,772 ft (845 m)	3,117 ft (950 m)	1,234 ft (376 m)	1,362 ft (415 m)	492 ft (150 m)	535 ft (163 m)

dB = decibel; ft = feet; m = meters; RMS = root mean square; [1]data derived from EHW-2 acoustic monitoring report; Appendix A details proxy source level selection and values

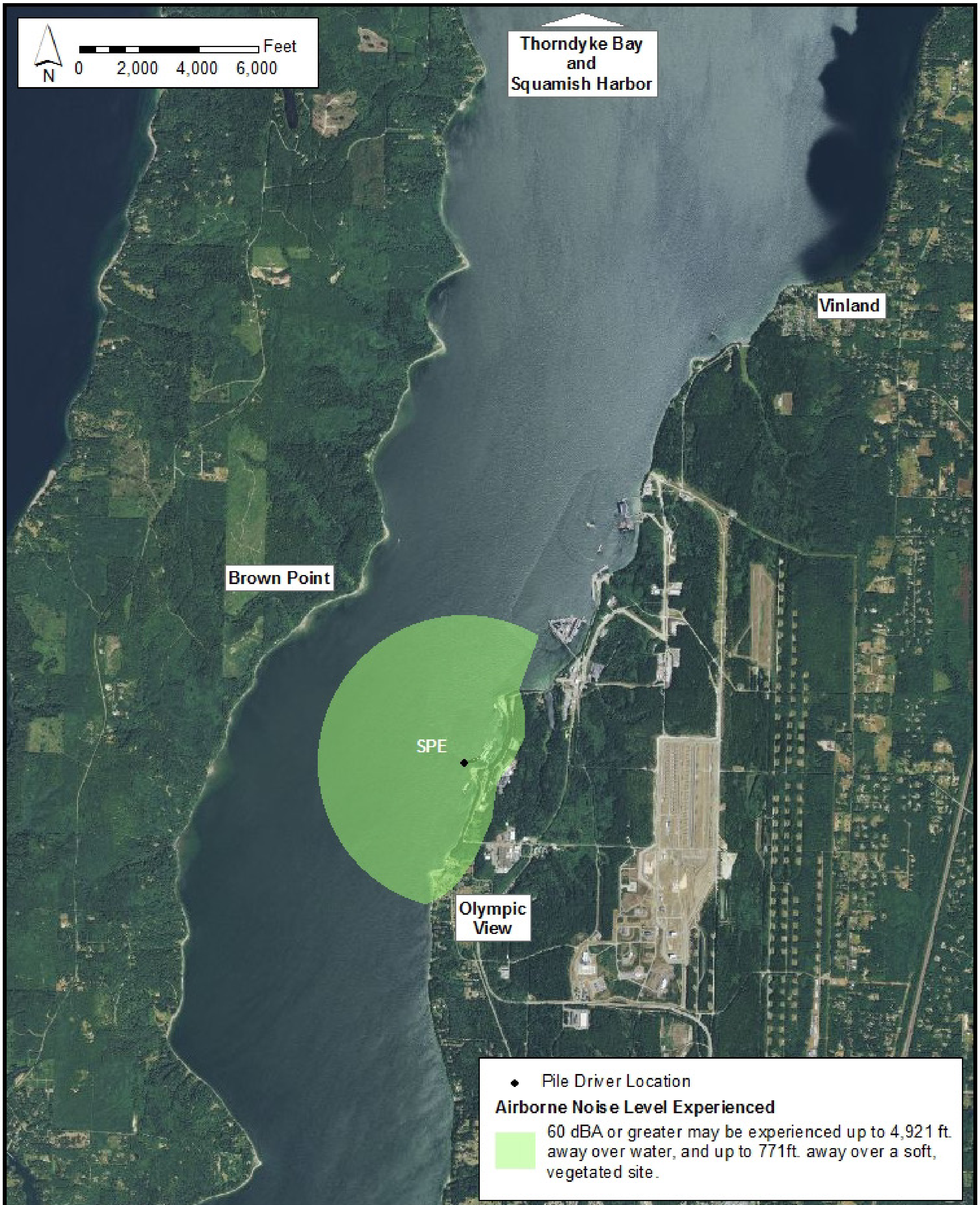

Figure 3.9-2. Areas Experiencing Airborne Noise Levels of 60 dBA or Greater During Impact Pile Driving, SPE Project

Recreational boaters and kayakers in Hood Canal adjacent to the project sites could be affected by pile driving noise above 60 dBA, although the floating security barrier would prevent recreational users from getting close enough to the pile driver to receive potentially harmful noise levels (84 dBA for 8 hours).

Areas experiencing noise levels above 60 dBA during impact pile driving are shown in Figure 3.9–2. Residential properties at the closest point (1.4 miles [2.2 kilometers]) on the western shore of Hood Canal with a direct line of sight to the impact pile driver could receive noise levels of approximately 56 dBA; however, this level would be quickly attenuated by vegetation and structures. Non-pile driving construction noise would be similar to existing levels along the Bangor waterfront and would not adversely affect off-base areas or sensitive receptors.

OPERATION/LONG-TERM IMPACTS

During operations, the number of operational actions would increase from existing levels but the noise levels generated would be similar to existing levels. The increase in the number of operational actions would result in noise-generating activities being more persistent and less intermittent than at present. This change in noise would not be audible at off-base areas or by sensitive receptors. Recreational users on Hood Canal may experience slightly more frequent operational noise associated with activities at the Service Pier.

3.9.3.3.3. SPE Alternative 3: Long Pier

SPE Alternative 3 would involve installation of 24-inch (60-centimeter) steel pipe piles and 18-inch (45-centimeter) concrete piles (Table 3.9–6). Therefore, the distances at which airborne noise is expected to return to ambient conditions are as previously detailed in Tables 3.9–3 and 3.9–4. Pile driving noise would occur over a maximum of 205 days, rather than 161 days for Alternative 2.

3.9.3.3.4. Summary of SPE Impacts

Impacts due to airborne noise associated with construction and operation of the SPE project, along with mitigation and consultation and permit status, are summarized in Table 3.9–9.

Table 3.9–9. Summary of SPE Impacts Due to Airborne Noise

Alternative	Environmental Impacts Due to Airborne Noise
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	*Construction:* Pile driving (no more than 161 days) would increase noise levels in residential and recreational areas (with a conservative assumed ambient noise level of 50 dBA) over a line-of-sight distance of approximately 3 miles [4.7 kilometers]. Pile driving noise would be audible in the community of Olympic View, and could potentially exceed WAC residential limits at properties with a direct line of sight to the impact pile driver. Temporary construction noise is exempt from WAC limits. Pile driving noise would exceed OSHA and Navy limits at the construction sites, requiring protective equipment. Non-pile-driving noise from typical construction activity would not adversely affect sensitive receptors off NAVBASE Kitsap Bangor. *Operation/Long-term Impacts:* Slight increase in the frequency but not the level of operational noise.
SPE Alternative 3: Long Pier	*Construction:* Pile driving (no more than 205 days) would increase noise levels in residential and recreational areas (with a conservative assumed ambient noise level of 50 dBA) over a line-of-sight distance of approximately 3 miles [5 kilometers]. Pile driving noise would be audible in the community of Olympic View, and could potentially exceed WAC residential limits at properties with a direct line of sight to the impact pile driver. Temporary construction noise is exempt from WAC limits. Pile driving noise would exceed OSHA and Navy limits at the construction sites, requiring protective equipment. Non-pile-driving noise from typical construction activity would not adversely affect sensitive receptors off NAVBASE Kitsap Bangor. *Operation/Long-term Impacts:* Slight increase in the frequency but not the level of operational noise.
Mitigation: The Navy would notify the public about upcoming construction activities and noise at the beginning of construction activities. Construction activities would not be conducted during the hours of 10:00 p.m. to 7:00 a.m.; in addition, pile driving would occur only during daylight hours. Appendix C (Mitigation Action Plan) details mitigation measures.	
Consultation and Permit Status: No consultations or permits are required.	

OSHA = Occupational Safety and Health Administration; WAC = Washington Administrative Code

3.9.3.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

Construction activities for the LWI and SPE projects would not overlap. Therefore, construction noise from the two projects would not be additive, but would occur over a maximum of four years rather than the two-year period for either project alone. Therefore, resulting noise disturbance impacts to nearby residential and recreational areas would occur for up to four years for a total of up to 285 days of pile driving.

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3.10. AESTHETICS AND VISUAL QUALITY

3.10.1. Affected Environment

Visual resources are the natural and manmade features that give a particular environment its aesthetic qualities. In undeveloped areas, landforms, water surfaces, and vegetation are the primary components that characterize the landscape. Manmade elements (such as buildings, fences, piers, and wharves) may also be visible. These may dominate the landscape or be relatively unnoticeable. In developed areas, the natural landscape is more likely to provide a background for more obvious manmade features. The size, form, material, and function of buildings, structures, roadways, and infrastructure generally define the visual character of the built environment. These features form the overall impression of an area or its landscape character that an observer perceives. Attributes used to describe the visual resource value of an area include landscape character, perceived aesthetic value, and uniqueness.

3.10.1.1. EXISTING CONDITIONS

The aesthetics on NAVBASE Kitsap Bangor are typical of facilities and structures used to support military operations. For offsite views of NAVBASE Kitsap Bangor, the base blends well with the surrounding area because much of it is forested and hidden from view and is compatible with the surrounding rural landscape. The prevalent view of NAVBASE Kitsap Bangor is from the west looking east across Hood Canal to the wharves and piers of the waterfront. Views from NAVBASE Kitsap Bangor depend upon location, but include the Olympic Mountains, Hood Canal, and the various facilities on the base.

NAVBASE Kitsap Bangor is an active military base located on the eastern shoreline of Hood Canal. The base topography is characterized by flat-topped ridges on the eastern and southern portions of the base. The shoreline of Hood Canal lies adjacent to steep ravines and hillsides leading to the upper portions of the base. The Olympic Mountains lie to the west and provide a scenic backdrop for the base.

Much of NAVBASE Kitsap Bangor is undeveloped with large stands of coniferous trees. As shown in Table 3.6–1, approximately 68 percent of the base is forested, 27 percent is developed, and 4 percent is brush and shrubland (the forested and brush/shrub categories include wetlands). Many of the views within the base are of forested areas with adjacent development. The aesthetics within the base are typical of office buildings, residences, industrial facilities, and other structures used to support military operations. Common views from the base consist of the Hood Canal waterway in the foreground with the undeveloped forested Toandos Peninsula and Olympic Mountains in the background to the west. A military security buffer zone (closed to public access) is located across Hood Canal on Toandos Peninsula (Figure 3.8–1). Views to the east are largely obscured by forest and the 400-foot (120-meter) ridge of the Kitsap Peninsula.

Development along the waterfront is centered on support structures for naval vessels. The waterfront area of the base includes structural facilities, such as piers, wharves, and cranes. In addition, military submarines and other support craft traversing Hood Canal use these piers and wharves for berthing.

Although physical access to the base and associated facilities is restricted from the general public, the public has visual access to a large area along the waterfront from a distance. The principal public viewpoints of NAVBASE Kitsap Bangor available to the general public are from boats on Hood Canal and from the southern shore of Toandos Peninsula where public access is allowed. The view of the Bangor waterfront from the water where the public can see the base consists of open water in the foreground, industrial waterfront-type facilities such as piers and wharves in the middle ground, and forested hillsides in the background. Most of the base waterfront is enclosed within a floating barrier consisting of metal pontoons approximately 18 feet (5 meters) apart, topped by a metal mesh screen extending approximately 14 feet (4 meters) above the water surface. This barrier affects the appearance of the open-water areas along the base shoreline. Recreational boaters are allowed to pass by the base but are not allowed to stop or slow down. Yellow buoy markers about 0.5 mile (0.8 kilometer) offshore have been installed to define military water boundaries. Views from the waterside include naval vessels that traverse the area and other commercial vessels and private boats.

From the landside (north, west, and south), offsite views of NAVBASE Kitsap Bangor are mostly forested, similar to and blending with the surrounding rural landscape. Off-base views of the developed areas on base are largely concealed by terrain and vegetation. Rural residential areas on the north and south end of the base have oblique views to the Bangor waterfront. Some existing structures (such as piers and wharves) may be visible. Specifically, some properties along the shore in Vinland have line-of-sight to the existing MSF wharf. Also, large naval vessels operating on Hood Canal are fairly prominent depending on the viewer's distance and the vegetation on particular private parcels.

The Bangor waterfront operates during the evening hours, and the wharves, piers, and related upland facilities are lighted. Thus, the light from the waterfront area is visible from a distance at night, such as from locations on the Toandos Peninsula, approximately 1.5 miles (2.4 kilometers) away. Receptor locations specific to the proposed project locations are discussed in the following sections.

3.10.1.1.1. AESTHETICS AT THE LWI PROJECT SITES

Aesthetics at the LWI project sites are typical of the Bangor waterfront. The south LWI project site is located in the midst of the industrial waterfront and is set back between current structures and the surrounding landscape. The north LWI project site is located at the north end of the industrial waterfront. As discussed above, lighting on facilities and piers in the vicinity of the LWI project sites is visible from surrounding locations in Hood Canal and the opposite shore at nighttime. However, brightness is attenuated by distance to viewing locations. The closest populated area is Thorndyke Bay, located approximately 3.3 miles (5.3 kilometers) north of the proposed north LWI project site. Some facilities extend offshore and have direct line of sight with a few residential parcels to the north of the base; however, these residences do not have line-of-sight to the LWI project sites due to intervening land and topography. Indirect light (i.e., a lightened night sky) from the waterfront area may also be visible at adjacent properties located north and west of the base.

3.10.1.1.2. AESTHETICS AT THE SPE PROJECT SITE

Aesthetics at the SPE project site are also typical of the Bangor waterfront. The SPE project site is proposed to extend from the existing portion of the Service Pier just north of where the land juts out slightly (known as Carlson Spit). The SPE project site is in line with and extends to the west slightly more than existing structures. Lighting on the facilities and piers in the vicinity of the SPE project site is visible from surrounding locations in Hood Canal and the opposite shore at nighttime. However, brightness is attenuated by distance to viewing locations. Some of the SPE's proposed facilities extend offshore and have direct line of sight with a few residential parcels to the south of the base (the new pier crane and the Pier Services and Compressor Building); however, these residences are approximately 0.6 mile (1.0 kilometer) from the SPE project site with intervening land, vegetation, and topography in the view. Indirect light (i.e., a lightened night sky) from the waterfront area may also be visible at adjacent properties located south of the base.

3.10.1.2. CURRENT REQUIREMENTS AND PRACTICES

There are no specific laws and regulations for aesthetic resources, although the *TRIDENT Support Site Master Plan* for the base contains policies that relate to visual resources (TRIDENT Joint Venture 1975). The plan contains long-range development goals and planning objectives that are useful for aesthetics. One of the long-range goals was to "…provide for an aesthetically pleasing physical working and living environment without compromising the efficient and economic accomplishment of assigned missions." This goal is further outlined in the plan's physical form objectives:

- Coordinate the development of facilities, exterior spaces, and landscaping to present a coherently organized image to residents, employees, and visitors;
- Maximize the use of views and site vistas in order to integrate site features and assets into the visual environment; and
- Develop a series of landscaped spaces, as a visual focus and functional relief for support site activities, in the residential areas, as well as in the community, personnel support, and administration areas.

Section 3.13 discusses project-associated consultations with the SHPO. The Navy consulted with the SHPO regarding the potential effect of the LWI and SPE projects on the visual context and aesthetic environment of the waterfront area in relation to historical properties (discussed in Section 3.13) and American Indian resources (discussed in Section 3.14).

3.10.2. Environmental Consequences

3.10.2.1. APPROACH TO ANALYSIS

The evaluation of impacts on visual resources considers the degree of visible change that a proposed action may cause, taking into account the value and sensitivity of the visual environment. An impact on aesthetics would occur if the changes in the existing environment were visually incompatible with surrounding areas, affected a large number of viewers, or modified the visual character of an area that contributes to the public's appreciation of the environment.

Views of the LWI and SPE project sites include those from off base, particularly Hood Canal and, to a lesser extent, those from the base itself, such as the KB Dock, the existing Service Pier, administrative and storage facilities, other maintenance and pier facilities, and the adjacent upland vicinity.

3.10.2.2. LWI PROJECT ALTERNATIVES

3.10.2.2.1. LWI ALTERNATIVE 1: NO ACTION

Under the No Action Alternative, the LWIs would not be built and overall operations would not change from current levels. Therefore, there would be no impacts on visual resources.

3.10.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

Overall, due to limited visual access, distance from public viewpoints, and the current modified visual context, LWI Alternative 2 would have little impact on the visual context and aesthetic environment outside of NAVBASE Kitsap Bangor during construction or operation.

CONSTRUCTION

Construction and related activities tend to cause visual disturbance to the landscape because of the changing nature of the views as construction proceeds. Visual clutter is caused by heavy construction equipment such as barges, cranes (including up to 80 days of pile driving), backhoes, etc., and stockpiled materials, which may be moved around a construction site. However, these activities are temporary, and impacts on visual character are also temporary, lasting only for the duration of construction (up to 2 years).

The project site along the waterfront is mostly shielded from onshore, close-in views by topography and to the east by the base itself. To the west, the Naval Restricted Area creates a buffer and separates viewers from the base waterfront by at least a half mile (0.8 kilometer), which would reduce the apparent visual scale of the construction sites. The closest off-base viewing locations on land are to the west along the Toandos Peninsula in Jefferson County, approximately 1.5 miles (2.4 kilometers) from the project site. The closest populated area is Thorndyke Bay, approximately 3.3 miles (5.3 kilometers) northwest of the north LWI project site. There are no publicly accessible places on land from which to view the project sites close up. Facilities under construction and construction equipment would be visible from a distance, resulting in a minor, temporary impact on visual character at those distant viewing locations.

OPERATION/LONG-TERM IMPACTS

The LWI would be consistent with the Bangor industrial waterfront and therefore would be considered compatible with the existing visual character. The surrounding visual context is already modified by manmade features such as Delta Pier, Marginal Wharf, and EHW-1, and the LWI would conform to the existing scale, lighting, and distribution of sites along the waterfront. Also, because of distance and intervening features, visibility of the LWI from off-base land areas would be limited.

The on-land towers would conform visually to other development and lighting along the waterfront. Lighting would increase slightly (at abutment only), but would be consistent with the existing industrial lighting characteristics of the Bangor waterfront and would have minimal impact on the overall viewshed.

The closest viewing locations would be on Hood Canal and the opposite shore in Jefferson County, as defined in the preceding section. Because the LWI, including the abutments and PSBs would conform visually to other development along the waterfront, they would not substantially change the visual character of the existing setting but would increase the industrial appearance of the waterfront. Vessels passing by would have closer, more direct views of the LWI project sites than from on-land sites; however, the visual character of the LWI would be similar to other industrial development at the base, resulting in a minimal visual impact.

Overall, LWI Alternative 2's visual compatibility, distance from populated areas, and the intervening features between populated areas would result in a minimal visual impact.

3.10.2.2.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

The impacts of LWI Alternative 3 would be similar to those of Alternative 2 since visual access is limited and would have little impact on the visual context and aesthetic environment outside of NAVBASE Kitsap Bangor during construction or operation.

LWI Alternative 3 would differ from Alternative 2 because there would be fewer barge trips, 50 fewer days of pile driving (no more than 30 days for Alternative 3 compared to up to 80 days for Alternative 2, and the PSB system would be greater in length at the project sites. No pile-supported pier would be constructed for this alternative, although Alternative 3 would include three observation posts that Alternative 2 would not have.

CONSTRUCTION

Visual impacts from construction would be less than for LWI Alternative 2, as the construction of the PSBs would not disturb any more land or vegetation than described for Alternative 2, and there would be fewer barge trips to/from the project sites, fewer piles, and no pile-supported pier would be constructed.

OPERATION/LONG-TERM IMPACTS

The PSB modifications would be the same design as the existing PSBs and would conform visually to other development along the waterfront; therefore, there would not be a substantial change in the visual character of the existing setting. There would be a minimal increase in the industrial appearance (including lighting) of the waterfront, but this would be less than for Alternative 2, because there would be no pier structure. The on-land towers would conform visually to other development and lighting along the waterfront. The lighting (abutments only) levels would be consistent with the existing industrial lighting characteristics of the Bangor waterfront and would have minimal impact on the viewshed. Alternative 3 would have three observations posts that Alternative 2 would not have, but these posts would be smaller than Alternative 2's piers and compatible with other industrial structures on this section of the waterfront.

Vessels passing by would have closer, more direct views of the LWI structures; however, the visual character of the PSBs and abutments would be similar to other land-based viewpoints and would not be visually distinct.

3.10.2.2.4. SUMMARY OF LWI IMPACTS

Impacts on aesthetics associated with the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.10–1.

Table 3.10–1. Summary of LWI Impacts on Aesthetics

Alternative	Environmental Impacts on Aesthetics
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Pier	*Construction:* Temporary disturbance of existing visual landscape during construction. *Operation/Long-term Impacts:* Minimal increase in the appearance of the industrial facilities at the waterfront over the long term.
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* Temporary disturbance of existing visual landscape during construction (less than for Alternative 2). *Operation/Long-term Impacts:* Minimal increase in industrial appearance of the waterfront over the long term (lesser impact than for Alternative 2 due to no pier structure and fewer lighting fixtures).
Mitigation: Because construction of the LWI would not affect aesthetics significantly, mitigation measures are not necessary.	
Consultation and Permit Status: The Navy consulted with the SHPO on the potential effect of the LWI projects on the visual context and aesthetic environment of the waterfront area in relation to historical properties (described in Section 3.13) and American Indian resources (described in Section 3.14). No other consultations or permits are required.	

SHPO = State Historic Preservation Officer

3.10.2.3. SPE PROJECT ALTERNATIVES

3.10.2.3.1. SPE ALTERNATIVE 1: NO ACTION

Under the No Action Alternative, the SPE would not be built and overall operations would not change from current levels. Therefore, there would be no impacts on the visual resources.

3.10.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

Overall, due to limited visual access, distance from public viewpoints, and the current modified visual context, SPE Alternative 2 would have little impact on the visual context and aesthetic environment outside of NAVBASE Kitsap Bangor during construction of SPE Alternative 2.

CONSTRUCTION

Construction and related activities tend to cause visual disturbance to the landscape because of the changing nature of the views as construction proceeds. Visual clutter is caused by heavy construction equipment such as barges, cranes, backhoes, and stockpiled materials, which may be moved around a construction site. However, these activities are temporary, and impacts on visual character are also temporary, lasting only for the duration of construction (up to 2 years).

The project site along the waterfront would be mostly shielded from onshore, close-in views by topography and to the east by the base itself. To the west, the Naval Restricted Area creates a buffer and separates viewers from the waterfront by at least 0.19 mile (0.31 kilometer) to the SPE project site, which reduces the apparent visual scale of construction equipment. The closest off-base viewing locations on land are approximately 1.5 miles (2.4 kilometers) from the SPE project site on the opposite side of Hood Canal in Jefferson County, and the northernmost edge of Olympic View approximately 0.6 mile (1.0 kilometer) south of the SPE project site (view partially obstructed by vegetation and land). There are no publicly accessible places on land from which to view the project sites close-up.

The Proposed Action would result in clearing approximately 7 acres (2.8 hectares) of vegetation in the upland areas to accommodate a parking lot and other facilities. The parking lot would be approximately 0.2 mile (0.3 kilometer) east of the coastline and surrounded by fairly dense vegetation which acts as a buffer and would significantly reduce the visual impact. The proposed Waterfront Ship Support Building would be constructed on an existing parking lot approximately 0.04 mile (0.06 kilometer) east of the coastline. The proposed Waterfront Ship Support Building would be sited between existing facilities that support the pier services and ship maintenance and behind an existing pier structure. This building would not be visible from offbase except from boats on Hood Canal. It would be partially hidden by other structures and vegetation and would be consistent in appearance with nearby structures. The existing PSBs would be relocated to attach to the end of the SPE; this would not result in a change in the overall visual aesthetic of this feature. Facilities under construction and construction equipment would be visible from the locations identified above, resulting in a minor, temporary (up to 2 years) impact on visual character at those locations.

OPERATION/LONG-TERM IMPACTS

The SPE would be consistent with the Bangor industrial waterfront and therefore would be considered compatible with the existing visual character. The surrounding visual context is already modified by manmade features such as the KB Dock, the existing Service Pier, the Carderock Pier, and other maintenance facilities that support the pier services and ship maintenance; and the SPE would conform to the existing scale, lighting, and distribution of sites along the waterfront. Also, because of distance and intervening features, visibility of the SPE from off-base land areas would be limited. As described in the preceding section, the closest viewing locations are Hood Canal outside the Naval Restricted Area, the community of Olympic View, and the opposite shore in Jefferson County. Because the SPE structure and PSBs would conform visually to other development along the waterfront, the SPE and its support facilities would not substantially change the visual character of the existing setting but would increase the industrial appearance (including lighting) of the waterfront. Lighting would increase, but would be consistent with the existing industrial lighting characteristics of the Bangor waterfront and would have minimal impact on the overall viewshed.

Vessels passing by would have closer, more direct views of the SPE project sites; however, the visual character of the SPE would be similar to other industrial development of the base.

Overall, SPE Alternative 2's visual compatibility, distance from populated areas, and the intervening features between populated areas would result in a minimal impact.

3.10.2.3.3. SPE Alternative 3: Long Pier

Similar to SPE Alternative 2, SPE Alternative 3 would have little impact on the visual context and aesthetic environment outside of NAVBASE Kitsap Bangor. This alternative differs from SPE Alternative 2 in that the pier structure would be longer to accommodate an in-line configuration for two submarines. SPE Alternative 3 would have the same upland development as SPE Alternative 2, including the parking lot, Waterfront Ship Support Building, and roadway improvements.

CONSTRUCTION

The impact of SPE Alternative 3 on visual resources would be greater than described for SPE Alternative 2 because the pier structure would be longer (975 feet [297 meters] for Alternative 3 versus 540 feet [165 meters] for Alternative 2). Nevertheless, Alternative 3 would also result in a minimal increase in industrial appearance (including lighting) of the waterfront, based on a minor adverse change to the visual appearance with low viewer response to this change.

Similar to SPE Alternative 2, construction and related activities would be temporary and impacts on visual character also would be temporary, lasting only for the duration of construction (maximum of 205 days of pile driving as compared to 161 days for SPE Alternative 2, up to 2 years total of construction activities). The Alternative 3 project site would be the same as for Alternative 2, but construction would extend at least an additional 435 feet (133 meters) due to the longer pier.

OPERATION/LONG-TERM IMPACTS

The SPE Alternative 3 pier structure would extend an additional 435 feet (133 meters) than SPE Alternative 2 and could be viewed from the most western point of Olympic View located south of the base. Although the SPE would conform visually to other development along the waterfront, it would still impact the visual character from the Olympic View viewpoint. There would be a minimal impact on the view from Olympic View as it is buffered by a distance of approximately 0.6 mile (1.0 kilometer) and the partially developed portion of land that juts out slightly between Olympic View and the pier structure. There would be a minimal increase in industrial appearance (including lighting) of the waterfront over the long term, which would present a greater impact than Alternative 2 due to the larger SPE structure and PSB relocation. The increase in lighting would be greater than for Alternative 2 due to the longer pier structure, but would be consistent with the existing industrial lighting characteristics of the Bangor waterfront and would have minimal impact on the overall viewshed.

Vessels passing by would have closer, somewhat more direct views of Alternative 2; however, the visual character would be similar to other industrial development of the base.

3.10.2.3.4. Summary of SPE Impacts

Impacts on aesthetics associated with the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.10–2.

Table 3.10–2. Summary of SPE Impacts on Aesthetics

Alternative	Environmental Impacts on Aesthetics
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	*Construction:* Temporary (up to 2 years) disturbance of existing visual landscape during construction. *Operation/Long-term Impacts:* Minimal increase in industrial appearance (including lighting) of the waterfront over the long term (50-year project lifespan).
SPE Alternative 3: Long Pier	*Construction:* Temporary (up to 2 years) disturbance of existing visual landscape during construction (moderately less than Alternative 2). *Operation/Long-term Impacts:* Minimal increase in industrial appearance (including lighting) of the waterfront over the long term (50-year project lifespan; greater impact than for Alternative 2 due to longer SPE structure and additional lighting fixtures). Minimal impact to the view from the most western point of Olympic View when viewing north (buffered by distance and landscape).
Mitigation: Because construction of the SPE would not affect aesthetics significantly, mitigation measures are not necessary.	
Consultation and Permit Status: The Navy consulted with the SHPO regarding the potential effect of the SPE project on the visual context and aesthetic environment of the waterfront area in relation to historical properties (described in Section 3.13) and American Indian resources (described in Section 3.14). No other consultations or permits are required.	

SHPO = State Historic Preservation Officer

3.10.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

LWI Alternative 2 would contribute new construction of a pile-supported pier, lighting towers, shoreline abutments, and temporary visual clutter associated with construction. LWI Alternative 3 would contribute additional PSB units, on-land towers, shoreline abutments, observation posts, and temporary visual clutter associated with construction. SPE Alternative 2 would contribute new construction of a short pier, parking lot, Pier Services and Compressor Building, Waterfront Ship Support Building, additional lighting fixtures, roadway improvements, and temporary visual clutter from construction. SPE Alternative 3 would make a greater contribution to the combined impacts than SPE Alternative 2 with the construction of a long pier that would extend an additional 435 feet (133 meters).

Combined, the LWI and SPE project impacts on visual aesthetics would increase the overall industrial appearance and the visual presence of the waterfront industrial area on areas within the direct vicinity of the project sites. However, the new facilities would be visually compatible by conforming to match the scale, lighting, and character of existing manmade features surrounding the project sites.

Combined impacts would be limited by being consistent with the overall existing character and not expanding beyond the existing boundaries of the NAVBASE Kitsap Bangor waterfront area. There would be a minimal combined visual impact from the increase in lighting to offshore areas of Hood Canal and neighboring land parcels due to buffering from distance, vegetation, landforms, and topography around the project site locations.

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3.11. SOCIOECONOMICS

3.11.1. Affected Environment

Socioeconomic resources are defined as the basic characteristics associated with the human environment, particularly population and economic activity. This section discusses the region's population and housing, economic activity, and education and childcare. It also addresses the potential effects construction and operation of the proposed project could have on socioeconomics.

3.11.1.1. EXISTING CONDITIONS

Socioeconomic resources described in this section include Kitsap County with emphasis on NAVBASE Kitsap Bangor, the cities of Bremerton and Poulsbo, the community of Silverdale, and portions of Jefferson County, as appropriate.

3.11.1.1.1. POPULATION AND HOUSING

NAVBASE Kitsap Bangor employs 11,500 military personnel and 14,900 DoD civilians (Kitsap Economic Development Alliance 2010). It is estimated that NAVBASE Kitsap Bangor and the surrounding military installations also support up to 15,000 retired military personnel and DoD civilians from the U.S. Navy, Coast Guard, and Marine Corps in Kitsap County. Approximately 9,900 of the total number of retirees are military retirees once assigned to NAVBASE Kitsap Bangor or Bremerton. It is estimated that approximately 25 percent of the active duty military population resides on the base. Housing for NAVBASE Kitsap Bangor is privatized with the exception of the Jackson Park community, part of NAVBASE Kitsap Bremerton, which remains as government-owned military family housing. The current military family housing inventory on NAVBASE Kitsap Bangor includes 1,279 units. Unaccompanied bachelor housing on NAVBASE Kitsap Bangor includes 952 permanent rooms and 113 transient rooms.

Population figures for Kitsap County, the cities of Bremerton, Bainbridge Island, and Poulsbo, and the community of Silverdale are presented in Table 3.11–1. Based on these figures, the number of military personnel and DoD civilians associated with NAVBASE Kitsap Bangor comprises approximately 10.5 percent of Kitsap County's population. The city of Bremerton is the largest city in Kitsap County, comprising 15.0 percent of the county's population. Between 2000 and the census in 2010, Kitsap County's population increased at an annual average rate of 0.8 percent per year.

Population in Kitsap County is projected to increase at an average annual rate of 0.1 percent for the next 30 years, reaching a population of 320,475 persons in 2040, assuming a consistent medium rate of growth. As depicted in Table 3.11–2, the most growth is anticipated during the 5-year period from 2015 to 2020. The growth rate in Kitsap County and the state are anticipated to be consistent with each other between 2015 and 2040 (Washington State Office of Financial Management 2012).

Table 3.11–1. Demographic Characteristics

Location	2000 Population	2010 Population
City of Bainbridge Island	20,308	23,025
City of Bremerton	37,259	37,729
City of Poulsbo	6,813	9,200
Silverdale CDP[1]	15,816	19,204
Kitsap County	231,969	251,133
State of Washington	5,894,121	6,724,540

Sources: U.S. Census Bureau 2000a, 2010a-e

1. The unincorporated community of Silverdale is a Census Designated Place (CDP). A CDP is defined as a statistical entity comprising a dense concentration of population that is not within an incorporated place but is locally identified by a name.

Table 3.11–2. Population Projections for Kitsap County and Washington State

Year	Kitsap County		Washington State	
	Number	Percent Increase	Number	Percent Increase
2010	251,133	n/a	6,724,540	n/a
2015	262,032	4.3%	7,022,200	4.4%
2020	275,546	5.2%	7,411,977	5.6%
2025	289,265	5.0%	7,793,173	5.1%
2030	301,642	4.3%	8,154,193	4.6%
2035	311,737	3.3%	8,483,628	4.0%
2040	320,475	2.8%	8,790,981	3.6%

Source: Washington State Office of Financial Management 2012

Housing characteristics for Kitsap County, the cities of Bremerton, Bainbridge Island, Poulsbo, and the community of Silverdale are presented in Table 3.11–3. There were 107,367 housing units in Kitsap County at the time of the 2010 Census, of which 97,220 units were occupied. The homeowner vacancy rate in the county was 2.2 percent and the rental vacancy rate was 8.6 percent. The total number of vacant rental units in the county numbered 10,147 units (U.S. Census Bureau 2010b).

Table 3.11–3. 2010 Census Housing Characteristics

Location	Housing Units	Occupied Units	Vacant Units	Homeowner Vacancy Rate	Rental Vacancy Rate
City of Bainbridge Island	10,584	9,470	1,114	2.4	6.3
City of Bremerton	17,273	14,932	2,341	4.2	11.4
City of Poulsbo	4,115	3,883	232	2.1	5.8
Silverdale CDP	8,555	7,828	727	1.6	9.1
Kitsap County	107,367	97,220	10,147	2.2	8.6
State of Washington	2,885,677	2,620,076	265,601	2.4	7.0

Source: U.S. Census Bureau 2010a-e

3.11.1.1.2. Economic Activity

Employment characteristics for the region are presented in Table 3.11–4. The civilian labor force in Kitsap County included an estimated 119,378 persons in 2010, of which an estimated 109,244 were employed. The unemployment rate was 8.5 percent. Median household income was $59,549, and persons below the poverty level represented 9.4 percent of the population (U.S. Census Bureau 2010g). The nationwide recession beginning in 2007 resulted in higher rates of unemployment and unemployment insurance claims. The decline in the housing market resulted in a particularly high rate of unemployment and unemployment insurance claims in the construction industry. According to the state of Washington's Employment Security Department, the number of initial unemployment insurance claims in the construction industry in July 2006 was 53 claims as compared to 396 initial claims in July 2009 and 235 initial claims in July 2012 (Washington State Employment Security Department 2012). The same trend is shown in the number of continuing unemployment insurance claims during the same time period. In July 2006, the number of continuing claims was 246 claims as compared to 1,117 claims in July 2009 and 457 claims in July 2012.

Table 3.11–4. Estimated 2010 Employment Characteristics

Location	Civilian Labor Force	Employment	Unemployment Rate
City of Bainbridge Island	11,032	10,335	6.3
City of Bremerton	17,411	15,177	12.8
City of Poulsbo	4,011	3,708	7.6
Silverdale CDP	9,157	8,433	7.9
Kitsap County	119,378	109,244	8.5
State of Washington	3,380,744	3,124,821	7.6

Source: U.S. Census Bureau 2010g

Government and government enterprises comprise the largest employment sector in the region, accounting for over one-third of all jobs in Kitsap County, as depicted in Table 3.11–5. The military accounted for 8.9 percent of total employment in Kitsap County overall, as compared to military employment in the state of Washington accounting for 2.2 percent of total employment (U.S. Bureau of Economic Analysis 2012). In terms of private employment, primary industries in Kitsap County are professional and technical services, retail trade, and health care. The military, specifically the Navy, has the largest economic impact on Kitsap County. It is estimated that the direct impact of military bases in Kitsap County includes 27,375 jobs (uniformed and civilian) and $1.1 billion in annual payroll. Furthermore, much of the private industry in the county is related to military activities, including defense-related suppliers and contractors. The military presence in Kitsap County is estimated to support 46,935 total jobs, representing 48 percent of all jobs in the county, and providing $1.8 billion in annual wages (Washington State Office of Financial Management 2004).

Tribal and state commercial hatcheries and chum salmon fisheries that occur in Hood Canal provide an opportunity for subsistence, recreational, and income-generating activities, which contribute to local and rural businesses in the area. Current economic analyses estimate that chum salmon production in the Hood Canal region generates over $6 million in local personal income (WDFW 2012).

Table 3.11–5. 2010 Employment by Industry in Kitsap County and Washington State

Industry	Kitsap County		Washington State	
	Number	Percent of total	Number	Percent of total
Total	122,084	100.0%	3,793,568	100.0%
Private				
Farm employment	679	0.6%	83,537	2.2%
Forestry, fishing, and related activities	(D)	N/A	36,226	1.0%
Mining	(D)	N/A	6,779	0.2%
Utilities	140	0.1%	5,300	0.1%
Construction	5,846	4.8%	200,663	5.3%
Manufacturing	1,892	1.5%	277,335	7.3%
Wholesale trade	1,596	1.3%	133,450	3.5%
Retail Trade	13,680	11.2%	383,760	10.1%
Transportation and warehousing	1,278	1.0%	108,207	2.9%
Information	1,594	1.3%	113,007	3.0%
Finance and insurance	3,858	3.2%	166,015	4.4%
Real estate and rental and leasing	5,269	4.3%	173,021	4.6%
Professional and technical services	8,073	6.6%	272,870	7.2%
Management of companies and enterprises	299	0.2%	34,261	0.9%
Administrative and waste services	5,047	4.1%	186,278	4.9%
Educational services	1,837	1.5%	69,909	1.8%
Health care and social assistance	13,568	11.1%	384,753	10.1%
Arts, entertainment, and recreation	2,997	2.5%	90,052	2.4%
Accommodation and food services	7,117	5.8%	240,984	6.4%
Other services, except public administration	6,244	5.1%	195,140	5.1%
Government				
Federal, civilian	16,068	13.2%	75,691	2.0%
Military	10,846	8.9%	81,698	2.2%
State and local	13,256	10.9%	474,632	12.5%

Source: U.S. Bureau of Economic Analysis 2012

3.11.1.1.3. EDUCATION AND CHILDCARE

There are no primary or secondary schools on the base. Central Kitsap School District #401 in Silverdale serves the educational needs of the region's youth, including military dependents associated with NAVBASE Kitsap Bangor. Enrollment in the district is approximately 11,416 students in the elementary through high school grades (Central Kitsap School District 2012). Military family dependents comprise 26 percent of the district's students, and a total of 50 percent of the student body are in families economically tied to the military sector in Kitsap County. The Navy Region Northwest Child Development Center located on NAVBASE Kitsap Bangor provides care for children from birth to 5 years of age. Services are primarily for families seeking full-time care. The center has the capacity to care for 156 children (Navylifepnw.com 2012).

3.11.1.2. CURRENT REQUIREMENTS AND PRACTICES

There are no governing regulations with regard to socioeconomics. No consultations or permits are required.

3.11.2. Environmental Consequences

3.11.2.1. APPROACH TO ANALYSIS

The evaluation of impacts on socioeconomics considers the magnitude of any increases in employment and population created by the proposed action and the resulting impact on supporting services such as housing and education, as well as to regional economic activity.

The economic impact analysis was conducted using the Impact Analysis for Planning (IMPLAN) economic forecasting model (MIG 2011). The IMPLAN model uses data from the U.S. Bureau of Labor Statistics and the U.S. Bureau of Economic Analysis to construct a mathematical representation of a local economy using region-specific spending patterns, economic multipliers, and industries. In this analysis, the IMPLAN model provided representations of the 2011 Kitsap County economy. Economic impacts are analyzed by introducing a change to a specific industry in the form of increased employment or spending; the IMPLAN model mathematically calculates the resulting changes in the local economy. In this analysis, the IMPLAN model estimates the economic effects of the estimated number of construction workers, construction expenditures, and the operations personnel on spending and employment in Kitsap County. The economic impact analysis separates effects into three components: direct, indirect, and induced. Direct effects are the additional employment and income generated directly by the expenditures of the personnel and construction expenditures. To produce the goods and services demanded by the change in employment and construction expenditures, businesses, in turn, may need to purchase additional goods and services from other businesses. The employment and incomes generated by these secondary purchases would result in the indirect effects. Induced effects are the increased household spending generated by the direct and indirect effects. The total effect from the economic impact analysis is the total number of jobs created throughout the ROI by the direct, indirect, and induced effects.

3.11.2.2. LWI PROJECT ALTERNATIVES

3.11.2.2.1. LWI ALTERNATIVE 1: NO ACTION

Under the No Action Alternative, the LWI would not be built and overall operations would not change from current levels. Therefore, there would be no socioeconomic impacts and socioeconomic conditions would be similar to those described in Section 3.11.1.

3.11.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

Construction of Alternative 2 would generate approximately 500 direct jobs, including the approximately 100 onsite construction jobs, and the related income would provide short-term benefits to the Kitsap County area during construction.

CONSTRUCTION

The direct, indirect, and induced economic impacts of construction workers and an estimated amount of construction expenditures for the LWI sites are summarized in Table 3.11–6. For every $100 million spent by the Navy in construction expenditures, an estimated 919 direct jobs and an estimated 426 indirect and induced jobs would be created using 2013 dollars. The project cost is estimated to be approximately $54.4 million, for a total economic impact of 500 direct jobs and 233 indirect and induced jobs. Total incremental economic output to the region would be about $80.4 million (Table 3.11–6). These new jobs created by the required construction workers and potential construction expenditures would be focused within the following industries: food services, real estate establishment, health care, architectural engineering, wholesale trade, and retail stores. Based on the economic analysis for the Proposed Action, construction would provide a substantial short-term economic benefit to the local and regional economy.

Table 3.11–6. Economic Impact of Construction of LWI Alternative 2

	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Construction Expenditures and Employment (Non-Recurring)				
Output	$54,400,000	$10,259,676	$15,746,143	$80,405,817
Income	$25,261,873	$3,976,436	$4,853,673	$34,091,982
Employment	500	99	134	733

Source: Analysis using the IMPLAN computer program (MIG 2011) in 2013 dollars

Employment of 100 construction workers represents approximately 1.7 percent of the existing construction industry in Kitsap County. As discussed in Section 3.11.1, the recession has resulted in a higher rate of unemployment in the local economy, particularly in the construction industry. It is anticipated that the job creation from the required construction workers and estimated expenditures would be accommodated by labor resources in Kitsap County. However, the local housing market in Kitsap County is expected to support any incoming temporary construction workers. The construction period would last about 27 months. Because the socioeconomic impacts related to construction employment and expenditures would occur only for the duration of the construction period, no permanent or long-lasting socioeconomic impacts are anticipated as a result of construction associated with Alternative 2.

No direct impacts to commercial or recreational fishing are anticipated because the area affected by water construction activities is not open to commercial or recreational fishing. Project impacts on fish populations (Section 3.3.2.2) are not expected to be sufficient to affect commercial or recreational fishery harvest or hatcheries.

Tribal shellfishing occurs for subsistence and commercial reasons. The construction of the southern portion of the LWI would result in eliminating access to a portion of the shellfish beds typically harvested by tribes. An estimated 0.68 acre (0.28 hectare) of oyster beds would be temporarily inaccessible during construction due to the presence of construction equipment and activities. Consequences to American Indian traditional resources are described in more detail in Section 3.14.

OPERATION/LONG-TERM IMPACTS

Because there would be no change in operations, there would be no operational impacts on socioeconomics from the LWI project. After construction, the tribes would be able to continue to harvest shellfish within the restricted area. However, long-term impacts due to the presence of structures would include the loss of an estimated 1,880 square feet (175 square meters) of shellfish beds to which the tribes would permanently no longer have access. Oyster density at the south LWI location is approximately 2.3 oysters per square foot (25.3 per square meter) (Leidos and Grette Associates 2013b). The presence of the pier structures could result in the loss of approximately 368 dozen oysters. If all these oysters were harvested for commercial purposes, the associated socioeconomic impact could be up to $2,208 per year, assuming an average price of $6 per dozen oysters. [1] The tribes harvest an average of approximately 30,000 dozen oysters per year at NAVBASE Kitsap Bangor, with an estimated commercial value of $180,000. Therefore, the $2,208 annual loss would represent approximately 1.2 percent of annual tribal income from this source.

3.11.2.2.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

CONSTRUCTION

The overall construction schedules for LWI Alternative 3 would be similar to those described under Alternative 2; however, the duration of in-water work would be shorter for Alternative 3 than for Alternative 2 (one in-water work season compared to two). Additionally, the project cost for Alternative 3 would be approximately $32.6 million, for a total economic impact of 300 direct jobs and 139 indirect and induced jobs. The total economic output to the region would be about $48.2 million (Table 3.11–7).

[1] Clam harvest information was not available for the impact analysis. The actual area of oysters in the structural footprint of the south LWI under Alternative 2 (i.e., oysters under piles and steel plate anchors) would be approximately 770 square feet (72 square meters). The dollar estimate ($2,208) was based on oyster values (available data) for the larger area of the shellfish habitat under the pier (i.e., the entire oyster area bound by the pier footprint, 1,880 square feet [175 square meters]), as opposed to the smaller area of oysters actually under piles and steel plate anchors.

Table 3.11–7. Economic Impact of Construction of LWI Alternative 3

	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Construction Expenditures and Employment (Non-Recurring)				
Output	$32,600,000	$6,148,262	$9,436,108	$48,184,368
Income	$15,138,549	$2,382,938	$2,908,635	$20,430,122
Employment	300	59	80	434

Source: Analysis using the IMPLAN computer program (MIG 2011) in 2013 dollars

Where tribal shellfishing occurs for commercial and subsistence, the construction of the southern portion of the LWI would result in eliminating access to a portion of shellfish beds typically harvested by tribes. An estimated 0.64 acre (0.26 hectare) of oyster beds would be temporarily (up to 2 years) inaccessible during construction due to the presence of construction equipment and activities. Consequences to American Indian traditional resources are described in more detail in Section 3.14.

OPERATION/LONG-TERM IMPACTS

Operations associated with the Alternative 3 would not impact socioeconomic resources. After construction, the tribes would be able to continue to harvest shellfish within the restricted area. Shellfish bed recovery in the construction area is expected within 3 years. However, long-term impacts due to disturbance from the pontoon feet would include the loss of an estimated 1,880 square feet (175 square meters) of oyster beds to which the tribes would permanently no longer have access. Oyster density at the south LWI location is approximately 2.3 oysters per square foot (25.3 per square meter) (Leidos and Grette Associates 2013b). Pontoon disturbance therefore could result in the loss of approximately 368 dozen oysters. If all of these oysters were harvested for commercial purposes, this loss could be up to $2,208 per year, assuming an average price of $6 per dozen oysters.[2] The tribes harvest an average of approximately 30,000 dozen oysters per year at NAVBASE Kitsap Bangor, with an estimated commercial value of $180,000. Therefore, the $2,208 annual loss would represent approximately 1.2 percent of annual tribal income from this source.

3.11.2.2.4. SUMMARY OF LWI IMPACTS

Impacts on socioeconomics associated with the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.11–8.

[2] Clam harvest information was not available for the impact analysis. The 1,880 square-foot (175-square meter) area is the entire disturbance footprint of the PSB feet on the intertidal zone, not just in the Devil's Hole delta oyster beds (420 square feet). Therefore, while the dollar estimate ($2,208) was based on oyster values (available data) the overall area impacted included both clam and oyster habitat.

Table 3.11–8. Summary of LWI Impacts on Socioeconomics

Alternative	Environmental Impacts on Socioeconomics
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Pier	*Construction:* Approximately 500 direct temporary jobs generated for duration of construction as a result of an expected $54.4 million in construction expenditures; a total of 233 indirect and induced jobs generated. Direct economic output of $54.4 million in construction expenditures would generate an additional $26 million in total economic output. Potential socioeconomic impact on tribes who would no longer have access to a portion of their shellfish beds for commercial harvest. No impacts to commercial or recreational fishing. *Operation/Long-term Impacts:* Potential long-term socioeconomic impact on tribes who would no longer have access to a portion of their shellfish beds for commercial harvest, up to $2,208 per year.
Alternative	**Environmental Impacts on Socioeconomics**
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* Approximately 300 direct temporary jobs generated for duration of construction as a result of an expected $32.6 million in construction expenditures; a total of 139 indirect and induced jobs generated. Direct economic output of $32.6 million in construction expenditures would generate an additional $48.2 million in total economic output. Potential socioeconomic impact on tribes who would no longer have access to a portion of their shellfish beds for commercial harvest. No impacts to commercial or recreational fishing. *Operation/Long-term Impacts:* Potential long-term socioeconomic impact on tribes who would no longer have access to a portion of their shellfish beds for commercial harvest, up to $2,208 per year.
Mitigation: Impacts on tribal harvests would be mitigated in accordance with a Memorandum of Agreement between the Navy and the affected tribes (Section 3.14.2).	
Consultation and Permit Status: No consultations or permits are required. Consultations related to American Indian Tribes are discussed in Sections 3.13 and 3.14.	

3.11.2.3. SPE PROJECT ALTERNATIVES

3.11.2.3.1. SPE ALTERNATIVE 1: NO ACTION

Under the No Action alternative, the SPE would not be constructed or operated and there would be no construction expenditures in the ROI. Therefore, socioeconomic conditions under the No Action alternative would be the same as those described as existing conditions in Section 3.11.1.

3.11.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

CONSTRUCTION

The direct, indirect, and induced economic impacts of construction workers and an estimated amount of construction expenditures for SPE Alternative 2 are summarized in Table 3.11–9. For every $100 million spent by the Navy in construction expenditures, an estimated 919 direct jobs and an estimated 426 indirect and induced jobs would be created using 2013 dollars. The project cost for SPE Alternative 2 is estimated to be approximately $89 million, for a total economic impact of 818 direct jobs and 380 indirect and induced jobs. Total economic output to the region would be about $131.5 million (Table 3.11–9). These new jobs created by the required construction workers and potential construction expenditures would be temporary, however, and would only last for the duration of the construction activities. The local housing market in Kitsap

County is expected to support any incoming temporary construction workers. Construction of the SPE would generate about two years of beneficial economic stimulus to the ROI.

No direct impacts to commercial or recreational fishing are anticipated because the area affected by water construction activities is not open to commercial or recreational fishing. Project impacts on fish populations (Section 3.3.2.2) are not expected to be sufficient to affect commercial or recreational fishery harvest or hatcheries. Tribal shellfishing is not expected to be affected because the areas involved in construction are not within the tribal shellfish beds.

Table 3.11–9. Economic Impact of Construction of SPE Alternative 2

	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Construction Expenditures and Employment (Non-Recurring)				
Output	$89,000,000	$16,785,132	$25,761,153	$131,546,285
Income	$41,329,167	$6,505,566	$7,940,752	$55,775,485
Employment	818	161	219	1,198

Source: Analysis using the IMPLAN computer program (MIG 2011) in 2013 dollars

OPERATION/LONG-TERM IMPACTS

Operation of SPE Alternative 2 would not affect local or regional socioeconomic conditions over the long term, because there would be no anticipated change in the number of military and civilian personnel based at NAVBASE Kitsap Bangor as a result of operating the pier extension and associated support facilities.

3.11.2.3.3. SPE Alternative 3: Long Pier

CONSTRUCTION

SPE Alternative 3 would be similar to SPE Alternative 2 in terms of the timeframe of construction activities; however, construction expenditures related to this alternative would be approximately $116 million (Table 3.11–10). Therefore, impacts on socioeconomic conditions from construction of Alternative 3 would be greater than the economic stimulus estimated under Alternative 2. Total economic output to the region under this alternative is summarized in Table 3.11–10.

Table 3.11–10. Economic Impact of Construction of SPE Alternative 3

	Direct Impact	Indirect Impact	Induced Impact	Total Impact
Construction Expenditures and Employment (Non-Recurring)				
Output	$116,000,000	$21,877,250	$33,576,334	$171,453,579
Income	$53,867,229	$8,479,165	$10,349,744	$72,696,138
Employment	1,066	209	285	1,560

Source: Analysis using the IMPLAN computer program (MIG 2011) in 2013 dollars

OPERATION/LONG-TERM IMPACTS

Operation of SPE Alternative 3 would not affect local or regional socioeconomic conditions over the long term, because there would be no anticipated change in the number of military and civilian personnel based at NAVBASE Kitsap Bangor as a result of operating the pier extension and associated support facilities.

3.11.2.3.4. Summary of SPE Impacts

Impacts on socioeconomics associated with the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.11–11.

Table 3.11–11. Summary of SPE Impacts on Socioeconomics

Alternative	Environmental Impacts on Socioeconomics
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	*Construction:* Approximately 818 direct temporary jobs generated for duration of construction as a result of an expected $89 million in construction expenditures; a total of 380 indirect and induced jobs generated. Direct economic output of $89 million in construction expenditures would generate an additional $42.5 million in total economic output. No impacts to commercial or recreational fishing. *Operation/Long-term Impacts:* No impact.
SPE Alternative 3: Long Pier	*Construction:* Approximately 1,066 direct temporary jobs generated for duration of construction as a result of an expected $116 million in construction expenditures; a total of 494 indirect and induced jobs generated. Direct economic output of $116 million in construction expenditures would generate an additional $55.5 million in total economic output. No impacts to commercial or recreational fishing. *Operation/Long-term Impacts:* No impact.
Mitigation: Any impact on tribal harvests would be mitigated in accordance with a Memorandum of Agreement between the Navy and affected tribes (Section 3.14.2).	
Consultation and Permit Status: No consultations or permits are required. Consultations related to American Indian Tribes are discussed in Sections 3.13 and 3.14.	

3.11.2.4. COMBINED IMPACTS OF THE LWI AND SPE PROJECTS

The project cost for LWI would range from $32.6 million to approximately $54.4 million and the cost for SPE would range from $89 million to $116 million, depending on the alternative, for combined construction expenditures ranging from $121.6 million to $170.4 million. For every $100 million in construction costs by the Navy, approximately 919 direct jobs and 426 direct and induced jobs are created. Construction of the two projects would overlap in time and collectively would create up to an estimated 1,566 direct jobs and 726 indirect and induced jobs. Based on the economic analysis, construction would provide a substantial benefit to the local and regional economy. Independently or in combination, operation of the two projects would not have significant economic impacts.

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3.12. ENVIRONMENTAL JUSTICE AND PROTECTION OF CHILDREN

3.12.1. Affected Environment

Environmental justice issues refer to an action's potential to result in disproportionate impacts on minority and low-income (MLI) populations as well as children. Factors considered in determining whether an alternative would have a significant impact on environmental justice and protection of children included the extent or degree to which its implementation would result in the following: (1) change in any social, economic, physical, environmental, or health conditions so as to disproportionately affect any particular low-income or minority group; or (2) disproportionately endanger children.

3.12.1.1. EXISTING CONDITIONS

The MLI and youth populations described in this section include those in Kitsap County with emphasis on NAVBASE Kitsap Bangor and the cities of Bremerton and Poulsbo, the community of Silverdale, and portions of Jefferson County, as appropriate.

Table 3.12–1 identifies total population and percentage of disadvantaged and youth populations in Bremerton, Poulsbo, Silverdale, Kitsap County, Jefferson County, and Washington State. Minority persons range from 21.7 percent of the population in Poulsbo to 30.5 percent in Bremerton, compared to 20.9 percent for Kitsap County overall. Minority persons comprise 10.7 percent of the population in Jefferson County. In Washington State, minorities comprise 27.5 percent of the population. Asians are the predominant minority group in each jurisdiction with the exceptions of Bremerton, where blacks are the dominant minority group, and Jefferson County where Hispanics are the dominant minority. With the exception of Jefferson County, American Indians account for less than 2 percent of the population in each jurisdiction, comparable to the state native population of 1.5 percent. The American Indian population, as a share of the total population, ranges from 0.5 percent in Bainbridge Island to 2.3 percent in Jefferson County (U.S. Census Bureau 2010a–h).

