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 3.3.1.3.8. 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 3.3.1.3.9. Other marine fish include all other species ranging from benthic dwelling (demersal) to shallow-water species. Other marine fish are discussed in Section 3.3.1.3.10.

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 2003, 2011, 2014). The federally managed species, lifestages, 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 lifestages 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 2014, Appendix B4). The PFMC (2014) has also designated EFH for each individual groundfish species by lifestage. 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 2014, 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 lifestages 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 2003, 2011, and 2014.
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 3.3.1.3.11, 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.

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*	Proposed *78 FR 2726, January 14, 2013*	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

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). Chinook are the largest species of salmonid. In general, juveniles out-migrate as 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). 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

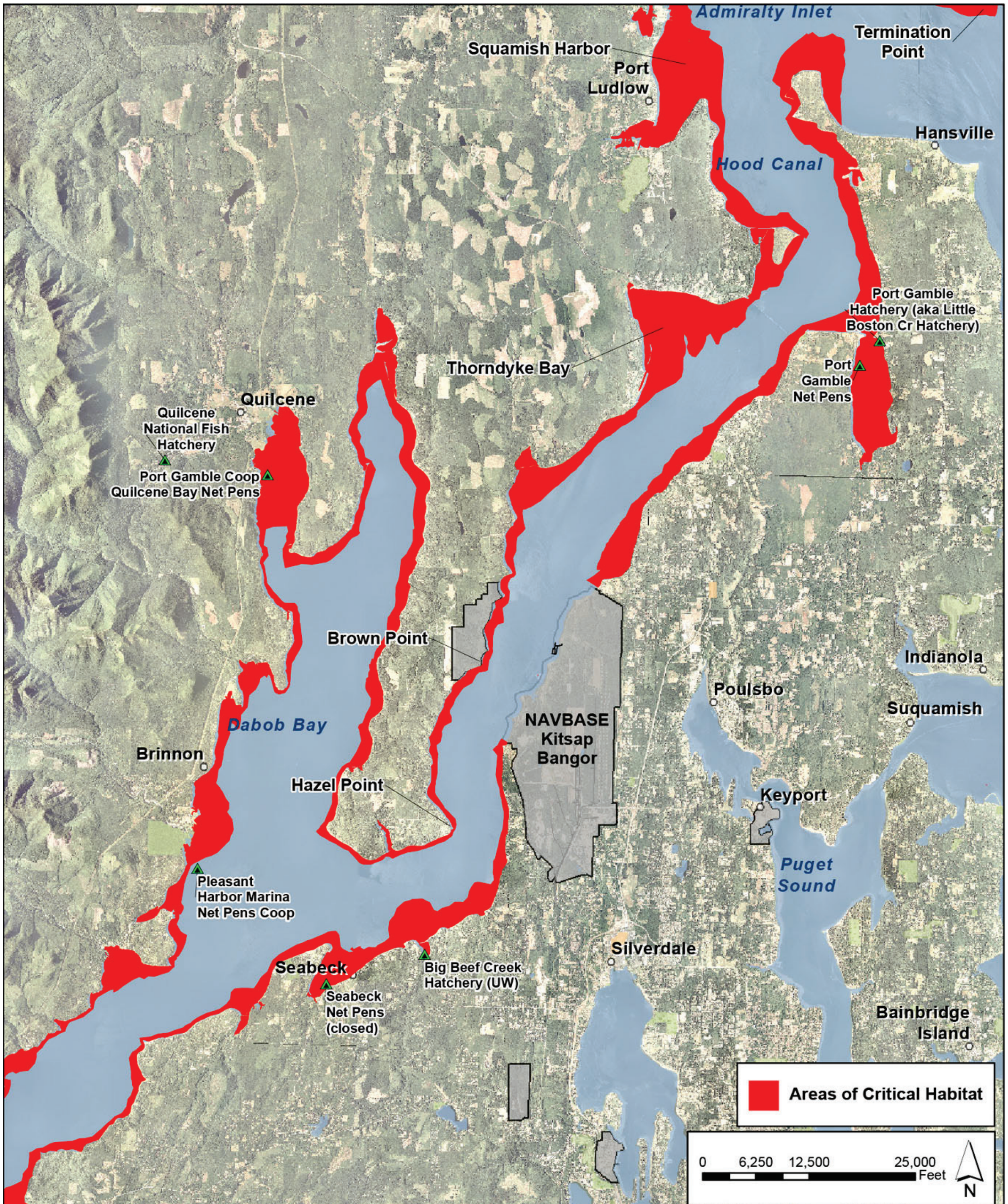


Figure 3.3–1. Puget Sound Chinook and Hood Canal Summer-Run Chum Salmon Critical Habitat for Hood Canal Nearshore Marine Areas

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) 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). 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) from critical habitat designation. No proposed 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. 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. It was thought that all Hood Canal bull trout originate from the Skokomish River (WDFW 2004). However, summaries of recent tagging studies (U.S. Fish and Wildlife Service [USFWS] 2011) and historical otolith analysis (Correa 2003) indicate that bull trout in the South Fork 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. No records exist of bull trout in the Hood Canal marine environment or freshwater systems on the Kitsap Peninsula (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) 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 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).

Figure 3.3–2. Bull Trout Critical Habitat for Hood Canal Nearshore Marine Areas

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 3.3.1.4.1. NAVBASE Kitsap Bangor is excluded by federal law (70 FR 52630) 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). Only two records occurred for Hood Canal, both in the 1960s. There have been no confirmed observations of bocaccio in Puget Sound for approximately 9 years (74 FR 18516), and Drake et al. (2010) concluded that if the species were to occur, it would likely be in low abundances.

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 3.3.1.4.1.

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). With the absence of associated catch records, and limited scientific surveys of these waters, the