Table 3.12–1. Minority and Low-Income Populations and Youth Populations

Location	Total Population	Percent Minority	Percent Low-Income	Percent Youth
City of Bremerton	37,259	30.5	19.4	19.5
City of Poulsbo	9,200	21.7	3.5	23.8
Silverdale CDP	19,204	27.7	7.5	21.9
Kitsap County	251,133	20.9	9.4	22.5
Jefferson County	29,872	10.7	13.5	14.9
State of Washington	6,724,540	27.5	12.1	23.5

Source: U.S. Census Bureau 2010a–h

The percent of low-income individuals in the affected region is below or comparable to state levels with the exception of Bremerton, which has a low-income population of 19.4 percent — 7 percent higher than the state and 10 percent higher than Kitsap County. Jefferson County has a low-income rate of 13.5 percent, which is comparable to the percent of low-income individuals in the state. The number of low-income individuals accounts for 7.5 percent of the population in Silverdale, 3.5 percent in Poulsbo, and 9.4 percent in Kitsap County.

In general, waterfront areas along the western shore of Hood Canal south of Squamish Harbor, including Thorndyke Bay, within Jefferson County are sparsely populated, rural residential areas. The population in Jefferson County is primarily located in the northeastern portion of the county outside of the Area of Potential Effect (APE) from noise or other environmental impacts. The population for the waterfront areas potentially impacted is only available by Census tract. The waterfront area in Jefferson County across Hood Canal from NAVBASE Kitsap Bangor is contained in Census Tract 9502.02, and in 2000 it had a population of 1,617 (U.S. Census Bureau 2000b). In 2010, the estimated population in Census Tract 9502.02 was 1,836 representing an annual increase of 1.3 percent between 2000 and 2010 (Washington State Office of Financial Management 2010). In 2010, there were an estimated 1,192 housing units in Census Tract 9502.02 of which 791 housing units are occupied.

The nearest sensitive noise receptors to NAVBASE Kitsap Bangor include schools and residences. A sensitive noise receptor is defined as a location or facility where people involved in indoor or outdoor activities may be subject to stress or considerable interference from noise. Such locations or facilities often include residential dwellings, hospitals, nursing homes, educational facilities, and libraries. Vinland Elementary School is located approximately 2 miles (3.5 kilometers) northeast of the closest project location, the north LWI project site. Other sensitive noise receptors include residences in Olympic View, located at the south boundary of NAVBASE Kitsap Bangor, in Vinland located just north of the NAVBASE Kitsap Bangor northern property boundary, and on the west side of Hood Canal, notably in the vicinity of Thorndyke Bay. Typical noise levels measured in a small-town residential neighborhood ranged from 43 to 64 dBA, with levels of 52 dBA occurring more than 50 percent of the time (Cavanaugh and Tocci 1998). Vinland and Thorndyke Bay and surrounding areas are predicted to have similar noise characteristics. Sensitive receptors also include recreational users on the eastern side of Toandos Peninsula, as well as boaters or kayakers located on Hood Canal within audible range of the construction site.

3.12.1.2. CURRENT REQUIREMENTS AND PRACTICES

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, directs federal agencies to address disproportionate environmental and human health impacts to MLI communities, which includes American Indian populations. No consultations or permits are required.

EO 12898 was issued in 1994 to focus federal agency attention on the environmental, human health, and socioeconomic conditions of MLI populations, to promote nondiscrimination in federal programs substantially affecting human health and the environment, and to provide MLI populations with access to public information on, and an opportunity for, public participation in matters relating to human health and the environment. EO 12898 applies equally to American Indian populations. EO 12898 directs preparers of EISs to address the following:

- Identify MLI populations in the area relative to the general demographic population.
- Identify and analyze potential environmental justice issues, concerns, or impacts, whether direct, indirect, or cumulative; this includes environmental (contaminants), human health (noise), socioeconomic (sacred grounds/selling resources), and subsistence resource use (fish, shellfish, etc.).
- Determine whether there will be a disproportionately high and adverse human health, environmental, or socioeconomic effect on MLI communities, including tribes.
- Provide opportunities for community input from MLI populations and American Indian tribes.
- Identify potential effects and mitigation measures in consultation with affected communities; improve accessibility of meetings, crucial documents, and notices, and ensure documents are concise, understandable, and translated.
- Ensure that the EIS: (1) describes the study area relative to its composition of potentially affected MLI communities; (2) provides the method used and analysis in order to determine how the effects on the environment, human health, and socioeconomics are distributed within the study area; (3) analyzes environmental justice issues, concerns, and impacts for the proposed action and each alternative including the No Action Alternative; (4) determines from the analysis whether impacts on MLI populations (including American Indian tribes) are disproportionately high and adverse as compared to/relative to the general population or comparison group; (5) determines if impacts can be mitigated when disproportionately high and adverse environmental, human health, and socioeconomic effects on MLI populations are identified; (6) identifies mitigation measures, if appropriate; and (7) elicits participation of affected stakeholders including MLI populations and American Indian tribes and considers community input in response to comments.

Environmental justice assessment applies to disadvantaged populations in the region, which includes minority and low-income persons.

These populations are defined as follows:

- *Minority Population:* Blacks, American Indians, Alaska Natives, Aleuts, Asians, Pacific Islanders, and persons of Hispanic or Latino origin of any race.
- *Low-Income Population:* Persons living below the poverty level, based on a 2009 equivalent annual income of $21,954 for a family of four persons.
- *Youth Population:* Children under the age of 18 years.

The youth population also is analyzed for potential health and safety risks. The President issued EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, in 1997. This order requires that each federal agency "(a) shall make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children; and (b) shall ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks."

3.12.2. Environmental Consequences

3.12.2.1. APPROACH TO ANALYSIS

The evaluation of impacts on environmental justice and protection of children analyzes the potential for the proposed action to cause disproportionate public health and environmental effects on MLI populations or youth populations. An environmental justice and protection of children analysis is conducted only on adversely impacted populations. Once an adverse impact has been established, further analysis needs to be conducted for the populations of concern.

3.12.2.2. LWI PROJECT ALTERNATIVES

3.12.2.2.1. LWI ALTERNATIVE 1: NO ACTION

Under the No Action Alternative, the LWI would not be built, the existing PSBs would not be relocated, and overall operations would not change from current levels. Therefore, there would be no disproportionate impacts on MLI populations nor environmental health risks or safety risks to children.

3.12.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

CONSTRUCTION

There would be no disproportionate construction-related impacts on the MLI populations and no environmental health risks or safety risks to children have been identified. Concerns about environmental justice and protection of children related to construction activity typically include exposure to noise, pollutants, other hazardous materials, and safety hazards. Because the project is located within a military restricted area, there is no potential for the public to be exposed to pollutants, other hazardous materials, or safety hazards. However, there would be potential for the public to be exposed to noise from construction activities.

Minority

Under this alternative, residential areas within Jefferson County located along the waterfront on the western shore of Hood Canal and south of Squamish Harbor, including Thorndyke Bay, would experience an increase in airborne noise levels up to 80 days during impact pile driving activities (Sections 3.9.2 and 3.9.3.2.2). The noise level would not exceed daytime maximum residential levels imposed by WAC (60 dBA) at Vinland, Thorndyke Bay, or other adjacent residential communities. Additionally, the noise levels would not be disproportionately high and adverse for minority populations, as this area does not constitute an environmental justice area of concern when comparing minority populations to the general population (Table 3.12–1).

Low-Income

Jefferson County has a slightly higher percentage of the population classified as low-income than the state level (Table 3.12-1). Residential areas within Jefferson County would be exposed to increase in noise levels during construction. However, since the noise level would not exceed daytime maximum residential levels imposed by WAC (60 dBA) at Vinland, Thorndyke Bay, or other adjacent residential communities, no disproportionate impact would be anticipated to low-income communities in Jefferson County.

Youth

Potential impacts to youth populations would be similar to those impacts as described under minority populations above. No disproportionately high and adverse impacts for youth populations have been identified, as this area does not constitute an environmental justice area of concern when comparing youth populations to the general population (Table 3.12-1). In addition, no environmental health risks or safety risks to children have been identified.

OPERATION/LONG-TERM IMPACTS

Because operation of the pile-supported piers would not increase airborne noise levels beyond areas directly adjacent to the piers and PSBs (Section 3.9.3.2.2), there would be no disproportionate operational/long-term impacts on MLI populations from the LWI project and no environmental health risks or safety risks to children.

Minority

No adverse long-term impacts to minorities have been identified during the operation of the alternative. Therefore, no further analysis needs to be conducted for the populations of concern.

Low-Income

No adverse long-term impacts to low-income populations have been identified during the operation of the alternative. Therefore, no further analysis needs to be conducted for the populations of concern.

Youth

No adverse impacts to youth have been identified under this alternative. Therefore, no further analysis needs to be conducted for the populations of concern.

3.12.2.2.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

CONSTRUCTION

The overall construction schedule under LWI Alternative 3 would be the same as for LWI Alternative 2; however, only one in-water construction season would be required and the duration of pile-driving would be shorter under Alternative 3 (up to 30 days vs. up to 80 days). Therefore, construction impacts on MLI populations and environmental health risks or safety risks to children would be similar to or less than impacts as described under Alternative 2.

Minority

Under this alternative, residential areas within Jefferson County located along the waterfront on the western shore of Hood Canal and south of Squamish Harbor, including Thorndyke Bay, would experience an increase in airborne noise levels up to 30 days during impact pile driving activities (Sections 3.9.2 and 3.9.3.2.2). The noise level would not exceed daytime maximum residential levels imposed by WAC (60 dBA) at Vinland, Thorndyke Bay, or other adjacent residential communities. Additionally, the noise levels would not be disproportionately high and adverse for minority populations, as this area does not constitute an environmental justice area of concern when comparing minority populations to the general population (Table 3.12–1).

Low-Income

Potential impacts to low-income populations would be similar to those impacts as described under minority populations above.

Youth

Potential impacts to youth populations would be similar to those impacts as described under minority populations above. Therefore, no disproportionately high and adverse impacts for youth populations have been identified. In addition, no environmental health risks or safety risks to children have been identified.

OPERATION/LONG-TERM IMPACTS

Operations/long-term impacts associated with LWI Alternative 3 would be similar to those described under Alternative 2. Therefore, under Alternative 3, there would be no disproportionate operational/long-term impacts on MLI populations and no environmental health risks or safety risks to children.

Minority

No adverse long-term impacts to minorities have been identified during the operation of the alternative. Therefore, no further analysis needs to be conducted for the populations of concern.

Low-Income

No adverse long-term impacts to low-income populations have been identified during the operation of the alternative. Therefore, no further analysis needs to be conducted for the populations of concern.

Youth

No adverse impacts to youth have been identified under this alternative. Therefore, no further analysis needs to be conducted for the populations of concern.

3.12.2.2.4. SUMMARY OF LWI IMPACTS

Impacts on MLI or youth populations associated with the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.12–2.

Table 3.12–2. Summary of LWI Impacts to MLI and Youth Populations

Alternative	Environmental Impacts to MLI and Youth Populations
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Pier	*Construction:* No disproportionate effects from construction on MLI populations. Construction would not cause any environmental health risk or safety risk to children. *Operations/Long-term Impacts:* No impact.
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* No disproportionate effects from construction on MLI populations. Construction would not cause any environmental health risk or safety risk to children. *Operations/Long-term Impacts:* No impact
Mitigation: Because construction of the LWI would not disproportionately affect MLI or youth populations, mitigation measures are not necessary.	
Consultation and Permit Status: No consultations or permits are required.	

MLI = minority and low-income

3.12.2.3. SPE PROJECT ALTERNATIVES

3.12.2.3.1. SPE ALTERNATIVE 1: NO ACTION

Under the No Action Alternative, the SPE would not be built and overall operations would not change from current levels. Therefore, there would be no impacts on MLI or youth populations.

3.12.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

CONSTRUCTION

As with the proposed construction of the LWI, concerns related to environmental justice and protection of children include exposure to noise, pollutants, and safety hazards. The construction of the SPE would involve construction within the base boundaries so no MLI populations outside the base boundaries are expected to be exposed to pollutants or safety hazards. Section 3.9.3.3.2 describes the noise levels generated as a result of the SPE pile driving.

Minority

The Olympic View community and properties off the western shore of the Hood Canal would be able to hear the pile driving activities above local background levels; however, noise levels would not exceed the WAC 173-60-40 permissible noise level (60 dBA) for residential areas. Temporary construction noise during the daytime is exempt from these limits; however, residents and sensitive receptors of Olympic View and on the western shore of Hood Canal could be affected by pile driving noise during these activities. Pile installation would require no more than 161 days of pile driving and would take place during the two in-water construction seasons; noise impacts would be temporary. No disproportionately high and adverse impacts for MLI populations have been identified, as this area does not constitute an MLI population when compared to the general population (Table 3.12–1).

Low-Income

Jefferson County has a higher percentage of the population classified as low-income than the state level. Residential areas within Jefferson County would be exposed to increase in noise levels during construction. However, since the noise level would not exceed daytime maximum residential levels imposed by WAC (60 dBA) at Vinland, Thorndyke Bay, or other adjacent residential communities, no disproportionate impact would be anticipated to low-income communities in Jefferson County.

Youth

Potential impacts to youth populations would be similar to those impacts as described under minority populations above. Therefore, no disproportionately high and adverse impacts for youth populations have been identified. In addition, no environmental health risks or safety risks to children have been identified.

OPERATION/LONG-TERM IMPACTS

Because additional noise associated with this alternative would not be audible at off-base areas or by sensitive receptors, there would be no operational/long-term impacts on MLI populations under this alternative. In addition, no environmental health risks or safety risks to children have been identified.

Minority

No adverse long-term impacts to minorities have been identified during the operation of the alternative. Therefore, no further analysis needs to be conducted for the populations of concern.

Low-Income

No adverse long-term impacts to low-income populations have been identified during the operation of the alternative. Therefore, no further analysis needs to be conducted for the populations of concern.

Youth

No adverse impacts to youth have been identified under this alternative. Therefore, no further analysis needs to be conducted for the populations of concern.

3.12.2.3.3. SPE ALTERNATIVE 3: LONG PIER

CONSTRUCTION

Exposure to noise levels, pollutants, and safety hazards would be similar to those described above for SPE Alternative 2. Construction would occur within the base boundaries and pollutants and safety hazards are not expected to affect off-base residents. Noise levels would also be similar to those described under the Alternative 2.

Minority

Under this alternative, noise levels would not exceed the WAC 173-60-40 permissible noise level for residential areas; however, residents in the Olympic View community and properties on the western shore of Hood Canal would be able to hear the pile driving activities above local background levels and could be adversely impacted during construction activities. Any impacts are anticipated to be temporary, lasting only for the duration of the pile installation, which would require no more than 205 days of pile driving and would take place during the two in-water construction seasons. No disproportionately high and adverse impacts for MLI populations have been identified, as this area does not constitute an MLI population when compared to the general population (Table 3.12–1).

Low-Income

Potential impacts to low-income populations would be similar to those impacts as described under minority populations above.

Youth

Potential impacts to youth populations would be similar to those impacts as described under minority populations above. Therefore, no disproportionately high and adverse impacts for youth populations have been identified. In addition, no environmental health risks or safety risks to children have been identified.

OPERATION/LONG-TERM IMPACTS

Because additional noise associated with operation of this alternative would not be audible at off-base areas or by sensitive receptors, there would be no operational/long-term impacts on MLI or populations under this alternative. In addition, no environmental health risks or safety risks to children have been identified.

Minority

No adverse long-term impacts to minorities have been identified during the operation of the alternative. Therefore, no further analysis needs to be conducted for the populations of concern.

Low-Income

No adverse long-term impacts to low-income populations have been identified during the operation of the alternative. Therefore, no further analysis needs to be conducted for the populations of concern.

Youth

No adverse impacts to youth have been identified under this alternative. Therefore, no further analysis needs to be conducted for the populations of concern.

3.12.2.3.4. SUMMARY OF SPE IMPACTS

Impacts on MLI or youth populations associated with the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.12–3.

Table 3.12–3. Summary of SPE Impacts to MLI and Youth Populations

Alternative	Environmental Impacts to MLI and Youth Populations
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	*Construction:* Residents in Olympic View and the western shore of Hood Canal could be adversely impacted temporarily during pile installation activities. No disproportionate effects from construction on MLI populations. Construction would not cause any environmental health risk or safety risk to children. *Operations/Long-term Impacts:* No impact.
SPE Alternative 3: Long Pier	*Construction:* Residents in Olympic View and the western shore of Hood Canal could be adversely impacted temporarily during pile installation activities (longer duration than Alternative 2). No disproportionate effects from construction on MLI populations. Construction would not cause any environmental health risk or safety risk to children. *Operations/Long-term Impacts:* No impact.
Mitigation: Because construction of the SPE would not disproportionately affect MLI or youth populations, mitigation measures are not necessary.	
Consultation and Permit Status: No consultations or permits are required.	

MLI = minority and low-income

3.12.2.4. COMBINED IMPACTS OF THE LWI AND SPE PROJECTS

Neither the LWI or SPE projects would have disproportionate impacts on minority or low-income populations because there are no low-income or minority populations within the locations for the proposed projects. There would be no disproportionately high and adverse environmental, human health, and socioeconomic effects on minority and low-income populations or children. Therefore, there would be no combined impact of the two projects on environmental justice populations or the protection of children.

3.13. CULTURAL RESOURCES

3.13.1. Affected Environment

A cultural resource is any definite location or object of past human activity, occupation, or use identifiable through inventory, historical documentation, or oral evidence. Cultural resources may include archaeological, architectural, and traditional resources, as well as historic districts, sites, or objects. Traditional resources are those that are associated "with cultural practices or beliefs of a living community that (a) are rooted in that community's history and (b) are important in maintaining and continuing cultural identity of the community" (National Park Service 1998). Cultural resources that are eligible for listing in the National Register of Historic Places (NRHP) are called historic properties. Some cultural resources that are important to American Indians may not be eligible for the NRHP but are still protected under the Native American Graves Protection and Repatriation Act (NAGPRA), the American Indian Religious Freedom Act (AIRFA), and other federal laws, regulations, and executive orders (EOs): National Historic Preservation Act (NHPA), Archaeological Resources Protection Act, EO 12898 *Environmental Justice*, EO 13007 *Indian Sacred Sites*, EO 13175 *Consultation and Coordination with Indian Tribal Governments, Presidential Memorandum dated November 5, 2009*, emphasizing agencies' need to comply with EO 13175, and the Presidential Memorandum dated April 29, 1994, *Government-to-Government Relations with Native American Governments*. American Indian treaty rights and traditional resources are addressed in Section 3.14.

3.13.1.1. EXISTING CONDITIONS

Cultural resources identified and inventoried within the boundaries of NAVBASE Kitsap Bangor include archaeological, architectural, and traditional resources. Although there are no NRHP-listed historic properties on or within approximately 5 miles (8 kilometers) of the NAVBASE Kitsap Bangor project area, several NRHP-eligible cultural resources have been recorded on NAVBASE Kitsap Bangor. Three of the NRHP-eligible architectural resources are within the combined project APEs. The portion of both LWI and SPE project areas on NAVBASE Kitsap Bangor with the highest probability for undiscovered archaeological resources and items subject to NAGPRA is the shoreline (refer to Section 3.13.1.1.2, under Potential for Previously Unidentified Resources).

3.13.1.1.1. CULTURAL RESOURCES IN THE NORTHWEST COASTAL REGION

The area near NAVBASE Kitsap Bangor was likely first inhabited 14,000 to 12,000 years ago by big game hunters known as Paleoindians, who arrived sometime between 14,000 to 8,000 years before present. Spaniards were the first Europeans to visit the Washington coast in the 18th century. In 1792, Captain George Vancouver made first contact with the tribes that would come to be known as the Skokomish, S'Klallam (Klallam, Clallam), and the Suquamish. These tribes were living in permanent villages and occupying seasonal hunting and fishing camps along Hood Canal (Suttles and Lane 1990). Ethnographers recorded geographic features of spiritual importance to tribes in the area, including locations within or near both project APEs, including Hood Canal, Devil's Hole, and the Kitsap/Bangor Dock Spit (Lewarch et al. 1993). However, to date no Traditional Cultural Properties (TCPs) (National Park Service 1998) or Properties of Traditional

Religious and Cultural Importance to an Indian Tribe (PTRCIT) (NHPA 54 USC Section 302706 and 36 CFR 800.4) have been identified in the APE for either the proposed LWI or SPE.

The American territorial government signed three treaties with local tribes that covered the lands surrounding Puget Sound (Marino 1990; Governor's Office of Indian Affairs 2010; and Historylink.org 2015): Treaty of Medicine Creek (1854, signed with the Nisqually, Puyallup, Steilacoom, Squawskin, S'Homamish, Stehchass, T'Peek-sin, Squi-aitl, and Sa-heh-wamish), Treaty of Point Elliot (1855, signed with the Dwamish, Suquamish, Sk-kahl-mish, Sam-ahmish, Smalh-kamish, Skope-ahmish, St-kah-mish, Snoqualmoo, Skai-wha-mish, N'Quentl-ma-mish, Sk-tah-le-jum, Stoluck-wha-mish, Sno-ho-mish, Skagit, Kik-i-allus, Swin-a-mish, Squin-ah-mish, Sah-ku-mehu, Noo-wha-ha, Nook-wa-chah-mish, Mee-see-qua-guilch, and Cho-bah-ah-bish), and Treaty of Point No Point (1855, signed with the S'Klallams, the Sko-ko-mish, To-an-hooch, and Chem-a-kum tribes). These treaties reserved a number of resource harvesting rights to the signatory tribes, particularly related to salmon and shellfish harvesting (Marino 1990; Governor's Office of Indian Affairs 2010).

The Navy facility at NAVBASE Kitsap Bangor, Naval Ammunition Depot Bangor, was built between 1944 and 1945 and was used as a site for shipping ammunition to locations in the Pacific during World War II and the subsequent Korean and Vietnam conflicts. In 1973, the Navy selected NAVBASE Kitsap Bangor as the homeport for the first squadron of TRIDENT submarines. Officially activated in 1977 as Naval Submarine Base (SUBASE) Bangor, the base merged with Naval Station Bremerton and Naval Undersea Warfare Center Keyport in 2004 to form the new command known as Naval Base Kitsap (Navy 2007).

3.13.1.1.2. CULTURAL RESOURCES AT SPECIFIC STUDY AREA SITES

The Washington SHPO concurs with the Navy's definition of the APE for the proposed LWI action (State of Washington Department of Archaeology & Historic Preservation [DAHP] January 13, 2014) and SPE action (DAHP August 12, 2015). As defined in 36 CFR 800.16(d), the APE is "the geographic area or areas within which an undertaking may directly or indirectly cause alteration in the character or use of historic properties, if any such properties exist. The APE is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking." For the purposes of describing the affected environment of cultural resources for the Proposed Actions, the APE for direct effects consists of those areas where there would be ground disturbance, or visual or audible effects out of character with the resource. These areas include the following: construction along the shoreline and adjacent bluff; other construction locations including the Waterfront Ship Support Building, new parking lot, and open storage area and utility pad; road improvements and utility upgrades; and any associated areas that may include temporary staging areas, equipment laydown, or other ground-disturbing activities. Indirect effects usually occur at some removal from the direct action, whether removed in time or space, and may be related to population increase at an installation or future change in use that affect the NRHP eligibility of the resource.

PREVIOUS RESEARCH

Although NAVBASE Kitsap Bangor has no properties listed in the NRHP, there are NRHP-eligible properties within the installation boundaries. The Navy has conducted numerous archaeological and architectural surveys and inventories on NAVBASE Kitsap Bangor between 1990 and 2013. Investigations in 1992 surveyed NAVBASE Kitsap Bangor for archaeological resources (Lewarch et al. 1993); in addition to recording numerous sites, this project developed a sensitivity model for the presence of archaeological sites associated with American Indians and Euro-American settlers. A number of project-specific archaeological investigations have surveyed the Lower Base, recording additional archaeological sites (HRA 2013; Stell Environmental Enterprises and Cardno TEC 2013). Recent architectural surveys evaluated the NRHP eligibility of buildings in the Upper and Lower Base (Sackett 2010; Cardno TEC 2013; HRA 2013).

The Navy determined NRHP eligibility of sites recorded on NAVBASE Kitsap Bangor and continues to consult with the SHPO for concurrence (e.g., Stell Environmental Enterprises and Cardno TEC 2013; HRA 2013). In addition, any resource that might be encountered during future investigations would be treated as eligible for the NRHP until such time as it could be evaluated for NRHP eligibility, in accordance with Section 106 of the NHPA[1] (36 CFR 800.13.2(c)).

ARCHAEOLOGICAL RESOURCES

Two archaeological sites associated with the activities of indigenous populations are located in the immediate vicinity of the project APEs. Only one is eligible for listing in the NRHP (Lewarch et al. 1997). This site, American Indian site 45KP108, is a shell midden (location where shells and other food debris have accumulated over time, often representing locations of past aboriginal use) known as the Carlson Spit Shell Midden, and is located on the south side of Carlson Spit. The other site, 45KP212, is a multi-component site in a highly disturbed midden deposit. The site includes moderate amounts of fire-cracked rock and scattered clam shell, along with more scattered historic-period to modern materials such as brick, metal, and concrete fragments, in a loosely compacted sandy loam. The SHPO concurred with the Navy determination that this site is not eligible for listing in the NRHP.

The historic period is represented by a number of archaeological sites, primarily associated with logging and subsistence farming activities in the area of NAVBASE Kitsap Bangor. These sites include farmsteads, a dump site, collapsed historic structures, tree stumps with saw and axe marks, foundations of buildings relocated or razed during World War II, historic land use complexes, orchard complexes, scattered fruit trees and ornamental plants, debris scatters, a marked historic grave (Lewarch et al. 1993), and a small collapsing cabin (Grant et al. 2010). Historic Navy activity is represented by a section of World War II–era railroad and emergency derail run-out, a multi-component site in a disturbed context, and a berm that was probably associated with Korean War–era magazines, which were removed. The SHPO has determined that these historic-era sites are not eligible for listing on the NRHP.

[1] The NHPA was recodified in December 2014 as part of a larger effort to better organize statutes related to the National Park Service. The code covering NHPA Section 106 is now located in Section 306108 of Title 54 USC.

ARCHAEOLOGICAL RESOURCES AT THE LWI PROJECT SITES

Recent surveys of the LWI project areas considered all areas above the water line, including the beach and equipment laydown areas (Grant 2011; HRA 2011, 2013; Stell Environmental Enterprises and Cardno TEC 2013). All areas were surveyed with the exception of an existing staging area near the intersection of Archerfish and Seawolf Roads. This area has previously experienced high levels of disturbance, and no additional subsurface disturbance is planned for the Proposed Action. Site 45KP212 lies within the south LWI APE. This site is not eligible for listing in the NRHP.

ARCHAEOLOGICAL RESOURCES AT THE SPE PROJECT SITE

A recent, intensive archaeological survey of the SPE APE included subsurface testing. Located in project areas where ground-disturbing actions are planned (a total of 9 acres [3.6 hectares]) for the proposed parking lot and other structures, this effort recorded three archaeological sites and ten archeological isolates dating to the historic era (Stell Environmental Enterprises and Cardno TEC 2013). The Navy is seeking concurrence from the SHPO that none of these resources are eligible for listing in the NRHP.

ARCHITECTURAL RESOURCES

Architectural resources representing three eras are located on NAVBASE Kitsap Bangor. The first set of resources includes the period of logging, subsistence farming, and recreation that preceded Navy ownership of the study area in the mid-1940s. These resources include cabins, concrete structures, and a well house that were recorded during the 1992 archaeological survey (Lewarch et al. 1993). The report titled *Early Settlement and Historic Context Study in Support of Environmental Requirements for Subdevron Five Homeporting Pier Extension and Waterfront Support Facility* was prepared by Cardno TEC in 2013. The report covers the historic context of early settlement at Bangor from 1840 to 1944 and evaluates the associated property types in order to identify and assess NRHP eligibility requirements and potential for early settlement properties within NBK Bangor. The report concluded that there are not any Early Settlement NRHP-eligible properties or sites located on NBK Bangor, at this time, which meet the NRHP-eligibility criteria due to a loss of integrity and a lack of significance. Because this study only inventoried property types and probability, no survey or inventory was completed.

The second and third sets of architectural resources relate to the Navy’s use of the installation during World War II and the Cold War and include areas inside and outside the APE: Marginal Wharf, Delta Pier, EHW-1, and Shelton-Bangor Railroad, as well as other structures such as the Devil’s Hole Causeway.

Marginal Wharf was built in 1944 and later was used to load munitions bound for the Vietnam conflict. It is not eligible for the NRHP. Delta Pier and EHW-1 had prominent roles during the Cold War, providing support for the TRIDENT Nuclear Submarine fleet (Sackett 2010). Both Delta Pier and EHW-1 are eligible for listing in the NRHP under Criterion A (association with “events that have made a significant contribution to the broad patterns of our history”) and Criterion C (“embody distinctive characteristics of a type, period or method of construction”) for their association with the United States Triad Strategic Nuclear Deterrent System during the Cold War era and their unique engineering, each representing a specific element that defines Strategic

Weapons Facility, Pacific (Sackett 2010; 36 CFR 60.4). The Shelton-Bangor Railroad, a World War II–era railroad that is eligible for listing in the NRHP (but outside the APE), is represented by an emergency derail run-out and a remaining section of the mainline that has direct association with Hood Canal, where the mainline terminated on the Marginal Wharf. The Devil's Hole Causeway, built soon after the end of World War II and later improved, is not considered eligible for listing (HRA 2013).

ARCHITECTURAL RESOURCES AT THE LWI PROJECT SITES

All architectural resources within the APE of the LWI project have been inventoried, and only two NRHP-eligible structures are within the APE. The determination of eligibility for Delta Pier and EHW-1 was concurred with by SHPO in a previous Section 106 consultation (letter dated July 20, 2011). Although Delta Pier and EHW-1 are in the APE, neither would experience physical or structural changes. The Proposed Action does occur within the viewshed of Delta Pier and EHW-1. However, the SHPO concurred with the Navy's finding of No Historic Properties Affected for the two structures. The Devil's Hole Causeway is also in the APE, although it is not considered eligible for listing in the NRHP.

ARCHITECTURAL RESOURCES AT THE SPE PROJECT SITE

Through the Section 106 process, the architectural inventory of the APE for the proposed SPE project recorded 14 built resources. The Navy considers none to be eligible for listing in the NRHP (Cardno TEC 2013) but SHPO has not yet concurred with these determinations. The viewsheds of Delta Pier and EHW-1 do not include the SPE project site.

TRADITIONAL CULTURAL PROPERTIES: LWI AND SPE APES

Cultural resources may also include TCPs (National Park Service 1998) and PTRCITs (NHPA USC 54 Section 302706 and 36 CFR 800.4). TCPs are eligible for listing in the NRHP owing to their "association with cultural practices or beliefs of a living community that (a) are rooted in that community's history and (b) are important in maintaining and continuing cultural identity of the community." TCPs may be identified by American Indians or other living communities. PTRCITs may be eligible for the NRHP if they meet NRHP criteria (36 CFR 800.16(l)(1)); even if not eligible for the NRHP, this resource type may be afforded protection by other laws, regulations, or executive orders (NHPA, Archaeological Resources Protection Act, EO 12898 *Environmental Justice*, EO 13007 *Indian Sacred Sites*, EO 13175 *Consultation and Coordination with Indian Tribal Governments, Presidential Memorandum dated November 5, 2009*, emphasizing agencies' need to comply with EO 13175, and the Presidential Memorandum dated April 29, 1994, *Government-to-Government Relations with Native American Governments*). For any cultural resource to be NRHP eligible, it must be a property (i.e., a physical place) in addition to meeting other eligibility criteria (including: having integrity of location, design, setting, materials, workmanship, feeling and association, and meeting one or more of the following criteria: Criterion A, be associated with significant events; Criterion B, be associated with the lives of significant persons; Criterion C, embody distinctive characteristics; Criterion D, yield or be likely to yield information important in prehistory or history [36 CFR 60.4]). To date no TCPs or PTRCITs have been identified in the APE for either the proposed LWI or SPE.

American Indian traditional resources, including shellfish harvested for subsistence needs, are discussed in Section 3.14.

SUBMERGED CULTURAL RESOURCES

The NHPA also applies to submerged or marine cultural resources, and the Navy is responsible for identifying cultural resources and effects on those resources within its jurisdiction and within the APE of a Navy NHPA Section 106 undertaking. Consultation procedures parallel the NHPA Section 106 procedures with added emphasis on the protection of submerged resources through avoidance.

NOAA nautical charts show no submerged ships, shipwrecks, or other noted obstructions in the vicinity of NAVBASE Kitsap Bangor (NOAA 2010a,b). A search of recorded archaeological sites on the Washington Information System for Architectural and Archaeological Records Data (WISAARD) showed no submerged resources within a 1-mile (1.6-kilometer) search radius of the shoreline (HRA 2013). Due to the amount of development along the Bangor shoreline, it is unlikely that there are undocumented historic-period resources present. There is a low likelihood that intact prehistoric archaeological deposits or features are present along the submerged shoreline due to Holocene sea level changes and their associated erosion of the Hood Canal coastline. During past Navy surveys for environmental and planning purposes, divers or remote sensors identified no visible historic properties such as shipwrecks, submerged aircraft, or prehistoric or historic-period features extending above the seafloor (e.g., SAIC 2009).

SUBMERGED CULTURAL RESOURCES AT THE LWI PROJECT SITES

There was no in-water historic properties survey of the underwater portion of the APE, but examination of NOAA charts, WISAARD, and diver surveys for other environmental and planning surveys of the nearshore identified no shipwrecks, submerged aircraft, or features that would be visible above the seabed. The probability for intact Paleo-Indian or Archaic archaeological deposits under the seabed is low owing to the destructive effects of sea level rise on the readily erodible local glacial deposits.

SUBMERGED CULTURAL RESOURCES AT THE SPE PROJECT SITE

As with the LWI in-water APE, there was no in-water historic properties survey of the underwater portion of the APE, although examination of NOAA charts, WISAARD, and diver surveys for other environmental and planning surveys of the nearshore identified no shipwrecks, submerged aircraft, or features that would be visible above the seabed. As with the LWI APE, the probability for intact Paleo-Indian or Archaic archaeological deposits under the seabed is low because historic sea level rise has had a destructive effect on the readily erodible local glacial deposits.

POTENTIAL FOR PREVIOUSLY UNIDENTIFIED RESOURCES

Analysis of the data collected in the 1992 survey and inventory (Lewarch et al. 1993) and regional literature resulted in the development of a probability model identifying areas of high, medium, and low sensitivity for the presence of cultural resources on NAVBASE Kitsap Bangor (Table 3.13–1). The model predicts that areas along saltwater shores have the highest probability for both pre- and post-contact cultural resources. A search of recorded archaeological sites on

WISAARD showed no submerged resources within a 1-mile search radius of the shoreline (HRA 2013). Due to the amount of development along the Bangor shoreline, it is unlikely that there are undocumented historic-period resources present. There is a low likelihood that intact prehistoric archaeological deposits or features are present along the submerged shoreline, due to Holocene sea level changes and their associated erosion of the Hood Canal coastline. Upland flat areas including meadows have a medium probability, and areas with a closed canopy forest are considered to have a low probability for the presence of surviving cultural resources (Lewarch et al. 1993). A survey in 2009 (Grant et al. 2010) tested the sensitivity assessments and found them still valid, within the limits of the investigation.

Historic land use complexes located inland from the combined project APEs illustrate the historic use of the project vicinity. These complexes, including the orchard trees near the SPE APE (proposed parking lot), have been evaluated for NRHP eligibility per the pre-Navy Early Settlement and Historic Context Study and Orchard Evaluation reports developed for the Navy (Cardno TEC 2013; Leidos et al. 2014).

Table 3.13–1. Probability Model for the Presence of Archaeological Resources on NAVBASE Kitsap Bangor

Probability	Environmental Characteristics
Prehistoric Period Sites	
High	Saltwater shores; near mouths of drainage; relatively flat areas inland from shorelines and blufflines; marshes, other unique habitats such as marshes
Medium	Upland flat areas overlooking drainages, meadows
Low	Closed canopy, climax forest; offshore
Historic Period Sites	
High	Saltwater shores; drainage mouths; relatively flat areas inland from shorelines and blufflines
Medium	Upland flat areas, meadows; marshes, other unique habitats
Low	Closed canopy, climax forest; offshore

Source: Lewarch et al. 1993

POTENTIAL FOR PREVIOUSLY UNIDENTIFIED RESOURCES AT THE LWI PROJECT SITES

The shoreline that includes the LWI project was originally surveyed for archaeological resources in 1992 (Lewarch et al. 1993) and again in support of the Proposed Action (HRA 2013). Although the shoreline where project activities would occur could be considered sensitive for the presence of cultural resources, pre-Navy logging and settlement, World War II development, and construction of current facilities (Delta Pier to the south and EHW-1 to the north) have all reduced the likelihood for the presence of intact archaeological resources. Disturbance and lack of intact resources was confirmed by the record search and analysis conducted for the recent archaeological survey (HRA 2013).

Subsurface sampling of the shoreline near the north LWI project areas in 2011 and 2013 also found evidence of extensive disturbance in the northern portion of the APE, in the form of areas of fill and bulldozed cuts (HRA 2011, 2013).

Potential for Previously Unidentified Resources at the SPE Project Site

As with the LWI project locations, the SPE project areas would generally be considered sensitive for the presence of cultural resources because of their proximity to the shoreline. However, extensive disturbance from historic activity has greatly reduced the probability that intact archaeological historic properties would be located anywhere within the APE for SPE projects. Extensive testing verified the level of disturbance, and found only historic–era archaeological sites. These sites do not contain significant information nor are any of them eligible for listing in the NRHP (SHPO has not yet concurred with these eligibility evaluations).

3.13.1.2. CURRENT REQUIREMENTS AND PRACTICES

Section 106 of the NHPA of 1966, as amended (16 USC 470, recodified in December 2014 in 54 USC 306108) requires federal agencies to identify historic properties within the proposed project APE, determine potential effects the proposed project may have on identified historic properties, and consult with the SHPO on determinations of eligibility and findings of effects. If the proposed project adversely affects an identified historic property, further consultation with the SHPO and the Advisory Council on Historic Preservation (ACHP), if they choose to participate in the event of adverse effects, is required to avoid, minimize, or mitigate the adverse effect. Federal regulations define historic properties to include prehistoric and historic sites, buildings, structures, districts, or objects listed in or eligible for inclusion in the NRHP, as well as artifacts, records, and remains related to such properties (NHPA, as amended [54 USC 300101 et seq.]). To be considered eligible for inclusion in the NRHP, cultural resources must be determined to be significant by meeting one or more of the criteria outlined in 36 CFR 60.4 (NRHP, Criteria for Evaluation). A historic property must also possess integrity of location, design, setting, materials, workmanship, feeling, and association. A property must be 50 years old or older to be considered eligible for inclusion in the NRHP or must have achieved exceptional importance within the last 50 years. For example, more recent historic resources on a military installation may be considered significant if they are of exceptional importance in understanding the Cold War.

Secretary of the Navy Instruction (SECNAVINST) 5090.8a, *Policy for Environmental Protection, Natural Resources and Cultural Resources Programs*, and Chief of Naval Operations Instruction (OPNAVINST) 5090.D (January 2014), Chapter 27, "Cultural Resources Management," require the Navy to consider the effects of its undertakings on cultural resources in its planning and program efforts. SECNAVINST 4000.35a, Department of the Navy Cultural Resources Program, establishes policy and assigns responsibilities within the Department of the Navy for fulfilling the requirements of cultural resources laws such as the NHPA.

The Navy concluded consultation with the SHPO regarding the potential effect of the LWI structure on the visual context and aesthetic environment of EHW-1 and Delta Pier, both of which are identified as historic properties within the APE. The Navy has determined there is no adverse effect on the NRHP eligibility of either historic property. For the SPE project, the Navy determined there were no NRHP-eligible buildings or structures within the SPE APE and that the project would have no effect on historic properties. The SHPO has concurred with the Navy's determinations of no effect for both the LWI and SPE projects (letters dated July 30, 2015, and October 7, 2015, respectively). The Navy is in consultation with Skokomish Indian Tribe, Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, and

Suquamish Tribe as required by the implementing regulations of Section 106 of the NHPA (36 CFR 800.4(a)(4)).

3.13.2. Environmental Consequences

Under federal law, a project may lead to effects on cultural resources (whether the resources are archaeological, architectural, or traditional) if the resources are listed in or are eligible for listing in the NRHP or are important to traditional cultural groups, such as American Indians. An NRHP-listed or eligible resource is known as a historic property. An action results in adverse effects on a historic property when it alters any of the resource's characteristics that make the historic property eligible for the NRHP, including relevant features of its environment or use.

3.13.2.1. APPROACH TO ANALYSIS

Analysis of impacts on cultural resources considers both direct and indirect impacts. Direct impacts may occur by physically altering, damaging, or destroying all or part of a resource; altering characteristics of the surrounding environment that contribute to the resource's importance; introducing visual or audible elements that are out of character with the property or alter its setting; or neglecting the resource to the extent that it deteriorates or is destroyed. Direct impacts can be assessed by identifying the types and locations of activities and determining the exact location of cultural resources that could be impacted. For example, introducing traffic to a previously quiet location could be considered an impact. Indirect impacts could result from project-related features that lead to effects that are removed in time or space from the action. For example, project-induced population increases could result in inadvertent impacts on cultural resources, including trampling and erosion or an increase in the potential for vandalism.

In all cases, the Navy would comply with Section 106 of the NHPA (Section 3.13.1.2), which requires the completion of consultation with the Washington SHPO and appropriate tribes.

3.13.2.2. LWI PROJECT ALTERNATIVES

3.13.2.2.1. LWI ALTERNATIVE 1: NO ACTION

Under the No Action Alternative, the LWI would not be constructed, overall operations would not change from current levels, and there would be no effect on historic properties. The Navy would continue to manage its cultural resources in accordance with Navy regulations and the NHPA.

3.13.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

CONSTRUCTION

All shoreline and upland areas with the potential for ground-disturbing activities have been surveyed (HRA 2013; Stell Environmental Enterprises and Cardno TEC 2013). The staging area for the LWI construction would be a 5.4-acre (2.2-hectare) site near the intersection of Archerfish and Seawolf Roads (Figure 2–1). This highly disturbed site has been used for staging other construction projects and was not surveyed for this project because the project would not result in further ground disturbance of the site.

Although the saltwater shoreline is generally sensitive for the presence of cultural resources, this particular shoreline is considered to have a low probability for the presence of unrecorded, significant archaeological resources due to the extent of prior disturbance. This was substantiated by the results of the archaeological survey and testing (Grant et al. 2010; Grant 2011; HRA 2013). One archaeological site, 45KP212, is located within the direct APE at the south LWI project area, and extends inland. Site 45KP212 is located in an extremely disturbed context, lacks integrity, and is not eligible for listing in the NRHP. Site 45KP108 is outside the APE.

No shipwrecks or submerged aircraft have been located in the APE. Although it is possible that isolated artifacts associated with fishing or marine mammal hunting may exist offshore in the submerged portion of the APE, there is low probability for the presence of intact inundated Paleo-Indian or early Holocene archaeological sites or features owing to destructive processes associated with sea level rise. Any evidence of pre-contact and early historic-period occupation and resource harvesting activities that may have existed likely would have succumbed to heavy disturbance of the shoreline caused by development of the shoreline for NAVBASE Kitsap Bangor facilities, such as the existing Delta Pier and EHW-1, construction of the causeway over Devil's Hole, and other shoreline activity (HRA 2011). During construction of the LWI south abutment, a portion of the existing anti-submarine/anti-torpedo wooden baulks at the north end of the Devil's Hole Causeway would be demolished. This would not be a significant impact because this architectural resource is not eligible for listing in the NRHP.

Two NRHP-eligible buildings or structures are located within the APE for visual effects: EHW-1 and Delta Pier (Table 3.13–2). Although neither would be modified or demolished as part of this alternative, the LWI would be a visible project element from both of these resources. The Navy determined that construction of the LWI would not adversely affect either the immediate setting of historic properties or association with their historic landscapes. The SHPO concurred with the Navy's determination on July 30, 2015.

Table 3.13–2. NRHP-Eligible Buildings/Structures Located in the Area of Potential Effect for Direct and Indirect Effects

Facility	Facility Number	Date Built	NRHP Status	Effect*
Delta (Refit) Pier	7400	1978	Eligible	No Adverse Effect
Explosives Handling Wharf-1	7501	1978	Eligible	No Adverse Effect

Based on a viewshed analysis (Sackett 2010) completed for a similarly located project, the viewshed of both Delta Pier and EHW-1 would be impacted by this alternative. Although the south LWI would lie between Delta Pier and areas to the south, the fence and towers would not block the view of Delta Pier enough to constitute an adverse effect. Similarly, the view from Delta Pier towards the south would not be adversely affected by the presence of the fence and towers, as the construction would be consistent with the scale and function of the nearby facilities. At the north LWI project site, the pier structure would not be prominently visible from the shore side of EHW-1, but it might be apparent from EHW-1 itself. However, the view toward the shore through the LWI would not be significantly blocked by the pier, fence, and towers. In accordance with Section 106 of the NHPA, the Navy consulted with the SHPO, seeking concurrence with the determination of no adverse effect on EHW-1 and Delta (or Refit) Pier. The SHPO concurred with the Navy's determination on July 30, 2015. No other known or identified historic properties are within the project viewshed.

Construction-related noise and traffic associated with the Proposed Action would not affect historic properties because it would be consistent with ongoing operation and maintenance of the existing facilities. The two NRHP-eligible buildings, Delta Pier and EHW-1, should not be affected by vibrations associated with the construction. Additional personnel associated with construction of this alternative would not constitute a significant source of indirect impacts. The Navy would ensure that construction crews are aware that any cultural resources discovered during any construction activity should not be disturbed, and crews would be instructed in procedures for reporting any such finds.

Although no TCPs or PTRCITs have been located within the LWI APE, a traditional shellfish harvesting area is located within the south LWI project site (see Section 3.14). Earth disturbing activities in the south LWI project area would be monitored by a professional archaeologist and a tribal cultural observer if requested by the affected tribes. In the unlikely event that items subject to NAGPRA are encountered, the Navy would implement a NAGPRA Plan of Action specifically developed for the south LWI project area or an installation-wide NAGPRA Comprehensive Agreement if one is in place at the time of construction. In the extremely unlikely event of encountering undisturbed archaeological resources that have the potential to yield information important in prehistory or history (e.g., an intact, datable feature surviving within 45KP212), the Navy would consult with the Washington SHPO and affected tribes and address the find in accordance with the post-review discovery clause of Section 106 of the NHPA (36 CFR Part 800.13(b)(3)).

OPERATION/LONG-TERM IMPACTS

Impacts on EHW-1 and Delta Pier related to the operation and maintenance of the LWI would be a continuation of the impacts from construction because the effect is primarily to setting. The presence of the north and south LWI would continue to affect the view from EHW-1 and Delta Pier, respectively, as well as the view to both of these historic properties from both the shore and from Hood Canal, but this would not be an adverse effect because the new structures would fit in with the current level of shoreline construction and would be consistent with the existing facilities. No other historic properties would be affected. Since there would be no additional ground disturbance, it is extremely unlikely that any previously undiscovered archaeological resources that might be present would be impacted through operations. Maintenance, as distinct from operation, associated with this alternative would have no impact on any historic property, since routine inspections, repair, and replacement of LWI, as required, would occur within the footprint of the existing structures.

3.13.2.2.3. LWI Alternative 3: PSB Modifications (Preferred)

CONSTRUCTION

Project areas with the potential for ground-disturbing activities are the same for LWI Alternative 3 as for LWI Alternative 2, and have been surveyed (HRA 2013; Stell Environmental Enterprises and Cardno TEC 2013). Sensitivity for the presence of previously unknown cultural resources is also the same, so that although the saltwater shoreline is generally sensitive for the presence of cultural resources, this particular shoreline is considered to have a low probability for the presence of unrecorded, significant archaeological resources due to the extent of prior disturbance, as substantiated by the results of the archaeological survey (HRA 2013; Stell Environmental Enterprises and Cardno TEC 2013). The archaeological resource that has been located along the shoreline and extends inland within the project APE (site 45KP212) is located in an extremely disturbed context, lacks integrity, and is not eligible for listing in the NRHP. No shipwrecks or submerged aircraft have been located in the APE. Demolition of a portion of the existing anti-submarine/anti-torpedo wooden baulks at the north end of the not-eligible Devil's Hole Causeway would not be a significant impact.

As with LWI Alternative 2, two NRHP-eligible buildings or structures are located within the APE for visual effects: EHW-1 and Delta Pier (Table 3.13–2). Neither would be modified or demolished as part of this alternative, although the LWI would be a visible project element from both of these buildings or structures. The Navy consulted with the SHPO, seeking concurrence on their determination that construction of the LWI would not adversely affect either the immediate setting of historic properties or association with their historic landscapes. The SHPO concurred with the Navy's determination on July 30, 2015.

As with LWI Alternative 2, the impact on the viewshed of both Delta Pier and EHW-1 would not constitute an adverse effect, nor would the view from Delta Pier toward the south be adversely affected by the presence of the PSBs or shoreline abutment, as the construction would be consistent with the scale and function of the nearby facilities. This finding of effect is based on a viewshed analysis (Sackett 2010) completed for a similarly located project. The situation at the north LWI project site is the same as for LWI Alternative 2, where the PSBs and shoreline abutment would not be prominently visible from the shore side of EHW-1, but might be apparent from EHW-1 itself. However, the view toward the shore through the LWI would not be significantly blocked by the PSB. In accordance with Section 106 of the NHPA, the Navy consulted with the SHPO, seeking concurrence with the determination of no adverse effect on EHW-1 and Delta (or Refit) Pier. The SHPO concurred with the Navy's determination on July 30, 2015. No other known or identified historic properties are within the project viewshed.

As with LWI Alternative 2, construction-related noise and traffic associated with the Proposed Action would not affect historic properties because it would be consistent with ongoing operation and maintenance of the existing facilities, and the two NRHP-eligible buildings, Delta Pier and EHW-1, should not be affected by vibrations associated with the construction. Additional personnel associated with construction of this alternative would not constitute a significant source of indirect impacts. Earth disturbing activities in the south LWI project area would be monitored by a professional archaeologist and a tribal cultural observer if requested by the affected tribes. In the unlikely event that items subject to NAGPRA are encountered, the Navy would implement a NAGPRA Plan of Action specifically developed for the south LWI project area or an installation-wide NAGPRA Comprehensive Agreement if one is in place at the time of construction. In the extremely unlikely event of encountering undisturbed archaeological resources that have the potential to yield information important in prehistory or history (e.g., an intact, datable feature surviving within 45KP212), the Navy would consult with the Washington SHPO and affected tribes and address the find in accordance with the post-review discovery clause of Section 106 of the NHPA (36 CFR Part 800.13(b)(3).

OPERATION/LONG-TERM IMPACTS

Impacts on EHW-1 and Delta Pier related to the operation and maintenance of LWI Alternative 3 would be the same as for LWI Alternative 2: a continuation of the impacts from construction because the effect is primarily on setting. The presence of the north and south LWI structures would continue to affect the view from EHW-1 and Delta Pier, respectively, as well as the view to both of these historic properties from both the shore and from Hood Canal, but this would not be an adverse effect because the new structures would fit in with the current level of shoreline construction and would be consistent with the existing facilities. No other historic properties would be affected. Since there would be no additional ground disturbance, it is extremely unlikely that any previously undiscovered archaeological resources that might be present would be impacted through operations. Maintenance, as distinct from operation, associated with this alternative would have no impact on any historic property, since routine inspections, repair, and replacement of LWI, as required, would occur within the footprint of the existing structures.

3.13.2.2.4. SUMMARY OF LWI IMPACTS

Impacts on cultural resources associated with the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.13–3.

Table 3.13–3. Summary of LWI Impacts on Cultural Resources

Alternative	Environmental Impacts on Cultural Resources
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Pier	*Construction:* No adverse effect on Delta Pier and EHW-1. Low potential for encountering undisturbed archaeological deposits and NAGPRA items in site 45KP212. *Operation/Long-term Impacts:* No adverse effect on Delta Pier and EHW-1.
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* No adverse effect on Delta Pier and EHW-1. Low potential for encountering undisturbed archaeological deposits and NAGPRA items in site 45KP212. *Operation/Long-term Impacts:* No adverse effect on Delta Pier and EHW-1.
Mitigation: Current practices to avoid, minimize, or mitigate adverse impacts on historic properties are described in Section 3.13.1.2. In the event of the discovery of archaeological resources with the potential to yield important information, the Navy would develop and implement mitigation measures in consultation with the SHPO and affected American Indian tribes, and possibly the ACHP. In the event of inadvertent discovery of American Indian remains, funerary items, sacred objects, or items of cultural patrimony, the Navy would implement project-specific NAGPRA Plan of Action or Comprehensive Agreement to repatriate the items subject to NAGPRA.	
Consultation and Permit Status The Navy concluded Section 106 consultation with the SHPO for historic resources. Consultation with American Indian tribes is ongoing. The Navy will consult with SHPO and affected American Indian tribes, and possibly the ACHP, in the event of the discovery of archaeological resources with the potential to yield important information. In the event NAGPRA items are discovered they will be subject to a project-specific Plan of Action or installation Comprehensive Agreement, if one is in place at the time of the discovery. No permits are required.	

ACHP = Advisory Council on Historic Preservation; NAGPRA = Native American Graves Protection and Repatriation Act; SHPO = State Historic Preservation Officer

3.13.2.3. SPE PROJECT ALTERNATIVES

3.13.2.3.1. SPE ALTERNATIVE 1: NO ACTION

Under the No-Action Alternative, the Service Pier would not be extended, overall operations would not change from current levels, and there would be no effect on historic properties. The Navy would continue to manage its cultural resources in accordance with Navy regulations and the NHPA.

3.13.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

CONSTRUCTION

Project elements include in- or over-water features and shoreline or inland features. In- and over-water features include the pier extension, pier crane, and Pier Services and Compressor Building location on the Service Pier. The latter two facilities would be built on the pier, requiring no additional disturbance. A search of recorded archaeological sites on the WISAARD showed no submerged resources within a 1-mile search radius of the shoreline (HRA 2013). Due to the amount of development along the Bangor shoreline, it is unlikely that there are undocumented historic-period resources present. There is a low likelihood that intact prehistoric archaeological deposits or features are present along the submerged shoreline, due to Holocene sea level changes and their associated erosion of the Hood Canal coastline.

Shoreline or in-land features include the Waterfront Ship Support Building to be located on an existing parking lot, a new parking lot, a shoreside emergency generator facility on a new concrete pad, road improvements, and a laydown area to be located on the existing parking lot where the Waterfront Ship Support Building would be built. The SPE upland APE has been surveyed for archaeological and architectural resources. None were located that meet the criteria for NRHP eligibility. Because of its location in a small cove, the SPE would not be visible from any historic properties, including Delta Pier and EHW-1, so there would be no impact on the viewshed of any NRHP-eligible resources. The SHPO concurred with the Navy's determination on October 7, 2015.

Because of the lack of NRHP-eligible resources within the APE, construction of SPE Alternative 2 would have no effect on historic properties. No TCPs or PTRCITs have been identified to date within the APE. The SHPO concurred with the Navy's determination on October 7, 2015.

Earth disturbing activities in the SPE project area would be monitored by a professional archaeologist and a tribal cultural observer if requested by the affected tribes. In the unlikely event that items subject to NAGPRA are encountered, the Navy would implement a NAGPRA Plan of Action specifically developed for the SPE project area or an installation-wide NAGPRA Comprehensive Agreement if one is in place at the time of construction. In the extremely unlikely event of encountering undisturbed archaeological resources that have the potential to yield information important in prehistory or history, the Navy would consult with the Washington SHPO and affected tribes and address the find in accordance with the post-review discovery clause of Section 106 of the NHPA (36 CFR Part 800.13(b)(3)).

OPERATION/LONG-TERM IMPACTS

Because there are no NRHP-eligible resources within the SPE APE, there would be no impacts on historic properties from operation and maintenance of the SPE Alternative 2 facility.

3.13.2.3.3. SPE ALTERNATIVE 3: LONG PIER

CONSTRUCTION

The difference between SPE Alternative 3 and the SPE Alternative 2 would only be the length of the pier. Since there are no NRHP-eligible resources within the SPE APE, the long pier would also have no effect on historic properties. Notwithstanding, the approach described above for Alternative 2 for unexpected discoveries would also be used for Alternative 3.

OPERATION/LONG-TERM IMPACTS

Similar to SPE Alternative 2, there would be no impacts on historic properties from operation and maintenance of the SPE Alternative 3 facility.

3.13.2.3.4. SUMMARY OF SPE IMPACTS

Impacts on cultural resources associated with the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.13–4.

Table 3.13–4. Summary of SPE Impacts on Cultural Resources

Alternative	Environmental Impacts on Cultural Resources
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	Construction: Low potential for encountering undisturbed archaeological deposits and NAGPRA items. Operation/Long Term Impacts: No impact.
SPE Alternative 3: Long Pier	Construction: Low potential for encountering undisturbed archaeological deposits and NAGPRA items. Operation/Long Term Impacts: No impact.
Mitigation: Current practices to avoid, minimize, or mitigate adverse impacts on historic properties are described in Section 3.13.1.2. In the event of the discovery of archaeological resources with the potential to yield important information, the Navy would develop and implement mitigation measures in consultation with the SHPO and affected American Indian tribes, and possibly the ACHP. In the event of inadvertent discovery of American Indian remains, funerary items, sacred objects, or items of cultural patrimony, the Navy would implement project-specific NAGPRA Plan of Action or Comprehensive Agreement to repatriate the items subject to NAGPRA.	
Consultation and Permit Status The Navy concluded Section 106 consultation with the SHPO for historic resources. Consultation with American Indian tribes is ongoing. The Navy will consult with SHPO and affected American Indian tribes, and possibly the ACHP, in the event of the discovery of archaeological resources with the potential to yield important information. In the event NAGPRA items are discovered they will be subject to a project-specific Plan of Action or installation Comprehensive Agreement, if one is in place at the time of the discovery. No permits are required.	

ACHP = Advisory Council on Historic Preservation; NAGPRA = Native American Graves Protection and Repatriation Act; SHPO = State Historic Preservation Officer

3.13.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

Continued construction projects and modifications to Navy facilities have the potential to adversely affect historic properties. While unlikely to result in adverse impacts, construction-related clearing and excavation operations associated with the proposed LWI and SPE actions could inadvertently disturb unknown archaeological resources. The LWI project would have an impact, but not an adverse impact, on two historic properties: the Delta Pier and EHW-1. These NRHP-eligible historic properties are both significant based on their Cold War–era associations. The SPE project would have no impact on historic properties, with the result that the two projects together would have no combined adverse impact on historic properties.

3.14. AMERICAN INDIAN TRADITIONAL RESOURCES AND TRIBAL TREATY RIGHTS

Protected tribal resources, as defined in DoD Instruction 4710.02, *DoD Interactions with Federally Recognized Tribes*, are "those natural resources and properties of traditional or customary religious or cultural importance, either on or off Indian lands, retained by or reserved by or for Indian Tribes through treaties, statutes, judicial decisions, or EOs, including tribal trust resources." Tribal trust resources are defined as "Indian lands or treaty rights to certain resources." These resources include plants, animals, and locations associated with hunting, fishing, and gathering activities for subsistence or ceremonial use. For the purposes of this section, the term "traditional resources" will be used to encompass protected tribal resources.

In accordance with DoD and Navy policies, the Navy invites government-to-government consultation with federally-recognized tribal governments when a proposed action may have the potential to significantly affect tribal rights, protected resources, or Indian lands. The Navy has completed government-to-government consultation with federally recognized tribes that use the resources in the vicinity of the project area.

American Indian traditional cultural properties and potential effects to any historic properties are discussed in Section 3.13 (Cultural Resources).

3.14.1. Affected Environment

The Navy consults with federally recognized American Indian tribes on actions with the potential to significantly affect protected tribal resources, tribal rights, or American Indian lands. The following tribes have tribal treaty rights in the project sites: Skokomish Indian Tribe, the Port Gamble S'Klallam Tribe, the Jamestown S'Klallam Tribe, the Lower Elwha Klallam Tribe, and the Suquamish Tribe.

3.14.1.1. EXISTING CONDITIONS

3.14.1.1.1. TRIBAL TREATY RIGHTS AND TRUST RESPONSIBILITIES; RESERVATION OF RIGHTS BY AMERICAN INDIANS

Treaties with American Indian tribes are considered government-to-government agreements, similar to international treaties, and preempt state laws. Tribal treaty rights are not affected by later federal laws (unless Congress clearly abrogates treaty rights). Treaty language securing fishing and hunting rights is not a "grant of rights (from the federal government to the Indians), but a grant of rights from them — a reservation of those not granted" (*United States v. Winans,* 25 S. Ct. 662, [1905]). This means that the tribes retain rights not specifically surrendered to the United States.

Furthermore, the United States has a trust or special relationship with American Indian tribes. This trust relationship provides the basis for legislation, treaties, and EOs that clarify the unique rights or privileges of American Indians. The trust responsibility has been interpreted to require federal agencies to carry out their activities in a manner that is protective of American Indian treaty rights. EO 13175, *Consultation and Coordination with Indian Tribal Governments,* affirms the trust responsibility of the United States and directs agencies to consult with American

Indian tribes and respect tribal sovereignty when taking actions affecting such rights. The Navy complies with this trust responsibility by complying with laws and regulations such as NEPA.

TREATIES OF POINT NO POINT AND POINT ELLIOT

The Treaty of Point No Point, " signed by Isaac I. Stevens, governor and superintendent of Indian affairs for the said Territory [of Washington], on the part of the United States, and the undersigned chiefs, headmen, and delegates of the different villages of the S'Klallams…, and also of the Sko-ko-mish, To-an-hooch, and Chem-a-kum tribes, occupying certain lands on the Straits of Fuca and Hood's Canal, in the Territory of Washington…" on January 26, 1855, secured these tribes the following:

> The right of taking fish at usual and accustomed grounds and stations is further secured to said Indians in common with all citizens of the Territory, and of erecting temporary houses for the purposes of curing, together with the privilege of hunting and gathering roots and berries on open and unclaimed lands. Provided, however, that they shall not take shell-fish from any beds staked or cultivated by citizens.

The Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam and Lower Elwha Klallam Tribes are signatories to this treaty. The U&A fishing grounds and stations for the Point No Point signatories encompass the co-use waterways and shorelines of Hood Canal and its tributaries, which include NAVBASE Kitsap Bangor (Point No Point Treaty Council [PNPTC] 2010).

The Suquamish Tribe secured the "right of taking fish at usual and accustomed grounds and stations" in the Treaty of Point Elliot, signed on January 22, 1855.

UNITED STATES V. WASHINGTON STATE

Known as the "Boldt Decision" after presiding U.S. District Court Judge George Boldt, *United States v. Washington* (384 F. Supp. 312 [W.D. Wash. 1974], aff'd, 520 F.2d 676 [9th Cir. 1975]) affirmed the rights of federally recognized Washington tribes (i.e., those who were party to the various treaties) to harvest fish in their usual and accustomed places, identified the U&A locations of various tribes, and also allocated 50 percent of the salmon and steelhead fishery to treaty tribes. The decision established that the Skokomish Indian Tribe, the Port Gamble S'Klallam Tribe, the Jamestown S'Klallam Tribe, the Lower Elwha Klallam Tribe, and the Suquamish Tribe have U&A fishing grounds and stations co-located in the project area.

At the heart of the decision was this interpretation of the treaty language from the Point No Point and Point Elliott treaties:

> By dictionary definition and as intended and used in the Indian treaties and in this decision, 'in common with' means sharing equally the opportunity to take fish ... therefore, non-treaty fishermen shall have the opportunity to take up to 50% of the harvestable number of fish ... and treaty right fishermen shall have the opportunity to take up to the same percentage. (U.S. District Judge George Boldt, *U.S. v. Washington*, 384 F. Supp. 312 [W.D. Wash. Feb 12 1974], aff'd, 520 F.2d 676 [9th Cir. 1975]).

In 1994, Federal District Court Judge Edward Rafeedie issued a decision regarding tribal treaty rights to take shellfish at U&A areas (United States v. Washington, 873 F. Supp 1422 [W.D. Wash. 1994]). This is commonly referred to as the "Rafeedie decision." Judge Rafeedie ruled that the treaties' "in common" language meant that the tribes had reserved harvest rights to half of all shellfish from all of the usual and accustomed places, except those places "staked or cultivated" by citizens – or those that were specifically set aside for non-Indian shellfish cultivation purposes.

"A treaty is not a grant of rights to the Indians, but a grant of rights from them," Judge Rafeedie wrote in his December 1994 decision, adding that the United States government made a solemn promise to the tribes in the treaties that they would have a permanent right to fish as they had always done. Judge Rafeedie ruled that all public and private tidelands within the case area are subject to treaty harvest, except for shellfish contained in artificially created beds. His decision requires tribes planning to harvest shellfish from private beaches to follow many time, place, and manner restrictions on harvest.

The U.S. Supreme Court declined to hear the case.

The Skokomish Indian Tribe's primary fishing rights in the waters of Hood Canal over those of other tribes granted rights under this treaty, particularly the Suquamish, was affirmed in a 1985 ruling by the Ninth Circuit Court of Appeals (*United States v. Skokomish Indian Tribe*, 764 F.2d 670 [9th Cir. 1985]). Since the 1985 court decision, the Suquamish Tribe must receive permission from the Skokomish Tribe to fish south of the Hood Canal Bridge; this permission has not been granted.

1993 CONGRESSIONAL LEGISLATION FOR PURCHASE OF TIDELANDS FOR NAVY MITIGATION OF TRIBAL TIDELAND ACCESS UNDER TREATIES IN PUGET SOUND

In 1993, pursuant to Public Law 102-396, § 9150 as amended, special legislation was enacted that authorized the Department of Defense to provide $5,000,000 to the State of Washington for the purchase of 1,500 acres of tidelands. The purpose of the acquisition was to mitigate responsibilities related to tideland access guaranteed under treaties between the federal government and American Indian tribes in the Puget Sound region, i.e., the Skokomish Indian Tribe, the Port Gamble S'Klallam Tribe, the Jamestown S'Klallam Tribe, the Lower Elwha Klallam Tribe, and the Suquamish Tribe. The Navy, on behalf of the U.S. Government and the State, executed a Memorandum of Agreement (MOA) wherein the State agreed to obtain tribal releases of treaty rights "for access to, or harvest of shellfish" located on these tidelands as long as the Navy installations in Puget Sound continued to exist. Since the mid-1990s, the State has purchased over 1,000 acres of tidelands that had been in private cultivation and were not available for tribal harvest until being purchased by the State.

3.14.1.1.2. American Indian Access and Use at NAVBASE Kitsap Bangor

The history of American Indians in Puget Sound and their use of the project area and Hood Canal are summarized in Section 3.13.1.1.1.

3.14.1.1.3. TRADITIONAL RESOURCES

NAVBASE Kitsap Bangor property and the controlled waterfront Navy restricted area are co-located in the adjudicated U&A fishing area for the Skokomish Indian Tribe, Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe. These tribes are signatory to the 1855 Treaty of Point No Point.

These Tribes currently have access to conduct shellfish harvests (clams and oysters) and shellfish seeding (clams and oysters). There have been no occurrences of the Tribes to gather cedar bark or medicinal plants even though this type of gathering has been offered to the Tribal staffs.

TRADITIONAL RESOURCES AT THE LWI PROJECT SITES

Devil's Hole Beach at NAVBASE Kitsap Bangor is located at the south LWI project site. In 1997, the Navy and the Skokomish Indian Tribe, Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe entered into a cooperative agreement for access to Devil's Hole Beach for shellfish harvesting (clams and oysters). The agreement gives the Tribes authority to manage the shellfish at the beach. This estimated 18-acre beach is located south of Delta Pier within the waterfront Navy restricted area and is known by the Tribes as "Bangor Beach." The cooperative agreement was established in response to ongoing litigation regarding the treaty tribes' rights to access and harvest shellfish in U&A areas referred to in the 1994 Rafeedie decision. At the time, all beaches at NAVBASE Kitsap Bangor were evaluated by the Navy and by the four Tribes, and Devil's Hole Beach was determined to be the Tribes' 50 percent share of the available, naturally occurring shellfish resources.

The Tribes harvest clams and oysters at Devil's Hole Beach approximately four times per year. Typically, the three S'Klallam Tribes harvest on the same day(s), and the Skokomish Indian Tribe harvests separately on other days. Harvests usually occur during low tide. The Tribes have also seeded clams and oysters at Devil's Hole Beach as recently as 2014 and 2015. Access to Devil's Hole Beach by tribal members is allowed only by land, not by water, and is coordinated with Navy personnel to ensure compliance with Navy safety and security policies.

Tribal fisheries (shellfish and finfish) in Hood Canal and near the south and north LWI project sites are managed by the PNPTC for shellfish (discussed in Section 3.2) and salmonid species (discussed in Section 3.3). Tribal finfishing (or any recreational or commercial finfishing) is not allowed within the water area contained by the PSB of the waterfront Navy restricted area. In accordance with the 1997 Navy-Tribal cooperative agreement, no tribal fishing (e.g., finfishing, crabbing, shellfishing, subtidal geoduck, shrimping, etc.) occurs at the north LWI project site, which is inside the waterfront Navy restricted area.

Marine water resources associated with the LWI, including longshore sediment transport, are discussed in Section 3.1; marine vegetation and invertebrates are discussed in Section 3.2.

TRADITIONAL RESOURCES AT THE SPE PROJECT SITE

In accordance with the 1997 Navy-Tribal cooperative agreement, no tribal fishing (e.g., finfishing, crabbing, shellfishing, subtidal geoduck, shrimping, etc.) occurs at the SPE project site due to its location within the waterfront Navy restricted area.

Salmonid species that may be present in the vicinity of the SPE project site are discussed in Section 3.3; marine water resources, including longshore sediment transport, are discussed in Section 3.1; and marine vegetation and invertebrates are discussed in Section 3.2. No other known traditional resources are located at the SPE project site.

3.14.1.2. CURRENT REQUIREMENTS AND PRACTICES

3.14.1.2.1. DoD and Navy Policies Regarding Tribal Consultation

On October 21, 1998, DoD promulgated its Native American and Alaska Native Policy, emphasizing the importance of respecting and consulting with tribal governments on a government-to-government basis (explanatory text was added on November 21, 1999). The policy requires an assessment, through consultation, of the effects of proposed DoD actions that may have the potential to significantly affect protected tribal resources (including traditional resources such as shellfish and fisheries), tribal rights (such as access to fisheries), and American Indian lands before decisions are made by the DoD services.

In 2005, the Navy updated its policy for consultation with federally recognized Indian tribes. Secretary of the Navy Instruction (SECNAVINST) 11010, *Department of the Navy Policy for Consultation with Federally Recognized Indian Tribes*, implements DoD policy within the Department of the Navy and encourages ongoing consultation. Subsequent updates to SECNAVINST 5090.8a (*Policy for Environmental Protection, Natural Resources, and Cultural Resources Programs 2006*) also mandate American Indian consultation.

In 2009, Commander, Navy Region Northwest issued its *Policy for Consultation with Federally-Recognized American Indian and Alaska Native Tribes* (Instruction 11010.14 of November 10, 2009) which sets forth policy, procedures, and responsibilities for consultations with federally recognized American Indian and Alaska Native Tribes in the Navy Region Northwest area of responsibility. The goal of the policy is to establish permanent working relationships built upon respect, trust, and openness with tribal governments.

Under these policies, the Navy is required to consider tribal comments and concerns prior to making a Navy final decision on a proposed action. However, reaching formal agreement with a tribe or obtaining tribal approval prior to a Navy final decision is not required.

3.14.1.2.2. Laws, Executive Orders, and Memoranda Mandating Consultation

In addition to the specific policy and SECNAVINST cited above, other federal laws, executive orders, and memoranda include policies requiring consultation with American Indians regarding concerns specific to Native interests. These include the following: NHPA, AIRFA, Archaeological Resources Protection Act, NAGPRA, EO 12898 *Environmental Justice*, EO 13007 *Indian Sacred Sites*, EO 13175 *Consultation and Coordination with Indian Tribal Governments,* the Presidential Memorandum dated November 5, 2009 emphasizing agencies' need to comply with EO 13175, and the Presidential Memorandum dated April 29, 1994, *Government-to-Government Relations with Native American Governments*.

3.14.1.2.3. GOVERNMENT-TO-GOVERNMENT CONSULTATION

In accordance with DoD policy and Navy instructions, the Navy invited government-to-government consultation regarding the Proposed Actions with the five federally recognized American Indian tribes that have treaty reserved rights and traditional resources in the project area: the Skokomish Indian Tribe, Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, and Suquamish Tribe.

The Navy and the Skokomish Indian Tribe have conducted government-to-government consultations to discuss the nature, scope, and schedule of the Navy's Proposed Actions since May 2008 for the LWI project and July 2012 for the SPE project. The consultations have focused on measures to address the potential effects of the projects on reserved tribal treaty rights and resources. On March 3, 2016, the Navy and the Skokomish Indian Tribe completed a MOA to undertake treaty mitigation projects for LWI and SPE by contributing funding to support the Skokomish River Basin restoration, with the terms and conditions of the MOA to apply only after the Navy begins in-water construction. The Skokomish River Basin Ecosystem Restoration Project is described in Appendix C: Mitigation Action Plan, Section 9.1.1.

The Navy and the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe have conducted government-to-government consultation to discuss the nature, scope, and schedule of the Navy's Proposed Actions since 2008 for the LWI project and 2012 for the SPE project. Although the Navy and these Tribes were not able to reach formal agreement on treaty mitigation projects at the time of publication of this FEIS, the Navy carefully considered tribal concerns regarding the Proposed Actions and assessed the potential for significant impact to tribal rights and protected resources. Based on the Navy's assessment, the Navy offered to fund one or more of the following treaty mitigation projects.

For LWI:

- Shellfish seeding and beach enhancement at locations off Navy property;
- Development and implementation of a floating upweller system (FLUPSY) management plan; and
- Kilisut Harbor Restoration Project.

For SPE:

- Shellfish seeding and beach enhancement at locations off Navy property; and
- Culvert replacement at Little Boston Road over Shipbuilders Creek.

The proposed treaty mitigation projects are described in Appendix C: Mitigation Action Plan, Section 9.2.

In addition to the Navy's funding treaty mitigation projects to mitigate for potential impacts to tribal rights and protected resources, the Navy would also provide compensatory mitigation under the USACE/USEPA *Compensatory Mitigation Rule for Loss of Aquatic Resources* that will also mitigate for impacts to some of the same treaty protected marine aquatic resources.

3.14.2. Environmental Consequences

3.14.2.1. APPROACH TO ANALYSIS

The evaluation of impacts on traditional resources considers whether the resource itself is significantly affected or if there is a significant change in access to the resource. Impacts may be clearly identified, as when a known traditional resource is directly and significantly affected or access is significantly changed. Consultation with potentially affected tribal governments of federally recognized American Indian tribes is necessary so that the Navy can carefully consider and evaluate the extent of any significant adverse effects and to reach agreement on appropriate treaty mitigation projects and/or measures.

3.14.2.2. LWI PROJECT ALTERNATIVES

3.14.2.2.1. LWI ALTERNATIVE 1: NO ACTION

With the No Action Alternative, the LWI project would not be constructed and overall operations would not change from current levels. The Navy would continue to manage traditional resources located on NAVBASE Kitsap Bangor in accordance with Navy policies, laws and regulations and the Navy would continue coordination with the Tribes to access to Devil’s Hole Beach for shellfish harvest in accordance with the 1997 cooperative agreement. There would be no change to the Tribes’ access to Devil’s Hole Beach. Therefore, there is no potential to significantly affect traditional resources at the LWI project sites.

3.14.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

CONSTRUCTION

The north and the south LWI project sites are located in the NAVBASE Kitsap Bangor waterfront Navy restricted area. At the north LWI project site, the Tribes do not have authorized access for fishing (finfish or shellfish) due to security and operational requirements. The south LWI project site is located at the north end of Devil’s Hole Beach where the Tribes currently harvest shellfish (clams and oysters). The Navy would continue to coordinate with the Tribes for continued access to Devil’s Hole Beach for shellfish harvests. During construction of the south LWI, there would be temporary loss of access to an estimated 0.68 acre (0.28 hectare) of shellfish resources for up to 2 years due to the safety zone established for construction activities and equipment. Recovery of shellfish resources in temporarily disturbed areas is expected to occur within 5 years after in-water construction activities have ceased. (Impacts to benthic resources are described in Section 3.2.2.2.2.) Current conditions at the NAVBASE Kitsap Bangor waterfront include ambient noise from everyday military operations; construction noise would include sounds from equipment, vessels, and pile driving. Since the Tribes would continue to access Devil’s Hole Beach approximately four times a year, construction impacts are not expected to have a significant effect on traditional resources. (Impacts to cultural resources are described in Section 3.13.)

Tribal fisheries outside of the naval restricted area (i.e., where construction would occur as described in Chapter 2) are focused on salmonid species. As discussed in Section 3.3.2.2, construction within the in-water work window (between July 15 and January 15), with the exception of non-pile driving in-water work, would minimize impacts on all juvenile salmonid species. Therefore, there are no anticipated significant impacts expected on juvenile salmonids from construction.

Adult salmonids return to Hood Canal during the in-water work window. Construction may impact adult salmon and steelhead that could be harvested by the tribes because pile driving (impact and vibratory) would be conducted during adult salmon and steelhead return to Hood Canal, which may cause the salmon and steelhead to move to a different location within Hood Canal. During construction, it is possible that adult salmon and steelhead could come within the injury zone of the impact hammer. No injury zone has been identified for vibratory hammers. Since juvenile salmon and steelhead are predominantly out of the area during the in-water work window, impacts on future salmon and steelhead populations are not anticipated. Although some adult salmon and steelhead could be injured during impact pile driving, the impact would be localized. Therefore, no significant impacts on the overall quantity of available adult salmon and steelhead in Hood Canal are expected during construction of the LWI project.

NAVBASE Kitsap Bangor waterfront construction and military activities are ongoing. While intermittent elevated noise (airborne noise and in-water sound) can be expected during construction, the highest intensity noise would be limited to the immediate vicinity of the construction activities. Non-military divers are not authorized to be in waters in the project area because of access restrictions associated with the Navy restricted areas. Divers in waters farther away from the construction areas and project area, including tribal divers engaged in resource harvest (e.g., geoduck harvests), may experience temporarily elevated noise conditions, but levels are not expected to differ appreciably from the range of noise typically generated in the heavily used waters of Hood Canal.

The transit of construction-related barges and vessels to and from NAVBASE Kitsap Bangor has the potential to interfere with tribal fishing in the co-use navigable marine waterways adjacent to NAVBASE Kitsap Bangor and along the transit route through Hood Canal. The Navy estimates that approximately 16 barge round-trips over the 2-year construction period could occur, or less than one round-trip per month. Considering that these transits would be inherently temporary, northern Hood Canal is over 2 miles wide on average, and vessel traffic in Hood Canal is sparse, it is expected that construction vessels would be able to avoid tribal fishing vessels in most instances. Therefore, this additional in-water traffic would not significantly affect tribal access to U&A fishing areas and traditional resources in Hood Canal during the 2-year construction time frame.

OPERATION/LONG-TERM IMPACTS

At the south LWI project site, construction of the LWI pier would divide Devil's Hole Beach into two sections (see figure 2.1). The Tribes would not be allowed to go around or under the pier and mesh barrier due to security restrictions. However, the Navy would continue to coordinate with the Tribes and Navy security personnel for access to both portions of Devil's Hole Beach for shellfish harvests. Approximately 0.043 acre (0.017 hectare) of shellfish resources would be permanently lost due to pilings installation. This equates to a loss of 0.023 percent of the overall estimated 18 acres of shellfish beach. This decrease is not expected to significantly impact tribal shellfish harvests. LWI Alternative 2 is not expected to alter water flow or along-shore sediment transport (Section 3.1.2.2.2) to the extent that shellfish resources at Devil's Hole Beach or sediments at the north LWI project site would be affected. The tribes harvest an average of approximately 30,000 dozen oysters per year at NAVBASE Kitsap Bangor, with an estimated commercial value of $180,000. The $2,208 annual loss (see Section 3.11.2.2.2) would represent approximately 1.2 percent of annual tribal income from this source. The toes of both abutments would be at or above the mean higher high water line. No other direct impacts would be anticipated for shellfish harvest at Devil's Hole Beach or fisheries as a result of operation and maintenance of the LWI at both the north and south project sites. The presence of the pier and mesh structures is expected to impede migration of juvenile salmon along the Bangor waterfront (Section 3.3.2.2.2). Considering the full life history and all mortality sources for the affected salmon species, however, an overall minimal effect on salmon populations and tribal harvest of salmon and steelhead is expected.

3.14.2.2.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

CONSTRUCTION

Impacts from construction of LWI Alternative 3 would be similar in nature to impacts from Alternative 2, with the notable exception that there would be no in-water pile driving and related impacts on tribal fisheries or non-military divers, and the impacts would be of lesser magnitude. In accordance with the 1997 Navy-Tribal cooperative agreement, no tribal fishing (e.g., finfishing, crabbing, shellfishing, subtidal geoduck, shrimping, etc.) occurs at the north LWI project site, which is inside the waterfront Navy restricted area.

The south LWI project site is located at the north end of Devil's Hole Beach where the Tribes currently harvest shellfish (clams and oysters). The Navy would continue to coordinate with the Tribes for continued access to Devil's Hole Beach for shellfish harvests. During construction of the south LWI, there would be temporary loss of access to an estimated 0.64 acre (0.26 hectare) of shellfish resources for up to 2 years due to the safety zones established for construction activities and equipment. Potential construction impacts to shellfish resources would be much less than under Alternative 2. Similar to Alternative 2, recovery of shellfish resources in temporarily disturbed areas is expected to occur within 5 years after in-water construction activities have ceased. (Impacts to benthic resources are described in Section 3.2.2.2.2.) Current conditions at the NAVBASE Kitsap Bangor waterfront include ambient noise from everyday military operations; construction noise would include sounds generated by equipment, vessels, and pile driving for abutments. Since the Tribes would continue to access Devil's Hole Beach approximately four times a year, potential construction impacts are not expected to have a significant effect on traditional resources. (Impacts to cultural resources are described in Section 3.13.)

Tribal fisheries in the vicinity of both the north and south LWI project sites are focused on salmonid species. As discussed in Sections 3.3.2.2 and 3.14.2.2.2, construction within the in-water work window (between July 15 and January 15), with the exception of non-pile driving in-water work, would minimize impacts on all juvenile salmonid species. Therefore, significant impacts on juvenile salmonids are not expected from construction.

The transit of construction-related barges and vessels to and from NAVBASE Kitsap Bangor has the potential to interfere with tribal fishing in the co-use navigable marine waterways adjacent to NAVBASE Kitsap Bangor and along the transit route through Hood Canal. The Navy estimates that approximately three (3) barge round-trips over the 2-year construction period could occur under Alternative 3. Considering that these transits would be inherently temporary, northern Hood Canal is over 2 miles wide on average, and vessel traffic in Hood Canal is sparse, it is expected that construction vessels would be able to avoid tribal fishing vessels in most instances. Therefore, this additional in water traffic would not significantly affect tribal access to U&A fishing areas in Hood Canal during the 2-year construction time frame.

OPERATION/LONG-TERM IMPACTS

As in Alternative 2, at the south LWI project site, construction of the LWI pier would divide Devil's Hole Beach into two sections (Figure 2.1). The Tribe would not be allowed to access shellfish directly under the PSB pontoons or under the observation post stairs due to security restrictions. However, the Navy would continue to coordinate with the Tribes and Navy security personnel for Tribal access to both sections of Devil's Hole Beach for shellfish harvests. Following construction, there would be a permanent loss of an estimated 0.043 acre (0.017 hectare) due to coverage by LWI structures (the area disturbed by the PSB pontoon feet and the area lost under the observation post stairs). This equates to a loss of 0.023 percent of the overall estimated 18 acres of shellfish beach. Recovery of harvestable shellfish in the temporarily disturbed areas is expected within 5 years after construction activities are complete. (Expected impacts to benthic resources are described in Section 3.2.2.2.3.) Tribal access to these resources would continue during recovery. LWI Alternative 2 is not expected to alter water flow or along-shore sediment transport (Section 3.1.2.2.2) to the extent that shellfish resources at Devil's Hole Beach or sediments at the north LWI project site would be affected. The $2,208 annual loss (see Section 3.11.2.2.3) would represent approximately 1.2 percent of annual tribal income from this source. The toes of both abutments would be at or above the mean higher high water line. Should substantial changes to the shellfish habitat that are attributable to the LWI project be observed, the Navy would offer to consult with the Tribes to discuss additional possible mitigation. No other direct impacts would be anticipated for shellfish harvest as a result of LWI operation and maintenance. The presence of the floating PSB is expected to have minimal effects on juvenile salmon and steelhead migration, with no resulting impacts on tribal salmon harvest.

3.14.2.2.4. SUMMARY OF LWI IMPACTS

Impacts on American Indian traditional resources associated with the construction and operation and maintenance phases of the LWI project alternatives, along with treaty mitigation and consultation status, are summarized in Table 3.14–1.

Table 13.14–1. Summary of LWI Impacts on American Indian Traditional Resources

Alternative	Environmental Impacts on American Indian Traditional Resources
LWI Alternative 1: No Action	No impact. The Navy would continue coordination with the Tribes to access Devil's Hole Beach for shellfishing in accordance with the 1997 cooperative agreement. There would be no change to the Tribes' access to Devil's Hole Beach.
LWI Alternative 2: Pile-Supported Pier	*Construction:* Restricted access to the immediate construction zone area for up to 2 years during construction but full access to remainder of Devil's Hole Beach. No other changes to Tribal access to traditional resources. Temporary loss of 0.68 acre (0.28 hectare) of Tribal shellfish harvesting area near the south LWI project site. Minimal impact of construction noise on Tribal shellfish harvesters. No significant impacts on the overall quantity of available adult salmon and steelhead in Hood Canal are expected with construction. No potential for significant affects to Tribal fishers from 16 construction vessel roundtrips transiting in co-use navigable waterways of Hood Canal over a 2 year period. *Operation/Long-term Impacts:* Permanent loss of shellfish resources (0.043 acre, 0.017 hectare). Tribal access to shellfish resources would remain in place but require increased coordination due to Navy security requirements. Minimal effect on tribal salmon harvest.
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* Restricted access to the immediate construction zone for up to 2 years during construction but full access to remainder of Devil's Hole Beach. No other changes to tribal access to traditional resources. Temporary loss of 0.64 acre (0.26 hectare) of tribal shellfish harvesting area at the south LWI project site. Minimal impact of construction noise on tribal shellfish harvesters. No significant impacts on the overall quantity of available adult salmon and steelhead in Hood Canal are expected with construction. No potential for significant affects to tribal fishers from 3 construction vessel roundtrips transiting in co-use navigable waterways of Hood Canal over a 2 year period. *Operation/Long-term Impacts:* Permanent loss of shellfish habitat (0.043 acre, 0.017 hectare), 0.23% of the estimated 18 acre shellfish harvest area at Devil's Hole Beach. Tribal access to shellfish resources would remain in place but require increased coordination due to Navy security requirements. No significant effect on tribal salmon harvest.

Table 3.14-1. Summary of LWI Impacts on American Indian Traditional Resources (continued)

Alternative	Environmental Impacts on American Indian Traditional Resources
Mitigation: Current practices for government-to- government consultation with tribal governments of federally recognized American Indian tribes are described in Section 3.14.1.2. Under either action alternative, and in accordance with Department of Defense, and Navy federal policies, the Navy invited government-to-government consultation with the five Tribes in 2008. On March 3, 2016, the Navy completed a Memorandum of Agreement (MOA) with the Skokomish Indian Tribe to undertake treaty mitigation projects for LWI by contributing funding to support Skokomish River Basin restoration, with the terms and conditions of the MOA to apply only after the Navy begins in-water construction. Although the Navy and Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes were not able to reach formal agreement on treaty mitigation projects at the time of publication of this FEIS, the Navy offered to fund one or more of the following treaty mitigation projects: • Shellfish seeding and beach enhancement at locations off Navy property; • Development and implementation of a floating upweller system (FLUPSY) management plan; and • Kilisut Harbor Restoration Project. These proposed treaty mitigation projects are described in Appendix C: Mitigation Action Plan, Section 9, Treaty Mitigation. In addition to the Navy funding treaty mitigation projects to compensate for potential for significant impact to tribal rights and protected resources, the Navy is also providing compensatory mitigation under the USACE/EPA Compensatory Mitigation Rule for Loss of Aquatic Resources that will also mitigate for impacts to some of the same treaty protected marine aquatic resources.	
Consultation and Permit Status: MOA between the Navy and Skokomish Indian Tribe was signed March 3, 2016. The Navy will continue government-to-government consultation with the Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes. No permits are required for the Navy to fund the Tribal mitigation projects; however, when the Navy requests a permit for LWI under the Clean Water Act from USACE, USACE may also conduct government-to-government consultation with the Tribes.	

3.14.2.3. SPE PROJECT ALTERNATIVES

Because the activities associated with the SPE project alternatives are not within shellfish beds, there would be no impact to this traditional resource. Impacts to salmon would be minimal and not sufficient to affect tribal salmon harvest.

3.14.2.3.1. SPE ALTERNATIVE 1: NO ACTION

With the No Action Alternative, the SPE would not be built and overall operations would not change from current levels. The SPE project site is located in the NAVBASE Kitsap Bangor waterfront Navy restricted area. The Tribes do not have authorized access due to security and operational requirements. The Navy would continue to manage traditional resources located on NAVBASE Kitsap Bangor in accordance with Navy policies, laws, and regulations. Therefore, there is no potential to significantly affect traditional resources.

3.14.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

CONSTRUCTION

The short pier alternative would have minimal construction-related impact on American Indian traditional resources. As discussed in Section 3.2.2.3, no shellfish harvest areas are within the SPE construction area. Further, the Tribes do not have authorized access to the SPE project site due to security and operational requirements. However, any geoduck or other clams lost in the SPE pile footprints during construction would no longer be available to contribute as seed stock for future generations. As discussed in greater detail in Section 3.3.2.3, the effect of construction of SPE Alternative 2 on salmonid species is expected to be minimal, with localized impacts to individual salmon and steelhead. This impact would not be sufficient to result in population-level effects on salmonids or significant impacts on Tribal harvest of salmon.

The transit of construction-related barges and vessels to and from NAVBASE Kitsap Bangor has the potential to interfere with tribal fishing in the co-use navigable marine waterways adjacent to NAVBASE Kitsap Bangor and along the transit route through Hood Canal. The Navy estimates that approximately six (6) barge round-trips over the 2-year construction period could occur. Considering that these transits would be inherently temporary, northern Hood Canal is over 2 miles wide on average, and vessel traffic in Hood Canal is sparse, it is expected that construction vessels would be able to avoid tribal fishing vessels in most instances. Therefore, this additional water traffic would not significantly affect tribal access to U&A fishing areas in Hood Canal during the 2-year construction time frame.

OPERATION/LONG-TERM IMPACTS

Alternative 2 would have minimal operation-related impact on American Indian traditional resources. As discussed in Section 3.2.2.3, no shellfish harvest areas would be within the SPE installation area. Further, the Tribes do not have authorized access to the SPE project site due to security and operational requirements. As discussed in Section 3.3.2.3, the presence of SPE Alternative 2 structures would have minimal impact on salmonids and would not be sufficient to result in population-level impacts on salmon or significant impacts on the Tribal harvest of salmon.

3.14.2.3.3. SPE Alternative 3: Long Pier

CONSTRUCTION

Construction-related impacts of SPE Alternative 3 would be similar to those of Alternative 2, including the same project features on land but a larger footprint for the pier and associated overwater portion. As discussed in Section 3.3.2.3, the effect of construction of SPE Alternative 3 on salmonid species is expected to be minimal and would not be sufficient to result in population-level impacts on salmon or impacts on tribal harvest of salmon. Similar to Alternative 2, transit of construction vessels could potentially interfere with tribal fishing vessels (6 barge round trips per month); however, this additional water traffic during the 2-year construction time frame would not significantly affect tribal access to U&A fishing areas in Hood Canal.

OPERATION/LONG-TERM IMPACTS

SPE Alternative 3 would have minimal impact, similar to SPE Alternative 2, on traditional resources. As discussed in Section 3.3.2.3, a minimal effect from the presence of SPE Alternative 3 structures on salmonid species would not be sufficient to result in population-level impacts on salmon or impacts on the Tribal harvest of salmon. As noted in Section 3.14.2.3.2, submarines in transit through Hood Canal could briefly affect access to U&A fishing and harvest areas.

3.14.2.3.4. Summary of SPE Impacts

Impacts on American Indian traditional resources associated with the construction and operation and maintenance phases of the SPE project alternatives, along with treaty mitigation and consultation status, are summarized in Table 3.14–2.

Table 13.14–2. Summary of SPE Impacts on American Indian Traditional Resources

Alternative	Environmental Impacts on American Indian Traditional Resources
SPE Alternative 1: No Action	No Impact. The Tribes do not have authorized access to the SPE project site.
SPE Alternative 2: Short Pier (Preferred)	*Construction:* Minimal Impact on salmon with no impact on tribal salmon harvest. No impact on tribal shellfish harvest areas but potential impacts on clam standing stock. Minimal potential for interference with tribal fishing vessels by construction vessels in Hood Canal. *Operations:* No impact on tribal salmon or shellfish harvest. Potential for sporadic interference with tribal fishing vessels by transiting submarines.
SPE Alternative 3: Long Pier	*Construction:* Minimal Impact on salmon with no impact on tribal salmon harvest. No impact on tribal shellfish harvest areas but potential impacts on clam standing stock. Minimal potential for interference with tribal fishing vessels by construction vessels. *Operations:* No impact on tribal salmon or shellfish harvest. Potential for sporadic interference with tribal fishing vessels by transiting submarines.
Mitigation: Current practices for government-to-government consultation with tribal governments of federally recognized American Indian tribes are described in Section 3.14.1.2. Under either action alternative, and in accordance with Department of Defense and Navy policies, the Navy invited and has been in government-to-government consultation with the Skokomish Indian Tribe since 2012. On March 3, 2016, the Navy and the Skokomish completed a Memorandum of Agreement (MOA) to undertake treaty mitigation for LWI and SPE proposed actions by contributing funding to support Skokomish River Basin restoration, with the terms and conditions of the MOA to apply only after the Navy begins in-water construction. The Navy began government-to-government consultation with the Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes in 2012. Although the Navy and these Tribes were not able to reach formal agreement on treaty mitigation at the time of publication of this FEIS, the Navy offered to fund one or more of the following treaty mitigation projects. • Shellfish seeding and beach enhancement at locations off Navy property; and • Culvert replacement at Little Boston Road over Shipbuilders Creek. These proposed treaty mitigation projects are described in Appendix C: Mitigation Action Plan, Section 9, Treaty Mitigation. In addition to the Navy funded treaty mitigation projects to compensate for potential for significant impact to tribal rights and protected resources, the Navy is also providing compensatory mitigation under the USACE/EPA Compensatory Mitigation Rule for Loss of Aquatic Resources that will also mitigate for impacts to some of the same treaty protected marine aquatic resources.	
Consultation and Permit Status: MOA between the Navy and Skokomish Indian Tribe was signed March 3, 2016. The Navy has not yet reached formal agreement with the Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes on treaty mitigation projects. No permits are required for the Navy to fund the Tribal mitigation projects; however, when the Navy requests a permit for SPE under the Clean Water Act from USACE, USACE may also conduct government-to-government consultation with the Tribes.	

3.14.3. Combined Impacts of LWI and SPE Projects

Construction of the LWI and SPE (all alternatives) are expected to have minimal combined impact on Hood Canal adult salmon and steelhead, which are tribal traditional resources. Although some adult salmon and steelhead could be affected by impact pile driving (LWI Alternative 2 and either SPE alternative, as explained in Section 3.3.2.4), the impact would be localized, and there would be minimal impact on the overall population of available adult salmon and steelhead in Hood Canal as a result of construction or operation of the LWI and SPE projects. Construction of the LWI structures could minimally interfere with migration of juvenile salmon, but the ultimate effect on tribal fish harvest would be minimal. There would be temporary loss (up to 2 years) of a very small area of shellfish resources within the construction zones, with some permanent loss due to displacement by LWI structures. Recovery in the temporarily disturbed shellfish areas is expected within 5 years after in-water construction activities have ceased. For safety purposes, access to shellfish beds in the immediate construction zone would be restricted for up to 2 years during construction, but tribal access to the majority of Devil's Hole Beach would continue in accordance with the 1997 cooperative agreement. The Navy would continue to coordinate access to both sections of Devil's Hole Beach once the LWI structures were in place. Implementation of both the LWI and SPE Proposed Actions would extend the period over which construction vessels could potentially interfere with tribal fishing vessels from approximately 2 years to approximately 4 years.

Treaty mitigation projects proposed for the LWI and SPE Proposed Actions are described in Appendix C: Mitigation Action Plan, Section 9, Treaty Mitigation, along with environmental impact assessments of the proposed treaty mitigation projects.

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3.15. TRAFFIC

3.15.1. Affected Environment

Transportation resources include roads, public transit, railroads, waterways, and non-motorized travel. The transportation setting for ground transportation includes those streets and intersections that would be used by both automobile and truck traffic to gain access to and from a project site, as well as those streets that would be used by construction traffic (i.e., equipment and commuting workers). The marine vessel setting includes the waterways (e.g., Hood Canal and Puget Sound) that would provide access to the project site.

3.15.1.1. EXISTING CONDITIONS

The area to be evaluated includes the road network within NAVBASE Kitsap Bangor and main access road routes to and from the base and marine waterways, such as Hood Canal and Puget Sound. The project is not anticipated to use rail service. Therefore, rail traffic is not discussed further.

Primary transport is by automobile, although bus service to the base is available from some parts of Kitsap County, as well as taxi service. The major population centers within Kitsap County, which are Silverdale, Poulsbo, Bremerton, Port Orchard, and Bainbridge Island, are all between a 10- and 40-minute drive from NAVBASE Kitsap Bangor.

3.15.1.1.1. VEHICLE TRAFFIC

ROADWAY CHARACTERISTICS

The primary access to NAVBASE Kitsap Bangor is State Route (SR)-3, which is the major roadway serving Bremerton, Poulsbo, Silverdale, and the Hood Canal Bridge. SR-3 has a posted speed limit of 60 mph and is a controlled access, four-lane, north-south highway located 1/3 mile (0.5 kilometer) east of the base. SR-3 connects with SR-305 near Poulsbo providing access from NAVBASE Kitsap Bangor to Bainbridge Island and the Seattle ferry. Travel time is approximately one hour and 15 minutes from Seattle. Travel time by highway from Tacoma is less than one hour.

There are two entrance routes to NAVBASE Kitsap Bangor from SR-3, either NW Trigger Avenue or NW Luoto Road (referred to as Trident Boulevard inside of base boundaries) (Figure 15–1). Trident Avenue/Luoto Road has six 12-foot (4-meter) travel lanes with 6-foot (2-meter) paved shoulders extending from the main gate to SR-3. Trigger Avenue has five 12-foot travel lanes with 6-foot paved shoulders. Both roads are posted for speeds up to 40 mph.

The internal NAVBASE Kitsap Bangor road system is composed of two- and four-lane paved roads that provide access to Naval and commercial facilities, housing, and the waterfront area. Roads in the vicinity of the waterfront are two-lane roads. Generally, travel lanes are from 10 to 12 feet (3 to 4 meters) in width with wide paved shoulders ranging from 5 to 10 feet (1.5 to 3 meters) or gravel shoulders from 2 to 5 feet (0.6 to 1.5 meters) in width. Speed limits on the base range from 20 to 45 mph. Traffic lights and signals have been installed where needed near the commercial area and main gates. Other intersections are controlled by four-way or two-way stop signs.

Figure 3.15–1. Roads on NAVBASE Kitsap Bangor

Internal roads are improved and maintained by the Navy. The key access streets serving the project site are Trigger Avenue, Trident Boulevard, Escolar Road, Greenling Road, Archerfish Road, and Flier Road. The Operational Area (OA) Gate on Trigger Avenue separates the upper base, which includes administrative, commercial and residential areas, from the lower base, which includes various industrial and "mission" areas including the waterfront area. Traffic delays occur at this gate during morning and afternoon peak hours.

TRAFFIC VOLUMES

Traffic counts were collected at two regional roadways that provide direct access to NAVBASE Kitsap Bangor: Trigger Avenue and Luoto Road. Table 3.15–1 provides the average daily traffic volumes on NW Trigger Avenue and NW Luoto Road immediately outside of base boundaries. NW Luoto Road has an average daily traffic volume of 12,295 vehicles, with automobiles comprising approximately 65 percent (7,984 vehicles) of the total. NW Trigger Avenue has a lower average daily traffic volume of 11,426 vehicles, with almost 72 percent of those trips (8,213 vehicles) being automobiles.

Table 3.15–1. Average Daily Traffic Volumes (2008) — Regional Roadways

Location	Cars	Trucks	Total
NW Trigger Avenue	8,213	3,213	11,426
NW Luoto Road	7,984	4,311	12,295

Source: All Traffic Data Services 2008

Vehicle trips for a.m. and p.m. peak hours are shown in Table 3.15–2. Peak-hour trips on NW Trigger Avenue typically occur from 7:00 to 8:00 a.m. and 3:00 to 5:00 p.m. The average a.m. and p.m. peak hour volumes on NW Trigger Avenue are 676 and 844, respectively. The peak volumes on NW Luoto Road occur at slightly different times than on NW Trigger Avenue and are more evenly distributed between the a.m. and p.m. peak periods. On NW Luoto Road, the peak volumes occur from 6:00 to 7:00 a.m. and 4:00 to 5:00 p.m. Average a.m. and p.m. peak hour volumes on NW Luoto Road are 978 and 918 vehicles, respectively.

Table 3.15–2. Average Peak Hour Volumes (2008) — Regional Roadways

Location	a.m. peak	p.m. peak
Trigger Avenue	676	844
Luoto Road	978	918

Source: All Traffic Data Services 2008

With the exception of peak hours, traffic from NAVBASE Kitsap Bangor generally does not cause congestion problems outside the base. This is because the base is close to major highways such as SR-3 and SR-308, which provide direct access to NW Trigger Avenue and NW Luoto Road. In addition, these two access roads are multi-lane roads capable of handling large volumes of traffic. During morning and afternoon peak hours, however, both the Trident/Luoto and Trigger gates experience backups and delays. These delays can affect traffic flow on SR-3 (morning only) and at the intersection of Trigger Boulevard and Frontier Road.

TRAFFIC VOLUMES TO AND FROM THE LWI PROJECT SITES

Existing average daily traffic volumes were obtained for internal base roadways that would be used during construction activities associated with the LWI project (Table 3.15–3). In addition to traffic counts, travel lane configuration, roadway grade, and types of traffic controls were verified and documented. The following roadways were selected because they are key access routes to and from the LWI project sites:

- Trigger Avenue south of Trident Boulevard,
- Trident Boulevard east of Trigger Avenue,
- Trigger Avenue east of Escolar Road,
- Escolar Road north of Trigger Avenue,
- Escolar Road north of Sturgeon Street,
- Greenling Road west of Archerfish Road,
- Archerfish Road north of Seawolf Road,
- Seawolf Road east of Flier Road,
- Flier Road north of Seawolf Road,
- Trigger Avenue south of Sturgeon Street,
- Sturgeon Street west of Trigger Avenue, and
- Sealion Road north of Sturgeon Street.

Table 3.15–3. Average Daily Traffic Volumes — NAVBASE Kitsap Bangor Roadways

Location	Cars	Trucks/Buses	Total
Trigger Avenue north of Thresher Avenue	6,854	266	7,120
Trident Boulevard east of Scorpion Avenue	10,830	751	11,581
Trigger Avenue east of Escolar Road	8,676	702	9,378
Escolar Road south of Goldfinch Lane	4,026	226	4,252
Escolar Road north of Sturgeon Street	3,446	96	3,542
Greenling Road west of Archerfish Road	829	25	854
Archerfish Road north of Seawolf Road	446	2	448
Seawolf Road east of Flier Road	n/a	n/a	510
Flier Road North of Seawolf Road	n/a	n/a	520
Trigger Avenue south of Sturgeon Street	n/a	n/a	2,710
Sturgeon Street west of Trigger Avenue	n/a	n/a	3,220
Sealion Road north of Sturgeon Street	n/a	n/a	2,100

Source: Parametrix 2011; All Traffic Data Services, Inc. 2012

Existing average morning and evening peak hour intersection turning movement volumes were obtained at intersections that would be used during construction activities associated with the LWI project within the study area (Table 3.15–4). Specifically, traffic counts were gathered during peak periods of 6:00 a.m. to 8:00 a.m. and 2:30 p.m. to 4:30 p.m. on a typical weekday at the following intersections:

- Trigger Avenue and Ohio Street,
- Trigger Avenue and Trident Boulevard,
- Trigger Avenue and Escolar Road,
- Escolar Road and Sturgeon Street,
- Escolar Road and Greenling Road,
- Archerfish Road and Seawolf Road,
- Seawolf Road and Flier Road, and
- Trigger Avenue and Sturgeon Street.

Table 3.15–4. Average Peak Hour Volumes — NAVBASE Kitsap Bangor Intersections

Location	Peak (a.m.)	Peak (p.m.)
Trigger Avenue/Ohio Street	1,267	1,424
Trigger Avenue/Trident Boulevard	1,693	1,512
Trigger Avenue/Escolar Road	1,445	1,480
Escolar Road/Sturgeon Street	625	460
Escolar Road/Greenling Road	398	347
Archerfish Road/Seawolf Road	91	72
Seawolf Road/Flier Road	45	36
Trigger Avenue/Sturgeon Street	313	415

Source: Parametrix 2011; All Traffic Data Services, Inc. 2012

Traffic Volumes to and from the SPE Project Site

Existing average daily traffic volumes were obtained for internal base roadways that would be used during construction activities associated with the SPE project site (Table 3.15–3). In addition to traffic counts, travel lane configuration, roadway grade, and types of traffic controls were verified and documented. The following roadways were selected because they are key access routes to and from the SPE project site:

- Trigger Avenue south of Trident Boulevard,
- Trident Boulevard east of Trigger Avenue,
- Trigger Avenue east of Escolar Road,
- Trigger Avenue south of Sturgeon Street,
- Sturgeon Street west of Trigger Avenue, and
- Sealion Road north of Sturgeon Street.

Existing morning and evening peak hour intersection turning movement volumes were obtained at intersections that would be used during the construction activities associated with the SPE projects within the study area (Table 3.15–4). Specifically, traffic counts were gathered during peak periods of 7:00 a.m. to 9:00 a.m. and 2:00 p.m. to 4:00 p.m. on a typical weekday at the following intersections:

- Trigger Avenue and Ohio Street,
- Trigger Avenue and Trident Boulevard,
- Trigger Avenue and Escolar Road, and
- Trigger Avenue and Sturgeon Street.

LEVEL OF SERVICE

Level of service (LOS) is a measure of roadway operation, which uses a qualitative grading scale from A to F. LOS A represents the best traffic operations and LOS F represents the worst traffic operations. LOS can be used to characterize the overall traffic operations along a roadway. Tables 3.15–5 and 3.15–6 provide descriptions of LOS in terms of intersection delay.

The minimum standard for road operations in Kitsap County is LOS D. The LOS on NW Trigger Avenue is LOS A (Kitsap County Department of Community Development 2005) and NW Luoto Road is LOS C (Rogers 2008, personal communication).

Table 3.15–5. Level of Service for At-Grade Signalized Intersections

LOS	Average Control Delay	General Description
A	≤ 10 seconds	Free Flow
B	> 10–20 seconds	Stable Flow
C	> 20–35 seconds	Stable Flow (Acceptable Delay)
D	> 35–55 seconds	Approaching Unstable Flow (Tolerable Delay)
E	> 55–80 seconds	Unstable Flow (Intolerable Delay)
F	> 80 seconds	Forced Flow (Jammed)

Source: Transportation Research Board, Highway Capacity Manual 2010

Table 3.15–6. Level of Service for At-Grade Unsignalized Intersections

LOS	Average Control Delay	General Description
A	0–10 seconds	Free Flow
B	> 10–15 seconds	Stable Flow
C	> 15–25 seconds	Stable Flow (Acceptable Delay)
D	> 25–35 seconds	Approaching Unstable Flow (Tolerable Delay)
E	> 35–50 seconds	Unstable Flow (Intolerable Delay)
F	> 50 seconds	Forced Flow (Jammed)

Source: Transportation Research Board, Highway Capacity Manual 2010

SPECIAL TRAFFIC CONDITIONS

Several internal roads are periodically closed to traffic to enable the movement of assets on NAVBASE Kitsap Bangor. These road closures are part of routine operations, and personnel on the base are familiar with these procedures. These closures may last several days and alternate routes are used.

3.15.1.1.2. Marine Vessel Traffic

The Sector Puget Sound Vessel Traffic Service, part of the U.S. Coast Guard and based in Seattle, monitors approximately 250,000 vessel movements in the sound annually. These movements are composed of tankers, cargo ships, ferries, and tug boats with tows (U.S. Coast Guard 2004).

Naval ships and support vessels access the base via the Strait of Juan de Fuca, Puget Sound, and Hood Canal. The majority of vessel traffic in Hood Canal consists of Navy-related marine traffic including submarines, escort vessels, tugs, and other vessels transiting to and from NAVBASE Kitsap Bangor. As Hood Canal is not a deep draft vessel operating area, this area is infrequently transited by commercial vessels, and vessel traffic data are not available for Hood Canal (Venture 2010, personal communication). Larger vessels (i.e., vertical clearance greater than 50 feet [15 meters]) transiting Hood Canal require opening of the Hood Canal Bridge. Typical bridge openings take approximately 30 minutes (WSDOT 2010b). As bridge openings are not scheduled in advance, vehicles traveling along SR-104 (Hood Canal Bridge) are subject to unexpected delays.

3.15.1.1.3. Public Transit

Kitsap Transit operates a regularly scheduled shuttle bus that provides access to NAVBASE Kitsap Bangor from Silverdale, with connections from Silverdale to other parts of the county including ferry terminals. An internal bus system operates 18 hours per day within the base. Taxi service is also available at the base from several private companies located in Bremerton, Silverdale, Bainbridge Island, and Port Orchard. Kitsap Transit buses and taxis do not service the NAVBASE Kitsap Bangor waterfront area; however, the Navy's internal bus system provides service to the Bangor waterfront for Navy and contract personnel.

3.15.1.2. CURRENT REQUIREMENTS AND PRACTICES

The Military Surface Deployment and Distribution Command Transportation Engineering Agency provides the DoD with transportation engineering, policy guidance, research, and analytical expertise. Several DoD directives apply to transportation planning and implementation at military bases, including the following:

- DoD Directive 4500.9 Transportation and Traffic Management, and
- DoD Directive 4510.11 Transportation Engineering.

These directives apply policies to proposed transportation improvements, travel, traffic management, and traffic safety.

For vessel traffic, the Protection of Naval Vessels rule (33 CFR 165.2010) issued under the authority in 14 USC 91 provides protective measures for both vessels and bases. This regulation establishes naval vessel protection zones surrounding U.S. Naval vessels in navigable waters of the U.S. Within a Naval Vessel Protection Zone, no vessel or person is allowed within 100 yards (91 meters) of a U.S. Naval vessel unless authorized by the U.S. Coast Guard or senior Naval officer in command. Two restricted areas are associated with NAVBASE Kitsap Bangor: Naval Restricted Areas 1 and 2 (33 CFR 334.1220) (Figure 1–2). Naval Restricted Area 1 covers the area to the north and south along Hood Canal encompassing the Bangor waterfront. Naval Restricted Area 2 encompasses the waters of Hood Canal within a circle of 1,000 yards (3,000 feet [914 meters]) diameter centered at the north end of NAVBASE Kitsap Bangor and partially overlapping Naval Restricted Area 1. The WRA is located within Restricted Area 1.

To maintain adequate levels of safety for vessel navigation during in-water construction activities, the Navy would request that the U.S. Coast Guard issue a Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity. The local Notice to Mariners would increase the awareness of all waterway users in the project vicinity and ensure adequate communication between the U.S. Coast Guard, Marine Exchange of Puget Sound, dredging contractors, dredge and vessel operators, and transiting vessels.

Impacts on motorists can be minimized by avoiding barge trips through the Hood Canal Bridge passage during peak commute hours of 6:00 a.m. to 8:30 a.m. and 3:30 p.m. to 6:00 p.m., Monday through Friday.

No consultations or permits are required.

3.15.2. Environmental Consequences

3.15.2.1. APPROACH TO ANALYSIS

The evaluation of impacts on transportation resources considers whether traffic volumes increase sufficiently to create a need to construct new transportation infrastructure, including new roads, stormwater design and culvert restoration along existing roads, traffic diversions needed during construction, new transit options for construction workers, or new parking areas.

Marine vessel traffic impacts are evaluated to determine whether marine-based construction equipment would interfere with normal navigational activities in Hood Canal or substantially increase vessel traffic volumes that would warrant construction of new facilities.

3.15.2.2. LWI PROJECT ALTERNATIVES

3.15.2.2.1. LWI ALTERNATIVE 1: NO ACTION

Under the LWI No Action Alternative, construction of the LWI would not occur and overall operations would not change from current levels. Existing ground and vessel traffic levels would remain unchanged. Therefore, no impacts on traffic would occur under the LWI No Action Alternative.

3.15.2.2.2. LWI Alternative 2: Pile-Supported Pier

CONSTRUCTION

Vehicular Traffic

Staging (i.e., parking lot, material/equipment storage, and soil stockpiling) for both LWI project sites would take place at a single site located near the intersection of Archerfish and Seawolf Roads (Figure 2–1). This site is approximately 5.4 acres (2.2 hectares) in size and has been used recently for staging for other projects. The staging area would accommodate construction worker parking, temporary material storage, and assembly. The staging area would generate traffic by supporting material deliveries, removal of debris, and distribution of construction personnel from a designated parking area to the staging area.

Traffic accessing the north LWI project site would head north on Escolar Road, traveling east on Greenling Road, and then north on Archerfish Road to reach the construction site via Seawolf and Flier Roads. Traffic accessing the south LWI project site would continue along Trigger Avenue west of Escolar Road to access the construction site via Sturgeon and Sealion Roads. Flier and Sealion Roads would be the primary haul routes for construction of the LWI north and south project sites, respectively. The soil hauling truck trips generated by the north LWI project site would follow Escolar → Greenling → Archerfish → Seawolf → Flier. The soil hauling truck trips generated by the south LWI project site would follow Trigger → Sturgeon → Sealion.

Truck traffic would be generated by the need to deliver construction materials and remove construction debris from the construction sites. Construction debris would be hauled off site to an approved disposal location. Over the duration of construction (24 months), a maximum of 100 workers are conservatively assumed to drive to and from the construction site daily. General large truck traffic is estimated to be approximately 8 trips per day on average, while other construction traffic such as inspectors, visitors and miscellaneous smaller vehicles is estimated to be 30 trips per day on average. This would result in a total of 135−140 vehicle trips per day on average for the duration of construction (Tables 3.15–7 and 3.15–8). Soil hauling is expected to require an additional 1,300 truck trips over a period of 6 months (95 work days) during 2016 and 2017, for a daily average of approximately 15−20 truck trips per day during that period. Based on relative cut and fill volumes, 80 percent of these soil hauling trucks are estimated to go the north site, while 20 percent would go to the south site. During peak construction activities, there would be a substantial increase in the peak number of truck trips. Peak period truck trips are estimated to increase up to 2−4 trips per hour for a period estimated at 10 days. The existing roads planned for construction traffic could accommodate the additional vehicles and trucks, and would not need to be upgraded to accommodate construction traffic. However, the additional traffic volumes may create longer wait times to enter the base, particularly during the a.m. peak hour, as vehicles queue up to pass through the security checkpoint. Project construction traffic would also result in additional delays at the OA Gate.

Table 3.15–7. Daily Average Traffic Volumes on NW Luoto Road for LWI Alternative 2

	2016	2017	2018
Non-Project Traffic	13,526	13,689	13,853
Construction Worker Automobile Trips[1]	100	100	100
Soil Hauling Truck Trips	20	20	0
Other Construction Truck Traffic	8	8	8
Other Construction Traffic	30	30	30
Total	13,684	13,847	13,991

1. The daily average number of construction workers is a conservative estimate based on the maximum workers onsite during the 808-day construction period.

Table 3.15–8. Daily Average Traffic Volumes on NW Trigger Avenue for LWI Alternative 2

	2016	2017	2018
Non-Project Traffic	12,570	12,721	12,873
Construction Worker Automobile Trips[1]	100	100	100
Soil Hauling Truck Trips	20	20	0
Other Construction Truck Traffic	8	8	8
Other Construction Traffic	30	30	30
Total	12,728	12,879	13,011

1. The daily average number of construction workers is a conservative estimate based on the maximum workers onsite during the 808-day construction period.

Regional Roadways

Construction activities would add traffic to NW Luoto Road/Trident Boulevard and NW Trigger Avenue. NW Luoto Road/Trident Boulevard has six lanes with 12-foot (4-meter) travel lanes and 6-foot (2-meter) paved shoulders extending from the main gate to SR-3. NW Trigger Avenue has five lanes with 12-foot travel lanes and 6-foot paved shoulders. As noted above, project construction traffic would exacerbate existing peak-hour delays at both the Trident/Luoto and Trigger gates and adjacent regional roadways, as well as at the OA Gate. There are no plans to expand these gates.

NAVBASE Kitsap Bangor Roadways

Intersection LOS Analysis

Construction-related traffic would have minor impacts (a few seconds or less) on several intersections during both the a.m. and p.m. peak hour (Table 3.15–9). However, these intersections would operate at an acceptable LOS D or better. Please refer to Appendix F for additional details regarding intersection LOS calculations. The LOS shown in Table 3.15–9 indicates the effect of the added traffic from the LWI projects.

Table 3.15–9. Peak Hour Intersection Level of Service Analysis — NAVBASE Kitsap Bangor Roadways

Intersection	AM Peak								PM Peak							
	BASELINE		FUTURE WITH CONSTRUCTION TRAFFIC						BASELINE		FUTURE WITH CONSTRUCTION TRAFFIC					
	2011 / 2012		2016		2017		2018		2011 / 2012		2016		2017		2018	
	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)
Trigger & Ohio	B	11.2	B	11.5	B	11.6	B	11.7	B	12.6	B	12.8	B	12.9	B	13.1
Trigger & Trident	B	19.8	C	23.2	C	23.8	C	29.2	B	10.2	B	12.1	B	12.2	B	12.3
Trigger & Escolar	A	5.5	A	7.8	A	7.9	A	8.1	D	37.9	D	42.5	D	43.9	D	45.3
Escolar & Sturgeon	B	14.3	C	16.9	C	17.1	C	17.2	C	22.9	D	26.1	D	26.7	D	28.1
Escolar & Greenling	B	11.5	C	16.2	C	16.6	C	16.8	A	9.9	B	13.7	B	13.9	B	14.1
Archerfish & Seawolf	A	9.4	B	11.4	B	11.4	B	11.6	A	9.3	B	11.2	B	11.2	B	11.4
Seawolf & Flier	A	8.9	A	9.3	A	9.3	A	9.4	A	9.3	A	9.5	A	9.5	A	9.6
Trigger & Sturgeon	B	11.1	B	11.7	B	11.7	B	11.8	B	10.0	B	10.3	B	10.3	B	10.5

1. Default values used in determining the LOS were obtained from Parametrix 2011 Bangor Traffic Analysis-Construction of EHW Impacts (Technical Memorandum)
2. LOS values shown for the unsignalized intersections are for the stop-controlled movements experiencing the highest delay.
3. LOS = Level of Service

Roadway LOS Analysis

Construction traffic would impact the LOS for several roadway segments (Table 3.15–10). During peak times of heavy construction traffic, overall average speed of vehicles would be reduced due to reduced LOS. However, these roadways would operate at an acceptable LOS D or better. Please refer to Appendix F for additional details regarding roadway LOS calculations. The LOS shown in Table 3.15–10 indicates the effect of the added traffic from the LWI project sites.

MARINE VESSEL TRAFFIC

Proposed in-water construction activities would require use of marine-based construction equipment (i.e., pile-driving rigs, support barges, tugboat, and work skiffs) to support construction of the LWI and transport materials to and from the project sites. Construction materials would remain on barges until used for construction. Marine-based construction equipment would be present within the project area for two in-water work seasons (August 1, 2016, to January 15, 2017, and July 15, 2017, to January 15, 2018). A total of approximately 16 barge round trips per year (slightly less than three round trips per month during the 6-month in-water work season), would be required to support construction activities during this period. Barges are expected to transit from various locations in Central Puget Sound to the construction site via Admiralty Inlet to Hood Canal. This level of vessel traffic is not expected to adversely impact vessel transit routes or normal navigational activities in Hood Canal or Puget Sound. Therefore, no significant impacts on marine vessel traffic during construction are expected.

Any support boat or barge used during in-water construction activities would generally be located in NAVBASE Kitsap Bangor restricted areas away from normal navigational activities. Standard U.S. Coast Guard safety precautions would be used by all contractors. Within the NAVBASE Kitsap Bangor restricted areas, marine-based construction equipment would be highly visible, well-marked, and would be relatively stationary as equipment (e.g., barge/tugboat and pile drivers) would only be moved prior to and after completion of in-water construction activities. Movement of construction vessels within the restricted areas would be coordinated with NAVBASE Kitsap Bangor Port Operations to ensure no interference with other Navy vessel movements. To maintain adequate levels of safety for vessel navigation during in-water construction activities, the Navy would request that the U.S. Coast Guard issue a Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity.

Construction vessels would require additional openings of the Hood Canal Bridge to access the project site. Each barge round trip and associated two bridge openings would result in delays (on average 30 minutes per opening for a total of 60 minutes per round trip) for motorists traveling on SR-104. The projected three round trips (six bridge openings) per month during the in-water work season would result in total delays on SR-104 of approximately 180 minutes (3 hours) per month. Based on a review of data on Hood Canal Bridge openings, the bridge typically opens 400 to 450 times per year for an average opening of just over once per day. June through October represents the period with the majority of openings due to an increase in pleasure boat traffic (Crawford 2010, personal communication). Impacts on motorists would be minimized by avoiding barge trips through the Hood Canal Bridge opening during peak commute hours of 6:00 a.m.to 8:30 a.m. and 3:30 p.m.to 6:00 p.m., Monday through Friday.

Table 3.15–10. Peak Hour Roadway Level of Service Analysis – NAVBASE Kitsap Bangor Roadways

Multi-Lane Roadway Sections																
Roadway Section	AM Peak								PM Peak							
	BASELINE		FUTURE WITH CONSTRUCTION TRAFFIC						BASELINE		FUTURE WITH CONSTRUCTION TRAFFIC					
	2011/2012		2016		2017		2018		2011/2012		2016		2017		2018	
	LOS	Density (veh/ mile/ lane)	LOS	Density (veh/ mile /lane)	LOS	Density (veh/ mile/ lane)	LOS	Density (veh/ mile /lane)	LOS	Density (veh/ mile/ lane)	LOS	Density (veh/ mile/ lane)	LOS	Density (veh/ mile/ lane)	LOS	Density (veh/ mile/ lane)
Trigger north of Thresher	A	7.8	A	8.9	A	9.1	A	9.2	A	6.7	A	7.7	A	7.9	A	8.1
Trident east of Trigger	A	7.2	A	8.4	A	8.4	A	8.5	A	6.9	A	8.0	A	8.1	A	8.1
Trigger north of Trident	B	14.8	B	17.3	B	17.5	B	17.6	B	13.0	B	15.4	B	15.6	B	15.7
Trigger east of Escolar	B	14.3	C	18.3	C	18.4	C	18.5	B	14.7	B	17.3	B	17.4	B	17.5
Trigger south of Sturgeon	A	2.3	A	2.7	A	2.7	A	2.8	A	3.5	A	3.9	A	3.9	A	4.0

Two-Lane Roadway Sections																
Roadway Section	AM Peak								PM Peak							
	BASELINE		FUTURE WITH CONSTRUCTION TRAFFIC						BASELINE		FUTURE WITH CONSTRUCTION TRAFFIC					
	2011/2012		2016		2017		2018		2011/2012		2016		2017		2018	
	LOS	Percent Time Spent Following (PTSF%)	LOS	Percent Time Spent Following (PTSF%)	LOS	Density (veh/ mile/ lane)	LOS	Percent Time Spent Following (PTSF%)	LOS	Percent Time Spent Following (PTSF%)	LOS	Percent Time Spent Following (PTSF%)	LOS	Density (veh/ mile/ lane)	LOS	Percent Time Spent Following (PTSF%)
Escolar north of Trigger	D	79.5%	D	83.2%	D	83.4%	D	83.7%	D	76.7%	D	80.9%	D	81.1%	D	81.2%
Escolar north of Sturgeon	D	72.3%	D	73.7%	D	73.9%	D	74.0%	C	68.8%	D	73.4%	D	73.5%	D	73.5%
Greenling west of Archerfish	C	58.9%	C	66.5%	C	66.8%	C	66.9%	B	51.3%	C	63.7%	C	63.9%	C	64.0%
Seawolf east of Archerfish	B	46.2%	C	60.2%	C	60.4%	C	60.5%	A	31.8%	C	57.6%	C	57.8%	C	58.0%
Flier north of Seawolf	A	37.1%	B	40.7%	B	40.8%	B	40.9%	A	38.7%	B	44.2%	B	44.4%	B	44.5%
Sturgeon west of Trigger	C	67.3%	C	68.5%	C	68.7%	C	68.9%	D	71.9%	D	73.5%	D	73.7%	D	73.8%
Sealion north of Sturgeon	C	62.1%	C	63.2%	C	63.4%	C	63.5%	C	66.1%	C	67.8%	C	68.0%	C	68.2%

1. Default values used in determining the LOS were obtained from Parametrix 2011 Bangor Traffic Analysis-Construction of EHW Impacts (Technical Memorandum)
2. LOS = Level of Service

PUBLIC TRANSIT

LWI Alternative 2 would not increase transit demand such that demands could not be accommodated by existing or planned transit capacity.

OPERATION/LONG-TERM IMPACTS

Operation and maintenance of LWI Alternative 2 would result in a minimal increase in vehicular and marine vessel traffic. Therefore, there would be no adverse impact on vehicular or marine traffic conditions.

3.15.2.2.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

CONSTRUCTION

VEHICULAR TRAFFIC

Construction of the upland portions of LWI Alternative 3 would be the same as construction of Alternative 2. Therefore, construction traffic for Alternative 3 would be the same as that for Alternative 2, and impacts on vehicular traffic would be the same as described for Alternative 2 (Section 3.15.2.2.2 above).

MARINE VESSEL TRAFFIC

Construction of Alternative 3 would require an estimated three round trips per year for construction barges, compared to 16 round trips per year for LWI Alternative 2. Therefore, impacts on marine vessel traffic would be less for Alternative 3 than for Alternative 2, with no significant impact on vessel traffic in Hood Canal. Further, construction of Alternative 3 would require only one in-water construction season versus two seasons for Alternative 2. To maintain adequate levels of safety for vessel navigation during in-water construction activities, the Navy would request that the U.S. Coast Guard issue a Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity.

Assuming the three barge round trips occur during the 6-month in-water construction season, there would be 0.5 additional openings of the Hood Canal Bridge per month on average, resulting in delays of 30 minutes per month on average on SR-104 during the single in-water construction season (August 1, 2016, through January 15, 2017). Impacts on motorists would be minimized by avoiding barge trips through the Hood Canal Bridge opening during peak commute hours of 6:00 a.m.to 8:30 a.m. and 3:30 p.m.to 6:00 p.m., Monday through Friday.

OPERATION/LONG-TERM IMPACTS

Operation and maintenance of LWI Alternative 3 would result in a minimal increase in vehicular and marine vessel traffic. Therefore, there would be no adverse impact on vehicular or marine traffic conditions.

3.15.2.2.4. Summary of LWI Impacts

Impacts on traffic associated with the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.15–11.

Table 3.15–11. Summary of LWI Impacts on Traffic

Alternative	Environmental Impacts on Traffic
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Pier	*Construction:* Exacerbation of existing peak-hour delays at both base gates. Minor impacts on traffic on the Hood Canal Bridge. Increased marine vessel and vehicular traffic levels would not be sufficient to require improvement to infrastructure. *Operation/Long-term Impacts:* Minimal increase in traffic and marine vessel levels.
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* Exacerbation of existing peak-hour delays at both base gates. Less impact on traffic on the Hood Canal Bridge than Alternative 2 (3 barge round trips per year versus 16 round trips per year and only one in-water construction season versus two under Alternative 2). Increased marine vessel and vehicular traffic levels would not be sufficient to require improvement to infrastructure. *Operation/Long-term Impacts:* Minimal increase in traffic and marine vessel levels.
Mitigation: Openings of the Hood Canal Bridge would be scheduled to avoid peak traffic hours to the extent possible. The Navy would develop a local Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity.	
Consultation and Permit Status: No consultations or permits are required.	

3.15.2.3. SPE PROJECT ALTERNATIVES

3.15.2.3.1. SPE Alternative 1: No Action

Under the No Action Alternative, construction of the SPE would not occur, the two SEAWOLF Class submarines would not be transferred to NAVBASE Kitsap Bangor, and overall operations would not change from current levels. Existing ground and vessel traffic levels would remain unchanged. Therefore, no impacts on traffic would occur under the No Action Alternative.

3.15.2.3.2. SPE Alternative 2: Short Pier (Preferred)

CONSTRUCTION

Vehicular Traffic

The SPE project is currently unprogrammed and a construction schedule has not been established. For the purposes of traffic impact analysis, a construction period of April 2018 through March 2020 has been assumed as a reasonably representative case.

The staging area (i.e., parking lot, material/equipment storage, and soil stockpiling) would be located at the SPE construction site, within the existing parking lot (and future Waterfront Ship Support Building), and so would result in no additional land clearing. This staging area would accommodate construction worker parking, temporary material storage, and assembly. The staging area would generate traffic by supporting material deliveries, removal of debris, and distribution of construction personnel from a designated parking area to the staging area(s).

Truck traffic would be generated by the need to deliver construction materials and remove construction debris from the construction sites. Construction debris would be hauled off site to an approved disposal location. Over the duration of construction (24 months), a maximum of 70 workers are conservatively assumed to drive to and from the construction site daily. General large truck traffic is estimated to be 18 trips per day on average, while other construction traffic such as inspectors, visitors and miscellaneous smaller vehicles is estimated to be 70 trips per day on average. This would result in a total of 158 vehicle trips per day on average for the duration of construction (Tables 3.15–12 and 3.15–13). The existing roads planned for construction traffic could accommodate the additional vehicles and trucks and would not need to be upgraded to accommodate construction traffic. However, the additional traffic volumes may create longer wait times to enter the base, particularly during the a.m. peak hour, as vehicles queue up to pass through the Trident/Luoto and Trigger gates. Project construction traffic would also result in additional delays at the OA Gate.

Table 3.15–12. Daily Average Traffic Volumes on NW Luoto Road for SPE Alternative 2

	2018	2019	2020
Non-Project Traffic	13,853	14,187	14,358
Construction Worker Automobile Trips[1]	70	70	70
Soil Hauling Truck Trips	0	0	0
Other Construction Truck Traffic	18	18	18
Other Construction Traffic	70	70	70
Total	14,011	14,345	14,516

1. The daily average number of construction workers is a conservative estimate based on the maximum workers onsite during the 808-day construction period.

Table 3.15–13. Daily Average Traffic Volumes on NW Trigger Avenue for SPE Alternative 2

	2018	2019	2020
Non-Project Traffic	12,873	13,184	13,342
Construction Worker Automobile Trips[1]	70	70	70
Soil Hauling Truck Trips	0	0	0
Other Construction Truck Traffic	18	18	18
Other Construction Traffic	70	70	70
Total	13,031	13,342	13,500

1. The daily average number of construction workers is a conservative estimate based on the maximum workers onsite during the 808-day construction period.

Regional Roadways

Construction activities would add traffic to NW Luoto Road/Trident Boulevard and NW Trigger Avenue. NW Luoto Road/Trident Boulevard has six lanes with 12-foot (4-meter) travel lanes and 6-foot (2-meter) paved shoulders extending from the main gate to SR-3. NW Trigger Avenue has five lanes with 12-foot travel lanes and 6-foot paved shoulders. As noted above, project construction traffic would exacerbate existing peak-hour delays at both the Trident/Luoto and Trigger gates and adjacent regional roadways. There are no plans to expand these gates.

NAVBASE Kitsap Bangor Roadways

Intersection LOS Analysis

Construction-related traffic would have minor impacts (a few seconds or less) on several intersections during both the a.m. and p.m. peak hour (Table 3.15–14). However, these intersections would operate at an acceptable LOS D or better. Please refer to Appendix F for additional details regarding intersection LOS calculations. The LOS shown in Table 3.15–14 indicates the effect of the added traffic from the SPE project.

Roadway LOS Analysis

Construction traffic would impact the LOS for several roadway segments (Table 3.15–15). During peak times of heavy construction traffic, the overall average speed of vehicles would degrade the LOS. However, these roadways would operate at an acceptable LOS D or better. Please refer to Appendix F for additional details regarding roadway LOS calculations. The LOS shown in Table 3.15–15 indicates the effect of the added traffic from the SPE project.

MARINE VESSEL TRAFFIC

Proposed in-water construction activities would require use of marine-based construction equipment (i.e., pile-driving rigs, support barges, tugboat, and work skiffs) to support construction of the SPE and transport materials to and from the project sites. Construction materials would remain on barges until used for construction. Assuming a construction period of April 2018 through March 2020, marine-based construction equipment would be present within the project area for two in-water work seasons (July 15, 2018, to January 15, 2019, and July 15, 2019, to January 15, 2020). A total of approximately six barge round trips per month would be required to support construction activities during this period. Construction of SPE Alternative 2 is not expected to require two full in-water construction seasons, however. Barges are expected to transit from various locations in Central Puget Sound to the construction site via Admiralty Inlet to Hood Canal. Construction vessels would require additional openings of the Hood Canal Bridge to access the project site.

Table 3.15–14. Peak Hour Intersection Level of Service Analysis — NAVBASE Kitsap Bangor Roadways

Intersection	AM Peak								PM Peak							
	BASELINE		FUTURE WITH CONSTRUCTION TRAFFIC						BASELINE		FUTURE WITH CONSTRUCTION TRAFFIC					
	2011 / 2012		2018		2019		2020		2011 / 2012		2018		2019		2020	
	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)	LOS	Delay (seconds)
Trigger & Ohio	B	11.2	B	11.8	B	11.9	B	12.0	B	12.6	B	13.0	B	13.1	B	13.2
Trigger & Trident	B	19.8	C	24.0	C	24.2	C	24.4	B	10.2	B	12.0	B	12.0	B	12.1
Trigger & Escolar	A	5.5	A	7.0	A	7.1	A	7.1	D	37.9	D	44.1	D	43.9	D	45.7
Trigger & Sturgeon	B	11.1	B	14.3	B	14.4	B	14.5	B	10.0	B	11.3	B	11.7	B	12.2

1. Default values used in determining the LOS were obtained from Parametrix 2011 Bangor Traffic Analysis-Construction of EHW Impacts (Technical Memorandum)
2. LOS values shown for the unsignalized intersections are for the stop-controlled movements experiencing the highest delay.
3. LOS = Level of Service

Table 3.15–15. Peak Hour Roadway Level of Service Analysis — NAVBASE Kitsap Bangor Roadways

Multi-Lane Roadway Sections																
Roadway Section	**AM Peak**								**PM Peak**							
	BASELINE		**FUTURE WITH CONSTRUCTION TRAFFIC**						**BASELINE**		**FUTURE WITH CONSTRUCTION TRAFFIC**					
	2011/2012		**2018**		**2019**		**2020**		**2011/2012**		**2018**		**2019**		**2020**	
	LOS	**Density (veh/ mile/ lane)**	**LOS**	**Density (veh/ mile/ lane)**	**LOS**	**Density (veh/ mile/ lane)**	**LOS**	**Density (veh/ mile/ lane)**	**LOS**	**Density (veh/ mile/ lane)**	**LOS**	**Density (veh/ mile/ lane)**	**LOS**	**Density (veh/ mile/ lane)**	**LOS**	**Density (veh/ mile/ lane)**
Trigger north of Thresher	A	7.8	A	9.0	A	9.1	A	9.2	A	6.7	A	7.9	A	7.9	A	8.1
Trident east of Trigger	A	7.2	A	8.5	A	8.6	A	8.7	A	6.9	A	8.1	A	8.2	A	8.3
Trigger north of Trident	B	14.8	B	17.7	B	17.9	C	18.1	B	13.0	B	15.7	B	15.9	B	16.1
Trigger east of Escolar	B	14.3	C	18.7	C	18.9	C	19.1	B	14.7	B	17.7	B	17.9	C	18.1
Trigger south of Sturgeon	A	2.3	A	3.9	A	4.0	A	4.1	A	3.5	A	5.0	A	5.1	A	5.2
Two-Lane Roadway Sections																
Roadway Section	**AM Peak**								**PM Peak**							
	BASELINE		**FUTURE WITH CONSTRUCTION TRAFFIC**						**BASELINE**		**FUTURE WITH CONSTRUCTION TRAFFIC**					
	2011/2012		**2018**		**2019**		**2020**		**2011/2012**		**2018**		**2019**		**2020**	
	LOS	**Percent Time Spent Following (PTSF%)**	**LOS**	**Percent Time Spent Following (PTSF%)**	**LOS**	**Density (veh /mile/ lane)**	**LOS**	**Percent Time Spent Following (PTSF%)**	**LOS**	**Percent Time Spent Following (PTSF%)**	**LOS**	**Percent Time Spent Following (PTSF%)**	**LOS**	**Density (veh/ mile/ lane)**	**LOS**	**Percent Time Spent Following (PTSF%)**
Sturgeon west of Trigger	C	67.3%	D	72.9%	D	73.0%	D	73.1%	D	71.9%	D	74.0%	D	74.1%	D	74.2%
Sealion north of Sturgeon	C	62.1%	D	69.2%	D	69.3%	D	69.4%	C	66.1%	D	72.2%	D	72.3%	D	72.3%

1. Default values used in determining the LOS were obtained from Parametrix 2011 Bangor Traffic Analysis-Construction of EHW Impacts (Technical Memorandum)
2. LOS values shown indicate the cumulative impacts of the LWI and SPE projects.
3. LOS = Level of Service

Any support boat or barge used during in-water construction activities would generally be located in NAVBASE Kitsap Bangor restricted areas away from normal navigational activities. Standard U.S. Coast Guard safety precautions would be used by all contractors. Within the NAVBASE Kitsap Bangor restricted areas, marine-based construction equipment would be highly visible, well-marked, and would be relatively stationary as equipment (e.g., barge/tugboat and pile drivers) would only be moved prior to and after completion of in-water construction activities. Movement of construction vessels within the restricted areas would be coordinated with NAVBASE Kitsap Bangor Port Operations to ensure no interference with other Navy vessel movements. To maintain adequate levels of safety for vessel navigation during in-water construction activities, the Navy would request that the U.S. Coast Guard issue a Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity.

During in-water construction, six barge round trips per month and the 12 associated bridge openings would result in delays (on average 30 minutes per opening for a total of 6 hours per month) for motorists traveling on SR-104, an adverse impact. Based on a review of data on Hood Canal Bridge openings, the bridge typically opens 400 to 450 times per year for an average opening of just over once per day. During the construction periods, SPE barge traffic would increase bridge openings by approximately one third. Again, construction of SPE Alternative 2 is not expected to take two full in-water work seasons, so impacts would likely occur over less than two full 6-month seasons. June through October represents the period with the majority of openings due to an increase in pleasure boat traffic (Crawford 2010, personal communication). Impacts on motorists would be minimized by avoiding barge trips through the Hood Canal Bridge opening during peak commute hours of 6:00 a.m.to 8:30 a.m. and 3:30 p.m. to 6:00 p.m., Monday through Friday.

The projected level of vessel traffic is not expected to adversely impact vessel transit routes in Hood Canal or Puget Sound, however. As marine-based construction equipment would not interfere with normal navigational activities in Hood Canal, no significant impacts on marine vessel traffic during construction would occur.

OPERATION/LONG-TERM IMPACTS

SPE Alternative 2 would require improvements to land-based associated support facilities, including construction of a Waterfront Ship Support Building and a new parking lot. The proposed Waterfront Ship Support Building would be located on an existing parking lot on the east side of Wahoo Road. Roadway improvements to accommodate changes in traffic patterns along Wahoo and Sealion roads as well as repairs to existing roads damaged from construction activity would also be included under this alternative.

SSN submarines visiting NAVBASE Kitsap Bangor to berth at the SPE for maintenance and to receive logistic support at the Navy's SSN research, development, test and evaluation hub would produce approximately two additional one-way transits per month, resulting in approximately two additional openings of the Hood Canal Bridge per month. Assuming 30 minutes per opening, this would increase traffic delays on SR-104 by approximately 60 minutes per month; this is considered a minimal impact. Small support vessel traffic at the Service Pier would occur within the Naval Restricted Area and so would not interfere with general marine vessel traffic. Adherence to the naval vessel navigation regulations described in Section 3.15.1.2 above would further reduce the potential for conflicts between Navy and general vessel traffic. Movement of support vessels within the restricted areas would be coordinated with NAVBASE Kitsap Bangor Port Operations to ensure no interference with other Navy vessel movements.

3.15.2.3.3. SPE Alternative 3: Long Pier

CONSTRUCTION

The upland features to be constructed under SPE Alternative 3, which would affect traffic on NAVBASE Kitsap Bangor during the construction period, would be the same as SPE Alternative 2. Therefore, the vehicular traffic impacts of SPE Alternative 3 would be the same as those of SPE Alternative 2. Refer to Section 3.15.2.3.2 for discussion on traffic data and analysis for the construction phase of the SPE project. The number of barge trips per month would be the same as for SPE Alternative 2. Because construction of SPE Alternative 3 is expected to take two full 6-month in-water work seasons, however, the resulting openings of the Hood Canal Bridge and impacts to traffic on SR-104 would occur over a longer period than for SPE Alternative 2.

OPERATION/LONG-TERM IMPACTS

Operations under SPE Alternative 3 would be the same as for SPE Alternative 2. Therefore, impacts to vehicular and marine vessel traffic would the same as for SPE Alternative 2.

3.15.2.3.4. Summary of SPE Impacts

Impacts on traffic associated with the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.15–16.

Table 3.15–16. Summary of SPE Impacts on Traffic

Alternative	Environmental Impacts on Traffic
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	*Construction:* Exacerbation of existing peak-hours delays at both base gates and adjacent regional roadways. Adverse impacts on traffic on the Hood Canal Bridge over two partial in-water construction seasons. Increased marine vessel and vehicular traffic levels would not be sufficient to require improvement to infrastructure. *Operation/Long-term Impacts:* Two additional openings of the Hood Canal Bridge per month, increasing traffic delays on SR-104 by approximately 60 minutes per month.
SPE Alternative 3: Long Pier	*Construction:* Exacerbation of existing peak-hours delays at both base gates and adjacent regional roadways. Adverse impacts on traffic on the Hood Canal Bridge over two 6-month in-water construction seasons. Increased marine vessel and vehicular traffic levels would not be sufficient to require improvement to infrastructure. *Operation/Long-term Impacts:* Two additional openings of the Hood Canal Bridge per month, increasing traffic delays on SR-104 by approximately 60 minutes per month.
Mitigation: Openings of the Hood Canal Bridge would be scheduled to avoid peak traffic hours to the extent feasible. The Navy would request that the U.S. Coast Guard issue a Notice to Mariners to establish uniform procedures to facilitate the safe transit of vessels operating in the project vicinity.	
Consultation and Permit Status: No consultations or permits are required.	

3.15.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

Current schedules indicate that construction of the LWI and SPE projects would not overlap. Therefore, the construction traffic impacts of the two projects would not occur at the same time and would not be additive. The impacts of the two projects would extend over a 4-year period, however, as opposed to the 2-year construction period for each project alone. The same is true for impacts to traffic on the Hood Canal Bridge; impacts would not be additive but would extend over 4 years. Because the LWI and SPE projects would generate very little operational traffic, the combined operational traffic impacts of the two projects would not be substantially different from present conditions.

3.16. AIR QUALITY

3.16.1. Affected Environment

Air quality in a given location is defined by the concentration of various pollutants in the atmosphere, generally expressed in units of parts per million (ppm) or micrograms per cubic meter ($\mu g/m^3$). The air quality of the area is measured in comparison to national and/or state ambient air quality standards (AAQS). The USEPA has established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: ozone (O_3), nitrogen dioxide (NO_2), carbon monoxide (CO), respirable particulate matter (PM) less than or equal to 10 microns in diameter (PM_{10}), particulate matter less than 2.5 microns in diameter ($PM_{2.5}$), sulfur dioxide (SO_2), and lead. The NAAQS represent the maximum allowable atmospheric concentrations that may occur and still protect public health and welfare with a reasonable margin of safety. The standards identify the maximum acceptable ground-level concentrations that may not be exceeded more than once per year and mean annual concentrations that may never be exceeded. WDOE has also established state standards with concentrations that are at least as restrictive as the NAAQS. The national and Washington State AAQS are shown in Table 3.16–1. Emissions from sources associated with the Proposed Action would not be allowed to contribute to a violation of an AAQS. In addition to the NAAQS, green houses gases (GHGs), gases that trap heat in the atmosphere, are reportable to the USEPA or WDOE when stationary source emissions from a facility exceed 25,000 metric tons carbon dioxide equivalent (CO_2e) or 10,000 metric tons CO_2e, respectively.

3.16.1.1. EXISTING CONDITIONS

For the majority of the year, air quality in the vicinity of the LWI and SPE project sites, the upland project area, and the greater area of NAVBASE Kitsap Bangor, all of which are located in Kitsap County, is generally rated as good, which is the highest air quality rating. Kitsap County is presently in attainment for all NAAQS. The Puget Sound Clean Air Agency (PSCAA) addresses air quality issues in Kitsap County and has created regulations requiring that a Notice of Construction (NOC) application be obtained for stationary emission sources that may have an impact on air quality. Typically these NOC approvals are applied for before operation of an emission source and require stringent operation and maintenance standards. PSCAA also implements regulations to minimize smoke emissions from stationary point sources and emissions of fugitive dust and smoke during construction projects. In addition, NAVBASE Kitsap Bangor is required by PSCAA to determine a twelve-month rolling average of criteria pollutant emissions and report these emissions to PSCAA per the terms of the NAVBASE Kitsap Bangor synthetic minor permit (NAVFAC Environmental 2012). Table 3.16–2 shows the most recent (2011) emissions on NAVBASE Kitsap Bangor.

Table 3.16–1. National and Washington State Ambient Air Quality Standards

Air Pollutant	Averaging Time	Washington/PSCAA AAQS[a]	NAAQS[a]	
			Primary[b]	Secondary[c]
CO	8-Hour[d] 1-Hour[d]	9 ppm 35 ppm	9 ppm 35 ppm	None None
Lead	Rolling 3-month[e]	0.15 μg/m^3	0.15 μg/m^3	0.15 μg/m^3
NO_2	Annual 1-Hour[g]	0.053 ppm 0.10 ppm	0.053 ppm[f] 0.10 ppm	0.053 ppm None
PM_{10}	24-Hour[h]	150 μg/m^3	150 μg/m^3	150 μg/m^3
$PM_{2.5}$	Annual[i] 24-Hour[j]	15 μg/m^3 35 μg/m^3	12 μg/m^3 35 μg/m^3	15 μg/m^3 35 μg/m^3
O_3	8-Hour[k]	0.075 ppm	0.075 ppm	0.075 ppm
SO_2	3-Hour[d] 1-Hour	0.5 ppm 0.75 ppm[d]	None 0.075 ppm	0.5 ppm None

Sources: PSCAA 2012; USEPA 2014a; WAC 173-470; WAC 173-474; WAC 173-475

AAQS = Ambient Air Quality Standards; ºC = degrees Celsius; CO = carbon monoxide; μg/m^3 = micrograms per cubic meter; NAAQS = National Ambient Air Quality Standards; NO_2 = nitrogen dioxide; O_3 = ozone; PSCAA = Puget Sound Clean Air Agency; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; ppb = parts per billion; ppm = parts per million; SIP = State Implementation Plan; SO_2 = sulfur dioxide; USEPA = U.S. Environmental Protection Agency

a. The NAAQS and Washington State standards are based on standard temperature and pressure of 25ºC and 760 millimeters of mercury, respectively. Units of measurement are ppm and μg/m^3.

b. National Primary Standards: The levels of air quality necessary to protect the public health with an adequate margin of safety. Each state must attain the primary standards no later than three years after the SIP is approved by the USEPA.

c. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a reasonable time after the SIP is approved by the USEPA.

d. Not to be exceeded more than once per year.

e. Final rule signed October 15, 2008. The 1978 lead standard (1.5 μg/m^3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

f. The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here to allow clearer comparison to the 1-hour standard.

g. To attain this standard, the three-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).

h. Not to be exceeded more than once per year on average over three years.

i. To attain this standard, the three-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 12.0 μg/m^3.

j. To attain this standard, the three-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 μg/m^3 (effective December 17, 2006).

k. To attain this standard, the three-year average of the fourth-highest daily maximum 8-hour average O_3 concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm (effective May 27, 2008).

Table 3.16–2. Existing Air Emissions for NAVBASE Kitsap Bangor (2011)

Total Air Pollutant Emissions (tons)					
VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$
34.30	19.34	27.57	0.33	10.74	1.86

Source: NAVFAC Environmental 2012

CO = carbon monoxide; NO_x = nitrogen oxides; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_x = sulfur oxides; VOC = volatile organic compound. NO_x and VOC emissions are tracked since they are precursors to ozone.

3.16.1.1.1. ATTAINMENT, AIR EMISSIONS, AND AIR QUALITY INDEX

The USEPA designates all areas of the U.S. as having air quality either better than (attainment) or worse than (nonattainment) the NAAQS. Areas which cannot be designated as either attainment or nonattainment due to lack of available information to the NAAQS are considered unclassifiable. A nonattainment designation means that a primary NAAQS has been exceeded in a given area. Areas that were previously designated nonattainment, but are now in attainment, are designated as maintenance areas. Kitsap County is presently in attainment for the six criteria pollutants of all NAAQS and has always attained these standards due to its rural nature and lack of substantial emission sources. All ambient pollutant levels in Kitsap County are also lower than the state AAQS shown in Table 3.16–1. The USEPA has developed a nationwide reporting index for the five major criteria pollutants (CO, NO_2, SO_2, O_3, and particulate matter), known as the Air Quality Index (AQI). The AQI is based on a 500-point scale. Ambient concentrations for the five major pollutants are converted into a separate AQI value for each pollutant, using standard formulas developed by the USEPA. The highest of these AQI values is reported as the AQI value for that day. For example, if an AQI is 132 for CO and 101 for particle pollution, the AQI value for that day would be 132 for CO. The index is scaled as follows: (1) 0–50 good, (2) 51–100 moderate, (3) 101–150 unhealthy for sensitive groups, (4) 151–200 unhealthy, (5) 201–300 very unhealthy, and (6) 301–500 hazardous (PSCAA 2013a).

For the Bangor waterfront, including the LWI and SPE project sites and upland project area, as well as Kitsap County, the AQI indicated that air quality was good for most (94.5 percent) of 2012 and moderate for the rest of the year (5.5 percent) (PSCAA 2013a). The highest AQI for Kitsap County in 2012 was 68; there were no occurrences of the AQI within the range of unhealthy for sensitive groups in 2012.

3.16.1.2. CURRENT REQUIREMENTS AND PRACTICES

The Clean Air Act (CAA) (Title 42, Chapter 85 of the U.S. Code) and its subsequent amendments form the basis for the national air pollution control effort. The USEPA is responsible for implementing most aspects of the CAA. The USEPA delegates the enforcement of the federal standards to most states. In Washington, WDOE administers the CAA in the state and its implementing regulations (RCW Chapter 70.94 and WAC 173-400). WDOE has, in turn, delegated to local air agencies the responsibility of regulating stationary emission sources. As indicated above, in Kitsap County PSCAA has this responsibility. In areas that exceed the NAAQS, the CAA requires preparation of a State Implementation Plan (SIP), detailing how the state will attain the standards within mandated time frames. Both the federal and state CAA identify emission reduction goals and compliance dates based on the air quality designation of the area. PSCAA has developed rules to regulate stationary sources of air pollution in Kitsap County (PSCAA 2013b).

CAA Section 176(c), General Conformity, established certain statutory requirements for federal agencies with proposed federal activities to demonstrate conformity of the proposed activities with each state's SIP for attainment of the NAAQS. In 1993, USEPA issued the final rules for determining air quality conformity. Federal activities must not:

(a) Cause or contribute to any new violation;
(b) Increase the frequency or severity of any existing violation; or
(c) Delay timely attainment of any standard, interim emission reductions, or milestones in conformity to a SIP's purpose of eliminating or reducing the severity and number of NAAQS violations or achieving attainment of NAAQS.

The General Conformity Rule applies only to nonattainment and maintenance areas. The proposed project is located in an attainment area; therefore, the General Conformity Rule does not apply. Hazardous air pollutants (HAPs) include air pollutants that can produce serious illnesses or increased mortality, even in low concentrations. HAPs are compounds that have no established federal ambient standards, but have thresholds established by some states. The USEPA currently regulates 187 HAPs identified in the CAA, while WDOE and PSCAA list about 400 chemicals, including the 187 from the CAA. HAPs are released by sources such as chemical plants, dry cleaners, printing plants, and motor vehicles.

The most common GHGs emitted from natural processes and human activities include carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). Each GHG is assigned a global warming potential (GWP). The GWP is the ability of a gas or aerosol to trap heat in the atmosphere. The GWP rating system is standardized to CO_2, which has a value of one. For example, CH_4 has a GWP of 21, which means that it has a global warming effect 21 times greater than CO_2 on an equal-mass basis, and N_2O has a GWP of 310. Total GHG emissions from a source are often reported as a CO_2e, which is calculated by multiplying the emission of each GHG by its GWP and adding the results together to produce a single, combined emission total representing all GHGs.

EO 13423, *Strengthening Federal Environmental, Energy, and Transportation Management Executive Order,* was signed by President Bush on January 24, 2007. The EO instructs federal agencies to conduct their environmental, transportation, and energy-related activities in an environmentally, economically, and fiscally sound; integrated; continuously improving; efficient; and sustainable manner. The EO requires federal agencies to meet specific goals to improve energy efficiency and reduce GHG emissions by annual energy usage reductions of 3 percent through the end of fiscal year (FY) 2015 or by 30 percent by the end of FY 2015, relative to the baseline energy use of the agency in FY 2003. On October 5, 2009, President Obama signed EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, to establish an integrated strategy toward sustainability in the federal government and to make reduction of GHGs a priority for federal agencies. On November 1, 2013, President Obama signed EO 13653, *Preparing the United States for the Impacts of Climate Change*, with the goal of preparing the United States for the impacts of climate change by undertaking actions to enhance climate preparedness and resilience. EO 13653 established the Council on Climate Preparedness and Resilience and the State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience. Project considerations related to sea level rise effects from climate change are addressed in Section 3.1

Currently, there are no formally adopted or published NEPA thresholds of significance for GHG emissions. However, on December 18, 2014, the Council on Environmental Quality (CEQ) issued for public comment revised draft guidance for greenhouse gas emissions and climate change impacts. This document provides direction to federal agencies on when and how to consider the effects of GHG emissions and climate change in their evaluation of all proposed federal actions in accordance with NEPA (CEQ 2014). Specifically, if a proposed action emits 25,000 metric tons or more of CO_2e on an annual basis, agencies should consider this as an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public. CEQ notes that the 25,000-metric ton reference point may provide a useful, presumptive, threshold for discussion and disclosure of GHG emissions because it has been used in USEPA CAA rulemakings.

The Proposed Actions for the two projects would not require any notice of construction permits. To minimize impacts, however, the project construction contractor would use standard BMPs to control fugitive dust during construction, according to PSCAA Regulations and Section 9.15 and 70.94 RCW of the Washington CAA. These BMPs would include measures such as the following:

- Minimizing the amount of land disturbance at a given time,
- Using water sprays on disturbed earth areas,
- Installing gravel at construction area access points to prevent tracking of soil onto paved roads, and
- Revegetating disturbed areas as soon as practicable.

3.16.2. Environmental Consequences

The evaluation of impacts on air quality considers whether conditions resulting from construction and operation of the projects would violate federal, state, or local air pollution standards and regulations. Applicable air pollution standards and regulations that are the basis for determinations of environmental consequences are discussed in Section 3.16.1.2.

PSCAA has not established criteria for assessing the significance of air quality impacts for environmental impact purposes. However, WAC 173-401-200 defines a stationary source as “major” if annual emissions exceed (1) 100 tons per year of a regulated air pollutant (VOCs, CO, nitrogen oxides [NO_x], SO_2, and PM_{10}), (2) 10 tons per year of a single HAP, or (3) 25 tons per year of combined HAPs. There are currently no PSCAA thresholds for $PM_{2.5}$ emissions. Emissions from a project alternative would be considered substantial if they exceed one of these PSCAA thresholds.

From the description of construction duration and activities in Section 2.0, equipment usage per construction activity was formulated using construction schedules of similar projects (see Appendix E) to calculate construction emissions. Construction activities would produce minimal fugitive dust (PM_{10} and $PM_{2.5}$) emissions and would not produce substantial air quality impacts with regard to levels of HAPs or the other criteria pollutants. Future operations would produce a nominal increase in emissions that would not exceed the PSCAA annual emissions thresholds.

3.16.2.1. APPROACH TO ANALYSIS

Impacts on air quality from construction would occur from combustive emissions due to the use of fossil fuel-powered construction equipment, support vessels for the delivery of piles, worker commuters, and excavation. Emission factors from USEPA NONROAD 2008 (USEPA 2009b) were used to quantify combustive emissions. Emissions from excavation of upland areas would produce minimal fugitive dust. The project alternative emissions would be substantial if they exceed one of the PSCAA thresholds identified in the preceding sections. Although these thresholds are designed to assess the potential for stationary sources to impact a localized area, almost all of the project emissions would occur from mobile sources that would operate and spread impacts over a large portion of NAVBASE Kitsap Bangor.

Reasonable precautions would be implemented to minimize fugitive dust, in accordance with PSCAA Regulations I, Section 9.15 Fugitive Dust Control Measures, and combustive emissions from pile driving or barge deliveries, and no temporary construction permit would be required to be obtained from PSCAA. In addition, none of these proposed alternatives would require an NOC approval application, GHG reporting to the USEPA, or modification of the NAVBASE Kitsap Bangor synthetic minor permit. Visible emission limits and work practices would be observed and implemented during the operation of all stationary point sources, cranes, pile hammers, or barge deliveries.

3.16.2.2. LWI PROJECT ALTERNATIVES

3.16.2.2.1. LWI ALTERNATIVE 1: NO ACTION

Under the No Action Alternative, none of the proposed construction activities would occur at the project site and overall operations would not change from current levels. Therefore, the No Action Alternative would not produce any impacts on air quality.

3.16.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

CONSTRUCTION

Table 3.16–3 summarizes the total emissions (combustion, fugitive dust emissions, and construction worker commuting emissions) of criteria pollutants that would occur from construction of LWI Alternative 2 within the project region. The data represent the total construction emissions for the entire project including Phase 1 construction of the Pile Supported Pier and Phase 2 mesh/grate installation. Emissions from these combined activities would be substantially lower (e.g., at least by 10 times) than any PSCAA threshold as discussed in Section 3.16.2.1 above. Therefore, construction of LWI Alternative 2 would not violate federal, state, or local air pollution standards and regulations.

LWI Alternative 2 would emit HAPs, as subsets of VOC and PM_{10} emissions, which could potentially affect public health. However, Alternative 2 would generate a combined total of

4.22 tons of VOC and PM_{10} emissions, representing a worst-case surrogate for HAPs emissions, which is lower than the 10 tons per year for a single HAP that PSCAA uses as a nominal threshold for major emissions (Table 3.16–3). As a result, HAPs emissions from construction of LWI Alternative 2 would be below those expected to affect public health.

Table 3.16–3. Total Air Emissions from Construction of LWI Alternative 2

Phase/Activity	Total Air Pollutant Emissions (tons)					
	VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Phase 1						
Construction Activities	0.77	5.55	5.91	0.27	0.48	0.42
Construction Commuters	1.96	16.73	10.08	0.01	0.52	0.01
Phase 2	0.16	0.56	2.50	0.40	0.33	0.31
Total Emissions	**2.89**	**22.84**	**18.49**	**0.68**	**1.33**	**0.75**
PSCAA Thresholds	**100**	**100**	**100**	**100**	**100**	**N/A**

Note: See Appendix E for a detailed presentation of emissions calculations.

CO = carbon monoxide; NO_x = nitrogen oxides; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PSCAA = Puget Sound Clean Air Agency; SO_x = sulfur oxides; VOC = volatile organic compound

LWI Alternative 2 construction activities would produce short-term emissions of GHGs. The GHGs emitted would include CO_2, CH_4, and N_2O. Table 3.16–4 shows the total GHG emissions that would occur from proposed LWI Alternative 2 construction activities. As indicated in the Regulatory Overview discussion above, CEQ recently issued revised draft guidance explaining how federal agencies should analyze the environmental impacts of GHG emissions and climate change when they describe the environmental impacts of a proposed action under NEPA. CEQ proposes a GHG emissions level of 25,000 metric tons per year as a useful indicator that a project may meet the foregoing “meaningful” standard for public disclosure. The revised draft guidance clarifies that the emissions level of 25,000 metric tons per year is neither an absolute standard nor an indicator of a level of emissions that may “significantly” affect the quality of the human environment, as that term is defined in CEQ’s NEPA regulations.

In the absence of an adopted or science-based NEPA significance threshold or conformity *de minimis* levels for GHGs, this EIS compares GHG emissions that would occur from construction activity to the currently available U.S. GHG emissions inventory for 2012 to determine the relative contribution due to GHG emissions from proposed project alternatives. These data show that the ratio of annual CO_2e emissions from construction of LWI Alternative 2 to the CO_2e emissions associated with the net U.S. sources in 2012 is approximately 1,978 metric tons/6,526 million metric tons (USEPA 2014b), or about 0.00003 percent of the U.S. CO_2e emissions inventory. Since GHG emissions from LWI Alternative 2 would equate to minimal amounts of the U.S. inventory, they would not substantially contribute to global climate change.

Table 3.16–4. Total GHG Emissions from Construction of LWI Alternative 2

Phase/Activity	Total GHG Emissions (metric tons)			
	N_2O	CH_4	CO_2	CO_2e
Phase 1				
Construction Activities	0.03	0.03	406.1	417.6
Construction Commuters	0.02	0.08	1,284.3	1,291.5
Phase 2	0.05	0.01	253.7	268.5
Total Emissions	**0.10**	**0.11**	**1,944.2**	**1,977.5**
U.S. 2012 Annual GHG Emissions (million metric tons)				**6,526**
Proposed Emissions as a percent of U.S. GHG Emissions				**0.00003**

Note: See Appendix E for a detailed presentation of emissions calculations.

CH_4 = methane; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; N_2O = nitrous oxide

OPERATION/LONG-TERM IMPACTS

Operation of LWI Alternative 2 would not produce any substantial changes to existing operational emissions at NAVBASE Kitsap Bangor. Therefore, operation of LWI Alternative 2 would not violate federal, state, or local air pollution standards and regulations.

3.16.2.2.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

Impacts on air quality from construction of LWI Alternative 3 would be lower than those for Alternative 2 and would entail installation of far fewer piles than Alternative 2. Installation of the PSB units and their anchors would result in lower emissions than pile driving and other aspects of Alternative 2 pier construction. The shoreline abutment and other upland components of Alternative 3 would be the same as for Alternative 2.

Table 3.16–5 summarizes the total emissions of criteria pollutants that would occur from construction of Alternative 3 within the project region. As shown in Table 3.16–5, these combined activities would not exceed any PSCAA threshold.

Table 3.16–5. Total Air Emissions from Construction of LWI Alternative 3

Activity	Total Air Pollutant Emissions (tons)					
	VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Construction Activities	0.66	5.24	3.82	0.04	0.29	0.24
Construction Commuters	1.96	16.73	10.08	0.01	0.52	0.01
Total Emissions	**2.63**	**21.97**	**13.90**	**0.06**	**0.81**	**0.26**
PSCAA Thresholds	**100**	**100**	**100**	**100**	**100**	**N/A**

Note: See Appendix E for a detailed presentation of emissions calculations.

CO = carbon monoxide; NO_x = nitrogen oxides; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PSCAA = Puget Sound Clean Air Agency; SO_x = sulfur oxides; VOC = volatile organic compound

LWI Alternative 3 would emit HAPs that could potentially impact public health. However, Alternative 3 would generate a combined total of 3.44 tons of VOC and PM_{10} emissions, which is lower than the 10 tons per year for a single HAP (Table 3.16–5). As a result, HAPs emissions from construction of LWI Alternative 3 would be below those expected to affect public health.

Similar to LWI Alternative 2, Alternative 3 would produce short-term emissions of GHGs, as shown in Table 3.16–6. Because GHG emissions from Alternative 3 would equate to minimal amounts of the U.S. inventory (0.00003 percent), they would not substantially contribute to global climate change.

Table 3.16–6. Total GHG Emissions from Construction of LWI Alternative 3

Activity	Total GHG Emissions (metric tons)			
	N_2O	CH_4	CO_2	CO_2e
Construction Activities	0.02	0.02	414.8	420.7
Construction Commuters	0.02	0.08	1,284.3	1,291.5
Total GHG Emissions	**0.04**	**0.10**	**1,699.1**	**1,712.2**
U.S. 2012 Annual GHG Emissions (million metric tons)				**6,526**
Proposed Emissions as a percent of U.S. GHG Emissions				**0.00003**

Note: See Appendix E for a detailed presentation of emissions calculations.

CH_4 = methane; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; N_2O = nitrous oxide

OPERATION/LONG-TERM IMPACTS

Similar to LWI Alternative 2 above, operation of Alternative 3 would not produce any substantial changes to existing operational emissions at NAVBASE Kitsap Bangor.

3.16.2.2.4. SUMMARY OF LWI IMPACTS

Impacts on air quality associated with the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.16–7.

Table 3.16–7. Summary of LWI Impacts on Air Quality

Alternative	Environmental Impacts on Air Quality
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Pier	*Construction:* Emissions would not exceed the thresholds for PSCAA. *Operation/Long-term Impacts:* None.
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* Emissions would not exceed the thresholds for PSCAA. Compared to LWI Alternative 2, there would be slightly lower emissions. *Operation/Long-term Impacts:* None.
Mitigation: No mitigation measures are necessary beyond the proposed BMPs.	
Consultation and Permit Status: No consultations or permits are required.	

BMP = best management practices; PSCAA = Puget Sound Clean Air Agency

3.16.2.3. SPE PROJECT ALTERNATIVES

3.16.2.3.1. SPE ALTERNATIVE 1: NO ACTION

Under the SPE No Action Alternative, none of the proposed construction activities would occur at the project site and overall operations would not change from current levels. Therefore, the SPE No Action Alternative would not produce any impacts on air quality.

3.16.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

CONSTRUCTION

The total emissions (combustion, fugitive dust emissions, and construction worker commuting emissions) of criteria pollutants that would occur from construction of SPE Alternative 2 within the project region are summarized in Table 3.16–8. These data represent the total construction emissions for the entire project including construction of the Pier Services and Compressor Building and the Waterfront Ship Support Building. The data in Table 3.16–8 show that the combined SPE Alternative 2 activities would be substantially less (at least 8 times lower) than any PSCAA threshold.

SPE Alternative 2 would emit HAPs, as subsets of VOC and PM_{10} emissions, which could potentially affect public health. However, the data in Table 3.16–8 show that SPE Alternative 2 would generate a combined total of 4.4 tons of VOC and PM_{10} emissions, representing a worst-case surrogate for HAPs, which is lower than the 10 tons per year for a single HAP. As a result, HAPs emissions from construction of SPE Alternative 2 would be below those expected to affect public health, following the approach in Section 3.16.2.1 above.

Table 3.16–8. Total Air Emissions from Construction of SPE Alternative 2

Activity	Total Air Pollutant Emissions (tons)					
	VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Overwater Construction	0.61	1.5	13.64	1.09	0.94	0.89
Pier Services and Compressor Bldg.	0.00	0.01	0.02	0.00	0.00	0.00
Waterfront Ship Support Building	0.05	0.30	0.47	0.10	0.10	0.09
Parking Lot	0.01	0.03	0.09	0.02	0.02	0.02
Construction Truck and Vehicle Trips	1.08	8.84	5.87	0.02	0.30	0.29
Construction Commuters	1.02	8.68	5.23	0.01	0.27	0.01
Total Emissions	**2.77**	**19.36**	**25.31**	**1.24**	**1.63**	**1.31**
PSCAA Thresholds	**100**	**100**	**100**	**100**	**100**	**N/A**

Note: See Appendix E for a detailed presentation of emissions calculations.

CO = carbon monoxide; NO_x = nitrogen oxides; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PSCAA = Puget Sound Clean Air Agency; SO_x = sulfur oxides; VOC = volatile organic compound

SPE Alternative 2 would produce short-term emissions of GHGs, as shown in Table 3.16–9. Because GHG emissions from SPE Alternative 2 relative to the U.S. inventory (USEPA 2014b) would be minimal (0.00003 percent), they would not contribute substantially to global climate change.

Table 3.16–9. Total GHG Emissions from Construction of SPE Alternative 2

Activity	Total GHG Emissions (metric tons)			
	N_2O	CH_4	CO_2	CO_2e
Overwater Construction	0.11	0.05	377.5	412.0
Pier Services and Compressor Bldg.	0.00	0.00	2.9	3.1
Waterfront Ship Support Building	0.01	0.00	73.1	76.7
Parking Lot	0.00	0.00	15.6	16.4
Construction Truck and Vehicle Trips	0.01	0.04	743.02	747.4
Construction Commuters	0.01	0.04	666.0	669.7
Total GHG Emissions	0.14	0.14	1,878.13	1,925.31
U.S. 2012 Annual GHG Emissions (million metric tons)				**6,526**
Proposed Emissions as a percent of U.S. GHG Emissions				**0.00003**

Note: See Appendix E for a detailed presentation of emissions calculations.
CH_4 = methane; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; N_2O = nitrous oxide

OPERATION/LONG-TERM IMPACTS

Two new facilities totaling 52,100 square feet (4,840 square meters) would be added to NAVBASE Kitsap Bangor as part of the operational changes for SPE Alternative 2. This alternative would produce an increase of less than 1 ton of combined criteria pollutants from the new facilities due to the use of small heating and cooling equipment, generators, or electricity usage (Appendix E). Maintenance of the SPE would include routine inspections, repair, and replacement of facility components as required. These activities would not result in substantial emissions or air quality impacts.

3.16.2.3.3. SPE ALTERNATIVE 3: LONG PIER

CONSTRUCTION

Impacts on air quality from construction of SPE Alternative 3 would be slightly greater than those for SPE Alternative 2 since this alternative would include the construction of a pier that is twice as long.

Table 3.16–10 summarizes the total emissions of criteria pollutants that would occur from construction of SPE Alternative 3 within the project region. These data show that the emissions from these combined activities would be substantially less than any PSCAA threshold.

SPE Alternative 3 would emit HAPs that could potentially affect public health. However, the data in Table 3.16–10 show that SPE Alternative 3 would generate a combined total of 5.46 tons of VOC and PM_{10} emissions, which is lower than the 10 tons per year for a single HAP. As a result, HAPs emissions from construction of SPE Alternative 3 would be below those expected to affect public health.

Table 3.16–10. Total Air Emissions from Construction of SPE Alternative 3

Activity	Total Air Pollutant Emissions (tons)					
	VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$
Overwater Construction	1.01	2.39	23.16	1.74	1.52	1.43
Pier Services and Compressor Bldg.	0.04	0.16	0.41	0.08	0.07	0.07
Waterfront Ship Support Building	0.05	0.30	0.47	0.10	0.09	0.10
Parking Lot	0.01	0.03	0.09	0.02	0.02	0.02
Construction Truck and Vehicle Trips	1.08	8.84	5.87	0.02	0.30	0.29
Construction Commuters	1.02	8.68	5.23	0.01	0.27	0.01
Total Emissions	**3.20**	**20.40**	**35.22**	**1.97**	**2.26**	**1.92**
PSCAA Thresholds	**100**	**100**	**100**	**100**	**100**	**N/A**

Note: See Appendix E for a detailed presentation of emissions calculations.

CO = carbon monoxide; NO_x = nitrogen oxides; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PSCAA = Puget Sound Clean Air Agency; SO_x = sulfur oxides; VOC = volatile organic compound

SPE Alternative 3 would produce slightly higher short-term emissions of GHGs than SPE Alternative 2, as shown in Table 3.16–11. However, because GHG emissions from SPE Alternative 3 relative to the U.S. 2012 inventory would be minimal (0.00003 percent), they would not contribute substantially to global climate change.

Table 3.16–11. Total GHG Emissions from Construction of SPE Alternative 3

Activity	Total GHG Emissions (metric tons)			
	N_2O	CH_4	CO_2	CO_2e
Overwater Construction	0.17	0.09	539.2	593.6
Pier Services and Compressor Bldg.	0.06	0.01	0.0	18.5
Waterfront Ship Support Building	0.08	0.01	0.0	26.5
Parking Lot	0.02	0.00	0.0	5.1
Construction Truck and Vehicle Trips	0.01	0.04	743.02	747.4
Construction Commuters	0.01	0.04	666.0	669.7
Total GHG Emissions	**0.35**	**0.19**	**1948.14**	**2,060.85**
U.S. 2012 Annual GHG Emissions (million metric tons)				**6,526**
Proposed Emissions as a percent of U.S. GHG Emissions				**0.00003**

Note: See Appendix E for a detailed presentation of emissions calculations.

CH_4 = methane; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; N_2O = nitrous oxide

OPERATION/LONG-TERM IMPACTS

Similar to SPE Alternative 2 above, operation of SPE Alternative 3 would result in only a nominal increase in criteria pollutants (Appendix E) that would not violate federal, state, or local air pollution standards and regulations.

3.16.2.3.4. SUMMARY OF SPE IMPACTS

Impacts on air quality associated with the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.16–12.

Table 3.16–12. Summary of SPE Impacts on Air Quality

Alternative	Environmental Impacts on Air Quality
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	*Construction:* Emissions would not exceed the thresholds for PSCAA. *Operation/Long-term Impacts:* Less than significant.
SPE Alternative 3: Long Pier	*Construction:* Emissions would not exceed the thresholds for PSCAA. Compared to SPE Alternative 2, there would be somewhat higher, but still minimal changes in equipment and mobile exhaust emissions from construction. *Operation/Long-term Impacts:* Less than significant.
Mitigation: No mitigation measures are necessary beyond the proposed BMPs.	
Consultation and Permit Status: No consultations or permits are required.	

BMP = best management practices; PSCAA = Puget Sound Clean Air Agency

3.16.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

Table 3.16-3 presents the combined emissions of the LWI and SPE projects, based on the LWI and SPE alternatives with the greatest emissions. The construction periods for the two projects are not expected to overlap. Therefore, annual emissions are expected to be lower than shown in the table, which represents a worst-case scenario. In any case, emissions from these combined projects would be lower than any PSCAA threshold.

Table 3.16–13. Combined Air Emissions of LWI and SPE (Worst-Case Alternatives)

Project Alternative	Total Air Pollutant Emissions (tons)					
	VOC	CO	NO_x	SO_x	PM_{10}	$PM_{2.5}$
LWI (Alternative 2)	2.89	22.84	18.49	0.68	1.33	0.75
SPE (Alternative 3)	3.20	20.40	35.22	1.97	2.26	1.92
Total Emissions	**6.09**	**43.24**	**53.71**	**2.65**	**3.59**	**2.67**
PSCAA Thresholds	**100**	**100**	**100**	**100**	**100**	**N/A**

Note: See Appendix E for a detailed presentation of emissions calculations.

CO = carbon monoxide; NO_x = nitrogen oxides; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PSCAA = Puget Sound Clean Air Agency; SO_x = sulfur oxides; VOC = volatile organic compound

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3.17. Impact Summary

This section summarizes and compares the environmental impacts of the action alternatives for each Proposed Action. The No Action Alternatives (Alternative 1 for each Proposed Action) would not have environmental impacts and are not addressed in this section.

3.17.1. LWI Alternatives

Table 3.17–1 summarizes the environmental impacts of LWI Alternatives 2 and 3. Alternative 3 is the Preferred Alternative, in part because it would have fewer environmental impacts than Alternative 2 and, therefore, it is also the environmentally Preferred Alternative and the Least Environmentally Damaging Practicable Alternative according to the CWA Section 404 (b)(1) guidelines. The principal reasons for Alternative 2's greater impacts are that it would have a larger number of piles (and thus greater noise impacts), in-water pile driving, greater habitat impacts, and greater potential to affect migration of juvenile salmonids than Alternative 3. Unlike Alternative 2, Alternative 3 would have two observations posts supported by piles in the upper intertidal zone, and would include the replacement of the existing observation post on Marginal Wharf. Upland impacts of the two alternatives would be the same, except that Alternative 2 would have greater adverse impacts on traffic and greater positive impacts on socioeconomics.

Construction of LWI Alternative 2 would include driving 120 in-water support piles for the permanent piers, 16 permanent piles for the dolphins (8 at each), and 120 in-water piles for the temporary construction trestle, which would generate underwater and airborne noise levels for up to 80 days. In comparison, construction of Alternative 3 would require no in-water pile driving, thus avoiding resulting underwater noise impacts to marine biota. For both alternatives, however, marine mammals (pinnipeds), marbled murrelets, and upland wildlife could be exposed to airborne noise from driving of the abutment piles. In addition to pile driving noise, construction impacts on the marine environment would include minor turbidity from pile driving (LWI Alternative 2 only), PSB mooring anchor removal and placement (both alternatives), and boat movement (both alternatives). For Alternative 2, pile driving noise could result in behavioral disturbance or injury of ESA-listed salmonids (Hood Canal summer-run chum salmon, Puget Sound Chinook salmon, Puget Sound steelhead, and bull trout) or marbled murrelets occurring in the immediate project area, as well as behavioral disturbance of marine mammals. ESA-listed rockfish (bocaccio, yellow-eye rockfish, and canary rockfish) are not expected in the project area. Marine mammals potentially affected by behavioral harassment (Alternative 2 only) would include the following non-ESA-listed species: Steller sea lion, harbor seal, California sea lion, harbor porpoise, and transient killer whales. The ESA-listed humpback whale is not expected to be exposed to behavioral harassment due to the rare occurrence of this species in the project area. The ESA-listed Southern Resident killer whale is not present in the project area. Limiting pile driving and abutment work below MHHW to the in-water work season of July 15 to January 15 would minimize potential impacts on ESA-listed salmonids. Pile driving noise for Alternative 3 (airborne noise only) is not expected to result in behavioral disturbance of pinnipeds or marbled murrelets, and would have no measurable impacts on ESA-listed fish.

Construction of the shoreline abutments would be the same for both alternatives and would require temporary excavation of an area of approximately 15,600 square feet (1,449 square meters) below MHHW. The stair landings and observation post piles for Alternative 3 would lie below MHHW, with a total area of approximately 142 square feet (13.2 square meters).

Alternative 2 would not have observation posts, so the area below MHHW would be 24 square feet (2.2 square meters). For both LWI Alternatives 650 feet (198 meters) of temporary coffer dam would be installed to provide for excavation of the abutment wall and stair landings. Once the abutment foundations would be built the excavated area below MHHW would be backfilled and a 2-foot (0.6-meter) high by approximately 10-foot (3 meter) wide riprap berm (303 cubic yards [232 cubic meters]) would be placed above the natural beach contour. Placement of the steel plate anchors and piles for LWI Alternative 2 would result in the permanent loss of 1,040 square feet (97 square meters) of eelgrass habitat. Placement of PSB buoy mooring anchors and PSB and buoy grounding under LWI Alternative 3 would result in the permanent loss of 580 square feet (54 square meters) of eelgrass habitat. Under Alternative 3, the observation posts constructed adjacent to the new abutments would shade benthic habitat in the upper intertidal zone (total of 2,000 square feet [186 square meters]) but not marine vegetation or oyster beds[1]. Similarly, the dolphin platforms (Alternative 2 only) would shade benthic habitat (128 square feet [12 square meters]) but not marine vegetation or oysters. The presence of the pier and in-water mesh under Alternative 2 could represent at least a partial barrier to the migration of ESA-listed salmonids along the Bangor waterfront. In contrast, Alternative 3 would have less of a barrier effect on ESA-listed salmonids because it would lack the pier and in-water mesh. The guard panels between PSB pontoons would have negligible impacts on migration of ESA-listed salmonids.

Practices and measures to minimize impacts to ESA-listed species would be implemented as described in the Mitigation Action Plan (Appendix C). Construction and operation of LWI Alternatives 2 and 3 may affect, but is not likely to adversely affect, ESA-listed salmonids, rockfish, humpback whales, Southern Resident killer whales, and marbled murrelets. The Navy conducted Section 7 consultation to address potential impacts on federally listed species and designated critical habitat. NMFS provided its concurrence with the Navy's ***not likely to adversely affect*** determinations under informal consultation on November 13, 2015. NMFS also concurred with the Navy's ***may adversely affect*** determination for EFH for under the MSA. NMFS determined that no conservation recommendations were required because implementation of the Navy's best management practices and mitigation measures will be sufficient to avoid, mitigate, or offset the impacts of the Proposed Action on intertidal EFH. In a concurrence letter dated March 4, 2016, USFWS stated that LWI project impacts to bull trout are not measurable and therefore insignificant, and impacts to marbled murrelets are discountable. USFWS also did not request additional conservation measures beyond the Navy's BMPs and mitigation measures. The preferred alternative (Alternative 3) would not result in harassment of marine mammal as defined by the MMPA, so MMPA consultation is not required.

For Alternative 2, periodic cleaning of the mesh by power washing would result in minor water quality impacts, which would be minimized by employing appropriate BMPs. Likewise for both alternatives, periodic cleaning of the PSB guard panels would result in minor water quality impacts, which would be minimized by employing appropriate BMPs. Pursuant to the CWA, the Navy submitted a JARPA for permits from USACE for fill associated with the abutment stair landings and riprap, and for a Section 401 water quality certification from WDOE. In accordance with the CZMA, the Navy submitted a CCD to WDOE.

[1] The replacement observation post on Marginal Wharf would be constructed on the existing wharf and would not increase overwater shading.

Impacts of both alternatives on the upland environment would be similar and include approximately 1.1 acre (0.44 hectare) of vegetation clearing, construction traffic, air pollutant emissions, and pile driving and conventional construction noise. With the exception of 0.12 acre (0.048 hectare) of new impervious surface and 0.1 acre (0.039 hectare) of permanent pervious surfaces such as aggregate pathways, the disturbed area would be revegetated with native species. There would be no impacts on wetlands. Wildlife could be disturbed by construction noise and lighting, but no terrestrial animals or plants protected under the ESA would be affected. Potential impacts to bald eagles may occur as a result of elevated noise levels or visual disturbance during construction, but no incidental takes are anticipated.

Nearby residential areas and recreational users of the waters off NAVBASE Kitsap Bangor may experience elevated noise levels during construction, but no other impacts on land use or recreation are anticipated. Both alternatives would have minimal impacts on aesthetics; impacts would be greater for Alternative 2 than for Alternative 3, because of the larger structure and larger number of piles for Alternative 2. Both alternatives would be consistent with the NAVBASE Kitsap Bangor TRIDENT Support Site Master Plan. Temporary socioeconomic impacts of construction would be positive: for every $100 million spent by the Navy in construction expenditures, an estimated 919 direct jobs would be created, as well as an estimated 426 indirect and induced jobs. Indirect or induced jobs would be concentrated in the following industries: food services, real estate establishment, health care, architecture and engineering, wholesale trade, and retail stores. For Alternative 2, the construction cost is estimated to be approximately $54 million, representing a total economic impact of 500 direct jobs and 233 indirect and induced jobs. Total economic output to the region would be in excess of $80 million. For Alternative 3, the construction cost is estimated to be approximately $33 million, representing the total economic impact of 300 direct jobs and 139 indirect and induced jobs. Total economic output to the region would be in excess of $48 million. Long-term socioeconomic impacts would be minimal. Neither alternative would have disproportionately high and adverse human health or environmental effects on minority populations or low-income populations because the affected areas do not disproportionately contain minority or low-income populations. In addition, because the project is located within a military restricted area, there would be no potential for children to be exposed to pollutants, other hazardous materials, or safety hazards as a result of construction and operation of either LWI alternative.

The cultural setting of Delta Pier and EHW-1, which are eligible to be listed in the NRHP, would not be adversely affected. In July 2015 the SHPO concurred with the Navy's determination of no adverse effect of the LWI project on historic properties under the NHPA. There would be a small potential for disturbance of archaeological resources (prehistoric sites) during construction; if any such resources were encountered, the Navy would coordinate with the SHPO and the tribes. Access to tribal shellfish harvesting areas would be restricted in the construction area only during construction of the LWI. During operations access would not be restricted but the new structures would result in permanent loss of 1,880 square feet (175 square meters) of the shellfish harvesting areas under Alternatives 2 and 3 (Table 3.17–1). Neither alternative would have population-level effects on salmon stocks harvested by the tribes. Construction vessels could interfere with tribal fishing vessels operating in Hood Canal. The Navy invited and has conducted government-to-government consultation with the five federally recognized American

Table 3.17–1. Summary of Environmental Impacts and Mitigation for LWI Alternatives

Resource Area	LWI Alternative 1: No Action	LWI Alternative 2: Pile-Supported Pier	LWI Alternative 3: PSB Modifications (Preferred)
Marine Water Resources	No change	• Temporary and localized disturbances to bottom sediment within the construction footprint, maximum 13.1 acres (5.3 hectares) • Temporary and localized changes to water quality (turbidity and suspended sediment concentrations) associated with resuspension of bottom sediments, but changes are not expected to exceed water quality standards • Localized scouring or accumulation of sediments, which would not result in measurable changes in overall sea bed elevations (i.e., deposition or erosion) or littoral transport processes • Release of organic matter from periodic cleaning of the LWI mesh and PSB guard panels	• Temporary and localized disturbances to bottom sediment within the construction footprint; maximum of 12.7 acres (5.2 hectares) • Temporary and localized changes to water quality (turbidity and suspended sediment concentrations) associated with resuspension of bottom sediments, but changes are not expected to exceed water quality standards • Localized disturbances of bottom sediments from grounding of PSB feet and buoys during low tidal stages • Release of organic matter from periodic cleaning of the PSB guard panels
Marine Vegetation and Invertebrates	No change	• Temporary shallow water construction impacts: approximately 6.3 acres (2.4 hectares), 3 acres (1.2 hectares) vegetated • Permanent loss of approximately 1,040 sq ft (97 sq m) of eelgrass habitat under steel plate anchors and piles • Long-term full shading from dolphin platforms of approximately 128 sq ft (12 sq m) of habitat (not vegetated) • Limited shading by pier grating not expected to have significant impacts on vegetation or invertebrates • Benthic habitat loss of approximately 5,952 sq ft (553 sq m) under piles, steel plate anchors, and abutment stair landings • Permanent loss of approximately 226 sq ft (95 sq m) of oyster beds under piles and steel plate anchors • Localized, negligible impacts on plankton	• Temporary shallow water construction impacts: approximately 5.9 acres (2.4 hectares), 2.8 acres (1.1 hectares) vegetated • Permanent loss of approximately 580 sq ft (54 sq m) of eelgrass habitat from anchor placement and PSB/buoy disturbance • Long-term full shading from observation posts of approximately 2,000 sq ft (186 sq m) of habitat (not vegetated) • Limited shading by PSBs and observation post stair grating not expected to have significant impacts on vegetation or invertebrates • Permanent loss of approximately 2,570 sq ft (239 sq m) of intertidal habitat due to grounding of PSBs and buoys • Permanent benthic habitat loss of approximately 142 sq ft (13 sq m) under observation post piles and abutment stair landings

Table 3.17–1. Summary of Environmental Impacts and Mitigation for LWI Alternatives (continued)

Resource Area	LWI Alternative 1: No Action	LWI Alternative 2: Pile-Supported Pier	LWI Alternative 3: PSB Modifications (Preferred)
Marine Vegetation and Invertebrates (continued)		• Practices and measures applied to offset impacts on eelgrass and other marine habitat (measures for water quality, shading, vessel movements; compensatory mitigation implemented under the HCCC ILF program, see Appendix C, Mitigation Action Plan)	• Permanent loss of approximately 640 sq ft (52 sq m) of oyster beds due to grounding of PSBs/buoys • Localized, negligible impacts on plankton • Practices and measures applied to offset impacts on eelgrass and other marine habitat (measures for water quality, shading, vessel movements; compensatory mitigation implemented under the HCCC ILF program, see Appendix C, Mitigation Action Plan)
Threatened and Endangered Species	No change	• May affect, not likely to adversely affect, ESA-listed Puget Sound Chinook, Puget Sound steelhead, Hood Canal summer-run chum salmon, bull trout, bocaccio, canary rockfish, yelloweye rockfish, humpback whale, Southern Resident killer whale, and marbled murrelet • May affect, not likely to adversely affect critical habitat for Puget Sound Chinook, Hood Canal summer-run chum salmon, bocaccio, canary rockfish, and yelloweye rockfish • No effect on critical habitat for Puget Sound steelhead, bull trout, Southern Resident killer whale, and marbled murrelet • Measures and practices to be implemented to offset impacts (measures proposed for pile driving noise)	• May affect, not likely to adversely affect, ESA-listed Puget Sound Chinook, Puget Sound steelhead, Hood Canal summer-run chum salmon, bull trout, bocaccio, canary rockfish, yelloweye rockfish, humpback whale, Southern Resident killer whale, and marbled murrelet • May affect, not likely to adversely affect critical habitat for Puget Sound Chinook, Hood Canal summer-run chum salmon, bocaccio, canary rockfish, and yelloweye rockfish • No effect on critical habitat for Puget Sound steelhead, bull trout, Southern Resident killer whale, and marbled murrelet • Measures and practices to be implemented to offset impacts (measures proposed for airborne pile driving noise)

Table 3.17–1. Summary of Environmental Impacts and Mitigation for LWI Alternatives (continued)

Resource Area	LWI Alternative 1: No Action	LWI Alternative 2: Pile-Supported Pier	LWI Alternative 3: PSB Modifications (Preferred)
Fish	No change	• Construction noise, including impact and vibratory pile driving noise (up to 80 days during first in-water work window) that may exceed current thresholds and guidelines for ESA-listed species behavior and injury • Temporary (24 months) and intermittent construction impacts including increased turbidity and reduction in aquatic vegetation and benthic habitats • Partial operational barrier effect, on nearshore-occurring migratory fish; minor loss of forage fish spawning habitat and supratidal fish habitat. • Measures and practices to be implemented to offset construction impacts (measures proposed for pile driving noise)	• Construction noise disturbance (no in-water pile driving) • Temporary (12 months) and intermittent construction impacts including increased turbidity and minor reduction in benthic habitats (less than Alternative 2) • Minimal barrier effect (less than Alternative 2) on nearshore-occurring juvenile and adult migratory fish; minor loss of forage fish spawning habitat and supratidal fish habitat. • Measures and practices to be implemented to offset construction impacts
Marine Mammals	No change	• Changes in prey availability due to loss or degradation of benthic habitat and operational barrier to migratory fish • Direct impacts due to pile driving noise sufficient to exceed NMFS disturbance thresholds • Estimated Level B (behavioral) incidental takes based on acoustic propagation model of pile driving noise: – Steller sea lion: 160 – CA sea lion: 2,880 – Harbor seal: 18,080 – Transient killer whale: 180 – Harbor porpoise: 320 • Measures and practices to be implemented to offset impacts (measures proposed for pile driving noise)	• Changes in prey availability due to minor loss / degradation of benthic habitat (less than Alternative 2) • No incidental takes from pile driving noise anticipated • Measures and practices to be implemented to offset impacts (measures proposed for airborne pile driving noise)

Table 3.17–1. Summary of Environmental Impacts and Mitigation for LWI Alternatives (continued)

Resource Area	LWI Alternative 1: No Action	LWI Alternative 2: Pile-Supported Pier	LWI Alternative 3: PSB Modifications (Preferred)
Marine Birds	No change	• Changes in prey availability due to loss and degradation of benthic habitat and operational barrier to migratory fish • Impacts due to pile driving noise sufficient to exceed auditory injury and masking thresholds for marbled murrelets • Measures and practices to be implemented to offset impacts (measures proposed for pile driving noise) • No incidental takes of MBTA-protected birds anticipated	• Changes in prey availability due to minor loss / degradation of benthic habitat (less than Alternative 2) • Impacts due to airborne pile driving noise sufficient to exceed masking thresholds for marbled murrelets • Measures and practices to be implemented to offset impacts (measures proposed for airborne pile driving noise) • No incidental takes of MBTA-protected birds are anticipated
Terrestrial Biological Resources	No change	• Approximately 1.1 acre (0.44 hectare) of vegetation cleared • Revegetation of 0.86 acre (0.35 hectare) • Intermittent construction noise impacts on wildlife over 24 months • Potential disturbance of foraging bald eagles; no incidental takes under Bald and Golden Eagle Protection Act anticipated • Minor increases in visual disturbance to wildlife due to human activity, lighting, and vehicle movements • Increased isolation of terrestrial habitat within the Waterfront Security Enclave due to loss of shoreline connectivity to adjacent habitat • Measures and practices to be implemented to offset potential impacts	• Approximately 1.1 acre (0.44 hectare) of vegetation cleared • Revegetation of 0.86 acre (0.35 hectare) • Intermittent construction noise impacts on wildlife during 24 months • Potential disturbance of foraging bald eagles; no incidental takes under Bald and Golden Eagle Protection Act anticipated • Minor increases in visual disturbance to wildlife due to human activity, lighting, and vehicle movements • Increased isolation of terrestrial habitat within the Waterfront Security Enclave due to loss of shoreline connectivity to adjacent habitat • Measures and practices to be implemented to offset potential impacts
Geology, Soils, and Water Resources	No change	• Temporary disturbance of approximately 1.1 acres (0.44 hectares) • Approximately 5,186 sq ft (482 sq m) of new impervious surface • Permanent disturbance of shoreline geology and soils at abutment	• Temporary disturbance of approximately 1.1 acres (0.44 hectares) • Approximately 5,186 sq ft (482 sq m) of new impervious surface • Permanent disturbance of shoreline geology and soils at abutment

Table 3.17–1. Summary of Environmental Impacts and Mitigation for LWI Alternatives (continued)

Resource Area	LWI Alternative 1: No Action	LWI Alternative 2: Pile-Supported Pier	LWI Alternative 3: PSB Modifications (Preferred)
Land Use and Recreation	No change	• Compatible with Navy Waterfront Functional Plan and TRIDENT Support Site Master Plan • Exposure to elevated noise in recreational areas from pile driving (up to 80 days) and other construction activities • Construction would not be conducted between 10 p.m. and 7 a.m.; pile driving during daylight only; Navy to request U.S. Coast Guard to issue a Notice to Mariners; Navy to notify public prior to construction	• Compatible with Navy Waterfront Functional Plan and TRIDENT Support Site Master Plan • Exposure to elevated noise in recreational areas from pile driving (up to 30 days) and other construction activities • Construction would not be conducted between 10 p.m. and 7 a.m.; pile driving during daylight only; Navy to request U.S. Coast Guard to issue a Notice to Mariners; Navy to notify public prior to construction
Airborne Acoustic Environment	No change	• Temporary / intermittent exposure to elevated noise levels in nearby residential / recreation areas • Construction would not be conducted between 10 p.m. and 7 a.m.; pile driving would occur in daylight hours only; Navy to notify public prior to construction	• Temporary / intermittent exposure to elevated noise levels in nearby residential / recreation areas (shorter duration than Alternative 2) • Construction would not be conducted between 10 p.m. and 7 a.m.; pile driving would occur in daylight hours only; Navy to notify public prior to construction
Aesthetics and Visual Quality	No change	• Temporary disturbance of existing visual landscape during construction • Minimal increase in industrial appearance, including lighting, of the waterfront over the long term	• Temporary disturbance of existing visual landscape during construction (moderately less than Alternative 2) • Minimal increase in industrial appearance of the waterfront over the long term (less impact than for Alternative 2 due to no pier structure)
Socioeconomics	No change	• Local beneficial economic impacts from construction activities • No impacts to commercial or recreational fishing • Potential long-term socioeconomic impact on tribes who would no longer have access to approximately 1,880 sq ft (175 sq m) of U&A shellfish beds (oysters and clams) for commercial harvest. Mitigation included in Memorandum of Agreement (MOA) between Navy and Skokomish Indian Tribe signed on March 3, 2016. The Navy will continue to consult with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe.	• Local beneficial economic impact from construction activities (less than Alternative 2) • No impacts to commercial or recreational fishing • Potential long-term socioeconomic impact on tribes who would no longer have access to approximately 1,880 sq ft (175 sq m) of U&A shellfish beds (oysters and clams) for commercial harvest. Mitigation included in Memorandum of Agreement (MOA) between Navy and Skokomish Indian Tribe signed on March 3, 2016. The Navy will continue to consult with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe.

Table 3.17–1. Summary of Environmental Impacts and Mitigation for LWI Alternatives (continued)

Resource Area	LWI Alternative 1: No Action	LWI Alternative 2: Pile-Supported Pier	LWI Alternative 3: PSB Modifications (Preferred)
Environmental Justice and Protection of Children	No change	• No disproportionate effects from construction or operations on minority disadvantaged populations or children	• No disproportionate effects from construction or operations on minority disadvantaged populations or children
Cultural Resources	No change	• Effect, not adverse, on Delta Pier and EHW-1 • Low potential for disturbance of archaeological or NAGPRA resources during construction • Consultation with SHPO completed. If resources found during construction, mitigation measures would be developed in consultation with SHPO and tribes; MOA signed with Skokomish Indian Tribe; the Navy will continue to consult with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe.	• Effect, not adverse, on Delta Pier and EHW-1 • Low potential for disturbance of archaeological or NAGPRA resources during construction • Consultation with SHPO completed. If resources found during construction, mitigation measures would be developed in consultation with SHPO and tribes; MOA signed with Skokomish Indian Tribe; the Navy will continue to consult with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe.
American Indian Traditional Resources	No change	• Restricted access to shellfish harvest area within the immediate construction zone during construction • Temporary (projected up to 7 years) loss of approximately 0.68 acre (0.28 hectare) of shellfish in tribal harvest area • Exposure to elevated noise levels and visual/integrity impacts during construction for tribal harvesters • Long-term (Operations) loss of approximately 1,880 sq ft (175 sq m) of shellfish beds • No population-level impacts on salmon stocks harvested by tribes • Interference with tribal fishing vessels by project construction vessels • Mitigation measures developed to offset impacts; MOA signed with Skokomish Indian Tribe; the Navy will continue to consult with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe.	• Restricted access to shellfish harvest area within the immediate construction zone during construction • Temporary (projected up to 6 years) loss of approximately 0.64 acre (0.26 hectare) of shellfish in tribal harvest area • Exposure to elevated noise levels during construction for tribal harvesters • Long-term (Operations) loss of approximately 1,880 sq ft (175 sq m) of shellfish beds • No population-level impacts on salmon stocks harvested by tribes • Interference with tribal fishing vessels by project construction vessels • Mitigation measures developed to offset impacts; MOA signed with Skokomish Indian Tribe; the Navy will continue to consult with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe.

Table 3.17–1. Summary of Environmental Impacts and Mitigation for LWI Alternatives (continued)

Resource Area	LWI Alternative 1: No Action	LWI Alternative 2: Pile-Supported Pier	LWI Alternative 3: PSB Modifications (Preferred)
Traffic	No change	• Increased vehicle traffic during construction (24 months), which would add to existing peak-hour delays at base gates • Increased marine vessel traffic during two in-water work seasons • Traffic delays due to increase in openings of Hood Canal Bridge during construction; barge trips scheduled to avoid commuting hours to maximum extent	• Increased vehicle traffic during construction (24 months), which would add to existing peak-hour delays at base gates • Minimal increased marine vessel traffic (less than Alternative 2) during one in-water work season • Minimal traffic delays (less than Alternative 2) due to increase in openings of Hood Canal Bridge during construction; barge trips scheduled to avoid commuting hours to maximum extent
Air Quality	No change	• Temporary construction emissions would not exceed threshold for major source (24 months). The project site is in an attainment area.	• Temporary construction emissions (less than Alternative 2) would not exceed threshold for major source (24 months). The project site is in an attainment area.

EHW-1 = Explosives Handling Wharf-1; ESA = Endangered Species Act; HCCC = Hood Canal Coordinating Council; ILF = In-Lieu Fee; MOA = Memorandum of Agreement; NAGPRA = Native American Graves Protection and Repatriation Act; NMFS = National Marine Fisheries Service; SHPO = State Historic Preservation Officer; sq ft = square feet; sq m = square meter; U&A = Usual and Accustomed; USACE = U.S. Army Corps of Engineers; USFWS = U.S. Fish and Wildlife Service

Indian tribes that have U&A areas in the vicinity of the project area: the Skokomish Indian Tribe, Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, Lower Elwha Klallam Tribe, and Suquamish Tribe. On March 3, 2016 the Navy and the Skokomish Indian Tribe completed a Memorandum of Agreement (MOA) to undertake treaty mitigation for the LWI project by contributing funding to support the Skokomish River Basin restoration, with the terms and conditions of the MOA to apply only after the Navy begins in-water construction. The Navy and the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe have conducted government-to-government consultation for the LWI project since 2008. Although the Navy and these Tribes were not able to reach formal agreement on treaty mitigation projects at the time of publication of this FEIS, the Navy carefully considered tribal concerns regarding the Proposed Actions and assessed the potential for significant impact to tribal rights and protected resources. Based on the Navy's assessment, the Navy offered to fund one or more of several proposed treaty mitigation projects.

Construction would generate truck traffic, but this traffic would be within the capacity of the base road system. However, construction traffic for both alternatives would exacerbate existing peak-hour delays at both gates to NAVBASE Kitsap Bangor and roads immediately outside the gates. Alternative 2 would have a greater impact than Alternative 3 on traffic crossing the Hood Canal Bridge because of the larger number of construction barges. Impacts on air quality would be not significant for either alternative because emissions would be well below regulatory thresholds.

Air quality in the vicinity of the LWI and SPE project sites, the upland project area, and the greater area of NAVBASE Kitsap Bangor, all of which are located in Kitsap County, is generally rated as good, which is the highest air quality rating. Kitsap County is presently in attainment for all NAAQS for criteria pollutants.

Table 3.17–2 identifies mitigation for impacts on aquatic habitat and Waters of the U.S.

Table 3.17–2. Mitigation for LWI Impacts on Aquatic Habitat and Waters of the U.S.

LWI Impact	LWI Alternative 2 Area	LWI Alternative 3 Area	LWI Anticipated Mitigation[1]
Habitat displaced by piles and/or anchors in shallow water (< 30 feet)	5,927 square feet (551 square meters)	118 square feet (11 square meters)	Mitigation for loss of aquatic resources would be provided by the Navy's participation in the HCCC ILF program for Hood Canal in accordance with the Compensatory Mitigation Rule.
Over-water area (shading) in shallow water[2]	14,883 square feet (1,383 square meters)	5,070 square feet (471 square meters)	Mitigation for loss of aquatic resources would be provided by the Navy's participation in the HCCC ILF program for Hood Canal in accordance with the Compensatory Mitigation Rule.
Eelgrass covered by steel plate anchors and piles	1,039 square feet (96 square meters)	N/A	Mitigation for loss of aquatic resources would be provided by the Navy's participation in the HCCC ILF program for Hood Canal in accordance with the Compensatory Mitigation Rule.

Table 3.17–2. Mitigation for LWI Impacts on Aquatic Habitat and Waters of the U.S. (continued)

LWI Impact	LWI Alternative 2 Area	LWI Alternative 3 Area	LWI Anticipated Mitigation[1]
Eelgrass covered by buoy mooring anchors or degraded by PSB and buoy grounding	N/A	580 square feet (54 square meters)	Mitigation for loss of aquatic resources would be provided by the Navy's participation in the HCCC ILF program for Hood Canal in accordance with the Compensatory Mitigation Rule.
Fill in waters of the U.S. (shoreline abutment stair landings and riprap)	4,124 square feet (383 square meters)	4,124 square feet (383 square meters)	Mitigation for loss of aquatic resources[3] would be provided by the Navy's participation in the HCCC ILF program for Hood Canal in accordance with the Compensatory Mitigation Rule.
Excavation in waters of the U.S. (shoreline abutments and stairs)	15,600 square feet (1,449 square meters)	15,600 square feet (1,449 square meters)	Mitigation for loss of aquatic resources[3] would be provided by the Navy's participation in the HCCC ILF program for Hood Canal in accordance with the Compensatory Mitigation Rule.
Total[4]	30,483 square feet (2,832 square meters)	20,670 square feet (1,920 square meters)	

HCCC = Hood Canal Coordinating Council; ILF = In-Lieu Fee; N/A = not applicable; PSB = port security barrier; USACE = U.S. Army Corps of Engineers

1. Final mitigation requirements for the selected alternative would be determined through the CWA permitting process. Please see Appendix C, the Mitigation Action Plan, for a discussion of compensatory mitigation.
2. No full shading of eelgrass is expected from either alternative.
3. Impact is from excavation during construction of the abutments and concrete fill from the abutment stair landings.
4. Total is the sum of the overwater area plus the excavation for the abutments; the abutment stair landing fill areas are included in the excavation areas; all other items are included in the overwater shading area.

3.17.2. SPE Alternatives

Table 3.17–3 compares the environmental impacts of SPE Alternatives 2 and 3. SPE Alternative 2 is the Preferred Alternative, in part because it would have fewer environmental impacts than Alternative 3 and, therefore, it is also the environmentally Preferred Alternative. The longer pier under Alternative 3 would result in more pile driving (and associated noise) and habitat impacts. Both alternatives would have minimal effects on juvenile salmon migration and tribal fisheries resources, no effect on tribal shellfish harvest beds, and potential impacts on clam seed stock under piles. Upland impacts for both alternatives would be the same, although Alternative 3 would have greater impacts on traffic on the Hood Canal Bridge and socioeconomics (positive) because of the larger construction project that would be required for the longer pier extension.

The principal difference between SPE Alternatives 2 and 3 is the length of the pier extension: 540 feet (165 meters) under Alternative 2 and 975 feet (297 meters) under Alternative 3. The width of both alternative pier extensions would be 68 feet (21 meters). SPE Alternative 2 would include driving of fewer piles (total of 385) than Alternative 3 (total of 660) and would generate

Table 3.17–3. Summary of Environmental Impacts and Mitigation for SPE Alternatives

Resource Area	SPE Alternative 1: No Action	SPE Alternative 2: Short Pier (Preferred)	SPE Alternative 3: Long Pier
Marine Water Resources	No change	• Temporary and localized disturbances to bottom sediments within the construction footprint, maximum 3.9 acres (1.6 hectares) • Temporary and localized changes to water quality associated with resuspension of bottom sediments, but changes are not expected to exceed marine water quality standards • Very localized scouring or accumulation of sediments, from small-scale changes in flow patterns, resulting in minor changes in sediment texture; these changes are not expected to exceed sediment quality standards • Marginal changes in current velocities but no measurable changes in other than localized sea bed elevations (i.e., deposition or erosion) or littoral transport processes expected	• Larger potential construction footprint of 6.6 acres (2.7 hectares); otherwise same as Alternative 2 • Temporary and localized changes to water quality associated with resuspension of bottom sediments, but changes are not expected to exceed marine water quality standards • Very localized scouring or accumulation of sediments, from small-scale changes in flow patterns, resulting in minor changes in sediment texture; these changes are not expected to exceed sediment quality standards • Marginal changes in current velocities but no measurable changes in other than localized sea bed elevations (i.e., deposition or erosion) or littoral transport processes expected
Marine Vegetation and Invertebrates	No change	• Temporary construction impacts in approximately 3.9 acres; small areas (0.28 acre [0.11 hectare]) of marine vegetation disturbed • Benthic habitat loss of approximately 1,965 sq ft (183 sq m) under piles • Localized, negligible impacts on plankton • Practices and measures applied to offset impact on marine habitat (measures for water quality, shading, vessel movements; compensatory mitigation implemented under the HCCC ILF program, see Appendix C, Mitigation Action Plan)	• Temporary construction impacts in approximately 6.6 acres (2.7 hectares); small areas (0.28 acre [0.11 hectare]) of marine vegetation disturbed • Benthic habitat loss of approximately 1,876 sq ft (174 sq m) under piles • Localized, negligible impacts on plankton • Practices and measures applied to offset impact on marine habitat (measures for water quality, shading, vessel movements; compensatory mitigation implemented under the HCCC ILF program, see Appendix C, Mitigation Action Plan)

Table 3.17–3. Summary of Environmental Impacts and Mitigation for SPE Alternatives (continued)

Resource Area	SPE Alternative 1: No Action	SPE Alternative 2: Short Pier (Preferred)	SPE Alternative 3: Long Pier
Threatened and Endangered Species	No change	• May affect, not likely to adversely affect, ESA-listed Puget Sound Chinook, Puget Sound steelhead, Hood Canal summer-run chum salmon, bull trout, bocaccio, canary rockfish, yelloweye rockfish, humpback whale, Southern Resident killer whale, and marbled murrelet • May affect, not likely to adversely affect, critical habitat for Puget Sound Chinook, Hood Canal summer-run chum salmon, bocaccio, canary rockfish, and yelloweye rockfish • No effect on critical habitat for Puget Sound steelhead, bull trout, Southern Resident killer whale, and marbled murrelet • Measures and practices to be implemented to offset impacts (measures proposed for pile driving noise; others to be developed in consultation with NMFS and USFWS)	• May affect, not likely to adversely affect, ESA-listed Puget Sound Chinook, Puget Sound steelhead, Hood Canal summer-run chum salmon, bull trout, bocaccio, canary rockfish, yelloweye rockfish, humpback whale, Southern Resident killer whale, and marbled murrelet • May affect, not likely to adversely affect, critical habitat for Puget Sound Chinook, Hood Canal summer-run chum salmon, bocaccio, canary rockfish, and yelloweye rockfish • No effect on critical habitat for Puget Sound steelhead, bull trout, Southern Resident killer whale, and marbled murrelet • Measures and practices to be implemented to offset impacts (measures proposed for pile driving noise; others to be developed in consultation with NMFS and USFWS)

Table 3.17–3. Summary of Environmental Impacts and Mitigation for SPE Alternatives (continued)

Resource Area	SPE Alternative 1: No Action	SPE Alternative 2: Short Pier (Preferred)	SPE Alternative 3: Long Pier
Fish	No change	• Construction noise, including impact and vibratory pile driving noise (up to 161 days over two in-water work seasons) that may exceed current thresholds and guidelines for ESA-listed species behavior and injury • Temporary (24 months over two in-water work seasons) and intermittent construction impacts including increased turbidity, artificial lighting, reduction in aquatic vegetation and benthic habitats • Offshore overwater structure (44,000 sq ft [4,090 sq m]) with support piles and fender piles (approximately 385) with limited artificial lighting • Little to no barrier effect on smaller, nearshore-migrating juvenile salmonids and forage fish, or larger, offshore migratory fish • Potential impact to adjacent nearshore sand lance spawning habitat • Measures and practices to be implemented to offset construction impacts (measures proposed for pile driving noise; others to be developed on consultation with NMFS)	• Construction noise, including impact and vibratory pile driving noise (up to 205 days over two in-water work seasons) that may exceed current thresholds and guidelines for injury and behavioral disturbance of ESA-listed species • Temporary (24 months over two in-water work seasons) and intermittent construction impacts including increased turbidity, artificial lighting, reduction in aquatic vegetation and benthic habitats, greater than Alternative 2 • Offshore overwater structure (70,000 sq ft [6,500 sq m]) with support piles and fender piles (approximately 660), with limited artificial lighting • Little to no barrier effect on smaller, nearshore-migrating juvenile salmonids and forage fish, or larger, offshore migratory fish • Potential impact to adjacent nearshore sand lance spawning habitat • Measures and practices to be implemented to offset construction impacts (measures proposed for pile driving noise; others to be developed on consultation with NMFS)

Table 3.17–3. Summary of Environmental Impacts and Mitigation for SPE Alternatives (continued)

Resource Area	SPE Alternative 1: No Action	SPE Alternative 2: Short Pier (Preferred)	SPE Alternative 3: Long Pier
Marine Mammals	No change	• Potential changes in prey availability due to loss and degradation of benthic habitat • Direct impacts due to pile driving noise sufficient to exceed NMFS behavioral disturbance thresholds • Estimated Level B (behavioral) incidental takes based on acoustic propagation modeling of pile driving noise: – Steller sea lion: 322 – CA sea lion: 5,796 – Harbor seal: 49,625 – Transient killer whale: 180 – Harbor porpoise: 875 • Measures and practices to be implemented to offset impacts (measures proposed for pile driving noise; others to be developed in consultation with NMFS)	• Potential changes in prey availability due to loss and degradation of benthic habitat (greater than Alternative 2) • Direct impacts due to pile driving noise sufficient to exceed NMFS behavioral disturbance thresholds • Estimated Level B (behavioral) incidental takes based on acoustic propagation modeling of pile driving noise: – Steller sea lion: 410 – CA sea lion: 7,380 – Harbor seal: 30,535 – Transient killer whale: 180 – Harbor porpoise: 620 • Measures and practices to be implemented to offset impacts (measures proposed for pile driving noise; others to be developed in consultation with NMFS)
Marine Birds	No change	• Changes in prey availability due to minor loss and degradation of benthic habitat • Impacts due to pile driving noise sufficient to exceed auditory injury and masking thresholds for marbled murrelet • Measures and practices to be implemented to offset impacts to marbled murrelets, developed in consultation with USFWS • No incidental takes of MBTA-protected birds anticipated	• Changes in prey availability due to minor loss / degradation of benthic habitat (greater than Alternative 2) Impacts due to pile driving noise sufficient to exceed auditory injury and masking thresholds for marbled murrelet (longer duration than Alternative 2) • Measures and practices to be implemented to offset potential impacts to marbled murrelets, developed in consultation with USFWS • No incidental takes of MBTA-protected birds anticipated

Table 3.17–3. Summary of Environmental Impacts and Mitigation for SPE Alternatives (continued)

Resource Area	SPE Alternative 1: No Action	SPE Alternative 2: Short Pier (Preferred)	SPE Alternative 3: Long Pier
Terrestrial Biological Resources	No change	• Permanent loss of approximately 7 acres (2.8 hectares) of forest vegetation and wildlife habitat; temporary loss of approximately 4 acres (1.6 hectares) of vegetation and wildlife habitat; to be revegetated following construction • Intermittent construction noise impacts on wildlife over 24 months • Increased potential for visual disturbance to wildlife due to human activity, lighting, and vehicle movements • Potential disturbance of foraging bald eagles; no incidental takes under Bald and Golden Eagle Protection Act anticipated • Measures and practices to be implemented to offset potential impacts	• Similar to Alternative 2. Permanent loss of approximately 7 acres (2.8 hectares) of forest vegetation and wildlife habitat; temporary loss of 4 acres (1.6 hectares) of vegetation and wildlife habitat; to be revegetated following construction • Intermittent construction noise impacts on wildlife over 24 months • Increased potential for visual disturbance to wildlife due to human activity, lighting, and vehicle movements • Potential disturbance of foraging bald eagles; no incidental takes under Bald and Golden Eagle Protection Act anticipated • Measures and practices to be implemented to offset potential impacts
Geology, Soils, and Water Resources	No change	• Temporary disturbance of approximately 4 acres (1.6 hectares) • 7 acres (2.8 hectares) of new impervious surface	• Same as Alternative 2. Temporary disturbance of approximately 4 acres (1.6 hectares) • 7 acres (2.8 hectare) of new impervious surface
Land Use and Recreation	No change	• Compatible with Navy Waterfront Functional Plan and TRIDENT Support Site Master Plan • Exposure to elevated noise in residential and recreational areas from pile driving (maximum 161 days over two in-water work seasons) and other construction noise • Construction would not be conducted between 10 p.m. and 7 a.m.; pile driving during daylight only; Navy to request U.S. Coast Guard to issue a Notice to Mariners; Navy to notify public prior to construction	• Compatible with Navy Waterfront Functional Plan and TRIDENT Support Site Master Plan • Exposure to elevated noise in residential and recreational areas from pile driving (maximum 205 days over two in-water work seasons) and other construction noise • Construction would not be conducted between 10 p.m. and 7 a.m.; pile driving during daylight only; Navy to request U.S. Coast Guard to issue a Notice to Mariners; Navy to notify public prior to construction
Airborne Acoustic Environment	No change	• Temporary / intermittent exposure to elevated noise levels in nearby residential / recreation areas • Construction would not be conducted between 10 p.m. and 7 a.m.; pile driving would occur in daylight hours only; Navy to notify public prior to construction	• Temporary / intermittent exposure to elevated noise levels in nearby residential / recreation areas (longer than Alternative 2) • Construction would not be conducted between 10 p.m. and 7 a.m.; pile driving would occur in daylight hours only

Table 3.17–3. Summary of Environmental Impacts and Mitigation for SPE Alternatives (continued)

Resource Area	SPE Alternative 1: No Action	SPE Alternative 2: Short Pier (Preferred)	SPE Alternative 3: Long Pier
Aesthetics and Visual Quality	No change	• Temporary disturbance of existing visual landscape during construction • Minimal increase in industrial appearance (including lighting) of the waterfront over the long term • Minimal impact to the view from the most western point of Olympic View when viewing north (buffered by distance and landscape)	• Temporary disturbance of existing visual landscape during construction • Minimal increase in industrial appearance (including lighting) of the waterfront over the long term (greater impact than for Alternative 2 due to longer SPE structure and additional lighting fixtures) • Minimal impact (but slightly greater than Alternative 2) to the view from the most western point of Olympic View when viewing north (buffered by distance and landscape)
Socioeconomics	No change	• Local beneficial economic impacts totaling $131 million from construction activities • No impacts to commercial or recreational fishing • MOA signed with Skokomish Indian Tribe; the Navy will continue to consult with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe	• Local beneficial economic impacts totaling $171 million from construction activities • No impacts to commercial or recreational fishing • MOA signed with Skokomish Indian Tribe; the Navy will continue to consult with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe
Environmental Justice and Protection of Children	No change	• No disproportionate effects from construction or operations on minority disadvantaged populations or children	• No disproportionate effects from construction or operations on minority disadvantaged populations or children
Cultural Resources	No change	• No Impact; low potential for disturbance of archaeological deposits or NAGPRA items • Consultation with SHPO completed. If resources found during construction, mitigation measures would be developed in consultation with SHPO and tribes; MOA signed with Skokomish Indian Tribe; the Navy will continue to consult with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe.	• No Impact; low potential for disturbance of archaeological deposits or NAGPRA items • Consultation with SHPO completed. If resources found during construction, mitigation measures would be developed in consultation with SHPO and tribes; MOA signed with Skokomish Indian Tribe; the Navy will continue to consult with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe.
American Indian Traditional Resources	No change	• Minimal construction (short-term) impact on salmon with no resulting impact on tribal salmon harvest; no long-term impact • Interference with tribal fishing vessels from construction and operational Navy vessel traffic	• Minimal construction (short-term) impact on salmon with no resulting impact on tribal salmon harvest; no long-term impact • Interference with tribal fishing vessels from construction and operational Navy vessel traffic

Table 3.17–3. Summary of Environmental Impacts and Mitigation for SPE Alternatives (continued)

Resource Area	SPE Alternative 1: No Action	SPE Alternative 2: Short Pier (Preferred)	SPE Alternative 3: Long Pier
		• No impact on tribal shellfish harvest areas, but potential impacts on clam seed stock under piles • MOA signed with Skokomish Indian Tribe; the Navy will continue to consult with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe. • Practices and measures developed in consultation with federally recognized American Indian tribes to offset minimal impacts	• No impact on tribal shellfish harvest areas, but potential impacts on clam seed stock under piles • MOA signed with Skokomish Indian Tribe; the Navy will continue consult with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe. • Practices and measures developed in consultation with federally recognized American Indian tribes to offset minimal impacts
Traffic		• Construction traffic would add to existing peak-hour delays at both base gates • Increased marine vessel traffic during two in-water work seasons • During in-water construction, six barge round trips per month and 12 associated bridge openings would result in traffic delays on SR 104 (30 minutes on average per opening for a total of 6 hours per month); barge trips would be scheduled to avoid commuting hours to maximum extent possible • Over long term, two additional openings of Hood Canal Bridge per month	• Construction traffic would add to existing peak-hour delays at both base gates (longer construction period than Alternative 2) • Increased marine vessel traffic during two in-water work seasons (longer period than Alternative 2) • During in-water construction, six barge round trips per month and 12 associated bridge openings would result in traffic delays on SR 104 (30 minutes on average per opening for a total of 6 hours per month) over a longer period than Alternative 2; barge trips would be scheduled to avoid commuting hours to maximum extent possible • Over long term, two additional openings of Hood Canal Bridge per month
Air Quality	No change	• Temporary construction emissions would not exceed threshold for major source. The project site is in an attainment area. • Negligible increase of emissions from operations from the new facilities	• Temporary construction emissions would not exceed threshold for major source. The project site is in an attainment area. • Negligible increase of emissions from operations from the new facilities

ESA = Endangered Species Act; HCCC = Hood Canal Coordinating Council; ILF = In-Lieu Fee; MOA = Memorandum of Agreement; NAGPRA = Native American Graves Protection and Repatriation Act; NMFS = National Marine Fisheries Service; SHPO = State Historic Preservation Officer; sq ft = square feet; sq m = square meter; USFWS = U.S. Fish and Wildlife Service pile driving noise over a shorter period. Alternative 2 would require up to 125 days of steel pile driving during the first in-water work window, and 36 days of concrete fender pile driving during the second, compared to Alternative 3's maximum of 155 days of steel pile driving during the first in-water work window, and 50 days of concrete pile driving during the second.

Pile driving noise could potentially result in behavioral disturbance or injury of marbled murrelets and ESA-listed salmon (Hood Canal summer-run chum salmon, Puget Sound Chinook salmon, Puget Sound steelhead, and bull trout. ESA-listed rockfish (bocaccio, yellow-eye rockfish, and canary rockfish) are not expected in the project area. Behavioral disturbance of marine mammals is also possible. Marine mammals potentially affected by behavioral harassment would include the Steller sea lion, harbor seal, California sea lion, harbor porpoise, and transient killer whales. These effects would occur over a shorter period for SPE Alternative 2 than for Alternative 3. The ESA-listed humpback whale is not expected to be exposed to behavioral harassment due to its rare occurrence in the project area. The ESA-listed Southern Resident killer whale is not present in the project area. Limiting pile driving to the established in-water work season (July 15 to January 15) would minimize the potential for impacts on ESA-listed fish.

The new overwater coverage created would be less under SPE Alternative 2 (44,000 square feet [4,090 square meters]) than Alternative 3 (70,000 square feet [6,500 square meters]), resulting in less shading of the benthic community. Under both alternatives, new pier structures would lie in water depths greater than 30 feet (9 meters), resulting in no shading of eelgrass or macroalgae habitat and minimal effects on salmon migration.

Practices and measures to minimize impacts to ESA-listed species would be implemented as described in the Mitigation Action Plan (Appendix C). Construction and operation of SPE Alternatives 2 and 3 may affect, but is not likely to adversely affect, ESA-listed salmonids and rockfish, humpback whales, Southern Resident killer whales, and marbled murrelets. The Navy is in ESA Section 7 consultation with the NMFS West Coast Region office. In a concurrence letter dated March 4, 2016, USFWS stated that SPE project impacts to bull trout are not measurable and therefore insignificant, and impacts to marbled murrelets are discountable. Consultations are also ongoing with the NMFS West Coast Region office under the MSA, and with the NMFS HQ Office for MMPA compliance. The Navy has submitted an IHA application for the first year of construction of the SPE and will prepare and submit an additional MMPA authorization application for the second year of construction.

Upland features of SPE Alternatives 2 and 3 would be the same, resulting in the same impacts. Construction of new project elements would result in permanent loss of 7 acres (2.8 hectares) of forest vegetation and wildlife habitat (Figures 2-9 and 3.5-3). An additional 4 acres (1.6 hectares) of vegetation would be disturbed temporarily during construction, but revegetated with native species following construction. There would be no impacts on wetlands. Wildlife would be disturbed by pile driving noise for a shorter period under Alternative 2 than under Alternative 3. Four trees potentially suitable for nesting by marbled murrelets may be removed under both alternatives. No other terrestrial animals or plants protected under the ESA would be affected. Wildlife could be disturbed by construction noise and lighting, but no terrestrial animals or plants protected under the ESA would be affected. Potential impacts to foraging bald eagles may occur as a result of elevated noise levels or visual disturbance during construction, but no incidental takes are anticipated.

When the SPE project is programmed and scheduled, the Navy will submit a CCD to WDOE and an application for permits under the CWA and Rivers and Harbors Act for the SPE project to USACE and WDOE.

Nearby residential areas and recreational users of the waters off NAVBASE Kitsap Bangor may experience elevated noise levels during construction, but no other impacts on land use or recreation are anticipated. SPE Alternative 2 would result in a shorter duration of construction, and would have somewhat less potential lighting impacts on residential areas, than SPE Alternative 3. Aesthetic impacts would be slightly greater under SPE Alternative 3, but minimal under both alternatives. Both alternatives would be consistent with the NAVBASE Kitsap Bangor TRIDENT Support Site Master Plan. Positive socioeconomic impacts would be greater for SPE Alternative 3. The construction cost for SPE Alternative 2 is estimated to be approximately $89 million, representing the total economic impact of 818 direct jobs and 380 indirect and induced jobs. Total economic output to the region would be in excess of $131 million. The construction cost for SPE Alternative 3 is estimated to be approximately $116 million, representing the total economic impact of 1,066 direct jobs and 494 indirect and induced jobs. Total economic output to the region would be in excess of $170 million. Neither alternative would have disproportionate adverse effects on minority or disadvantaged populations.

In October 2015, the SHPO concurred with the Navy's determination of no adverse effect of the SPE project on historic properties under the NHPA. There would be a small potential for disturbance of archaeological resources (prehistoric sites) during construction; if any such resources were encountered, the Navy would coordinate with the SHPO and the tribes. Neither alternative would affect tribal fishing access at NAVBASE Kitsap Bangor, nor have a population-level effect on salmon stocks harvested by the tribes. Construction vessels and operational transits of submarines could interfere with tribal fishing vessels in Hood Canal. The Navy invited and has conducted government-to-government consultation with the five federally recognized American Indian tribes that have U&A areas in the vicinity of the project area: the Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, Lower Elwha Klallam, and Suquamish Tribes. On March 3, 2016 the Navy and Skokomish Indian Tribe completed a Memorandum of Agreement (MOA) to undertake treaty mitigation projects for the SPE project by contributing funding to support the Skokomish River Basin restoration, with the terms and conditions of the MOA to apply only after the Navy begins in-water construction. The Navy began government-to-government consultation with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe for the SPE project in 2012. Although the Navy and these Tribes were not able to reach formal agreement on treaty mitigation projects at the time of publication of this FEIS, the Navy carefully considered tribal concerns regarding the Proposed Actions and assessed the potential for significant impact to tribal rights and protected resources. Based on the Navy's assessment, the Navy offered to fund one or more of several proposed treaty mitigation projects.

Construction traffic would exacerbate existing peak-hour delays at both gates to NAVBASE Kitsap Bangor and on roads immediately outside the gates; construction traffic impacts would persist longer for Alternative 3 than Alternative 2. On-base construction traffic impacts would be minimal. During construction, both alternatives would increase the frequency of openings of the Hood Canal Bridge, an adverse impact on travelers on SR-104; this impact would last longer for Alternative 3 than for Alternative 2. Over the long term, there would be an estimated two additional openings of the Hood Canal Bridge per month under either action alternative. Impacts on air quality would be minimal because emissions would be well below regulatory thresholds. Air quality in the vicinity of the LWI and SPE project sites, the upland project area, and the greater area of NAVBASE Kitsap Bangor, all of which are located in Kitsap County, is generally rated as good, which is the highest air quality rating. Kitsap County is presently in attainment for all NAAQS for criteria pollutants.

Table 3.17–4 identifies mitigation of impacts on aquatic habitat and Waters of the U.S. that would be required by a permit issued for the project by USACE.

Table 3.17–4. Mitigation for SPE Impacts on Aquatic Habitat and Waters of the U.S.

SPE Impact	SPE Alternative 2 Area	SPE Alternative 3 Area	SPE Anticipated Mitigation[1]
Habitat displaced by piles in deep water (> 30 feet)	1,965 square feet (183 square meters)	1,876 square feet (174 square meters)	Mitigation for loss of aquatic resources would be provided by the Navy's participation in the HCCC ILF program for Hood Canal in accordance with the Compensatory Mitigation for Losses of Aquatic Resources, Final Rule.
Overwater area (full shading) in deep water (more than 30 feet (9 meters) below MLLW). There would be no shading shallower than 30 feet below MLLW.	1.0 acre (0.41 hectare)	1.6 acres (0.65 hectare)	Mitigation for loss of aquatic resources would be provided by the Navy's participation in the HCCC ILF program for Hood Canal in accordance with the Compensatory Mitigation for Losses of Aquatic Resources, Final Rule.

MLLW = mean lower low water; USACE = U.S. Army Corps of Engineers

1. Final mitigation requirements for the selected alternative would be determined through the Clean Water Act permitting process. Habitat displaced by piles is included in the habitat in the overwater area. Project would not shade or displace shallow habitat. Please see Appendix C, the Mitigation Action Plan, for a discussion of compensatory mitigation.

CHAPTER 4

CUMULATIVE IMPACTS

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4.0 CUMULATIVE IMPACTS

4.1. PRINCIPLES OF CUMULATIVE IMPACTS ANALYSIS

The approach taken herein to analyze cumulative effects[1] meets the objectives of the National Environmental Policy Act (NEPA) of 1969, Council on Environmental Quality (CEQ) regulations, and CEQ guidance. CEQ regulations (40 Code of Federal Regulations [CFR] 1500-1508) provide the implementing procedures for NEPA. The regulations define "cumulative effects" as:

> . . . the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

CEQ provides guidance on cumulative impacts analysis in *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997). This guidance further identifies cumulative effects as those environmental effects resulting "from spatial and temporal crowding of environmental perturbations. The effects of human activities will accumulate when a second perturbation occurs at a site before the ecosystem can fully rebound from the effects of the first perturbation." Noting that environmental impacts result from a diversity of sources and processes, this CEQ guidance observes that "no universally accepted framework for cumulative effects analysis exists," while also noting that certain general principles have gained acceptance. One such principle provides that "cumulative effects analysis should be conducted within the context of resource, ecosystem, and community thresholds—levels of stress beyond which the desired condition degrades." Thus, "each resource, ecosystem, and human community must be analyzed in terms of its ability to accommodate additional effects, based on its own time and space parameters." Therefore, cumulative effects analysis normally will encompass a Region of Influence (ROI) or geographic boundaries beyond the immediate area of the proposed action and a timeframe including past actions and foreseeable future actions, to capture these additional effects. Bounding the cumulative effects analysis is a complex undertaking, appropriately limited by practical considerations. Thus, CEQ guidelines observe that it "is not practical to analyze cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful."

For the proposed action to have a cumulatively significant impact on an environmental resource, two conditions must be met. First, the combined effects of all identified past, present, and reasonably foreseeable projects, activities, and processes on a resource, including the effects of the proposed action, must be significant. Second, the proposed action must make a substantial contribution to that significant cumulative impact. Finally, if the effects of the proposed action alone would have a significant impact on an environmental resource within its ROI, then the impacts of the proposed action in combination with all other past, present, and reasonably foreseeable actions would normally be cumulatively significant.

[1] CEQ Regulations provide that the terms "cumulative impacts" and "cumulative effects" are synonymous (40 CFR 1508.8[b]).

Cumulative impacts are those changes to the physical, biological, and socioeconomic environments that would result from a proposed action when added to other past, ongoing, and reasonably foreseeable actions, regardless of what agency of government or person undertakes such other actions (40 CFR 1508.7).

4.1.1. Identifying Region of Influence or Geographical Boundaries for Cumulative Impacts Analysis

The ROI or geographic boundaries for analyses of cumulative impacts can vary for different resources and environmental media. For air quality, the potentially affected air quality regions are the appropriate boundaries for assessment of cumulative impacts from releases of pollutants into the atmosphere. For wide-ranging or migratory wildlife, specifically marine mammals, fish, and sea birds, any impacts of the proposed action might combine with the impacts of other activities or processes within the range of the population. The ROI or geographic boundary for the majority of resources analyzed for cumulative impacts in this Environmental Impact Statement (EIS) is Hood Canal and the Hood Canal watershed.

The cumulative impacts analysis for the Land-Water Interface (LWI) and Service Pier Extension (SPE) projects considers known past, present, and reasonably foreseeable future actions throughout Hood Canal, including Naval Base (NAVBASE) Kitsap Bangor and its 4.5-mile (7.2-kilometer) shoreline on the canal. Although some marine organisms occurring along NAVBASE Kitsap Bangor move beyond Hood Canal, these organisms spend much of their time in Hood Canal; other species are essentially resident. Therefore, cumulative impacts on marine organisms are most likely to result from actions within Hood Canal. Hood Canal (and its watershed) is the most relevant region for defining populations or communities of marine and coastal resources occurring along NAVBASE Kitsap Bangor. Surrounding communities in which actions of NAVBASE Kitsap Bangor are most likely to contribute to cumulative social impacts include Silverdale, Poulsbo, and Bremerton, all of which are on the Kitsap Peninsula and within Kitsap County, as well as Jefferson County on the western shore of Hood Canal across from NAVBASE Kitsap Bangor and Mason County to the south of NAVBASE Kitsap Bangor. An ROI for evaluating the cumulative impacts of the proposed action is defined for each resource in Section 4.3.

4.2. PROJECTS AND OTHER ACTIVITIES ANALYZED FOR CUMULATIVE IMPACTS

4.2.1. Past, Present, and Reasonably Foreseeable Future Actions

Identifiable present effects of past actions are analyzed to the extent they may be additive to impacts of the proposed action. In general, the Navy lists and analyzes the effects of individual past actions only where appropriate; cumulative impacts analysis typically focuses on aggregate effects of past actions. This analysis depends on the availability of data and the relevance of future effects of past, present, and future actions. Although certain data (e.g., extent of forest cover) may be available for extensive periods in the past (i.e., decades), other data (e.g., water quality) may be available only for much shorter periods. Because specific information and data on past projects and actions are usually scarce, the analysis of past effects is often qualitative (CEQ 1997). Analysis will primarily include present and reasonably foreseeable future actions that may have effects additive to the effects of the proposed action. These actions include all likely future development of the region even when foreseeable future action is not planned in sufficient detail to permit complete analysis (CEQ 1997).

Table 4–1 lists the past, present, and reasonably foreseeable future actions at NAVBASE Kitsap Bangor and within the ROI that have had, continue to have, or would be expected to have some impact on the natural and human environment. The projects in this table are limited to those implemented in the last 5 years or those with ongoing contributions to environmental effects. Navy projects were selected based on best available knowledge about proposed future actions as well as a review of available NEPA and permitting documentation for past, current, and future actions. Projects expected to have measurable contributions to impacts within the ROI for a resource area were included in the cumulative analysis. In July 2014, the Navy purchased a bedland easement in Hood Canal. The State of Washington has denied Hood Canal Sand and Gravel's Joint Aquatic Resource Permit Application for their proposed project. Therefore, the construction and operation of Hood Canal Sand and Gravel's pit to pier project is no longer reasonably foreseeable and has been removed from the cumulative impact analysis.

The cumulative analysis considers reasonably foreseeable proposed plans and actions that are focused on shoreline developments in the Hood Canal watershed and that have a potential to result in cumulative impacts on the environment. Figures 4–1 and 4–2 show the locations of the actions which can be shown on these figures (for example, some of the actions are located outside the coverage of the figures, others have many sites, and the locations of some security projects cannot be shown in public documents). Although no official boundaries exist along the waterway, the northeastern section of the canal, extending from the mouth of the canal at Admiralty Inlet to the southern tip of Toandos Peninsula, is referred to as northern Hood Canal, the reach from Toandos Peninsula south to Great Bend is referred to as mid-Hood Canal, and the reach from Great Bend to Lynch Cove is referred to as southern Hood Canal. The LWI and SPE project sites are within northern Hood Canal. Cumulative projects were identified through contacts with the Kitsap County, Mason County, and Jefferson County Departments of Community Development, Washington State Department of Transportation (WSDOT), natural resource agencies, and American Indian tribes.

Because the LWI and SPE are independent actions, their environmental impacts are evaluated independently in Chapter 3. The combined impacts of the LWI and SPE are addressed in each resource section in Chapter 3. In this cumulative impacts analysis, the combined impacts of the LWI and SPE are evaluated for their contribution to cumulative impacts with past, present, and reasonably foreseeable future actions.

Overlap in the construction periods for multiple, closely located projects can result in short-term, cumulative impacts that are in addition to standard, longer-term cumulative impacts. Based on current projected schedules, construction of the following projects may overlap with construction of the LWI and SPE: existing EHW (EHW-1) Pile Replacement, the Transit Protection System (TPS) Pier, Magnetic Silencing Facility (MSF) modification, and installation of Electromagnetic Measurement Range Sensor System equipment on NAVBASE Kitsap Bangor. The EHW-1 Pile Replacement and TPS Pier projects would entail substantial pile driving that would be cumulatively considerable with the Proposed Actions. The EHW-1 Pile Replacement project includes removal of degraded piles and vibratory and impact driving of steel replacement piles. The number of new piles entailed in the TPS Pier project has not been determined (project in development stage). Cumulative impacts arising from these potential construction overlaps are addressed in this chapter where appropriate. Construction of the Waterfront Security Enclave project, which is related to the LWI project, has been completed.

Table 4–1. Past, Present, and Reasonably Foreseeable Future Actions in Hood Canal

Project	Project Description	Project Timeframe		
		Past	Present	Future
NAVBASE Kitsap Bangor Waterfront Operations	Waterfront operations include the overall integration of all port operations along the NAVBASE Kitsap Bangor waterfront. Activities include vessel traffic movement and management, personnel clearance and tracking, and ingress/egress within the restricted areas.	X	X	X
NAVBASE Kitsap Bangor Waterfront Facilities Maintenance	Common maintenance activities include pressure washing of waterfront piers to remove bird fecal material, marine fouling organisms (e.g., mussels, algae) and foreign materials (e.g., dirt). Maintenance area includes walkways and approaches to the piers. Other maintenance activities may involve repair and replacement of structures or facilities as needed. Recently completed maintenance actions included pile driving for KB Dock repair (5 piles replaced in 2015).	X	X	X
EHW-1 Maintenance	This multi-year project involves replacing deteriorated piles, the most recent phase, and installation of 29 30-inch (76-centimeter) steel piles. Phased repair of this structure is expected to continue until 2024.	X	X	X
Force Protection and Weapons Security Measures (locations UCNI)	The project involves installation and operation of facilities, including construction of an Auxiliary Reaction Force Facility (14,000 square feet [1,300 square meters]) and an Armored Fighting Vehicle Operational Storage Facility (16,146 square feet [1,500 square meters]); alteration of two buildings for a new armory (2,500 square feet [232 square meters]); and replacement of an Alert Force Garage (2,530 square feet [235 square meters]) including a new paved access road.	X	X	X
Road Improvements	Road clearing and grading are continuous. Loss of vegetation and habitat can be expected from road improvements, including those for the D5 Road and Transfer Facilities and Missile Haul Road.	X	X	X
CSDS-5 Support Facilities	The Navy implemented upgrades to waterfront and shore-based support facilities for its Submarine Development Squadron Five Detachment on NAVBASE Kitsap Bangor. These upgrades were completed in July 2005. Anticipated levels of mission support and the operational tempo of assigned submarines require additional shore-side buildings for administration, operations, industrial, and support functions. Security requirements and operational efficiency dictate consolidation of off-base contractor space onto a contiguous site adjacent to the shore-based support facilities. At the existing Service Pier, the Navy improved barge mooring capacity by replacing an existing research barge with a new research barge and installing new mooring piles to anchor the new research barge. This work occurred in summer of 2013 and involved installation of 18 new piles over a 3-week period.	X		
Mission Support Facilities	Mission support facilities may include activities or projects such as the addition of power booms, captivated camels, and piles for support or attachment; installation of emergency power generation capability; and other activities to support facilities or operations.	X	X	X

Table 4–1. Past, Present, and Reasonably Foreseeable Future Actions in Hood Canal (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
Navy Surface Warfare Center Carderock Division (NSWCCD) Detachment Bremerton Command Consolidation	Construction of in-water facilities includes a new access pier (8,800 square feet [820 square meters]), pontoon (21,600 square feet [2,000 square meters]), vessel overwater footprint (13,623 square feet [1,266 square meters]) and associated mooring components and 102 new steel piles. Project tasks also include road improvements to Carlson Spit Access Road, a 23,000 square feet (2,140 square meters) building, and the addition of 100 workers.	X		
Waterfront Security Enclave and Security Barriers	Construction of enclave fencing for the entire NAVBASE Kitsap Bangor Waterfront Restricted Area and construction of an associated parking area and other facilities. Mitigation action is restoring tidal influence to Cattail Lake, thereby increasing intertidal habitat. Construction was completed in June 2013.	X		
NAVBASE Kitsap Bangor Test Pile Program	This project involved installation and removal of up to 29 test and reaction piles on NAVBASE Kitsap Bangor to gather geotechnical and noise data to validate the design concept for the EHW-2 and future projects at the Bangor waterfront. The test pile program required a maximum of 40 work days for completion, with less than 15 days of pile driving. Pile driving was conducted from July 16 through October 31, 2011.	X		
Relocate Nearshore Port Security Barriers	Project moved four mooring buoys and anchoring systems, previously located between EHW-1 and Marginal Wharf and used to moor the nearshore port security barriers when they are not in use. The mooring system was relocated to an area within Naval Restricted Area 1, near Delta pier. The project occurred in 2011. This resulted in minor seafloor disturbance when the anchors were lifted from the seafloor and repositioned.	X		
TRIDENT Second Explosives Handling Wharf (EHW-2)	Construction and Operation. The proposed project would include a new Explosives Handling Wharf; upland road; an abutment where the trestles connect to the shore; and an upland construction staging area. Approximately 20 existing facilities and/or structures in proximity to the proposed structure would be modified or demolished. Four new buildings would be constructed to house the functions of some of the buildings to be demolished or vacated. The primary impacts during project construction include pile-driving noise and its effects on marine biota, turbidity, and air pollutant emissions. Upland construction would result in permanent and temporary vegetation disturbance; loss of 0.20 acre of wetland; wildlife harassment (primarily from construction noise); and disruption of recreational areas during pile-driving. Long-term impacts would include loss and shading of marine habitat, including eelgrass, macroalgae, and the benthic community, and interference with migration of juvenile salmon, some species of which are protected by the ESA. Construction would occur over 4 years, with in-water work subject to timing restrictions. During construction, measures and BMPs will be implemented to avoid or minimize potential impacts on species, marine and upland habitats, cultural resources, land use, recreation, and traffic. A NEPA Record of Decision was signed in 2012.		X	X

Table 4–1. Past, Present, and Reasonably Foreseeable Future Actions in Hood Canal (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
TRIDENT Second Explosives Handling Wharf (EHW-2) (continued)	Mitigation. To compensate for unavoidable impacts on aquatic resources and ensure no net loss of these resources, the Navy purchased credits from the Hood Canal in-Lieu Fee Program. To restore temporarily disturbed construction areas, the Navy will implement a revegetation plan for construction laydown areas and temporarily disturbed areas. To improve scientific understanding of marine species, the Navy will fund research studies on: (1) ocean acidification and (2) Hood Canal chum salmon. To improve salmon production and harvest opportunities in Hood Canal, the Navy will fund improvements at three existing fish hatcheries on Hood Canal and replacement of one finfish spawning facility on Hood Canal. To improve shellfish production and harvest opportunities, the Navy will fund: (1) improvements to beach substrate and 3 years of shellfish seeding on 24 acres of beach; (2) 5 years of shellfish seeding on priority shellfish enhancement areas in Hood Canal and adjacent Admiralty Inlet; (3) construction of a shellfish wet lab, education, and training building at Port Gamble; (4) construction of a floating shellfish nursery at Port Gamble; and (5) geoduck surveys and a geoduck pilot research study. In addition, the Navy will fund acquisition and preservation of upland habitat at Port Gamble.			
Swimmer Interdiction Security System In-water Structure and Support Facilities	The Navy has implemented a Swimmer Interdiction Security System to meet special U.S. Government security requirements for military installations in response to the terrorist attacks of September 11, 2001. The system protects waterside Navy assets and sailors, and would remain in operation as long as valuable naval assets were located on NAVBASE Kitsap Bangor. Specially trained marine mammals and their human teammates respond rapidly to security alerts by detecting, classifying, and marking the location of underwater objects or intruders. Humans work aboard small power boats, and marine mammals would be in enclosures. A Draft EIS was made available to the public for comment in December 2008, with a Record of Decision signed in 2009.	X	X	X
Relocate Floats to Delta Pier	This project removed and disposed of an existing wooden float on the south side of the Delta Pier, and relocated two existing concrete floats from the Marginal Wharf to the location of the wooden float at the Delta Pier. Six concrete piles were installed to secure the concrete floats at the Delta Pier. Five creosote-treated piles, which would no longer be required at the Marginal Wharf, were removed. A single concrete pile was installed to secure the end of the floats, which remain at the Marginal Wharf. The result was a net reduction of 741 square feet (69 square meters) in over-water coverage. The project was completed in 2015.	X		
Electromagnetic Measurement Range	The proposed Electromagnetic Measurement Range Sensor System equipment project includes installation of sensor equipment, including an underwater instrument array, data/power cables, a pile-supported platform, an in-water navigation aid, and an upland monitoring system on NAVBASE Kitsap Bangor.			X

Table 4–1. Past, Present, and Reasonably Foreseeable Future Actions in Hood Canal (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
Northwest Training Range Complex (NWTRC) EIS, Pacific Ocean	A wide variety of military training activities are conducted in the W-237 operating areas west of Washington, including training exercises in anti-air, anti-surface, and anti-submarine warfare; electronic combat exercises; mine countermeasures training; naval special warfare training; and various support operations. The Navy has developed policies and procedures to preclude harm and to minimize the effects of Navy training on terrestrial and marine species and habitats. This action involves activities at Floral Point, which is within the Region of Influence for this cumulative analysis. The Navy prepared an EIS/OEIS to assess effects of ongoing and potential future training activities in the Northwest Training Range Complex. Training activities are ongoing. The current permits cover training activities until 2015.	X	X	X
NAVSEA NUWC Keyport Range Complex Extension	This project involves an increase in the underwater Hood Canal Military Operating Area, including areas in and outside Hood Canal. The EIS included the Dabob Bay Range Complex and a proposed expansion of the Marine Operating Areas both to the north and south of their existing limits. Training activities are ongoing. Permits expire in 2016.	X	X	X
Northwest Testing and Training (NWTT)	Combined EIS for ranges covered by the Northwest Training Range Complex (NWTRC) and NUWC Keyport; adds the other RDT&E conducted in the Pacific Northwest and pier side maintenance at PSNS, NAVSTA Everett, and NAVBASE Kitsap Bangor waterfront. The project includes pier side sonar testing conducted as part of overhaul, modernization, maintenance, and repair activities at Puget Sound Naval Shipyard in Bremerton, Naval Base Kitsap at Bangor, and Naval Station Everett. The Navy proposes to adjust training and testing activities from current levels to the level needed to support Navy requirements beginning October 2015.			X
Marine Structure Maintenance and Pile Replacement Program	Programmatic EA to cover upcoming marine structure maintenance and pile replacement projects at six NRNW installations for 2018–2023.			X
Service Pier Electrical Upgrades	This project would correct existing power and communications deficiencies, expand power and communications distribution from Substations #4 and #5 to the existing Service Pier, and install a multi-phased emergency industrial power generator to support multiple Command Tenants on NAVBASE Kitsap Bangor. Site preparation would include removal of overhead power lines and communication lines, site clearing and grubbing, installation of erosion controls, grading, excavation, and preparation for construction. The EA is anticipated to be completed in 2017, followed by project implementation.			X
Bangor Transit Protection System (TPS) Pier	This project consists of a new floating pier with finger piers, connected to the shore by a trestle and ramp. Total overwater area is approximately 1.6 acres (0.65 hectare). On-land facilities would include a new operations and headquarters building with a footprint of 9,000 square feet (836 square meters), and parking lots totaling 22,000 square feet (2,045 square meters).			X

Table 4–1. Past, Present, and Reasonably Foreseeable Future Actions in Hood Canal (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
Magnetic Silencing Facility (MSF) Modification	The proposed project would provide a berth for U.S. Coast Guard Blocking Vessels at the existing Magnetic Silencing Facility. The Proposed Action includes: installation of steel support structure in two locations with two 10- by 40-foot (3- by 12-meter) open deck mooring camels; installation of four double-bitts on the pier deck; and repair of approximately 25 piles. No new piles would be installed, and no structure will be installed on the sea bottom.			X
Port Gamble Dock	The Olympic Property Group has applied for a permit for a dock at a former mill site in Port Gamble. The proposed dock would be 365 feet (111 meters) in length with an area of about 4,800 square feet (446 square meters), and will include an abutment, pier, truss, and gangway, as well as a primary float, seaplane float, and kayak launching float. The dock would accommodate up to nine boats.			X
Kitsap Memorial State Park	Washington State Parks conducted a slope stabilization project for an approximately 1,000-foot (305-meter) long, creosote-treated bulkhead at Kitsap Memorial State Park in Poulsbo on Hood Canal. The treated wood bulkhead was removed and the shoreline “naturalized” as part of the project. The project was permitted by both an approved shoreline exemption under normal maintenance repair and replacement and an approved Site Development Activity Permit. Naturalization of the shoreline improved nearshore habitat in this stretch of Hood Canal.	X		
Hood Canal Bridge improvements	In 2009, the Washington State Department of Transportation completed upgrades to the Hood Canal Bridge. The project involved reconstruction of the east half of the Hood Canal Bridge to current design standards and improvements to the remainder of the structure. The bridge was redesigned to current wind, wave, and seismic standards. To improve safety and mobility, it now features two 12-foot traffic lanes and 8-foot shoulders. The resulting dependability of the drawspan has reestablished the 600-foot opening for large vessels that pass through the bridge.	X		
Olympic View Marina	Olympic View Marina, LLC, replaced the abandoned Seabeck Marina on Seabeck Bay approximately 7 miles south of NAVBASE Kitsap Bangor on the east side of Hood Canal. The original construction plan included installation of 72,510 square feet (6,740 square meters) of piers, floats, and gangways (approximately 1.66 acres of overwater structures) for the moorage of approximately 200 boats but the replacement was smaller than originally designed. The original design called for 250 steel piles (14- to 20-inch [36- to 51-centimeter]-diameter) and a 600-foot (183-meter) breakwater. This project would result in short-term water quality and noise impacts during construction, as well as long-term shading under the new overwater structures and loss of marine habitats from installation of the breakwater and pier piles. Upland vegetation would be cleared for the on-land structures. In order to permit rebuilding of the marina, the shoreline designation of the old Seabeck Marina in the Kitsap County Shoreline Management Master Program was amended from “conservancy” to “rural” in April 2009. In January 2010, workers began installing piles for the docks. Removal of concrete debris from the beach was completed in October 2010. The breakwater was installed in 2014. Additional moorage slips may be added as demand increases.	X	X	X

Table 4–1. Past, Present, and Reasonably Foreseeable Future Actions in Hood Canal (continued)

Project	Project Description	Project Timeframe		
		Past	Present	Future
Belfair Sewer Line	Mason County is constructing a sewer line in the Belfair area (extreme south end of Hood Canal, approximately 25 miles (40 kilometers) south of NAVBASE Kitsap Bangor, and not shown in Figure 4–1) to replace aging and failing septic systems with a sanitary sewer system. The sewer line would run on both the north and south shores of southern Hood Canal. The project was developed as part of the Mason County Facilities Plan approved in 2002, which received state funding from the 2005 Legislature. The sewer line would not be located directly adjacent to Hood Canal, so construction would have little potential for marine impacts. The first phase of construction has been completed and the wastewater treatment and reclamation plant began operating in July 2012. One purpose of the project is to reduce the impact of failing septic systems to water quality in Hood Canal. The Belfair Sewer Line would help to decrease water quality impacts on Hood Canal by eliminating inadequate septic systems.	X	X	
Pleasant Harbor Marina and Golf Resort	The Statesman Group of Companies proposed a new master-planned development at Pleasant Harbor south of Brinnon. The project locale is on the west side of Hood Canal approximately 9 miles (15 kilometers) southwest of NAVBASE Kitsap Bangor. The development includes resort housing, a hotel, a restaurant, a spa, a clubhouse, a 9-hole golf course and 3-hole practice course, and other resort-type facilities. It would involve refurbishment of an existing 300-slip marina and development of resort facilities along the shoreline. Replacement of the marina docks was completed in early 2013. A supplemental EIS was published in December 2015 (the original EIS was published in November 2007 and a draft supplemental EIS was published in November 2014). The EIS documents address nine issues and impacts: (1) shellfish, (2) water quality, (3) transportation, (4) public services, (5) shorelines, (6) fish and wildlife, (7) rural character, (8) archaeology and cultural resources, and (9) critical areas. Project construction would likely result in short-term water quality and noise impacts. Refurbishing the marina would result in some loss of nearshore marine benthic habitat in the immediate project vicinity. The golf course and upland facilities would require considerable clearing of upland vegetation (estimated at 128 acres [52 hectares]), with a potential for erosion and water quality impacts. Impervious surfaces are predicted to be approximately 12 percent of the total area, or approximately 28 acres (11 hectares).	X	X	X

BMP = best management practice; CSDS-5 = Commander, Submarine Development Squadron 5; EA = environmental assessment; EHW = Explosives Handling Wharf; EIS = environmental impact statement; ESA = Endangered Species Act; KB = Keyport/Bangor; MSF = Magnetic Silencing Facility; NAVSTA = Naval Station; NEPA = National Environmental Policy Act; NRNW = Navy Region Northwest; NSWCCD = Navy Surface Warfare Center Carderock Division; NUWC = Naval Undersea Warfare Center; NWTRC = Northwest Training Range Complex; NWTT = Northwest Testing and Training; OEIS = overseas environmental impact statement; PSNS = Puget Sound Naval Shipyard; ROD = Record of Decision; SEIS = supplemental environmental impact statement; TPS = Transit Protection System; U.S. = United States; WDNR = Washington Department of Natural Resources

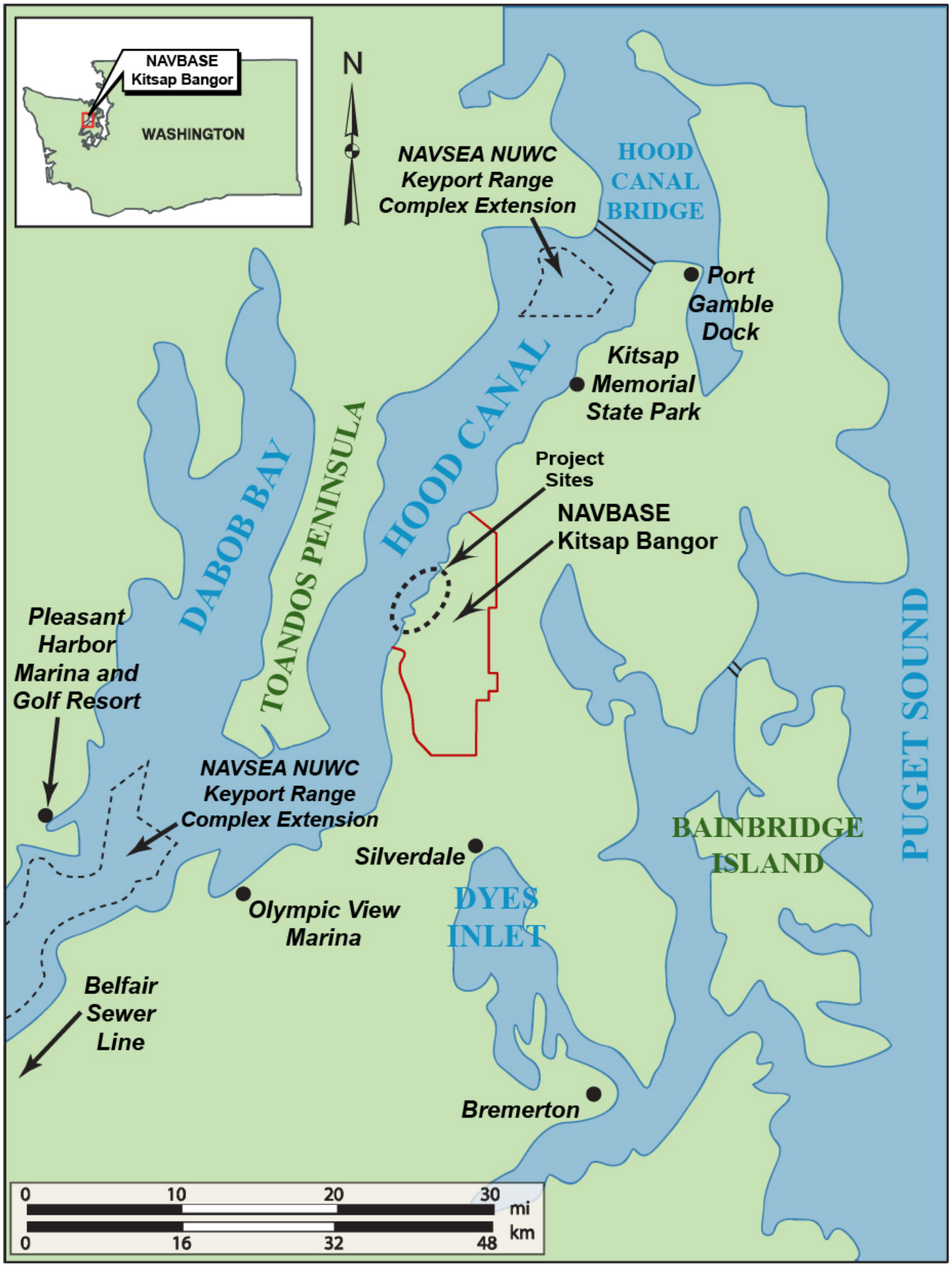
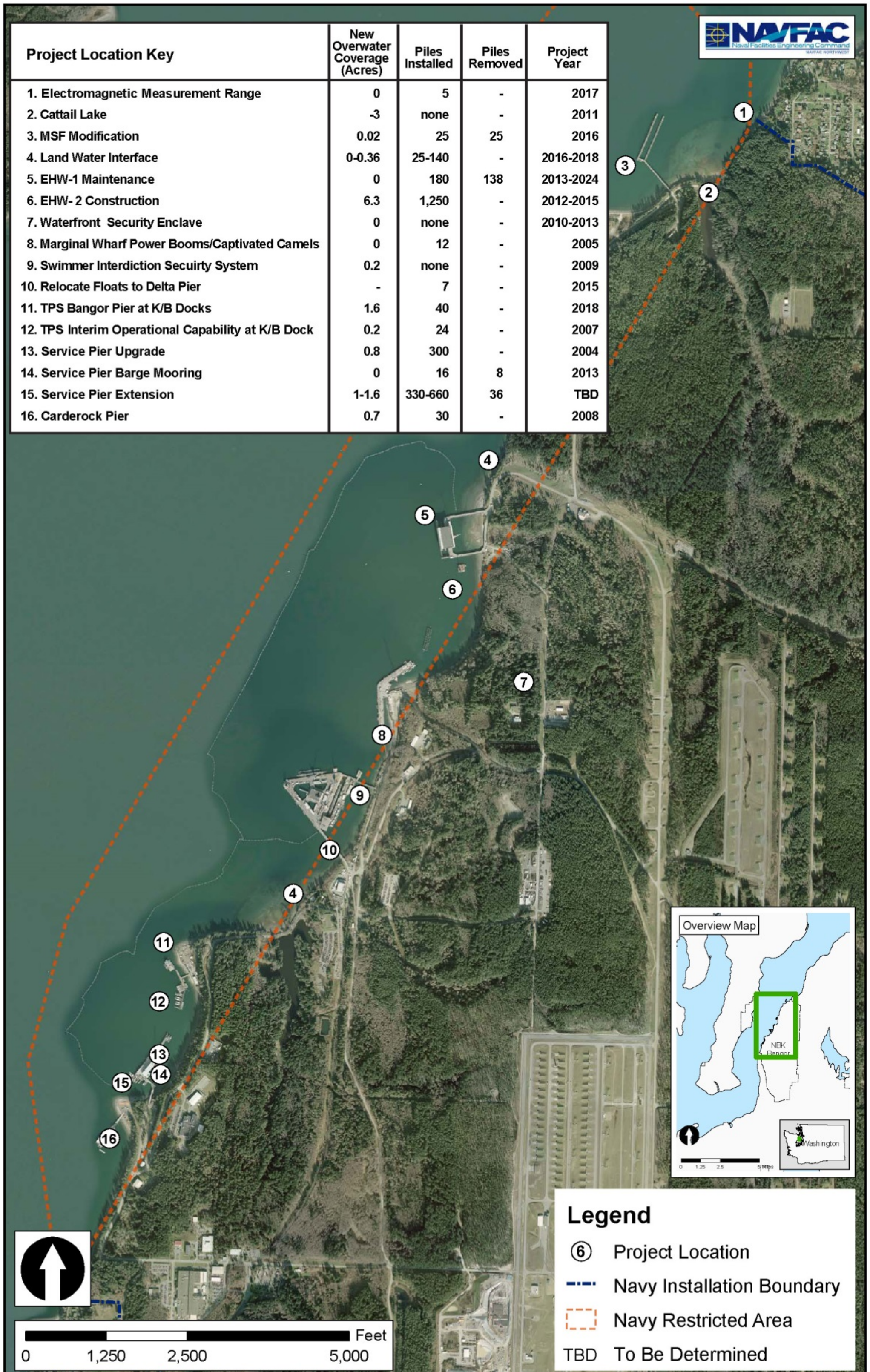


Figure 4–1. Locations of Future Non-Navy Actions and NAVSEA NUWC Keyport Range Complex Extension



Project Location Key	New Overwater Coverage (Acres)	Piles Installed	Piles Removed	Project Year
1. Electromagnetic Measurement Range	0	5	-	2017
2. Cattail Lake	-3	none	-	2011
3. MSF Modification	0.02	25	25	2016
4. Land Water Interface	0-0.36	25-140	-	2016-2018
5. EHW-1 Maintenance	0	180	138	2013-2024
6. EHW- 2 Construction	6.3	1,250	-	2012-2015
7. Waterfront Security Enclave	0	none	-	2010-2013
8. Marginal Wharf Power Booms/Captivated Camels	0	12	-	2005
9. Swimmer Interdiction Secuirty System	0.2	none	-	2009
10. Relocate Floats to Delta Pier	-	7	-	2015
11. TPS Bangor Pier at K/B Docks	1.6	40	-	2018
12. TPS Interim Operational Capability at K/B Dock	0.2	24	-	2007
13. Service Pier Upgrade	0.8	300	-	2004
14. Service Pier Barge Mooring	0	16	8	2013
15. Service Pier Extension	1-1.6	330-660	36	TBD
16. Carderock Pier	0.7	30	-	2008

Figure 4–2. Locations of Past, Present, and Future Navy Actions

4.2.1.1. OTHER REGIONAL ACTIVITIES, PROCESSES, AND TRENDS

In addition to the past, present, and planned future projects listed in Table 4–1 other activities, such as shoreline development and improvement of environmental quality in Hood Canal, were considered in the cumulative impact analysis as described in the following sections.

4.2.1.1.1. SHORELINE DEVELOPMENT

Hood Canal and its shorelines are designated as “Shorelines of Statewide Significant” under Washington’s Shoreline Management Act (SMA). As stipulated in Washington’s SMA, preferred uses for shorelines of statewide importance include the following: (1) recognize and protect the statewide interest over local interest, (2) preserve the natural character of the shoreline, (3) favor long-term over short-term benefits, (4) protect the resources and ecology of the shoreline, (5) increase public access to publicly owned shorelines, and (6) increase shoreline recreational opportunities (Revised Code of Washington [RCW] 90.58.020 and Washington Administrative Code [WAC] 173-26-181).

Development along the shoreline of Hood Canal has been relatively intense. Residential uses predominate, with lot sizes smaller than those in the upland area. Some of these residences have docks. Commercial facilities are scattered along the shoreline; the community of Seabeck, to the south, has a store, a few businesses, a marina, and a retreat center. The Hood Canal Bridge is north of NAVBASE Kitsap Bangor and the project area. Farther south is Scenic Beach State Park. Future general development in the Hood Canal watershed would increase impervious surface and thereby affect vegetation and soils, with potential impacts on water quality in streams and Hood Canal.

The shoreline of Hood Canal has been, and continues to be, subject to development by property owners. Over the past 5 years, an average of 15 shoreline development permit applications (i.e., Joint Aquatic Resources Permit Applications [JARPAs]) per year have been submitted by property owners within the ROI. The permitted actions, such as pier/dock construction, shoreline stabilization, stairways/beach access, shoreline construction, and submarine cable installation, are likely to continue within this region at the same pace (i.e., approximately 15 per year) over the next several years.

The rate of development in the area has been and will be influenced by zoning and land use designations. Kitsap County has zoned land uses adjacent to the base designated as Rural Residential (maximum of one dwelling unit per 5 acres [2 hectares]) (Kitsap County Department of Community Development 2010). Small unincorporated communities close to the base include Vinland on the northern boundary, Olympic View to the south, and Silverdale to the southeast. The Vinland and Olympic View communities are predominantly designated as Rural Residential. The land uses of the nearby Silverdale community are mostly designated as Urban Industrial and Urban Low-Density Residential (one to nine dwellings per acre [0.4 hectare]). The residential areas only allow for single family dwellings and, coupled with the low density designation, would allow for slow development rates in those areas with an expected overall county growth rate of less than 9 percent over a 7-year period. This rate is down from 22 percent over the previous decade. The largest incorporated city near the base is Poulsbo, about 2 miles (3.2 kilometers) east of the base.

Approximately 27 percent of the Hood Canal shoreline is modified with bulkheads, riprap, or other structures (Puget Sound Partnership 2008); approximately 25 percent of the Kitsap County shoreline is modified (Judd 2010). In comparison, an estimated 6 percent of the NAVBASE Kitsap Bangor shoreline is modified (Judd 2010).

4.2.1.1.2. AGENCY PLANS FOR IMPROVING ENVIRONMENTAL CONDITIONS IN HOOD CANAL

As described in previous chapters, there are several water quality parameters of concern in Hood Canal, including low dissolved oxygen (DO) levels and high nutrients, particularly in the southern part of the canal. The area of concern for low DO levels is south of the Bangor waterfront. Because of these water quality problems and concern for salmon and the overall environmental health of Hood Canal, several government entities and community groups have joined together to plan and develop programs to improve environmental conditions in Hood Canal. The primary action plan was developed by the Hood Canal Coordinating Council (HCCC), a consortium of county governments, tribes, and other groups that was formed to help recover summer-run chum salmon populations in Hood Canal and the eastern Strait of Juan de Fuca and to restore native plant communities along adjacent shorelines. In 2014 the HCCC published the *Hood Canal Integrated Watershed Plan – Five-Year Strategic Priorities.* The plan includes five focal components: shellfish, commercial shellfishing, forests, forestry, and salmon. Future actions taken under this plan are expected to improve habitat and water quality conditions in Hood Canal and its watershed, with potential benefits to fish and wildlife species occurring in these areas.

Recommended key actions in the HCCC's plan include updating Kitsap County's Shoreline Master Plan (which was completed in 2014) and critical areas ordinances, conducting a nearshore assessment (conducted in 2009–2010), adopting the Kitsap County draft shoreline environmental designations (designated in 2013), and continuing to monitor the Big Beef Creek summer-run chum salmon reintroduction project (HCCC 2005). Under its Marine Riparian Initiative, the HCCC worked with several existing entities and programs to develop a coordinated approach to revegetating marine shorelines (HCCC undated). This initiative involved training Master Gardeners, Water Watchers, and other volunteer groups to provide site-specific planting plans for landowners to address soil and slope stability, sediment control, wildlife, microclimate, shade, nutrient input for detrital food webs, fish prey production, habitat/large woody debris structure, water quality, human health and safety, and aesthetics.

The Kitsap County Health District (2005) has also identified part of Upper Hood Canal as a restoration area. The goals of the Upper Hood Canal Restoration Project are to protect public health and the environment by identifying and correcting sources of fecal coliform contamination from failing onsite sewage systems and inadequate animal waste management, obtaining water quality data, and educating Upper Hood Canal residents about the low DO problem and actions they can take to reduce bacteria and nutrient concentrations in Hood Canal. The restoration area extends approximately 20 miles (32 kilometers) along the eastern shore of Hood Canal from Olympic View Road in the north to the Kitsap County–Mason County line in the south. Most of this area lies directly south of NAVBASE Kitsap Bangor, but a portion lies along the western edge of the southern part of the base. Of particular concern are low DO levels resulting from algal blooms, which are triggered by increases in nutrients from failing onsite sewage systems, inadequate animal waste management (i.e., hobby farms), and stormwater flowing into Hood

Canal. This work is continuing as part of the District's Water Pollution Identification & Correction program (Kitsap Public Health District 2016). Actions taken under this program are expected to improve water quality conditions in western Kitsap County including the Hood Canal watershed, with potential benefits to fish and wildlife species occurring in these areas.

The Navy and Washington Department of Natural Resources (WDNR) signed a restrictive easement on July 7, 2014. The Navy paid $720,000 for the easement, which precludes construction in the easement area. The easement covers 4,804 acres (1,944 hectares) of aquatic land, which extends from the Hood Canal Bridge to just south of the Hamma Hamma River Delta. The easement covers a strip of land, from 18 feet (5.5 meters) below MLLW down to 70 feet (21 meters) below MLLW. The restrictive easement will prevent construction and development in the footprint of the easement. It will not affect public access, privately owned lands, recreational uses, aquaculture, or geoduck harvest. All 4,804 acres overlay designated critical habitat for ESA-listed salmonid species. The restrictive easement area also protects large tracts of wild stock geoduck and extensive eelgrass habitat. The easement will protect the area for 55 years. WDNR will continue to manage the land under its aquatic lands program.

Under the Readiness and Environmental Protection Integration Program, the Navy has established a multi-year agreement with The Trust for Public Lands, WDNR, and Jefferson Land Trust. To date, the Navy and its partners have purchased protective easements on 5,149 acres (2,084 hectares) of upland and shoreline properties around Hood Canal, including protection of approximately 2 miles (3 kilometers) of the riparian corridor along the Dosewallips River. The Dosewallips transaction completed the protection of the riparian corridor from the shoreline of Hood Canal to the Olympic National Forest. Beyond the riparian corridor which is protected by an easement and managed by Washington State Parks, the Navy purchased a restrictive easement to maintain 3,607 acres (1,460) of working forest as a buffer and permanently protect these lands from development. Within the Dabob Bay Natural Area, the Navy and WDNR have partnered on transactions which protect 122 acres (49 hectares). These areas provide protection for designated critical habitat for ESA-listed salmonid species. Additional Readiness and Environmental Protection Integration Program transactions are underway within the agreement area around Hood Canal.

4.2.1.1.3. PUGET SOUND TREND DATA (INCLUDING HOOD CANAL)

Trend data in the Puget Sound region have been summarized in the *2007 Puget Sound Update—Ninth Report of the Puget Sound Assessment and Monitoring Program* (PSAT 2007a) and the *2012 State of the Sound* (Puget Sound Partnership 2012). [2007 information is used for some indicators (e.g., birds) that were not fully developed at the time the 2012 report was published.] These trends were used, where applicable, in Section 4.3, to help indicate the cumulative impacts of past, present, and future actions. Some of the relevant trends include the following:

- A decrease in marine birds (particularly scoters, loons, and grebes) and increase in California sea lions and harbor seals;
- A decline in native eelgrass in Hood Canal;
- An increase in the size and duration of phytoplankton blooms and a corresponding decrease in overall DO levels;

- A decrease in some fish stocks (salmon, rockfish, spiny dogfish, Pacific cod, and hake);
- Increased shoreline sediment erosion due to shoreline armoring and in-water structures; and
- An overall decline in fecal coliform levels.

4.2.1.1.4. HABITATS OF MIGRATORY MARINE ANIMALS

Migratory or wide-ranging marine animals that may be present in the project area may be affected by natural events and anthropogenic activities in areas far removed from Hood Canal waters — on breeding grounds, migration routes, wintering areas, or other habitats within a species' range. Events and activities that affect the habitats and populations of these marine species outside Hood Canal include the following:

- Disease;
- Natural toxins;
- Weather and climatic influences;
- Natural predation;
- Fishing;
- Hunting;
- Ocean pollution;
- Habitat modification or destruction;
- Commercial shipping, fishing, and other vessel traffic; and
- Whaling for scientific purposes.

4.3. CUMULATIVE IMPACTS ANALYSIS

This section presents an assessment of the cumulative environmental impacts of the LWI and SPE when combined with past, present, and reasonably foreseeable actions. The purpose of the cumulative impacts analysis is to identify and describe impacts of the Proposed Actions that may be insubstantial by themselves but would be considered substantial in combination with the impacts of other actions and trends. The impacts of other actions are assessed using available information, and trends in environmental conditions are derived from the *2007 Puget Sound Update—Ninth Report of the Puget Sound Assessment and Monitoring Program* (PSAT 2007a) and *2012 State of the Sound* (Puget Sound Partnership 2012).

Since the information available on past, present, and reasonably foreseeable actions varies in quality and level of detail, impacts of these actions were quantified where feasible based on available data; otherwise, professional judgment and experience were used to make a qualitative assessment of impacts. In some cases, there may be a combination of both quantitative and qualitative analysis. Where this is the case, professional judgment was used to evaluate the impact based on the combined information.

Several major sources of quantitative information were available, particularly concerning past and present Navy actions. Among these were NEPA and Endangered Species Act (ESA) documentation, including environmental impact statements, environmental assessments, and biological assessments.

As noted in Section 4.2.1 above, the combined impacts of the LWI and SPE are described for each resource in Chapter 3. In this assessment of cumulative impacts, the combined contribution of the LWI and SPE Proposed Actions to cumulative impacts is described for each resource. For each of the Proposed Actions, the action alternatives would contribute to the same types of cumulative impacts, but the magnitude of these contributions would differ between alternatives. Ranges are presented for these contributions when quantifiable impacts differ between alternatives. The primary difference in impacts between the LWI action alternatives is that Alternative 2 entails construction of a pile-supported pier, resulting in more pile driving and generally greater impacts on marine habitats and species than Alternative 3, which would not involve pier construction. The primary difference in impacts between the SPE alternatives is that Alternative 3 (Long Pier Alternative) would result in greater overwater coverage, habitat displacement, and pile driving.

Regardless of the alternatives selected, the proposed Mitigation Action Plan (Appendix C) was designed and will be implemented to compensate for the impacts on marine habitats and species, so that the Proposed Actions will make no net contribution to cumulative impacts. Effects of this mitigation for specific resources are delineated in the following sections.

Potential cumulative impacts include that construction and operation of the LWI and SPE would contribute to regional cumulative impacts on marine resources such as shallow-water habitat, including loss of eelgrass, macroalgae, and habitat for juvenile salmon and other fish and invertebrate species. However, through the implementation of proposed compensatory aquatic mitigation actions in the Mitigation Action Plan (Appendix C), the project's contribution to cumulative impacts would not be significant.

The other construction impacts of the Proposed Actions, such as air and water quality effects, would be minor and highly localized and, thus, would not contribute significantly to cumulative impacts in the region.

Impacts on upland habitats and species from LWI and SPE would be moderate, and all but 7.2 acres (2.9 hectares) would be revegetated; approximately 4.9 acres (2 hectares) would be revegetated, so there would be little contribution to cumulative upland impacts. During construction, marine vessel traffic from LWI and SPE would roughly double the frequency of openings of the Hood Canal Bridge from other actions, an adverse impact on travelers on SR-104. Bridge openings would be scheduled to avoid peak traffic hours to the extent possible. The multiple projects would have cumulative positive economic benefits.

It is also possible that construction of the LWI and SPE would overlap in time with construction of other waterfront structures on NAVBASE Kitsap Bangor. In this case, pile driving for the multiple projects could result in cumulative noise impacts. As a result, more individuals of marine species (fish, marine mammals, and marine birds) would be affected, but it is unlikely that population-level effects due to cumulative sound levels would be greater than those of the

LWI and SPE projects alone. Noise impacts on nearby residential and recreational areas also would increase slightly due to the separated locations of the multiple construction projects. It is not expected that there would be major marine construction projects outside of NAVBASE Kitsap Bangor that would overlap with the other Navy projects and cause cumulative noise impacts. Concurrent construction of multiple projects would exacerbate traffic impacts on base roads and delays at the gates entering the base, with increased impacts on traffic on adjacent regional roadways.

4.3.1. Marine Water Resources

4.3.1.1. HYDROGRAPHY

The ROI for hydrography is defined as Hood Canal. Hydrographic processes in Hood Canal mix, disperse, and redistribute the watershed loadings such that marine water and sediment quality conditions at different locations within Hood Canal reflect the magnitude and relative contributions of inputs from multiple sources within the ROI.

The overall hydrography of Hood Canal probably has not changed much over time, except for localized changes in water movement around manmade, in-water structures. Past and present placement of in-water structures during construction (e.g., anchors, piles, floats, boat ramps) for Navy actions such as Marginal Wharf, Service Pier, Keyport/Bangor (KB) Dock, Delta Pier, and EHW-1 has impacted or is impacting the circulation and pattern of currents by creating eddies and increasing or decreasing current velocity in the vicinity of these structures. Particularly during peak tides, the flow patterns around piles become more turbulent as the water mass is forced against the piles, thus deflecting the linear flow laterally and downward. This produces a decrease in velocities of the water column downcurrent of the piles, but an overall increase in the turbulence and mixing in the water mass. These effects are localized and do not affect regional circulation patterns, tidal flows, or longshore sediment supply and transport processes within Hood Canal.

The impacts of past and present actions on hydrographic conditions in Hood Canal are described in Section 3.1.1 for existing conditions. Similar to the proposed LWI and SPE projects, other past, present, and future actions that construct and operate structures in the intertidal and subtidal nearshore areas of Hood Canal have or will result in localized and temporary disturbances of bottom sediments, with the potential for altering bathymetry, flow patterns, and littoral transport processes.

From a regional perspective, Puget Sound has approximately 2,500 miles (4,000 kilometers) of shoreline, consisting in large part of beaches and coastal bluffs that are subject to continual erosion (Shipman 2010). Erosion of bluffs (“feeder bluffs”) is considered an important source for the sediment supply to Puget Sound beaches (Johannessen 2010). The Puget Sound shoreline is becoming progressively hardened (i.e., covered with artificial structures) to prevent erosion of the shoreline and protect upland infrastructure. An estimated 25 percent of the West Kitsap county shoreline is armored (Judd 2010). Shoreline armoring is believed to affect the natural coastal sediment supply and transport processes and potentially contribute to beach narrowing, sediment coarsening, and loss of upper intertidal habitat (Ruggiero 2010).

Several waterfront facilities, such as Carderock Pier, Keyport Bangor Docks, Delta Pier, Marginal Wharf, and EHW-1, currently exist at NAVBASE Kitsap Bangor. These structures are separated by expanses of uninterrupted shoreline and open water between them. Depending on the direction and intensity of the local winds, individual structures offer varying amounts of fetch for the generation of wind waves, as well as protection from the effects of those waves. In most cases, the pier facilities are constructed on a foundation of solid piles configured in a manner that serves to disrupt well-organized wave fields approaching the shoreline from open water. This acts to reduce the amount of energy reaching shallow subtidal and intertidal zones adjacent to each pier facility and the capacity of the waves to re-suspend and transport unconsolidated seafloor sediments. Evidence from bathymetric surveys and aerial photographs confirms the presence of sediment deposits along portions of the shoreline, some of which are co-located with the pier facilities, suggesting that the piles in the pier foundations promote a depositional environment and the accretion of unconsolidated material in the form of shallow subtidal shoals and broadening intertidal beaches (Morris et al. 2009). However, in some cases, the co-occurrence of shoreline structures and shoals may be coincidental. For example, an aerial photograph of EHW-1 taken shortly after the structure was constructed shows the presence of a shoal immediately inshore of the wharf, indicating that the shoal was present at the time the wharf was constructed (Prinslow et al. 1979, Plate 1). Other localized areas of shoaling, such as immediately north of Keyport-Bangor Point, are related to sediment discharge from the adjacent wetland (Devil’s Hole) and the presence of headlands that deflect tidal currents and waves.

Future shoreline development and placement of in-water structures, including EHW-2 and the Olympic View Marina, would likely add to existing erosion and accretion of shoreline sediments. Washington State Parks recently completed naturalization of 1,000 feet (305 meters) of bulkheaded shoreline at Kitsap Memorial Park (description in Table 4–1), reducing hard surfaces along the Hood Canal shoreline. The Kitsap County Nearshore Assessment, West Kitsap Addendum (Judd 2010) determined that of the 35 littoral cells associated with the West Kitsap County shoreline, 20 (57 percent) had low impacts on shoreline processes while seven (20 percent) had high impacts. The NAVBASE Kitsap Bangor waterfront is ranked low for disturbance for dominant processes, which include sediment erosion and transport, but moderate to high disturbance for controlling factors including disturbance to wave energy, disturbance to slope, and frequency of disturbance. For the littoral cells adjacent to the NAVBASE Kitsap Bangor waterfront, scores for these controlling factors generally were above the mean value for West Kitsap County shoreline, indicating a relatively higher level of disturbance. The high military activity in the area may have contributed to the elevated scores.

Cumulatively, the LWI and SPE would contribute to regional changes in nearshore sediment dynamics. Specifically, construction of the abutments for the LWI project could result in small decreases in the sediment supply to the littoral cell. However, the north and south abutments would only be 72 feet (22 meters) long, and would lie above the mean high water (MHW) line, although the abutment stair landings (12 square feet [1 square meter] at each abutment) and a portion of riprap would be below the mean higher high water (MHHW) line. The portions of the bluffs that would be disturbed by the LWI abutments do not exhibit characteristics of feeder bluffs (e.g., presence of recent landslide scarps, bluff toe erosion, abundant sand/gravel in bluff, etc.; Johannessen 2010; MacLennan and Johannessen 2014). Therefore, the proportional change in the regional sediment supply associated with construction of the abutments is expected to be small. Further, the pile-supported LWI (Alternative 2), observation posts (LWI Alternative 3), and SPE structures could intercept a portion of the longshore sediment supply to the shoreline downdrift from the NAVBASE Kitsap Bangor waterfront. The LWI and SPE structures (all alternatives) would attenuate some of the energy of surface waves associated with storm events approaching the project site from the north and south. This reduction in wave energy in areas shoreward of the barriers would reduce the frequency and magnitude of sediment resuspension events and promote conditions more conducive to long-term retention of sediments and accumulation of fine-grained sediment in the form of a shoal area or comparatively broader intertidal area (Kelty and Bliven 2003). While the structures could have a minor effect on the frequency and magnitude of storm-related wave events that provide sufficient energy to resuspend bottom sediments in nearshore areas of the project sites, this is not expected to result in substantial, long-term reductions in the longshore sediment transport rates (cbec 2013).

Conclusions regarding the cumulative effect of existing in-water infrastructure at NAVBASE Kitsap Bangor on longshore sediment supply, based on assessments of historical changes in the shoreline, are inconsistent. Golder Associates (2010) concluded that while the sediment supply rate in the vicinity of the Bangor waterfront is low, the presence of existing pile-supported structures at the NAVBASE Kitsap Bangor waterfront has not caused appreciable changes in the morphology of the shoreline. In contrast, MacLennan and Johannessen (2014) concluded that apparent changes in the NAVBASE Kitsap Bangor shoreline have been substantial. These changes were attributable to several factors, including northward shifts in the positions of spits due to the natural effects of prevailing winds and waves, erosion in areas of feeder bluffs, sediment accumulation near Devil's Hole, and inaccuracies in the historical mapping. However, in some areas, such as north of EHW-1, MacLennan and Johannessen (2014) attributed the absence of shoreline recession to the wave dampening effects of in-water structures.

A substantial portion (34 percent) of the Puget Sound and Northern Straits shoreline has been modified, resulting in regional alterations of beach habitat and changes in sediment deposition and erosion patterns (Johannessen and MacLellan 2007). As discussed in Section 3.1, the effects of in-water structures associated with the LWI and SPE projects (all alternatives) alone on sediment transport processes would be minor. However, these projects would contribute cumulatively to changes in sediment supply within Hood Canal, as well as long-term changes in sediment deposition and erosion patterns within NAVBASE Kitsap Bangor, similar to those noted by MacLennan and Johannessen (2014). Outside of NAVBASE Kitsap Bangor, the scale of these changes related to the cumulative contributions of the LWI and SPE projects may not be discernable from future changes related to natural processes.

4.3.1.2. WATER QUALITY

The ROI for marine water quality is defined as Hood Canal and its watershed. The evaluation for the ROI for water quality also considered several different scales of ROI for use in the cumulative analysis. Sub-basins and drift cells were considered as smaller, more discrete ROI, and the larger Puget Sound region was considered as a larger scale. Based on the available information on management of water quality, planning, recovery efforts, and trend data, the Hood Canal Basin was determined to be an appropriate ROI for water quality. This ROI is large enough to capture projects contributing to water quality impacts and also has available water quality management plans and data. Watershed drainage represents an important source for freshwater and sediments, as well as human-derived pollutants associated with the watershed runoff that contributes to contaminant loading of Hood Canal. Hydrographic processes in Hood Canal mix, disperse, and redistribute the watershed loadings such that marine water conditions at different locations within the canal reflect the magnitude and relative contributions of inputs from multiple sources within the ROI.

The impacts of past and present actions on water quality are described in Section 3.1.1 for existing conditions. Water quality in Hood Canal has been and is being impacted by past and present in-water and upland actions and would potentially be impacted by future actions. Specific impacts include: (1) stormwater and urban runoff; (2) nutrient and pollutant loading from leaking or ineffective septic systems; (3) incidental spills associated with boat operations, such as fueling, or other activities conducted on piers, wharves, and floats; (4) sediment disturbance and turbidity from in-water construction activities; and (5) contaminant loadings attributable to the use over time of materials such as treated wood piles. These sources include inputs of pollutants to Hood Canal that are periodic (e.g., fuel, oil, and other contaminants) and continuous (e.g., leaching septic tanks and runoff), impacting water quality parameters such as turbidity, pH, DO, biochemical oxygen demand (BOD), and chemical contaminant and fecal bacteria levels.

Most development in the Hood Canal watershed (except NAVBASE Kitsap Bangor) uses septic systems, and many older systems have failed over time (Hood Canal Dissolved Oxygen Program [HCDOP] 2005). Fecal coliform bacteria and nutrients are periodically discharged into Hood Canal through stormwater runoff from areas with inadequate septic systems. Though fecal coliform bacteria are not harmful to humans, the presence of fecal coliform indicates the possible presence of pathogenic viruses or bacteria. Fecal coliform bacteria can also be absorbed and concentrated in shellfish making them unsuitable for human consumption.

Nutrients are a larger problem because they can cause algae to bloom. When algal blooms occur, they cause DO to be rapidly used up during bacterial decomposition of decaying organic matter. A rapid loss of DO can result in fish kills. Animal wastes from hobby farms or sites where animals are bred are also a source of nutrients. These sources have long been recognized as primary contributors to the low DO conditions in Hood Canal (HCDOP 2005). Efforts have been made to eliminate the use of septic systems or to repair failing systems to the extent possible, particularly in nearshore areas, and to control point sources such as hobby farms. However, in the Hood Canal watershed, some future development would continue to use septic systems because sewers are not available in many areas.

Fecal coliform levels in the vicinity of NAVBASE Kitsap Bangor typically are low (below State standards), and they have remained relatively stable during the past decade (Puget Sound Partnership 2010). Since 1994, the Washington Department of Health (WDOH) has upgraded twice the number of shellfish growing areas (indicating reduced fecal coliform contamination at the beds) than they have downgraded (indicating increased fecal coliform contamination at the beds). Fecal coliform contamination at shellfish growing sites in northern Hood Canal has been negligible (Puget Sound Partnership 2010). Construction of new sewer lines in southern Hood Canal and other actions (e.g., future phases of the Belfair Sewer Line; also see Section 4.2.1.1.2) should contribute in the future to lower coliform levels in southern and mid-Hood Canal.

Although fecal coliform levels are expected to decrease, the *State of the Sound Report* (Puget Sound Action Team [PSAT] 2007b) concluded that the overall trend is for continued deterioration of water quality in Hood Canal due to a rise in toxic contaminants and a lowering of DO levels, which are regarded as water quality parameters of major concern. Various waters in Puget Sound are listed as impaired by Washington Department of Ecology (WDOE), including southern Hood Canal (PSAT 2007b).

Most of the future actions would have no impact or variable (sometimes minimal) short-term impacts on marine water quality, and some future actions would be designed to minimize impacts and/or improve water quality. For example, all new piers, including the proposed LWI and SPE structures, would use concrete or steel piles, which, unlike the creosote-treated piles used in the past, would not have the potential for leaching hydrocarbon compounds into the water. The same would be the case for the Port Security Barriers (PSBs) and associated anchors. Several proposed projects (e.g., future phases of the Belfair Sewer Line) and actions (e.g., initiatives reflected in Hood Canal agency plans) would be implemented specifically to improve water quality in Hood Canal (Section 4.2.1.1.2). Additionally, per Clean Water Act (CWA) Section 303(d), a Total Maximum Daily Load (TMDL) is expected to be implemented in the future to evaluate the sources contributing to low DO levels in the vicinity of NAVBASE Kitsap Bangor and potential loading allocations that would result in consistent compliance with state standards for DO.

Construction of the proposed LWI and SPE projects would not be expected to contribute to or exacerbate cumulative water quality impacts because project-related changes would be localized and would not overlap in space with those of other cumulative projects. Even if the construction periods for the proposed projects and the TPS and MSF projects were to overlap in time, their water quality impacts would be localized, with little potential to overlap in space. Thus, cumulative water quality impacts would not occur.

The proposed LWI and SPE projects would result in only small increases in boat traffic with minor potential for contributing cumulatively to increased risks of vessel-related spills. Therefore, it is not expected that operations associated with the proposed projects would result in cumulative water quality impacts that would affect important species such as fish, marine mammals, and marine birds in Hood Canal (Sections 4.3.3, 4.3.4, and 4.3.5, respectively). Similarly, the other project alternatives would not contribute to significant cumulative impacts on water quality.

4.3.1.3. SEDIMENT

The ROI for marine sediments is defined as Hood Canal and its watershed. Similar to marine water quality, watershed drainage represents an important source of suspended materials and sediments, as well as human-derived pollutants that contribute to the contaminant loading of Hood Canal. Hydrographic processes in Hood Canal mix, disperse, and redistribute the watershed loadings such that marine sediment quality conditions at different locations within Hood Canal reflect the magnitude and relative contributions of inputs from multiple sources within the ROI. The impacts of past and present actions are described in Section 3.1.1 for existing sediment conditions.

Past, present, and future actions involving in-water construction, including associated pile driving and dredging, in Hood Canal have caused, are causing, or would cause short-term disturbances to sediment. Disturbed sediment creates plumes of turbid water that carry fine-grained material downcurrent from the disturbed area. Thus, it is assumed that there have been some very slight changes in the ratio of fine- to coarse-grained sediment in localized areas over time.

Future actions (Navy and non-Navy) would potentially disturb bottom sediments over an area of approximately 7.9 additional acres (3.2 hectares), for a total estimated area of 34.6 acres (14 hectares). Additional area has been affected by past non-Navy actions, such as dock and bulkhead construction and operations. Together the LWI and SPE would impact up to 2 acres (0.8 hectare), for a total of up to 36.6 acres (approximately 15 hectares) in which in-water structures have affected or will affect bottom sediments.

Many of the in-water projects including marinas, boat ramps, and Navy piers have resulted in an increased use of boats in the nearshore area. Boats that operate in these areas have the potential to disturb sediments from propeller wash, which could result in slight changes in the ratio of fine- to coarse-grained sediment in localized areas. However, the cumulative impacts of in-water construction and propeller wash have been inconsequential when compared with movement of sediment by tides and currents.

Sediment quality has also been impacted by development over time. In some locations, chemicals discharged into Hood Canal via stormwater runoff, streams, and other sources have accumulated in sediments and been absorbed in the tissues of marine organisms. In general, however, levels of chemical contaminants and toxicity in Hood Canal sediments are low (WDOE 2007). Sediment quality in the vicinity of the proposed projects is generally good (Hammermeister et al. 2009). The organic content of sediment is low, and levels of measured contaminants, such as metals, butyltins, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and pesticides, are below thresholds specified in sediment quality standards. Although past, present, and future actions have had, continue to have, or would be expected to have sediment quality impacts, as described above, the proposed projects would not contribute substantively to cumulative impacts on sediment quality in Hood Canal. As discussed in Section 3.1.2, impacts on sediment quality from the construction and operational phases of the proposed projects would be limited to temporary and localized impacts from construction activities or accidental spills. However, these are not expected to contribute to substantial cumulative impacts on sediment quality. Similarly, the other project alternatives would not contribute to significant cumulative impacts on sediment quality.

4.3.2. Marine Vegetation and Invertebrates

4.3.2.1. MARINE VEGETATION

The ROI for evaluating cumulative impacts on marine vegetation is defined as Hood Canal. Recent regional surveys indicate decreasing eelgrass in Hood Canal (PSAT 2007a), so the potential for the projects to contribute to these impacts is important. Therefore, Hood Canal is relevant for determining cumulative impacts on marine vegetation and eelgrass in particular. Marine vegetation in Hood Canal would not be affected by actions outside Hood Canal.

The impacts of past and present actions on marine vegetation are described in Section 3.2.1.1 for existing conditions. Marine vegetation in Hood Canal has been, is being, or would be disturbed by past, present, and future placement of in-water structures such as piles and anchors, dredging, underwater fills, and construction of overwater structures. These impacts include temporary or permanent loss of vegetation, reduced productivity, and changes in the type or abundance of vegetation. Recent trend data indicate that some of the more sensitive and important vegetation for critical habitat in Hood Canal, such as eelgrass, has decreased over time. According to the most recent survey data available (Gaeckle et al. 2011), there is strong evidence of eelgrass (*Zostera marina*) decline in the Hood Canal Region. This region had the highest proportion of significant negative results for the four eelgrass parameters tested (site-level area, deep edge depth, shallow edge depth, and 5-year area trends). According to the report, roughly 85 percent of the cumulative tests that were significant indicated that the *Z. marina* area is declining or the seagrass bed is receding at the shallow or deep edge (i.e., a significant shallow or deep depth change that causes bed size reduction) in this region. The *2012 State of the Sound* report (Puget Sound Partnership 2012) attributes Hood Canal eelgrass losses to eutrophication, which has contributed to macroalgae blooms and stressed eelgrass beds.

Currently, there are approximately 37.7 acres (15 hectares) of eelgrass extending in a strip along the intertidal/nearshore zone of the Bangor waterfront. Based on the known extent of current eelgrass beds, an estimated 5.2 acres (2.1 hectares) of eelgrass may have been lost over time due to placement of in-water structures such as piles and anchors, nearshore vessel activities, or displacement by the invasive brown alga, *Sargassum muticum*. Approximately 24.7 acres (10 hectares) of overwater shading have been created by past actions on NAVBASE Kitsap Bangor (Table 4–2). The overwater shading reduces the productivity of marine vegetation such as eelgrass and macroalgae. Information is not readily available to quantify the amount of shading and eelgrass loss attributable to all past and present non-Navy actions in Hood Canal, although that area is likely to be similar to or greater than the area affected by past and present Navy actions.

Ongoing action for NAVBASE Kitsap Bangor EHW-2 and for the future actions (TPS pier and MSF modification) would result in approximately 7.9 acres (3.2 hectares) of new shading and the loss of less than 0.1 acre (0.04 hectare) of eelgrass. These actions have been designed to avoid eelgrass beds to the extent possible. To compensate for unavoidable impacts on aquatic resources from EHW-2, the Navy purchased aquatic habitat credits from the Hood Canal in-Lieu Fee Program. Other future non-Navy actions involving the placement of piles and anchors and resultant shading would also reduce the amount of eelgrass and macroalgae. Future actions impacting eelgrass would require mitigation (in compliance with the U.S. Army Corps of Engineers (USACE) rule on compensatory mitigation for losses of aquatic resources) such that there would be no net loss of these resources. It is estimated that up to 12 acres (4.8 hectares) of overwater structures would be created by the actions described in Table 4–1. As described in Section 3.2.2, macroalgae are generally less sensitive to the effects of shading due to lower light requirements.

Table 4–2. Cumulative Loss of Marine Vegetation on NAVBASE Kitsap Bangor in acres (hectares)

Parameter	Total Overwater Shading Area	Eelgrass Loss[1]	Macroalgae Loss[2]
Past Navy Waterfront Construction and/or *Sargassum* invasion	24.7 (10)	5.2 (2.1)	Not determined
EHW-2[3]	6.3 (2.5)	0.09 (0.04)	0.13 (0.05)
Land/Water Interface[4]	0.12–0.34 (0.047–0.14)	0.013–0.024 (0.0054–0.01)	0.05–0.078 (0.02–0.032)
Bangor TPS Pier	1.6 (0.65)	TBD	TBD
Service Pier Extension[4]	1.0–1.6 (0.41–0.65)	0	0
MSF Modification	0.02 (0.07)	0	0
Non-Navy Future Hood Canal Projects	1.7 (0.67)	Not determined	Not determined
Total	**up to 36.3 (14.7)**	**5.3 plus undetermined amount**	**0.14 plus undetermined amount**

EHW = Explosives Handling Wharf; MSF = Magnetic Silencing Facility; TBD = to be determined; TPS = Transit Protection System

1. For the purposes of cumulative impact assessment, eelgrass loss is the known area of flora under fully shading proposed structures (EHW-2), the area in the steel plate anchor and pile footprints (LWI Alternative 2), or the area under PSB mooring anchor footprints and PSB foot and buoy disturbance footprints (LWI Alternative 3).
2. For the purposes of cumulative impact assessment, macroalgae loss is the known area under the proposed structure (EHW-2), or the area under the steel plate anchor and pile footprints (LWI Alternative 2), or area under PSB mooring anchor footprints and PSB foot disturbance footprints (LWI Alternative 3). Total macroalgae areas were estimated for LWI.
3. Impacts on eelgrass and other marine vegetation from the EHW-2 project were mitigated through purchase of aquatic habitat credits from the Hood Canal In-Lieu Fee Program.
4. Impacts on eelgrass and other marine vegetation from the proposed project would be mitigated as part of the Mitigation Action Plan. The SPE is located outside of marine vegetation depths at NAVBASE Kitsap Bangor and would not contribute to marine vegetation losses during operation.

The estimated combined impact of past Navy actions, future non-Navy actions, and the LWI and SPE projects and other future Navy actions is up to 36.6 acres (14.8 hectares) of overwater structures, as well as a related loss of eelgrass and macroalgae. That is, actions that have contributed to past declines can be expected to contribute to future declines of eelgrass in Hood Canal (PSAT 2007a). Hood Canal currently supports approximately 550 acres (223 hectares) of eelgrass; northern Hood Canal (north of the tip of Toandos Peninsula) supports approximately 220 acres (89 hectares) (Simenstad et al. 2008). Cumulative impacts on eelgrass beds would affect the functions of these habitats, including primary productivity, habitat for invertebrates and epiphytic algae, and feeding and refuge for juvenile fish (including ESA-protected salmonids and their forage species) (Section 4.3.3). The impacts of the LWI on marine vegetation, including eelgrass, would be mitigated as part of the Mitigation Action Plan described in Appendix C. The SPE would not contribute to marine vegetation loss. Therefore, construction and operation of the LWI and SPE projects would not make a long-term net contribution to cumulative impacts on marine vegetation.

4.3.2.2. BENTHIC COMMUNITIES

The ROI for evaluating cumulative impacts on benthic communities and shellfish is defined as Hood Canal. Regional surveys indicate a reduction in abundance and diversity for the benthic community in Hood Canal (PSAT 2007a), so the Proposed Actions' contributions to these impacts are important. Therefore, Hood Canal is relevant for determining cumulative impacts on benthic communities and shellfish. Benthic communities and shellfish in Hood Canal would not be affected by actions outside of Hood Canal.

The impacts of past and present actions on benthic communities are described Section 3.2.1.1 for existing conditions. Past, present, and future Navy and non-Navy actions, including marinas, residential docks, boat ramps, and piers involving placement of piles and anchors have resulted or would result in the direct loss of the benthic soft-bottom habitat. This habitat is replaced by hard surfaces represented by piles and anchors and, as a result, the types of benthic organisms have changed and are changing in these localized areas. Hard surfaces create sites for colonization by species adapted to these surfaces, such as mussels and sea anemones. Thus, the cumulative impact of in-water structures has been to replace native soft-bottom habitat with hard-surface habitat over time. This has adversely impacted some species (including prey species for juvenile salmonids) while benefiting others. It is estimated that approximately 2.4 acres (0.97 hectare) of benthic soft-bottom habitat has been lost and converted to hard-surface habitat due to placement of in-water structures along the Bangor waterfront to date.

The overwater portion of structures has also increased shading and nighttime lighting impacts on the benthic community. Shading can impact the abundance of some benthic organisms and lighting can increase predation rates. Shading and loss/alteration of soft-bottom habitat has impacted the type and abundance of benthic organisms that occur in the vicinity of these structures. In addition, in-water structures at the NAVBASE Kitsap Bangor have resulted in accretion of sediments in protected areas created by these structures and possibly erosion in areas downdrift of the structures. The areas of accretion would favor benthic species typical of coarse sediments. Any areas of erosion would result in adverse impacts on sediment-dwelling species. These changes would adversely affect foraging by juvenile salmon, which prefer species typical of fine-grained sediments and eelgrass beds.

The recent trend for the benthic community in Hood Canal is a reduction in abundance and diversity (PSAT 2007a). This trend is strongest in southern Hood Canal and in deeper waters and includes decreases in the native Olympia oyster, which occurs intertidally in Hood Canal but has not been detected in surveys along the Bangor waterfront. Stress-sensitive species (i.e., those species that cannot tolerate poor water quality conditions such as low DO levels or high toxicant concentrations in sediments) are more abundant in northern Hood Canal, which includes NAVBASE Kitsap Bangor, than in southern Hood Canal. Low DO levels are considered a likely cause of this trend, but other contributing factors such as sediment contamination are being investigated (PSAT 2007a).

Future in-water structures would similarly result in a direct loss of soft-bottom habitat. Specifically, approximately 0.2 acre (0.08 hectare) of soft-bottom habitat would be replaced with hard surfaces for EHW-2, less than 0.002 acre (0.0067 hectare) combined for the Commander, Submarine Development Squadron Five (CSDS-5) Support Facilities barge replacement and

Electromagnetic Measurement Range, and up to 0.18 acre (0.074 hectare) of soft bottom would be filled with steel plate anchors, piles, or other structures for the LWI and SPE projects. The EHW-2 project includes several measures to mitigate for project impacts on benthic species. To improve shellfish production and harvest opportunities, the Navy will fund improvements to beach substrate and 3 years of shellfish seeding on 24 acres of beach; 5 years of shellfish seeding on priority shellfish enhancement areas in Hood Canal and adjacent Admiralty Inlet; construction of a shellfish wet lab, education, and training building at Port Gamble; construction of a floating shellfish nursery at Port Gamble; and surveys of geoduck and a geoduck pilot research study. Projects other than LWI would not affect tribal shellfish areas.

Future non-Navy actions are estimated to result in a loss of less than 0.01 acre (0.004 hectare) of soft-bottom habitat, based on reviews of available information for those projects. Washington State Parks recently completed naturalization of 1,000 feet (305 meters) of bulkheaded shoreline at Kitsap Memorial Park (description in Table 4–1), reducing hard surfaces along the Hood Canal shoreline.

The conversion of soft-bottom habitat to hard surfaces from past, present, and foreseeable future actions would total approximately 2.6 acres (1 hectare) from Navy actions, not including LWI and SPE, and an unquantified amount from past non-Navy actions. Non-Navy anticipated construction would convert an additional 0.01 acre (0.004 hectare). The Proposed Actions (LWI and SPE projects) would convert up to 0.18 acre (0.074 hectare) of soft bottom, putting the total impacts from all future actions at about 2.8 acres (1.1 hectares). The trend for Hood Canal as a whole is for decreasing abundance and diversity of the soft-bottom benthic community, although this trend is more pronounced in southern Hood Canal than in the NAVBASE Kitsap Bangor area. Considering all factors, the up to 0.18 acre (0.074 hectare) of benthic habitat impacted by the Proposed Actions would contribute to cumulative impacts on the benthic community in Hood Canal. However, this contribution would be compensated for by the Mitigation Action Plan described in Appendix C.

4.3.2.3. PLANKTON

The ROI for evaluating cumulative impacts on plankton is defined as Hood Canal. Recent regional surveys indicate an increasing trend in phytoplankton blooms in Hood Canal (PSAT 2007a). Therefore, Hood Canal is relevant for determining cumulative impacts on plankton. Plankton in Hood Canal would not be substantially affected by actions outside of Hood Canal.

The impacts of past and present actions on plankton are described in Section 3.2.1.1 for existing conditions. Plankton populations have been largely unaffected by past and present in-water development in the ROI, and future in-water development is also unlikely to adversely impact plankton. When piers are constructed, slight changes in plankton abundance and community type may occur from disturbance to the water column, increased nighttime lighting, overwater shading, and an increase in plankton filter feeders that colonize new underwater structures. However, since plankton are not sessile and tides and currents continually move the water column, residence times under structures is typically short. Thus, slight increases in predation or disturbances to the water column from in-water structures would have little impact on plankton given the available habitat for these species in Hood Canal.

Plankton have been impacted by upland developments that contribute sources of nutrients to Hood Canal. For example, upland projects that use fertilizers are likely to produce stormwater runoff that contains nutrients such as nitrogen and phosphorus. Other sources include failing septic systems and runoff from sites where animals are raised. Projects that contribute nutrients to Hood Canal cause plankton blooms close to the source of the nutrient input. While these nutrients favor plankton productivity, blooms reduce the available DO in the water and adversely impact other marine organisms. In Hood Canal, there has been an increasing trend in phytoplankton blooms, primarily due to changes in nutrient levels, mostly in southern Hood Canal. Blooms of plankton are lasting longer and occurring more frequently (PSAT 2007a).

Cumulative impacts on plankton attributable to past, present, and foreseeable future actions include the creation of sites for plankton filter feeders, nighttime artificial lighting, and shading, all of which reduce plankton productivity. The Proposed Actions would have similar impacts, although the proposed nighttime artificial lighting for both the LWI and SPE would be on only as needed and would not be continuous. Because the area affected by other actions is such a small part of the available habitat in Hood Canal, impacts and cumulative impacts to plankton from the projects would be inconsequential.

4.3.3. Fish

The ROI for evaluating cumulative impacts on marine fish is defined as Hood Canal. Depending on the species, there is varying potential for actions elsewhere in Hood Canal to impact fish affected by LWI and SPE. Resident Hood Canal fish species are unlikely to be affected by actions outside of Hood Canal. Those species that are the most transitory would be Hood Canal salmonids, whereas resident species are more restricted in their movement. Juvenile salmonids originating from Hood Canal streams migrate northward along the shoreline. In general, on exiting Hood Canal these fish turn west toward the Strait of Juan de Fuca and the Pacific Ocean and do not enter the waters of Puget Sound proper. Migratory fish such as salmon move beyond Hood Canal, but the potential for human actions to affect these fish as they move between the mouth of Hood Canal and the Pacific Ocean is considered low. The contribution of effects on fish occurring in the ocean to cumulative impacts of the projects cannot be determined based existing data, but it is acknowledged there is a relationship.

4.3.3.1. SALMONIDS

The impacts of past and present actions on marine fish are described in Section 3.3.1.1 for existing conditions. Past actions have adversely impacted populations of salmonids (salmon, steelhead, and trout, including threatened and endangered species) in Hood Canal and tributaries through loss of foraging and refuge habitat in shallow areas, reduced function of migratory corridors, loss and degradation of spawning habitat in streams, interference with migration, adverse impacts on forage fish habitat and spawning, contamination of water and sediments, and depletion of DO. Another factor that has resulted in adverse impacts on salmonid abundance is the overharvest by fisheries. This impact has been greatest on native stocks. Practically all chum salmon and most Chinook salmon spawning in Hood Canal stream systems are derived from naturalized hatchery stock. Populations of pink salmon, coho salmon, bull trout, and steelhead are also in decline. The net result is that several Hood Canal salmonid species have been listed as threatened under the ESA. Existing Navy structures have affected salmonid and forage fish habitat, and similar to in-water structures throughout Puget Sound have probably impeded and continue to impede juvenile salmon migration to some degree (Salo et al. 1980; Simenstad et al. 1999; Nightingale and Simenstad 2001a; and Southard et al. 2006) (as discussed in Section 3.3.2.2.2 for physical habitat and barriers during operations). Current and future waterfront projects along NAVBASE Kitsap Bangor would be designed and implemented to minimize impacts on salmonid habitat and migration and on forage fish. Design aspects include large spacing between piles (e.g., 20 feet [6 meters] for the larger piers), increased structure height-over-water in nearshore waters, and building materials (e.g., grating) that allow for light transmission.

The *State of the Sound Report* (PSAT 2007b) described several trends that may be indicative of cumulative impacts on the growth and development of salmonids. There was an increasing trend for toxics to be concentrated in the tissues of Puget Sound Chinook and coho salmon. These salmon have been found to have in their bodies 2 to 6 times the PCBs and 5 to 17 times the polybrominated diphenyl ethers (PBDEs) of other West Coast salmon populations. As of the 2012 State of the Sound report (Puget Sound Partnership 2012), concentrations of PBDEs in multiple fish species appeared to be dropping but PAHs and PCBs showed no progress overall toward the 2020 goal. However, PCBs in adult coho salmon returning to Puget Sound rivers were below thresholds. Wild salmon stocks declined from 93 to 81 healthy stocks between 1992 and 2002, and 7 stocks became extinct during that same period. Commercial, tribal, and sport fishing contribute to impacts on fish stocks in Puget Sound in general.

Future Navy and non-Navy actions could have some of the same impacts as described above for past actions, notably habitat loss or alteration and the decreased function of migratory corridors. However, federal or federally funded actions that have occurred since legislation was enacted, such as the ESA and NEPA, have been considering and are required to (1) consider environmental impacts on threatened and endangered species, (2) prepare analysis (including a biological assessment), and (3) consult with federal regulatory agencies to minimize project impacts. Future actions are also required to go through this same process. Future actions on NAVBASE Kitsap Bangor will be designed and implemented to minimize impacts on salmonids. For the proposed projects, these measures include designs that minimize impacts on intertidal and shallow subtidal habitats to the maximum extent practicable, limiting in-water work to the maximum extent practicable, observing work windows (except for non-pile-driving work for the LWI project), taking measures to reduce construction-related noise, and implementing habitat mitigation. The above processes and actions will help to ensure that impacts of projects are below levels that would endanger the continued existence of these species.

Currently, efforts are being made to reverse the decline of fish populations by regulating development and restoring fish habitat. Numerous salmon preservation and restoration groups have proposed and constructed habitat restoration projects in Hood Canal. Most of these projects are on the east and south sides of the canal. The majority of Hood Canal salmonid-bearing river systems also occur in the southern portion of the canal. Efforts to reduce construction impacts to salmonids and other fish have resulted in a schedule of in-water work periods that all projects must adhere to, as authorized by state (Washington Department of Fish and Wildlife [WDFW]) or federal (USACE) regulatory authorities. The work windows help minimize adverse impacts migrating and spawning fish.

Past, present, and future development projects have had, continue to have, or would be expected to have the potential to result in many of the impacts described above for salmonids and add to declining population trends. Although there are ongoing and future actions and plans to improve conditions for salmonids in Hood Canal (described above), impacts of the projects would result in short-term increases in underwater noise and turbidity; long-term increases in nearshore migrational barriers; and degradation of some nearshore physical habitats and biological communities, thereby contributing to cumulative impacts on these species. The contribution of the proposed projects to cumulative impacts on nearshore habitat would be compensated for by the Mitigation Action Plan described in Appendix C.

Because the LWI and SPE construction may overlap with construction of the EHW-1 Pile Replacement, TPS Pier, MSF modification, and installation of Electromagnetic Measurement Range Sensor System equipment on NAVBASE Kitsap Bangor, salmonids (which are migratory) would be exposed to pile-driving noise and increased turbidity levels within a short period. Concurrent pile driving between LWI or SPE and these other projects would result in 3 decibels (dB) higher noise levels in some locations, as described above for LWI and SPE combined (Appendix D). The greatest potential for higher cumulative noise levels would occur between the north LWI and EHW-1, and SPE and the TPS Pier, where the area in which cumulative impacts on salmonids could occur would be extended beyond that affected by LWI and SPE combined (Appendix D). Proposed Navy projects include several measures to mitigate for impacts on salmonids. These would improve scientific understanding, the Navy will provide funding for research studies on: (1) ocean acidification and (2) Hood Canal chum salmon. They would also improve salmon production and harvest opportunities in Hood Canal, the Navy will fund improvements at three existing fish hatcheries on Hood Canal and replacement of one finfish spawning facility on Hood Canal.

Observing the in-water work window would avoid construction-related impacts on 95 percent of juvenile salmonids, except for the impacts of non-pile-driving work. It is likely there would still be adverse impacts on salmonids from pile driving. As described in Appendix D, the main effect of concurrent pile driving would be to extend the area over which fish and other marine biota are exposed to pile-driving noise by up to 1.3 miles (2.1 kilometers). Following the completion of construction activities, increased noise levels at a given location would generally not occur. However, if two closely located pile-driving projects occurred at the same time, underwater noise levels could increase by as much as 3 dB at sites roughly equidistant between the multiple pile-driving rigs (Appendix D). If the actual construction schedules for these projects overlapped for less than two construction seasons, or did not overlap, cumulative impacts would be reduced accordingly.

4.3.3.2. OTHER MARINE FISH SPECIES

Prior to the 1980s, in-water construction of docks, piers, and boat ramps in Hood Canal impacted fish species presence and abundance (including threatened and endangered species). Underwater noise from pile driving, for example, can cause fish mortality as well as changes in fish behavior. Since the 1980s, in-water construction has been limited to work windows that minimize adverse impacts on migrating juvenile salmonids. Even so, underwater construction noise continues to adversely impact the abundance and occurrence of some fish close to construction activities.

Navy and non-Navy actions involving placement of in-water structures have changed and would continue to change fish habitat in and around these structures. In-water structures can impact fish in several ways: (1) increasing the presence of predators that prey on juvenile fish; (2) posing a barrier to fish movement, particularly juvenile fish; (3) causing direct loss of marine vegetation such as eelgrass, which is important habitat for forage fish and other species; and (4) creating shade that reduces the productivity of aquatic vegetation and benthic organisms, which are preyed on by fish.

Water quality has been and is being impacted by past and present actions and could be impacted by potential future development. In particular, DO levels in Hood Canal are chronically impacted by nutrient levels from development activities that have increased over time. Nutrients can cause algal blooms that deplete DO and result in fish kills (Section 3.3.2.2.2). Many of the other types of past and ongoing impacts described above for salmonids also apply to other marine species.

Trend data have shown a decrease in some fish species such as rockfish (including threatened and endangered species), spiny dogfish, Pacific cod, and hake, as well as increased toxics in the tissues of some species such as Chinook salmon (PSAT 2007a). Commercial, tribal, and sport fishing contribute to impacts on fish stocks in Puget Sound in general.

Future Navy and non-Navy actions could have impacts similar to those described above for past actions. Impacts on fish populations are expected to be reduced by (1) the protective measures taken to minimize impacts during construction activities, (2) the design elements that reduce long-term impacts on nearby habitats, and (3) the strengthened environmental planning and design of recent and future actions. Future actions, including Navy actions, will be designed and implemented to minimize impacts on fish and their habitat. In addition, many of the habitat restoration projects discussed above for salmonids would also benefit non-salmonid fish species.

Past, present, and future development actions have had, continue to have, or would be expected to result in many of the impacts on marine fish described above and thus to add to declining population trends. Although ongoing and future actions and plans are intended to improve conditions for marine fish species in Hood Canal (described above), impacts of the Proposed Actions would result in short-term increases in underwater noise and turbidity (as described above for salmonids), and long-term degradation of some nearshore physical habitats and biological communities, thereby contributing to cumulative impacts on these species. It is not possible to specify the significance of this contribution for the impacted species, except that it would occur at a time of downward trends for these populations. All construction-related actions on NAVBASE Kitsap Bangor are designed and implemented to minimize impacts on marine fish species to the maximum extent practicable. These measures include minimizing the disturbance of highly productive intertidal and shallow subtidal habitats, limiting in-water work, observing work windows, and taking measures to reduce construction-related noise. Although these actions do not necessarily mean that the Proposed Actions and all future actions would have no impact on marine fish species, such actions would help to ensure that the impacts of projects were below levels that would endanger the continued existence of these species. Cumulative impacts from a possible overlap between the construction periods for the LWI and SPE with EHW-1 Pile Replacement, TPS Pier, MSF modification, and Electromagnetic Measurement Range projects would be similar to those described above for salmonids (Section 3.3.2.2.2).

4.3.4. Marine Mammals

The ROI for evaluating cumulative impacts on marine mammals is defined as Hood Canal. Depending on the species, there is a varying potential for actions elsewhere in Hood Canal to affect marine mammals affected by the LWI and SPE projects. Resident harbor seals are unlikely to be affected by actions outside Hood Canal. Other marine mammal species (sea lion species and cetaceans) are migratory or wide-ranging and may be affected by these actions. The contribution of effects on marine mammals occurring in the ocean and inland waters outside of Hood Canal to cumulative impacts of the proposed projects is difficult to define, but it is acknowledged that there is a relationship.

Construction of some past, present, and future shoreline projects has involved, is involving, and would involve activities such as pile driving or dredging that generate high levels of noise. While these impacts are usually temporary, they may be of an intensity to cause short-term behavioral impacts on marine mammals (e.g., avoidance or changes in feeding behavior). These higher noise levels can constitute harassment (a type of “take”) of marine mammals under the ESA and Marine Mammal Protection Act (MMPA). Operations on the NAVBASE Kitsap Bangor waterfront, including Delta Pier and KB Docks, as well as non-Navy actions, have resulted in increased human presence, noise, boat movement, and other activities.

Future in-water projects by the Navy (EHW-1 Pile Replacement, TPS Pier, MSF modification, and Electromagnetic Measurement Range platform construction, in addition to the proposed LWI and SPE projects) and non-Navy projects would increase the number of in-water structures, and increase human activity levels (e.g., visual disturbance from increased boat operations). In-water facilities themselves tend to have minimal impacts on marine mammals and may provide some benefits. While harbor seals infrequently utilize manmade structures on the Bangor waterfront, these same facilities may be used as haul-outs for other species such as California sea lions. Marine mammals that frequent the Bangor waterfront have demonstrated their ability to habituate to current high levels of human activity and the net effect is expected to be minimal relative to the large range of these species within inland waters.

Past, present, and future development have contributed and would contribute to a continuing increase in concentrations of toxic materials and PCBs in waters such as Hood Canal (PSAT 2007a; Puget Sound Partnership 2012). There are numerous sources and pathways for toxics to enter the environment and food of marine mammals. For example, toxics may enter marine waters through the following: surface water runoff, aerial deposition, wastewater discharges, combined sewer overflows, groundwater discharge, leaching from contaminated bottom sediments, direct spills into marine waters, and migrating biota such as salmon. These contaminants are affecting the health of marine mammals. For example, the levels of contaminants in harbor seals have increased dramatically over the past 20 years (PSAT 2007a; Puget Sound Partnership 2010). Because marine mammals are highly mobile, the noise impacts of the Proposed Actions could be cumulative with noise impacts on marine mammals from other actions and activities in the Hood Canal region. However, the fact that the noise impacts would be temporary would reduce the magnitude of cumulative effects. Because other impacts on marine mammals from the Proposed Actions and other projects are expected to be minimal, other cumulative impacts on marine mammals are considered unlikely.

The greatest potential for cumulative impacts on marine mammals would be simultaneous exposure to pile-driving noise (underwater and airborne) from the Navy's current and future waterfront construction projects at NAVBASE Kitsap Bangor (EHW-1 Pile Replacement, LWI, SPE, TPS Pier, and Electromagnetic Measurement Range projects). Overlapping construction projects involving pile driving would likely impact more marine mammals (through behavioral harassment and possible temporary hearing impacts) than any project alone. As described in Appendix D, the main effect of concurrent pile driving would be to extend by approximately 1.3 miles (2.1 kilometers) the area over which marine mammals and other marine biota are exposed to pile-driving noise. Increased noise levels at a given location would generally not occur; however, if two closely located pile-driving projects such as EHW-1 and LWI, or SPE and TPS Pier, occurred at the same time, noise levels could increase by as much as 3 dB at sites roughly equidistant between the multiple pile-driving rigs (Appendix D). The overlap in construction is based on currently projected schedules for the multiple projects and is subject to change (likely resulting in reduction in the period of overlap). Cumulative impacts would be reduced through the implementation of impact minimization measures including soft starts and noise attenuating devices (e.g., bubble curtains) for pile driving, and implementation of marine mammal monitoring with shutdown zones to preclude injury.

4.3.5. Marine Birds

The ROI for evaluating cumulative impacts on marine birds is defined as Hood Canal. Depending on the species, there is a varying potential for actions elsewhere in Hood Canal to affect marine birds affected by the LWI and SPE projects. Resident species are unlikely to be affected by actions outside Hood Canal. Migratory or wide-ranging marine bird species, however, may be affected by such actions. The contribution of effects on marine birds occurring in other inland waters and the ocean to cumulative impacts of the LWI and SPE projects is difficult to define, but it is acknowledged that there is a relationship.

Construction and operation of past and present waterfront projects, such as Delta Pier and KB Docks, as well as any future Navy or non-Navy actions, have resulted or would result in increased human presence, noise, boat movement, and other activities, driving away some water-dependent wildlife such as marine birds from these areas. Marine birds typically avoid areas with continuous activity or periodic loud noise. Often, however, birds will return to these areas when human presence is lower or there is less activity. There may also be some benefits, as some birds may use these in-water structures for roosting or nesting.

Trend data for Hood Canal indicate that marine bird species have been on the decline. Of the 30 most common marine birds, 19 have experienced declining populations of 20 percent or more over the past 20 years. Exact causes for the declines are mostly unknown, but possible reasons include increased predation, habitat loss, changing migration patterns, decreases in forage fish populations, hunting, and disturbance to breeding grounds in the Arctic (PSAT 2007a). In the Puget Sound region, the population of the marbled murrelet, a species listed as threatened under the Federal ESA, declined more than 20 percent between the 1970s and 1990s but has been fairly stable in recent years (PSAT 2007a). The principal reason for the earlier decline was loss of nesting habitat (old-growth forest).

Future in-water Navy projects (EHW-1 Pile Replacement, TPS pier, MSF modification, and Electromagnetic Measurement Range platform construction, in addition to LWI and SPE) and non-Navy projects would increase the number of in-water structures, and increase human activity levels (e.g., visual disturbance from increased boat operations). In-water facilities themselves tend to have minimal impacts on marine birds and may provide some benefits. Many marine birds perch on, or shelter near, manmade structures on the Bangor waterfront. Marine birds that frequent the Bangor waterfront have demonstrated their ability to habituate to current high levels of human activity and the net effect is expected to be minimal relative to the large range of these species within inland waters.

Past, present, and future development projects have had, continue to have, or would be expected to have many of the same impacts on marine birds described above and add to past or current declining population trends. Because marine birds are highly mobile, noise impacts of the Proposed Actions could be cumulative with noise impacts from other actions and activities in the Hood Canal region. However, since noise impacts of the proposed projects on marine birds would be temporary the magnitude of cumulative effects would tend to be reduced. Because other impacts on marine birds from LWI, SPE, and other projects are expected to be minimal (as described above and in Section 3.5.2), other cumulative impacts on marine birds are considered unlikely.

The greatest potential for cumulative impacts on marine birds would be simultaneous exposure to pile-driving noise (underwater and airborne) from the Navy's current and future waterfront construction projects at NAVBASE Kitsap Bangor (EHW-1 Pile Replacement, LWI, SPE, TPS Pier, and Electromagnetic Measurement Range). This is likely to impact more marine birds (as modeled through behavioral harassment only) than any project alone. As described in Appendix D, the main effect of concurrent pile driving would be to extend by approximately 1.3 miles (2.1 kilometers) the area over which marine birds and other marine biota would be exposed to pile-driving noise. Increased noise levels at a given location would generally not occur; however, if two closely located pile-driving projects such as EHW-1 and LWI, or SPE and TPS Pier, occurred at the same time, noise levels could increase by as much as 3 dB at sites roughly equidistant between the multiple pile-driving rigs (Appendix D). The overlap in construction is based on currently projected schedules for the multiple projects and is subject to change (likely resulting in reduction in the period of overlap). Cumulative impacts would be reduced through the implementation of impact minimization measures, including noise attenuating devices (e.g., bubble curtains) for impact pile driving, and implementation of marbled murrelet monitoring with shutdown zones to preclude injury.

4.3.6. Terrestrial Biological Resources

4.3.6.1. VEGETATION

The ROI for evaluating cumulative impacts on native vegetation is defined as the Hood Canal watershed. Overall, native upland vegetation in the vicinity of Hood Canal has decreased in extent due to shoreline and upland development. The contribution of such development in the Hood Canal watershed is relevant for determining cumulative impacts on vegetation. Native vegetation in the watershed would not be affected by actions outside Hood Canal.

On NAVBASE Kitsap Bangor, past and present development has resulted or is resulting in the loss of approximately 1,100 acres (445 hectares) of forested area to development and 300 acres (121 hectares) to grassland/shrubland habitat. Similarly, past and present non-Navy actions have contributed or are contributing to vegetation loss or conversion due to residential and commercial development in the general area. Since the 1960s approximately 1,000 acres (405 hectares) on NAVBASE Kitsap Bangor have been replanted with native species, although the long-term impact of these replantings on vegetation resources at the base has not been quantified. The vegetation community on NAVBASE Kitsap Bangor and the surrounding area provides habitat for a variety of wildlife species, as well as other functions, such as shading and a source of woody debris for fish habitat in streams.

The overall trend in the project area has been a decrease in vegetation as land has been developed, and has been a noted problem along the shoreline areas of Hood Canal. To mitigate the loss of vegetation from shoreline development along Hood Canal, the HCCC has been supporting projects that increase shoreline vegetation, initiating for example a Marine Riparian Initiative to reestablish more native vegetation and eradicate noxious weeds (discussed in Section 4.2.1.2.2, Agency Plans for Improving Environmental Conditions in Hood Canal).

Future Navy and non-Navy actions would also result in loss of vegetation. Based on review of information on other future Navy projects, and available information on past, present, and future non-Navy actions, it is estimated that future Navy and non-Navy actions would result in a loss of approximately 296 and 167 acres (120 and 68 hectares) of vegetation, respectively. Construction of the LWI and SPE projects combined would permanently remove approximately 7.2 acres (2.9 hectares) of second-growth forest and native and invasive shrub habitat. An additional 4.9 acres (2 hectares) of temporarily disturbed area would be revegetated with native plant species. As there are no rare, threatened, or endangered plant species on NAVBASE Kitsap Bangor, there would be no cumulative impact from the Proposed Actions on ESA-listed plant species.

The Proposed Actions would at most contribute less than 0.1 percent to the total area of vegetation cleared on NAVBASE Kitsap Bangor by past, present, and future Navy actions. While the Proposed Actions would cause some loss of vegetation, given the amount and location of this loss there would be little impact on wildlife habitat or the vegetative community on NAVBASE Kitsap Bangor (there is an abundance of vegetation in the immediate vicinity of the proposed projects and on NAVBASE Kitsap Bangor), and even less in the broader Hood Canal region. Therefore, the proposed projects would make a minimal contribution to cumulative impacts on vegetation.

4.3.6.2. WILDLIFE

The ROI for evaluating cumulative impacts on terrestrial wildlife is defined as Hood Canal. Depending on the species, there is a varying potential for actions elsewhere in Hood Canal to affect wildlife species affected by the LWI and SPE projects. Resident species are unlikely to be affected by actions outside Hood Canal, although migratory birds or other wide-ranging wildlife species may be affected by such actions. The contribution of effects on migratory or wide-ranging species to cumulative impacts of the proposed projects is difficult to define, but it is acknowledged that there is a relationship.

Approximately 1,400 acres (567 hectares) of forested wildlife habitat have been or are being lost and/or impacted by past and present development on NAVBASE Kitsap Bangor. These projects and future projects have resulted in or would result in the removal of mostly second- and third-growth forested habitat; this forested area has been replaced by buildings, parking lots, or grassland that is not considered optimum wildlife habitat. Over time, the loss of wildlife habitat and increased human activity have resulted in fewer native species and occasional replacement by non-native wildlife species that are more adapted to an urban environment. In addition, forest fragmentation due to roads, buildings, fences, and other development can restrict wildlife movement within a contiguous habitat. Similar loss of wildlife habitat has occurred throughout the Hood Canal region due to past and present non-Navy development.

There is a general trend toward loss or conversion of wildlife habitat due to development, although the pace of this conversion is slower in the Hood Canal region because the canal region is less urbanized. There are large, rather undeveloped areas, such as NAVBASE Kitsap Bangor, outside the urban areas of Kitsap County, and development is on rather large lots (i.e., lots greater than 5 acres [2 hectares]). Further, as a result of explosives safety requirements, future base activities will continue to restrict the development of land around NAVBASE Kitsap Bangor.

With future growth of developed areas in the region, more wildlife habitat is expected to be converted or lost. Approximately 296 acres (120 hectares) and 167 acres (68 hectares) of wildlife habitat would be lost due to future Navy and non-Navy actions, respectively (Section 4.3.6.1). An additional 111 acres (45 hectares) of forest habitat would be isolated from contiguous habitat and the marine shoreline by security barriers, although this vegetation would not be cleared. The loss or conversion of habitat and loss of access to habitat would impact wildlife as discussed above. Construction of the LWI and SPE projects combined would permanently remove approximately 7.2 acres (2.9 hectares) of wildlife habitat. An additional 4.9 acres (2 hectares) of temporarily disturbed habitat would be revegetated with native plant species. Even with revegetation, however, the impact is considered long-term and there would be some loss of wildlife habitat. The proposed projects would contribute less than 2 percent to the area of wildlife habitat lost to development on NAVBASE Kitsap Bangor, and given the amount and location of this loss, would have little impact on wildlife habitat or movement. There is an abundance of wildlife habitat in the immediate vicinity of the Proposed Actions and on NAVBASE Kitsap Bangor. Therefore, the Proposed Actions would make a minimal contribution to cumulative impacts on wildlife.

Upland wildlife would be exposed to construction noise from multiple projects on NAVBASE Kitsap Bangor. The most important example would be pile-driving noise from the EHW-1 Pile Replacement, LWI, SPE, TPS Pier, and Electromagnetic Measurement Range projects, as described in Appendix D and Section 3.9. Pile driving for these projects may overlap for a presently unknown number of construction seasons. The main effect of concurrent pile driving would be to extend the area over which biota were exposed to pile-driving noise. Noise levels at a given location would not generally increase; increases of up to 3 dB would occur only infrequently at a location equidistant between two construction sites (e.g., the North LWI and EHW-1) when pile driving at those sites was concurrent. This could affect sensitive wildlife receptors located along the eastern shore of Hood Canal.

4.3.6.3. WETLANDS

The ROI for evaluating cumulative impacts on wetlands is defined as the Hood Canal watershed. Overall, wetlands in the vicinity of Hood Canal have decreased in extent due to shoreline and upland development (Todd et al. 2006). The contribution of such actions in the Hood Canal watershed is relevant for determining cumulative impacts on wetlands. Wetlands in the watershed would not be affected by actions outside of Hood Canal.

Existing records are not adequate to fully estimate how much wetland was or is being lost or impacted by past and present development on NAVBASE Kitsap Bangor and in the surrounding area. There are approximately 254 acres (103 hectares) of wetlands on NAVBASE Kitsap Bangor and several in the immediate vicinity of the Proposed Actions. Wetlands and their buffers provide valuable functions such as flood storage, wildlife habitat, and improved water quality, and these functions have been lost due to the filling and disturbance of wetlands.

Wetlands are now protected, and regulations on filling or disturbance require replacement of wetland or buffer area and function. The goal of many federal agencies, including the Navy, is no net loss of wetlands, particularly high-quality wetlands. Therefore, the trend is toward either a gain in wetland area or maintenance of the existing amounts (no net loss) of wetland and wetland function. Future Navy or non-Navy actions may result in loss of wetland area, but mitigation would be required in accordance with the requirements of CWA Section 404. Thus, future actions would not result in an overall loss of wetland area over the long term.

As discussed above, neither the LWI nor SPE would result in a loss of wetland. Therefore, the Proposed Actions would not add to the cumulative wetland impacts of past, present, and other future actions.

4.3.7. Geology, Soils, and Water Resources

The ROI for evaluating cumulative impacts on geology, soils, and water resources is defined as the Hood Canal watershed within and in the vicinity of NAVBASE Kitsap Bangor. Major contributors to cumulative impacts on this area include land clearing and soil disturbance, particularly on geologically hazardous slopes; erosion; sedimentation and contamination in water bodies; creation of impervious surfaces, and groundwater recharge.

4.3.7.1. GEOLOGY AND SOILS

Land clearing and disturbance to soils from past, present, and future Navy actions and non-Navy actions have resulted, are resulting, or would result in the loss of soil due to erosion caused by wind and rain. Soil loss can affect the ability of vegetation to become established, and eroded soils can be carried into surface water by stormwater runoff and thus impact water quality. Some past non-Navy development has also adversely impacted geologically hazardous areas such as steep slopes by increasing stormwater runoff and/or overburdening the tops of slopes with structures, which has led to slope failures. However, geologically hazardous areas are now managed more carefully by following the guidance or standards of local governments or agencies (e.g., Kitsap County Code for Geologically Hazardous Areas) and applying construction best management practices (BMPs) for sloped surfaces. Standard stormwater construction BMPs have also reduced the amount of soil erosion that occurs during land disturbing activities.

There are no trend data indicating whether soil is being lost at an increasing rate in the Hood Canal region. However, it is assumed that the rate of soil loss has decreased over time because of better management techniques for protecting disturbed or hazardous soils and controlling stormwater runoff.

Future Navy and non-Navy actions would result in disturbance from land clearing, and there would be some soil lost due to wind or rain erosion. However, given that construction BMPs would largely control erosion, no significant soil loss is expected. Future development is expected to have less of an adverse impact on geologically hazardous areas due to the implementation of full geotechnical and engineering investigations or simple avoidance of these areas.

Past, present, and future Navy actions, including the proposed projects, have disturbed or would disturb approximately 1,500 acres (607 hectares) of soil on NAVBASE Kitsap Bangor. Construction of the LWI and SPE would contribute to cumulative impacts by temporarily disturbing a total of approximately 4.9 acres (2 hectares) of onshore land during construction. It is anticipated that there would be little loss of soil and no mass wasting activities during construction because soil types are not highly erosive or unstable (with the exception of the abutment locations), rather gentle slopes are represented, and erosion-control BMPs would be used. Further, these areas would be stabilized and revegetated following construction. LWI and SPE combined would create approximately 7.1 acres (2.9 hectares) of new impervious surface, with stormwater controls implemented to minimize impacts. The increased contribution of land clearing for the LWI and SPE projects would be a small fraction of the total amount of existing and proposed cleared land on NAVBASE Kitsap Bangor. While the Proposed Actions would add to the total amount of disturbed land, when combined with other Navy and non-Navy actions, the cumulative impact in terms of soil disturbance would be negligible.

4.3.7.2. WATER RESOURCES

Development in the region has created impervious surfaces, such as roads, buildings, and parking lots, and has considerably impacted surface water and groundwater. Past, present, and future Navy actions and non-Navy actions have produced, are producing, or would produce impervious surfaces that impact surface water by increasing stormwater runoff and often concentrating runoff into peak discharges. The higher volumes of runoff entering surface water during storms can erode stream banks and channels, disturb fish habitat, and degrade water quality by increasing turbidity. Runoff from impervious surfaces can entrain and carry sediment and contaminants such as fuel or oil into receiving waters, where it adversely impacts water quality. Impervious surfaces also impact groundwater by limiting the rate of groundwater recharge, which is an important consideration for drinking water supplies that rely on groundwater. Thus, impervious surfaces may have a detrimental impact on aquifer recharge areas. Based on review of aerial photographs of existing structures, it is estimated that past and present Navy actions on NAVBASE Kitsap Bangor have resulted or are resulting in the creation of approximately 909 acres (368 hectares) of impervious surface.

Regionally, the amount of impervious surface has increased over time, and this trend is expected to continue. For example, between 1991 and 2001 there was an increase of 10.4 percent in the Puget Sound region, and by 2001 approximately 7.3 percent of the region below 1,000 feet (305 meters) of elevation was covered with impervious surfaces (PSAT 2007b). Between 2001 and 2006, developed lands increased by about 3 percent with nearly two-thirds of that increase being impervious surfaces (Puget Sound Partnership 2010). According to the *State of the Sound Report*, there is a substantial decline in biological function when a watershed nears 10 percent impervious surface (PSAT 2007b). While the trend is for the amount of impervious surface to increase, the rate at which this is occurring in Kitsap County is rather slow relative to other counties in the Puget Sound region.

Based on current projections, it is estimated that future Navy actions would create approximately 55 acres (22 hectares) of impervious surface, and non-Navy actions would create 30 acres (12 hectares). The added impervious surface would have the same potential to impact surface and groundwater as described in Section 3.7.2. However, there are requirements for controlling runoff from impervious surface, and most development would have to include implementation of runoff detention and/or treatment measures. Projects in areas of aquifer recharge may also be required to implement measures to ensure that groundwater recharge is not adversely impacted. Thus, impervious surfaces created by future projects are less likely than past actions to adversely impact surface and groundwater.

Construction of the LWI and SPE projects would contribute to cumulative impacts, although not substantially, by creating approximately 7.1 acres (2.9 hectares) of impervious surface on the upland portion of the project sites. Stormwater runoff from these uncovered areas would be controlled by being collected, detained, and treated prior to discharge. Since stormwater runoff from uncovered areas would be controlled, the only impact on surface water would be the additional treatment volume. In terms of groundwater recharge loss, the impervious surface in upland areas would have a negligible impact on groundwater supply and quality because the proposed sites are in a groundwater discharge zone, which is not utilized as a water source.

While the proposed projects would add slightly to the total amount of impervious surface attributable to Navy and non-Navy actions, the cumulative impact on surface water would be negligible given additional measures to control and treat stormwater runoff. No additional impacts on groundwater are expected.

4.3.8. Land Use and Recreation

The ROI for evaluating cumulative impacts on land use and recreation is defined as the surrounding communities in which actions on NAVBASE Kitsap Bangor are most likely to contribute to cumulative impacts. This includes portions of Kitsap Peninsula and Kitsap County in the NAVBASE Kitsap Bangor vicinity, as well as Hood Canal and Jefferson County on the western shore of Hood Canal across from NAVBASE Kitsap Bangor.

Land development from past and present actions has converted or is converting many areas of the natural environment to land uses ranging from rural to urban and industrial. For example, NAVBASE Kitsap Bangor has changed from its rural residential, agricultural, and heavily forested beginnings to its present use as the base of operations and support for the TRIDENT

Fleet Ballistic Missile (TRIDENT) submarine program, with approximately 20 percent of the property developed. Recreational facilities (e.g., parks and trails) have also been developed in association with land development.

Land development and changes in land use could have impacts on various resources including noise, air quality, water quality, socioeconomics, utilities, aesthetics, and energy use, and transportation as discussed in the respective sections in this chapter. Changes in land use could also create issues related to compatibility with adjacent land uses. Land use laws, planning policies, and project reviews are intended to minimize or eliminate such compatibility issues.

The trend is for development to continue converting natural areas to residences, businesses, and other developed uses. Recreational facilities would also be developed as population and demand for public recreation increased. Future Navy and non-Navy actions would also convert undeveloped land to developed use, with impacts similar to those discussed above.

The LWI and SPE projects would not change the land/water use designations at the immediate project site, but would add to the density and location of the developed areas attributable to past, present, and other future Navy and non-Navy actions. That contribution, however, would be minimal, less than 1 percent of the extent of existing developed areas on NAVBASE Kitsap Bangor. Thus, despite temporary impacts from construction noise, the Proposed Actions would make a minimal contribution to cumulative impacts on land use and recreation.

4.3.9. Airborne Acoustic Environment

The ROI for evaluating cumulative impacts on the airborne acoustic environment includes the waterfront and woodland areas near the project site, extending to the Vinland neighborhood just north of the NAVBASE Kitsap Bangor northern property boundary, the Olympic View neighborhood just south of the southern base boundary, the waterfront industrial area encompassing Delta Pier and Marginal Wharf, and shoreline properties on the west side of Hood Canal, west and northwest of the project sites.

Most past, present, and future actions have generated, are generating, or would generate some type of noise, either from a facility itself, from vehicles traveling to and from a site, or from humans. Noise is typically a nuisance factor for sensitive receptors such as residences, hospitals, or parks, where quiet conditions are important. This is particularly true during evening hours. Close proximity to high sound levels can result in physiological problems or hearing damage. Over time the trend has been for noise levels to increase as development has occurred, particularly during daytime hours when activity levels are highest. Noise levels tend to be fairly low outside the urban areas of Kitsap County due to development on large lots (greater than 5 acres [2 hectares]) and a general lack of industrial activity. However, some industrial areas, such as the NAVBASE Kitsap Bangor waterfront, generate higher noise levels.

Future Navy and non-Navy actions would also generate noise. The type of noise and noise levels produced would be dependent on the specific project. The impact of these noise sources would depend on their location relative to sensitive receptors, but it is likely that some of these future actions would produce nuisance noise. There are requirements to limit the level of noise produced by residential, commercial, or industrial land uses. Thus, some future development would have requirements to provide soundproofing measures. The proposed projects would generate noise from equipment, industrial activities, vessel movement, and human activities. The highest noise levels would be generated by pile driving during construction. Impact hammer pile-driving would generate average (i.e., root mean square [RMS]) noise levels of 109 A-weighted decibel (dBA) re 20 μPa at a distance of 50 feet (15 meters), while vibratory pile driving would generate RMS noise levels of 95 dBA re 20 μPa at 50 feet (15 meters). Residential areas near Olympic View, Thorndyke Bay, and to a lesser extent Suquamish Harbor on the western shore of Hood Canal, would experience increased noise levels during pile driving, as would recreational users on Hood Canal or the western shores of Hood Canal. Combined noise impacts of multiple Navy projects on the communities of Olympic View and Vinland, and nearby schools are not expected to be significant due to the attenuating effects of intervening distance, topography and vegetation. The cumulative impacts of pile-driving noise on fish, mammals, and marine birds are discussed in Sections 4.3.3, 4.3.4, and 4.3.5, respectively. In the long term, noise produced by operation of LWI and SPE would not increase over what is currently generated by EHW-1 and other facilities on the Bangor waterfront.

LWI and SPE construction activities may overlap with EHW-1 Pile Replacement, TPS Pier, and Electromagnetic Measurement Range projects. As discussed in Appendix D this could result in cumulative noise impacts during the period of overlap. As discussed above for LWI and SPE combined, one effect of this temporal overlap in pile driving would be to extend the affected area affected by individual projects. Since the north LWI and SPE projects would be at the northern and southern boundaries of the noise-generating projects (e.g., the Electromagnetic Measurement Range would not generate significant airborne noise), the affected area would not be extended by these multiple projects. Noise level increases of up to 3 dB would occur only for the infrequent case of a location approximately equidistant between two construction sites when pile driving at those sites was concurrent. These areas would be along the NAVBASE Kitsap Bangor waterfront and would not affect off-base areas. In all other cases, noise levels at a given location would be predominated by the closer pile-driving activity. (The intervening headland between the EHW/LWI and SPE sites would reduce the potential for additive noise levels from the multiple projects.) General construction noise for each of the two projects would also overlap, but these noise levels would be similar to existing levels along this industrial waterfront and thus much lower than the levels from pile driving. Therefore, the resulting cumulative noise impacts from general construction are expected to be minimal. If the actual period of construction overlap for the two projects is less than currently projected, resulting cumulative impacts would be reduced accordingly.

After construction, operational noise levels would not change for the LWI, and for the SPE, would be typical of the industrial NAVBASE Kitsap Bangor waterfront. Therefore operations for LWI and SPE would not contribute to cumulative noise impacts.

4.3.10. Aesthetics and Visual Quality

The ROI for evaluating cumulative impacts on aesthetics and visual quality is defined as the surrounding areas in which actions on NAVBASE Kitsap Bangor are most likely to contribute to cumulative visual impacts. This includes Hood Canal, portions of the residential areas on Kitsap Peninsula, and Jefferson County on the western shore of Hood Canal across from NAVBASE Kitsap Bangor. The SPE project is closest to a residential area (Olympic View) while the LWI is further north and buffered by distance, existing dense vegetation, and a spit of vegetated land to the south.

Visual conditions have been or are being altered by past and present actions as development changes portions of the natural environment to a built environment. However, much of the area around Hood Canal has retained its natural and rural visual quality because of large-lot residential development, an abundance of forested land, and unobstructed views of Hood Canal and the Olympic Mountains. Approximately 68 percent of NAVBASE Kitsap Bangor is forested, thereby helping to retain the natural visual quality at the base.

The trend is for development to continue, which would alter visual resources. Since development in the county tends to be slow and continues to occur on larger lots in many areas, visual resources will change, but at a slow pace. Distant views to the west would not likely be blocked by new development because of the height and proximity to the Olympic Mountains. Future Navy and non-Navy actions would continue the trend of converting land from natural or undeveloped conditions to built conditions. Thus, visual resources would change to more urbanized views. Navy policies (e.g., TRIDENT Joint Venture 1975) recommend using existing developed areas and maintaining natural areas in their existing condition as much as is practicable, and would help minimize impacts on visual quality on NAVBASE Kitsap Bangor. During the period of potential concurrent construction of the proposed projects and the EHW-1 Pile Replacement, TPS Pier, MSF modification, and Electromagnetic Measurement Range projects, a cumulative aesthetic impact on views from Hood Canal would be expected.

While the LWI and SPE would contribute to a change in visual conditions along the waterfront, they would be visually compatible with adjacent facilities and not alter the existing visual resources substantively as previously discussed. Nevertheless, the LWI and SPE projects would make a minor contribution to the cumulative aesthetic impacts of past, present, and other future actions. LWI Alternative 2 would make a greater contribution to cumulative visual impacts than LWI Alternative 3, based on the pier included for the former compared to no pier for the latter alternative. SPE Alternative 3 would make a slightly greater contribution to cumulative visual impacts than SPE Alternative 2.

4.3.11. Socioeconomics

The ROI for evaluating cumulative impacts on socioeconomics is defined as the surrounding communities in which actions of NAVBASE Kitsap Bangor are most likely to contribute to cumulative socioeconomic impacts (e.g., Silverdale, Poulsbo, and Bremerton, all of which are located on the Kitsap Peninsula and within Kitsap County) as well as Jefferson County on the western shore of Hood Canal across from NAVBASE Kitsap Bangor.

Socioeconomic conditions have been or are being profoundly changed by past and present development. For example, NAVBASE Kitsap Bangor has become one of the primary employers in Kitsap County. Development of the TRIDENT base and other military installations has increased the population, long-term employment opportunities, and income of Kitsap County, as well as the demand for housing and various public services (e.g., police, fire, emergency and medical services, and schools). It is estimated that nearly 47,000 personnel (military personnel, civilians, and contractors) work for the military in Kitsap County.

Population, housing, and economic activity are increasing at a moderate rate in Kitsap County (Section 3.11). These changes are attributable to development, population in-migration, changes in economic conditions, and changes in social and political factors. Future Navy and non-Navy actions would generate employment and income. Projects that prompt in-migration would increase the demand for housing and public and social services. However, these conditions would vary over time based on the changing conditions discussed above.

Construction of the LWI and SPE would employ up to approximately 1,566 people for the duration of the construction period. Construction of the EHW-1 Pile Replacement, TPS Pier, MSF modification, and Electromagnetic Measurement Range projects would employ approximately 190 people. During the period of potential construction overlap between these projects, the cumulative socioeconomic effect would be correspondingly increased over what it would be for the LWI and SPE projects alone (Section 3.11.2.2).

In the long term, the LWI and SPE projects would not result in a notable change in staffing or employment.

The temporary loss of access to shellfish beds during construction of the LWI could result in a short-term socioeconomic impact, lasting on the order of a few years during construction and recovery of shellfish beds, since tribal shellfishing is an important subsistence and commercial resource. Over the long term, impacts due to the presence of permanent structures could result in a loss of an estimated $2,208 per year in commercial fishery sales. Mitigation for impacts to tribal resources would be determined through ongoing consultations between the Navy and the affected American Indian tribes. An MOA between the Navy and the Skokomish Indian Tribe was signed on March 3, 2016, and government-to-government consultation with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe is in progress. Tribal treaty mitigation is discussed further in Section 3.14 and in Appendix C.

4.3.12. Environmental Justice and Protection of Children

The ROI for evaluating cumulative impacts on environmental justice is defined as the surrounding communities in which actions of NAVBASE Kitsap Bangor are most likely to contribute to cumulative socioeconomic impacts (i.e., Silverdale, Poulsbo, and Bremerton, all of which are located on the Kitsap Peninsula and within Kitsap County) as well as Jefferson County on the western shore of Hood Canal across from NAVBASE Kitsap Bangor.

Because the LWI and SPE projects together would not have disproportionate impacts on minority or low-income populations, or on children, they would not contribute to cumulative impacts of these types when considered in conjunction with past, present, and reasonably foreseeable actions.

4.3.13. Cultural Resources

The ROI for evaluating cumulative impacts on cultural resources is defined as NAVBASE Kitsap Bangor facilities. Cultural resources are unique as well as finite in nature, so that an adverse impact on a single historic property affects the complement of historic properties within the ROI.

The trend associated with cultural resources is ongoing identification and preservation of resources. Federal laws and regulations have been established to protect and preserve archaeological and cultural resources. Future Navy or non-Navy actions that involve earth disturbance have some potential for disturbing archaeological resources, and it is possible that such disturbance could go unrecognized and unrecorded. Future Navy actions that involve alterations to National Register of Historic Places (NRHP)-eligible buildings or structures, the construction of new buildings or structures, or square footage reductions all have the potential for direct or indirect impacts on historic properties. However, the Navy would comply with Section 106 of the National Historic Preservation Act (NHPA) for both the LWI and SPE projects, and other reasonably foreseeable further actions within the ROI. This includes mitigation of adverse impacts that could not be avoided or minimized, thereby addressing the cumulative impact of those actions.

Other projects such as those along the waterfront, including the EHW-2 and EHW Security Facility, in conjunction with the proposed projects, could result in cumulative impacts on the historical integrity of the existing EHW or the Delta Pier, although these are unlikely to be significant impacts and would not adversely affect the NRHP eligibility of either historic property. Otherwise, the Proposed Actions would not result in cumulative impacts on other NRHP-eligible architectural or archaeological cultural resources. Other projects involving ground disturbance such as road improvements or building construction have the potential to encounter previously unknown archaeological resources. In all cases, the Navy would comply with Section 106 of the NHPA by identifying the presence of historic properties, evaluating their NRHP eligibility, assessing impacts, and consulting with the State Historic Preservation Officer (SHPO) and Tribes on the mitigation of any adverse impacts, and would take the same action if any unanticipated archaeological resources are discovered. With these procedures in place, the Proposed Actions would not add to the cumulative impacts on archaeological or architectural resources.

4.3.14. American Indian Traditional Resources and Tribal Treaty Rights

The ROI for evaluating cumulative impacts on American Indian traditional resources and treaty rights consists of areas in which affected tribes have been granted treaty rights, including NAVBASE Kitsap Bangor. The Navy has an active consultation process in place, with emphasis on protection and avoidance of areas of traditional cultural importance, as well as access to the resources found on the installation. Through this ongoing process, the Navy will take all feasible measures to keep traditional resources on NAVBASE Kitsap Bangor protected and accessible.

American Indian traditional resources in the ROI, such as traditional use areas (e.g., cedar growth for bark gathering), subsistence resources (e.g., fish [salmon] and shellfish [oysters and clams]), and special places (religious and traditional), have been impacted over time as a result of land development and population growth that resulted in increased use of natural resources such as fish and shellfish. Traditional use areas and subsistence resources are known to be outside of as well as inside the project area. Impacts on traditional resources include loss of access to traditional use areas, conversion of a traditional area or special place to another land use, and reduction in the abundance of tribal resources for economic, subsistence, or ceremonial/religious uses. Ocean acidification and resulting adverse effects on calcification will continue to be a cumulative stressor on shellfish populations in the area.

The trend associated with American Indian traditional resources is ongoing identification and preservation of resources. Federal laws and regulations have been established to protect and preserve traditional cultural resources. In addition, American Indian tribes have been proactive in acquiring traditional areas and preserving cultural resources, including subsistence resources. Most cultural resources on the base that are considered American Indian traditional use areas, subsistence resources, and special places have been identified and will be avoided whenever possible. Access to these resources is also allowed for American Indian tribes with treaty rights.

The Navy will continue to consult with affected American Indian tribes regarding the Proposed Actions and other future Navy projects at the Bangor waterfront (Table 4–1). Past, present, and future Navy activities have the potential to affect protected tribal treaty rights and resources on Bangor, including access to shellfish (oysters and clams). These projects could have impacts on tribal treaty rights and traditional resources similar to those identified for the Proposed Actions. The LWI Proposed Action would affect access to Usual and Accustomed (U&A) shellfish beds, and construction noise and visual effects would influence the setting and integrity of these harvest sites, which would also be affected in the long term by the presence of the LWI structure. Construction vessels for both projects and operational transits of submarines could interfere with tribal fishing vessels, resulting in impacts to access and harvest. The Proposed Actions could have a minimal impact on fisheries via barrier effects on juvenile and adult migratory fish, including salmon. Shellfish harvest impacts are expected to be short term and minor, temporarily affecting access to between 0.64 and 0.68 acre (0.26 and 0.28 hectare) of the approximately 18-acre (7-hectare) tribal shellfish harvesting area.

The impacts of the Proposed Actions would contribute to cumulative effects on traditional resources and treaty rights in the region, which are acknowledged above. These contributions would be offset through implementation of appropriate mitigation measures determined through ongoing consultations between the Navy and affected American Indian tribes. An MOA between the Navy and the Skokomish Indian Tribe was signed on March 3, 2016, and government-to-government consultation with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe is in progress. Tribal treaty mitigation is discussed further in Section 3.14 and in Appendix C.

4.3.15. Traffic

The ROI for ground transportation includes those streets and intersections that would be used by both automobile and truck traffic to gain access to and from the LWI and SPE, as well as those streets that would be used by construction traffic (e.g., transport of equipment and commuting workers). The streets most likely to be affected by cumulative project-related auto and truck traffic include NW Trigger Avenue and NW Luoto Road (referred to as Trident Avenue outside of base boundaries). The ROI for marine vessel traffic is defined as Hood Canal.

Vehicle circulation patterns have changed and traffic volumes have increased in Kitsap County along with increases in population and increased employment for past and present actions, particularly projects on NAVBASE Kitsap Bangor and other Navy installations. Growth is inevitably accompanied by increased vehicle traffic and consequent impacts on road travel such as intersection delay, lowered levels of service, and decreased safety. The trend in Kitsap County, which parallels the national trend, is for people to own more vehicles and drive more vehicle miles. Recent increases in gas prices have caused some people to look for other transportation options (e.g., mass transit) or to alter their driving habits. Marine vessel traffic levels have increased throughout the years to accommodate growth in the region.

Future Navy and non-Navy actions would generate additional traffic with impacts similar to those discussed above. Transportation agencies have attempted to keep up with increased traffic, but in many areas traffic volumes exceed the capacity of roads or intersections. Kitsap County has adequate capacity on most of its roads and intersections. However, in the more urbanized areas there are capacity problems on some road segments.

The proposed LWI and its future operation on NAVBASE Kitsap Bangor following completion of the construction activities would not generate additional traffic. Hence, the impacts of this proposed project on the major access roadways, internal base roadway network, and intersections post construction would be negligible.

The proposed SPE and its future operation, including support facilities, on NAVBASE Kitsap Bangor following completion of the construction activities would not result in a notable increase in staffing or employment at NAVBASE Kitsap Bangor. Access to and from the proposed main parking lot that is a component of the SPE Proposed Action would be via Sturgeon Street and controlled by a stop sign. The proposed parking lot would be 7 acres (2.8 hectares) and contain about 420 parking spaces.

Analysis of the added traffic following construction of the SPE site under the highest peak hour traffic demand conditions indicated the following:

- Trigger & Sturgeon (AM Peak) — level of service (LOS) C/20.5 seconds (decline from LOS B), and
- Trigger & Escolar (PM Peak) — LOS D/51.6 seconds (approaching LOS E).

Recent traffic counts of average daily traffic entering or leaving the base on Trigger Avenue or Luoto Road totaled 23,721 trips (All Traffic Data Services 2008). Traffic volumes on these two thoroughfares are expected to increase 10 percent by 2018, although such an increase would contribute only negligibly to the cumulative impacts of past, present, and other future actions along these major access roadways.

The construction periods for the LWI and SPE projects would not overlap. However, construction of these projects has the potential to overlap with construction of the EHW-1 Pile Replacement, TPS Pier, MSF modification, and Electro-magnetic Measurement Range projects. Any overlap of the construction period for the LWI and SPE with that for any of the other projects would tend to increase the traffic impacts. During the overlap periods, the combined impact on base roads used by construction traffic would be approximately two times higher than increase for just the LWI and SPE projects alone (see Section 3.15.2.2 for individual LWI and SPE impacts). However, this would still represent a minor contribution to cumulative traffic impacts both on and off base. Future Navy and non-Navy projects along the shoreline could increase marine vessel traffic levels within Hood Canal. As discussed above, construction of the LWI and SPE projects is not expected to overlap with one another, but would overlap with other Navy construction projects. During these periods of overlap, the frequency and duration of related openings of the Hood Canal Bridge would be greater than for the LWI or SPE projects alone. The increase in the number of openings caused by LWI and SPE would contribute to the cumulative impact of bridge openings on vehicular traffic. Notices to Mariners and other measures described in Section 3.15.1.2 would prevent adverse impacts to marine navigation. Operation of the LWI and SPE (which would result in an average of two additional bridge openings per month) would not notably increase marine traffic or delays due to bridge openings over the long term.

4.3.16. Air Quality

The ROI for air quality is the Puget Sound Clean Air Agency (PSCAA) region, which encompasses localities in Kitsap County or the Hood Canal region, as the PSCAA is delegated by the state of Washington to regulate the state's Clean Air Act (CAA). Since short-term construction air quality impacts from the LWI and SPE projects would be limited to the Kitsap County or Hood Canal region only, the cumulative air quality impacts are addressed in terms of contributions to the PSCAA region.

Existing air quality has been, is being, or would potentially be impacted by past, present, and future actions to varying degrees, depending on the project. For example, residences and facilities such as parks have had little impact on air quality, while vehicles and industrial operations may produce a number of emissions, including volatile organic compounds (VOCs), nitrogen oxides, particulates, or other emissions.

The trend for air quality is fairly stable, since point sources have been targeted by regulations and are limited in their emissions. Also, outside urban areas of the county, air emission sources such as woodstoves are fairly spread out due to development of large lots, and any impacts are localized. The Hood Canal region is rated as good (the highest rating) in air quality (PSCAA 2013a), is in compliance with all air quality standards, and is currently in an attainment area for all pollutants. Kitsap County is in attainment for all National Ambient Air Quality Standards (NAAQS). The most recent emissions inventory for the PSCAA shows that a rather low percentage of total emissions is associated with stationary and mobile sources in Kitsap County. Past development and subsequent operation of emission sources in Kitsap County have not contributed to exceedances of the NAAQS, and the region is in attainment for all applicable air quality standards.

Future Navy and non-Navy actions that produced sizeable air emissions would be required to install abatement measures to limit emissions and would be required to comply with permit conditions on the amount of air pollutants generated. Thus, it is not anticipated that future actions would result in violations of air quality standards. Planned future development in Kitsap County is consistent with or below the emissions estimates contained in the State Implementation Plan. The Proposed Actions would generate short-term and minimal long-term air emissions, such as VOCs, carbon monoxide, nitrogen oxide, and particulates from boats, vehicles, and equipment. However, the impacts would be localized and individual emissions of these criteria pollutants would be well below the air quality standard compliance levels.

Emissions from the Proposed Actions are not expected add to the cumulative impacts on existing air quality of all past, present, and reasonably foreseeable actions. This is because existing levels of criteria pollutants and greenhouse gas emissions are low, emissions from the Proposed

Actions would be localized, future point sources would be required to control emissions, and the level and the type of development that would occur in the reasonably foreseeable future would not produce substantial emissions.

4.3.16.1. GREENHOUSE GASES

It is generally accepted in the scientific community that human-generated emissions of greenhouse gases (GHGs) over the past century have led to increasing global air temperatures. GHGs, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases, have a propensity to trap heat in the atmosphere. CO_2 is the predominant greenhouse gas emitted by human activities, primarily from the combustion of fossil fuels such as coal, oil, and natural gas. The observed increase in average global air temperatures since the mid-twentieth century is very likely a result of increased atmospheric concentrations of GHGs (Intergovernmental Panel for Climate Change 2007). This phenomenon is commonly referred to as "global warming." Global warming due to GHG emissions induces climate change through the complex interaction of increased temperature with various natural processes such as ocean and atmospheric circulation. Effects of climate change in turn create complex feedback loops, such as loss of reflective snow and ice cover, which increase the rate of climate change. Scientists are now in general agreement that climate change is occurring (American Meteorological Society 2007), and that current trends are very likely to continue unless worldwide emissions and atmospheric concentrations of CO_2 and other GHGs are substantially reduced (Ledley et al. 1999; Energy Information Administration 2008).

4.3.16.1.1. CLIMATE CHANGE

The effects of climate change may not be readily apparent in all geographic areas, including the immediate project region, since the effects occur on a global scale. Among the effects are rising air and ground temperatures, loss of sea ice, sea level rise, loss of protection from fall storms, and retreat of the permafrost boundaries. Sea ice has retreated by about 14 percent since 1978 and thinned by 60 percent since the 1960s, resulting in widespread effects on marine ecosystems, coastal climates, and human settlements. Recent warming has been accompanied by increases in forest disturbances, including insect infestations. The relationship of the proposed projects to sea level rise is discussed in Section 3.1.

Effects of climate change on marine mammals and other marine organisms are poorly understood due to lack of integrated baseline data (Burek et al. 2008). This lack of data on health, diseases, and toxic effects in marine mammals severely limits abilities to predict the effects of climate change on the health of these species. The overall health of an individual animal is the result of complex interactions among immune status, body condition, pathogens and their pathogenicity, toxicant exposure, and the various environmental conditions that interact with these factors. Climate change could affect these interactions in several ways. There may be direct effects from loss of the sea ice habitat, elevations of water levels and air temperature, and increased occurrence of severe weather. Some of the indirect effects of climate change on animal health will likely include alterations in pathogen transmission due to a variety of factors, effects on body condition due to shifts in the prey base/food web, changes in toxicant exposures, and factors associated with increased human habitation in the Arctic (e.g., chemical and pathogen pollution in the runoff due to human and domestic-animal wastes and chemicals and increased ship traffic with the attendant increased risks of ship strike, oil spills, ballast pollution, and possibly acoustic injury). The extent to which climate change will impact marine mammal health will also vary among species, with some species more sensitive to these factors than others. Baseline data on marine mammal health parameters along with matched data on the population and climate change trends are needed to document these changes (Burek et al. 2008).

4.3.16.1.2. Ocean Acidification and Cumulative Effects

It has been suggested that the continued emission of CO_2 is causing seawater to become more acidic as CO_2 from the atmosphere dissolves in the oceans; for example, ocean acidification from increased CO_2 is a recognized phenomenon (Cicerone et al. 2004; Feely et al. 2004; Sabine et al. 2004). Scientists estimate that the oceans are now about 25 percent more acidic than they were at the start of the industrial revolution about 300 years ago. The negative effects of ocean acidification are likely to be felt on biological processes such as calcification (Orr et al. 2005; Kleypas and Eakin 2007). Ocean acidification from CO_2 and reduced ventilation also may result in decreases in sound absorption for frequencies lower than 10 kilohertz (kHz) (Hester et al. 2008). This would result in increases in ambient noise levels in ocean environments and enhanced propagation of anthropogenic sound. While this phenomenon is under study (Hester et al. 2008), the effects of CO_2 emissions on ocean acidity and the resultant potential for enhanced sound propagation remain indeterminate due to incomplete information.

The potential effects of proposed GHG emissions are by nature global and cumulative impacts, as individual sources of GHG emissions are not large enough to have an appreciable effect on climate change. Therefore, an appreciable impact on global climate change would only occur when proposed GHG emissions combined with GHG emissions from other manmade activities on a global scale.

Currently there are no formally adopted or published NEPA thresholds of significance for GHG emissions. Formulating such thresholds is problematic, as it is difficult to determine what level of proposed emissions would substantially contribute to global climate change. Therefore, in the absence of an adopted or science-based NEPA significance threshold for GHGs, this EIS compares GHG emissions that would occur from the combined projects of the LWI and SPE to the U.S. GHG baseline inventory of 2012 (USEPA 2014b) to determine the relative increase in proposed GHG emissions (Table 4–3).

The combined GHG emissions associated with the proposed projects would be extremely low (0.00006 percent of the U.S. inventory), emissions would be localized, and emission controls on future point sources would be required. Therefore, the effect would be that the level and the type of development for the reasonably foreseeable future would not produce substantial emissions or have an appreciable contribution to cumulative GHG impacts.

Table 4–3. Combined GHG Emissions of LWI and SPE (Worst Case Alternatives)

Phase/Activity	Total GHG Emissions (metric tons)			
	N_2O	CH_4	CO_2	CO_2e
LWI (Alternative 2)	**0.10**	**0.11**	**1,944.2**	**1,977.5**
SPE (Alternative 3)	**0.36**	**0.20**	**2,019.4**	**2,135.5**
Total Emissions	**0.46**	**0.31**	**3,963.6**	**4,113.1**
U.S. 2012 Annual GHG Emissions (10^6 metric tons)[1]				**6,526**
Proposed Emissions as a percent of U.S. GHG Emissions				**0.00006**

CH_4 = methane; CO_2 = carbon dioxide; CO_2e = carbon dioxide equivalent; N_2O = nitrous oxide
1. Source: USEPA 2014b

4.3.16.2. NAVY STEWARDSHIP AND ENERGY CONSERVATION

In response to concerns over climate change, the Navy has initiated broad programs to reduce energy consumption and shift energy demand to renewable and alternative fuels to an extent consistent with its national security mission, thereby reducing emissions of CO_2 and other GHGs. A number of shore installation and fleet programs have substantially reduced the generation of GHGs, primarily through the conservation of fossil fuels and electricity.

Ashore, the Navy has aggressively encouraged its installations to reduce energy use, both through facility competitions and through investments in solar, wind, and geothermal technologies. Since 1985, the Navy has sponsored a worldwide energy management program that has reduced its energy use by more than 29 percent (NAVFAC Public Affairs 2005). At Pearl Harbor, for example, the installation of approximately 2,800 energy-efficient light fixtures has reduced electricity use by about 758 megawatt-hours per year, equal to 448 tons per year of CO_2 emissions (NAVFAC Public Affairs 2008). New air conditioning chillers also installed at this facility will save another 252 megawatt-hours of electricity per year, equal to about 149 tons per year of CO_2 emissions. Implementing similar energy conservation measures at Navy shore installations worldwide has substantially decreased the Navy's carbon footprint, and the Navy continues to identify new energy conservation measures.

Developed in the 1990s by the U.S. Green Building Council (USGBC), LEED is a certification system for environmentally friendly construction, indicating the project meets or exceeds government mandates as well as industry standards. Buildings can achieve certified, silver, gold or platinum designation of LEED compliance. The Navy requires all construction and major renovation projects to be compliant to LEED silver standards or better. Federal mandates for environmental certification are one of the reasons for the Navy's rule requiring LEED certification of silver or better on all new construction.

The process of getting a building LEED certified is not easy. The intent to apply for certification begins with design of the building by identifying performance goals required by the LEED system. Once these requirements are met, and a design is generated that conforms to these goals, the actual construction of the building must also be tailored to meet these needs. The USGBC reviews the documented evidence of conformance to determine if the building satisfies the requirements for certification. The Navy's requirement for LEED silver certification of all new buildings and major construction renovation projects represents its continued commitment to environmentally friendly endeavors.

Energy conservation aboard Navy vessels at sea also has achieved substantial reductions in fuel consumption, and thus emissions of GHGs. Naval Sea Systems Command has established an Energy Conservation Awards Program to reward leading fuel conservers among underway surface ships with special recognition and cash incentives. During the first half of 2009, this program reduced the Navy's fuel consumption by about 682,000 barrels, or about 346,000 tons of CO_2 emissions (Navy News Service 2009).

The Navy also is researching and implementing new technologies that may result in substantial additional fuel savings. For example, the new amphibious assault ship *Makin Island*, using a new hybrid power propulsion system, saved an estimated 900,000 gallons of fuel (equal to about 11,000 tons of CO_2) on its initial voyage from the Gulf of Mexico to San Diego. As new Navy ships are placed into service and older ships are retired, the overall fuel efficiency of the Navy's fleet will substantially increase (Biello 2009).

Further, the Navy also is investigating new hull-cleaning technologies that could substantially reduce drag from fouling of vessel hulls by marine organisms, potentially saving millions of gallons of fuel per year. Finally, the Navy has successfully tested the use of biofuels with camelina oil to power aircraft. The Green Hornet biofuel program is the first aviation test program to test and evaluate the performance of a 50/50 biofuel blend in supersonic (above mach 1) operations — a critical test point to successfully clear the F/A-18 E/F for biofuel operations through its entire flight envelope (Navy News Service 2010). Camelina jet biofuel produces 80 percent lower carbon emissions than conventional jet fuels (Biello 2009).

These examples illustrate the Navy's leadership role in achieving large-scale energy reductions that will substantially contribute to a long-term national effort to mitigate global climate change.

CHAPTER 5

OTHER CONSIDERATIONS REQUIRED BY NEPA

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5.0 OTHER CONSIDERATIONS REQUIRED BY NEPA

5.1. LAND-WATER INTERFACE

5.1.1. Unavoidable Adverse Impacts

The analysis of the LWI project presented in this EIS has identified the potential for adverse environmental impacts. Mitigation measures that would be implemented to either avoid or minimize these impacts have been identified. The adverse impacts that remain after implementing mitigation measures are considered to be unavoidable. These impacts include increased noise during construction and its effect on fish, wildlife, and humans; loss of marine habitat including eelgrass due to the placement of new in-water structures within the NAVBASE Kitsap Bangor WRA; and the loss of upland vegetation for roads and buildings (permanent) and for staging areas and utility work (temporary).

The Proposed Action would cause short-term unavoidable impacts during construction, particularly with regard to pile-driving activities. Pile driving would generate high levels of underwater noise and vibration, as well as airborne noise. These high sound levels would adversely impact fish, marine mammals, and other wildlife and would be unavoidable. Pile-driving noise during construction would adversely impact residential areas and recreation on the western side of Hood Canal. Pile driving also would increase turbidity on a localized basis.

The new in-water structures would create a partial barrier to juvenile salmon migration, as well as shading and nighttime lighting. These changes would unavoidably impact the distribution of aquatic vegetation (e.g., eelgrass) and the type, abundance, and/or behavior of some species in the vicinity of the in-water structures.

Forest and shrub vegetation would be temporarily lost for various construction actions, and would revert to pre-construction conditions following completion of construction and revegetation. A portion of the shellfish areas, some of which are important tribal resources, would be impacted. The potential for impacts on tribal salmon fishery resources would be minimal. There would be an unavoidable increase in the use of utilities and energy to support the project, as well as increased demand on the NAVBASE Kitsap Bangor road system, including increased peak hours delays at base gates. There would be modest delays of traffic on SR-104 due to openings of the Hood Canal Bridge.

5.1.2. Relationship Between Short-Term Uses of the Human Environment and the Enhancement of Long-Term Productivity

Pursuant to NEPA regulations (40 CFR 1502.16), an EIS must consider the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. Construction and operation of the LWI under the Proposed Action would cause temporary and long-term impacts and use of natural resources. Construction impacts would include increased noise, air pollutant emissions, traffic, disturbance to fish and wildlife, and lost marine and upland vegetation, and soft-bottom habitat, as well as some project benefits such as increased employment and income. Ongoing impacts from operations would vary by alternative but would include loss or alteration of marine habitat, increases in nighttime lighting, shading of marine vegetation, partial barriers to fish migration, impacts on tribal fishery resources (minimal), energy use, and traffic. However, the Proposed Action would also provide some benefits, such as increased employment.

The Proposed Action would somewhat reduce long-term productivity of resources in the project area. For example, the LWI would cause loss, alteration, and/or shading of marine habitats for the life of the facility, which would reduce the primary productivity of marine vegetation, fish, plankton, and benthic organisms. The Proposed Action would result in some loss of tribal shellfish habitat and would potentially interfere with migration of juvenile salmon, reducing the productivity of tribal resources. It would remove several areas of upland vegetation and reduce the available wildlife habitat in the area. The proposed Mitigation Action Plan (Appendix C) would be implemented to compensate for the impacts of the selected LWI alternative on marine habitats and species such that the Proposed Action would have no net contribution to cumulative impacts.

5.1.3. Irreversible and Irretrievable Commitments of Resources

Section 102(c)(v) of NEPA requires that an EIS identify “any irreversible and irretrievable commitments of resources which would be involved in the Proposed Action should it be implemented.” Implementation of this action would involve commitment of a range of natural, physical, human, and fiscal resources.

Raw construction materials, such as cement, aggregate, wood, steel, water, and fossil fuel, and labor would be expended in constructing the LWI. Natural resources and labor would also be used to fabricate material and equipment that would be used in the facility. These materials and labor, as well as the expenditure of funds, would be irreversibly committed to the project. However, these types of construction materials and labor are not in short supply and their continued use would not adversely impact the availability of these resources.

Resources would continue to be consumed during operation. The project would require expenditure of capital, energy, and natural resources. These resources once consumed are lost permanently.

5.1.4. Energy Requirements and Conservation Potential

Construction and operation of the LWI would result in an increase in energy demand over current conditions. Although the required energy demands would be met by the existing utility infrastructure on NAVBASE Kitsap Bangor, energy requirements would be subject to any established energy conservation practices. The use of energy sources would be minimized wherever possible without compromising the safety or efficiency of operations.

5.1.5. Natural or Depletable Resource Requirements and Conservation Potential

Electricity is the only resource that would be permanently and continually consumed by the project. To the extent practicable, pollution prevention considerations are included in the Proposed Action. In addition, sustainable management practices are in place that protect and conserve natural and cultural resources.

5.1.6. Regulatory Compliance

Implementation of the Navy's Proposed Action for the LWI would not conflict with the objectives or requirements of federal, state, or local plans, policies, or legal requirements (Table 5–1). The Navy is consulting with regulatory agencies as appropriate during the NEPA process and prior to implementation of the Proposed Action to ensure requirements are met. The consultations described below are for the preferred alternative.

Table 5–1. Summary of Regulatory Compliance for the LWI

Law or Regulation	Responsible Agency	Compliance
National Environmental Policy Act	Navy	This EIS has been prepared in accordance with NEPA, CEQ regulations, and Navy NEPA regulations and procedures. Public participation and review is being conducted in compliance with NEPA.
Federal Water Pollution Control Act (Clean Water Act)	USACE, USEPA, and WDOE	Through the JARPA process, the Navy applied to USACE for a Section 404 permit for placement of fill material below the MHHW tidal level and a Section 401 Water Quality Certification from WDOE. The Navy will also apply for a Construction Stormwater Permit from the USEPA, Region 10.
Rivers and Harbors Act	USACE	A Rivers and Harbors Act Section 10 permit from the USACE is required for placement of new structures in navigable waters. The Navy applied for a Section 10 permit through the JARPA process.
Endangered Species Act	NMFS and USFWS	The EIS analyzes potential effects on species listed under the ESA, and the Navy has submitted a biological assessment to NMFS and USFWS. In accordance with ESA requirements, the Navy completed consultation for the preferred alternative under Section 7 of the ESA with the NMFS, who issued a Letter of Concurrence with the Navy's effect determinations of may affect not likely to adversely affect, listed species. USFWS issued a concurrence letter stating that LWI project impacts to bull trout are not measurable and therefore insignificant, and impacts to marbled murrelets are discountable.
Marine Mammal Protection Act	NMFS	In accordance with the MMPA, the Navy has consulted with NMFS and determined that an IHA application is not required for the preferred alternative of the LWI project.
Magnuson-Stevens Fishery Conservation and Management Act	NMFS	The Navy submitted an EFH Assessment to NMFS and completed consultation with NMFS under the MSA.
Migratory Bird Treaty Act	USFWS	The Navy has determined that the Proposed Action would not adversely affect migratory birds under the MBTA.
Bald and Golden Eagle Protection Act	USFWS	The Navy has determined that the Proposed Action would not result in incidental takes of bald or golden eagles under the Bald and Golden Eagle Protection Act.
Coastal Zone Management Act	NOAA and WDOE	The Navy submitted a CCD to WDOE in compliance with the CZMA, stating that federal actions that have reasonably foreseeable effects on coastal uses or resources must be consistent to the maximum extent practicable with the enforceable policies of approval for state coastal management programs.

Table 5–1. Summary of Regulatory Compliance for the LWI (continued)

Law or Regulation	Responsible Agency	Compliance
Clean Air Act	USEPA	This Proposed Action has been analyzed in accordance with the federal CAA and will comply with the criteria in Section 176(c) regarding General Conformity. Kitsap County is in attainment for all NAAQS and no conformity determination is required.
National Historic Preservation Act	SHPO	The Navy concluded consultation with the SHPO under Section 106 of the NHPA. SHPO concurred with the Navy's definition of the APE and finding of no adverse effect.
Executive Order 13175, Government-to-Government Consultation	Navy	The Navy invited government-to-government consultation with potentially affected American Indian tribes concerning potential effects of the Proposed Action on protected tribal resources and treaty rights. A Memorandum of Agreement between the Navy and the Skokomish Indian Tribe was signed om March 3, 2016. Government-to-government consultation with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe is in progress.
Native American Graves Protection and Repatriation Act	Navy and SHPO	If the Navy were to encounter human remains, funerary objects, sacred objects, or objects of cultural patrimony as defined by NAGPRA, the Navy would comply with NAGPRA and Navy instructions and consult with the SHPO, affected American Indian tribes, USACE, and other interested parties.
Energy Independence and Security Act, Section 438	Navy	The Proposed Action would maintain site hydrology to the maximum extent feasible and would consider the USEPA technical guidance for compliance with Section 438 of the EISA.
Executive Order 12898, Environmental Justice	Navy	Implementation of the Proposed Action would not result in any disproportionately high and adverse human health or environmental effects on minority or low income populations.
Executive Order 13045, Children's Health and Safety	Navy	Implementation of the Proposed Action would not result in disproportionate environmental health or safety risks to children.
Executive Order 13653, Preparing the United States for the Impact of Climate Change	Navy	In response to concerns over climate change, the Navy has initiated broad programs to reduce energy consumption and shift energy demand to renewable and alternative fuels to an extent consistent with its national security mission, thereby reducing emissions of carbon dioxide and other greenhouse gases (GHGs). A number of shore installation and fleet programs have substantially reduced the generation of GHGs, primarily through the conservation of fossil fuels and electricity.

Law or Regulation	Responsible Agency	Compliance
Executive Order 13693, Planning for Federal Sustainability in the Next Decade	Navy	The Navy complies with EO 13693 throughout its planning, design, construction, remediation, and environmental management programs. Navy projects are planned and developed in compliance with the Department of Defense Strategic Sustainability Performance Plan, which provides guidelines for installations, ships, aircraft, and tactical vehicles focusing on sustainable buildings, renewable energy, water use efficiency and management, fleet management, sustainable procurement, pollution prevention and waste reduction, electronic stewardship and data centers, performance contracting, and climate change adaptation. These guidelines have informed the planning and design of the LWI Proposed Action.

CAA = Clean Air Act
CCD = Coastal Consistency Determination
CEQ = Council on Environmental Quality
CZMA = Coastal Zone Management Act
EFH = Essential Fish Habitat
EISA = Energy Independence and Security Act
ESA = Endangered Species Act
GHG = greenhouse gas
IHA = Incidental Harassment Authorization
JARPA = Joint Aquatic Resources Permit Application
MBTA = Migratory Bird Treaty Act
MHHW = mean higher high water
MMPA = Marine Mammal Protection Act
MSA = Magnuson-Stevens Fishery Conservation and Management Act
NAAQS = National Ambient Air Quality Standards
NAGPRA = Native American Graves Protection and Repatriation Act
NEPA = National Environmental Policy Act
NHPA = National Historic Preservation Act
NMFS = National Marine Fisheries Service
NOAA = National Oceanic and Atmospheric Administration
SHPO = State Historic Preservation Officer
USACE = U.S. Army Corps of Engineers
USEPA = U.S. Environmental Protection Agency
USFWS = U.S. Fish and Wildlife Service
WDOE = Washington Department of Ecology

5.2. SERVICE PIER EXTENSION

5.2.1. Unavoidable Adverse Impacts

The analysis of the SPE project presented in this EIS has identified the potential for adverse environmental impacts. Mitigation measures that would be implemented to either avoid or minimize these impacts have been identified. The adverse impacts that remain after implementing mitigation measures are considered to be unavoidable. These impacts include increased noise during construction and its effect on fish, wildlife, and humans; loss of marine habitat due to the placement of new in-water structures within the NAVBASE Kitsap Bangor WRA; and the loss of upland vegetation for roads and buildings (permanent) and for staging areas and utility work (temporary).

The SPE Proposed Action would cause short-term unavoidable impacts during construction, particularly with regard to pile-driving activities. Pile driving would generate high levels of underwater noise and vibration, as well as airborne noise. These high sound levels would adversely impact fish, marine mammals, and other wildlife and would be unavoidable. Pile-driving noise during construction would adversely impact residential areas and recreation on the western side of Hood Canal. Pile driving would increase turbidity on a localized basis. There would also be adverse impacts on travelers on SR-104 due to delays caused by openings of the Hood Canal to accommodate construction vessel traffic.

The new in-water structures would create shade and nighttime lighting, which would cause minor changes in habitat conditions for fish, marine mammals, and other aquatic organisms. These changes would unavoidably impact the type, abundance, and/or behavior of some species in the vicinity of the in-water structures. The in-water structures could alter the behavior of returning adult salmon, but are not expected to affect juvenile salmon migration in the long term. The potential for impacts on tribal salmon fishery resources would be minimal. New structures would displace approximately 7 acres (2.8 hectares) of forest habitat.

There would be an unavoidable increase in noise in the use of utilities and energy to support the project, as well as increased traffic. In the long term, this impact would be negligible.

5.2.2. Relationship Between Short-Term Uses of the Human Environment and the Enhancement of Long-Term Productivity

Pursuant to NEPA regulations (40 CFR 1502.16), an EIS must consider the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. Construction and operation of the SPE under the Proposed Action would cause temporary and long-term impacts and use of natural resources. Construction impacts would include increased noise, air pollutant emissions, traffic, disturbance to fish and wildlife, and lost upland vegetation and soft-bottom habitat, as well as some project benefits such as increased employment and income. Ongoing impacts from operations would vary by alternative but would include loss of marine habitat, increases in nighttime lighting, energy use, and traffic. However, the Proposed Action would also provide some benefits, such as increased employment.

The Proposed Action would somewhat reduce long-term productivity of resources in the project area. For example, the SPE would cause loss and/or shading of marine habitats for the life of the facility. It would remove upland vegetation and reduce the available wildlife habitat in the area. The proposed Mitigation Action Plan (Appendix C) would be implemented to compensate for the impacts of the selected SPE alternative on marine habitats and species such that the Proposed Action would have no net contribution to cumulative impacts.

5.2.3. Irreversible and Irretrievable Commitments of Resources

Section 102(c)(v) of NEPA requires that an EIS identify “any irreversible and irretrievable commitments of resources which would be involved in the Proposed Action should it be implemented.” Implementation of this action would involve commitment of a range of natural, physical, human, and fiscal resources.

Raw construction materials, such as cement, aggregate, wood, steel, water, and fossil fuel, and labor would be expended in constructing the SPE. Natural resources and labor would also be used to fabricate material and equipment that would be used in the facility. These materials and labor, as well as the expenditure of funds, would be irreversibly committed to the project. However, these types of construction materials and labor are not in short supply and their continued use would not adversely impact the availability of these resources.

Resources would continue to be consumed during operation. The project would require expenditure of capital, energy, and natural resources, such as water. These resources once consumed are lost permanently.

5.2.4. Energy Requirements and Conservation Potential

Construction and operation of the SPE would result in an increase in energy demand over current conditions. Although the required energy demands would be met by the existing utility infrastructure on NAVBASE Kitsap Bangor, energy requirements would be subject to any established energy conservation practices. The use of energy sources would be minimized wherever possible without compromising the safety or efficiency of operations.

5.2.5. Natural or Depletable Resource Requirements and Conservation Potential

Resources that would be permanently and continually consumed by the project include water, electricity, natural gas, and fossil fuels. To the extent practicable, pollution prevention considerations are included. In addition, sustainable management practices are in place that protect and conserve natural and cultural resources.

5.2.6. Regulatory Compliance

Implementation of the Navy's Proposed Action for the SPE would not conflict with the objectives or requirements of federal, state, or local plans, policies, or legal requirements (Table 5–2). The Navy is consulting with regulatory agencies as appropriate during the NEPA process and prior to implementation of the Proposed Action to ensure requirements are met. The consultations described below are for the preferred alternative.

Table 5–2. Summary of Regulatory Compliance for the SPE

Law or Regulation	Responsible Agency	Compliance
National Environmental Policy Act	Navy	This EIS has been prepared in accordance with NEPA, CEQ regulations, and Navy NEPA regulations and procedures. Public participation and review is being conducted in compliance with NEPA.
Federal Water Pollution Control Act (Clean Water Act)	USACE, USEPA, and WDOE	Through the JARPA process, the Navy will apply to USACE for a Section 401 Water Quality Certification from WDOE. The Navy will also apply for a Construction Stormwater Permit from the USEPA, Region 10. Operational stormwater discharges will be covered by the NAVBASE Kitsap Bangor Multi-Sector General Permit (MSGP) from the USEPA, Region 10.
Rivers and Harbors Act	USACE	A Rivers and Harbors Act Section 10 permit from the USACE is required for placement of new structures in navigable waters. The Navy will apply for a Section 10 permit through the JARPA process.
Endangered Species Act	NMFS and USFWS	The EIS analyzes potential effects on species listed under the ESA, and the Navy has submitted a biological assessment to NMFS and USFWS. NMFS has indicated formal ESA consultation will be required. USFWS issued a concurrence letter stating that SPE project impacts to bull trout are not measurable and therefore insignificant, and impacts to marbled murrelets are discountable.
Marine Mammal Protection Act	NMFS	The Navy submitted an application for an IHA to NMFS and is in consultation with NMFS in accordance with the MMPA.
Magnuson-Stevens Fishery Conservation and Management Act	NMFS	The Navy submitted an EFH Assessment to NMFS and is in consultation with NMFS under the MSA.
Migratory Bird Treaty Act	USFWS	The Navy has determined that the Proposed Action would not adversely affect migratory birds under the MBTA.
Bald and Golden Eagle Protection Act	USFWS	The Navy has determined that the Proposed Action would not result in incidental takes of bald or golden eagles under the Bald and Golden Eagle Protection Act.
Coastal Zone Management Act	NOAA and WDOE	The Navy is preparing a CCD in compliance with the CZMA, stating that federal actions that have reasonably foreseeable effects on coastal uses or resources must be consistent to the maximum extent practicable with the enforceable policies of approval for state coastal management programs. The CCD will be submitted to WDOE, who makes the federal consistency determination.
Clean Air Act	USEPA	This Proposed Action has been analyzed in accordance with the federal CAA and will comply with the criteria in Section 176(c) regarding General Conformity. Kitsap County is in attainment for all NAAQS and no conformity determination is required.
National Historic Preservation Act	SHPO	The Navy concluded consultation with the SHPO under Section 106 of the NHPA. SHPO concurred with the Navy's definition of the APE and finding of no adverse effect.

Table 5–2. Summary of Regulatory Compliance for the SPE (continued)

Law or Regulation	Responsible Agency	Compliance
Executive Order 13175, Government-to-Government Consultation	Navy	The Navy invited government -to-government consultation with potentially affected American Indian tribes concerning potential effects of the Proposed Action on protected tribal resources and treaty rights. A Memorandum of Agreement between the Navy and the Skokomish Indian Tribe was signed om March 3, 2016. Government-to-government consultation with the Port Gamble S'Klallam Tribe, Jamestown S'Klallam Tribe, and Lower Elwha Klallam Tribe is in progress.
Native American Graves Protection and Repatriation Act	Navy and SHPO	If the Navy were to encounter human remains, funerary objects, sacred objects, or objects of cultural patrimony as defined by NAGPRA, the Navy would comply with NAGPRA and Navy instructions and consult with the SHPO, affected American Indian tribes, USACE, and other interested parties.
Energy Independence and Security Act, Section 438	Navy	The Proposed Action would maintain site hydrology to the maximum extent feasible and would consider the USEPA technical guidance for compliance with Section 438 of the EISA.
Executive Order 12898, Environmental Justice	Navy	Implementation of the Proposed Action would not result in any disproportionately high and adverse human health or environmental effects on minority or low income populations.
Executive Order 13045, Children's Health and Safety	Navy	Implementation of the Proposed Action would not result in disproportionate environmental health or safety risks to children.
Executive Order 13653, Preparing the United States for the Impacts of Climate Change	Navy	In response to concerns over climate change, the Navy has initiated broad programs to reduce energy consumption and shift energy demand to renewable and alternative fuels to an extent consistent with its national security mission, thereby reducing emissions of carbon dioxide and other greenhouse gases (GHGs). A number of shore installation and fleet programs have substantially reduced the generation of GHGs, primarily through the conservation of fossil fuels and electricity.
Executive Order 13693, Planning for Federal Sustainability in the Next Decade	Navy	The Navy complies with EO 13693 throughout its planning, design, construction, remediation, and environmental management programs. Navy projects are planned and developed in compliance with the Department of Defense Strategic Sustainability Performance Plan, which provides guidelines for installations, ships, aircraft, and tactical vehicles focusing on sustainable buildings, renewable energy, water use efficiency and management, fleet management, sustainable procurement, pollution prevention and waste reduction, electronic stewardship and data centers, performance contracting, and climate change adaptation. These guidelines have informed the planning and design of the SPE Proposed Action. For example, the proposed Waterfront Ship Support Building would be designed and constructed to be eligible to receive at minimum a LEED certification of Silver (Section 2.2.1.3.2).

Table 5–2. Summary of Regulatory Compliance for the SPE (continued)

CAA = Clean Air Act
CCD = Coastal Consistency Determination
CEQ = Council on Environmental Quality
CZMA = Coastal Zone Management Act
EFH = Essential Fish Habitat
EISA = Energy Independence and Security Act
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JARPA = Joint Aquatic Resources Permit Application
MBTA = Migratory Bird Treaty Act
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MSGP = Multi-Sector General Permit
NAAQS = National Ambient Air Quality Standards
NAGPRA = Native American Graves Protection and Repatriation Act
NEPA = National Environmental Policy Act
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NMFS = National Marine Fisheries Service
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USFWS = U.S. Fish and Wildlife Service
WDOE = Washington Department of Ecology

CHAPTER 6

REFERENCES AND LISTS

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6.0 REFERENCES AND LISTS

6.1. DISTRIBUTION LIST

Federal Agencies, Commissions, and Elected Officials

Marine Mammal Commission
National Oceanic and Atmospheric Administration
    National Marine Fisheries Services, Northwest Region
    Northwest Fisheries Science Center
    Office of Protected Resources
Pacific States Marine Fisheries Commission
U.S. Army Corps of Engineers, Seattle District
U.S. Coast Guard, District 13
U.S. Environmental Protection Agency
    Region 10
    Washington Operations Office
U.S. Fish & Wildlife Service, Western Washington Office
U.S Representatives
    District 1
    District 2
    District 6
    District 7
    District 8
    District 9
U.S. Senators

State Agencies and Elected Officials

Governor's Office of Indian Affairs
Governor's Office of Regulatory Assistance
Puget Sound Partnership
Washington Department of Archaeology & Historic Preservation
Washington State Department of Ecology
    Northwest Region
    Shorelands and Environmental Assistance Program
Washington State Department of Fish and Wildlife
    Headquarters
    Region 6
Washington State Department of Natural Resources
    Aquatics Shoreline District
    Olympic Region
    South Puget Sound Region
Washington State Office of the Attorney General
Washington State Office of the Governor
Washington State Office of the Lieutenant Governor

Washington State Parks Foundation
Washington State Representatives, District 11
Washington State Representatives, District 23
Washington State Representatives, District 24
Washington State Representatives, District 26
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Local Agencies and Elected Officials

City of Bainbridge Island
City of Bremerton
City of Port Orchard
City of Port Townsend
City of Poulsbo
City of Seattle
Hood Canal Coordinating Council
Hood Canal Dissolved Oxygen Program
Jefferson County Commissioners
Jefferson County Department of Natural Resources
King County Council

Kitsap County Commissioners
Kitsap County Community Development
Kitsap Regional Coordinating Council
Mason County Commissioners
Northwest Straits Commission

Native American Tribes and Organizations

Jamestown S'Klallam Tribe
Lower Elwha Klallam Tribe
Northwest Indian Fisheries Commission
Point No Point Treaty Council
Port Gamble S'Klallam Tribe
Skokomish Tribe
Suquamish Tribe

Organizations

Hood Canal Coordinating Council
Hood Canal Environmental Council

Libraries

Jefferson County Library
Kitsap Regional Library – Poulsbo Branch
Kitsap Regional Library – Silverdale
Kitsap Regional Library – Sylvan Way Branch
Port Townsend Public Library
Seattle Public Library – Central

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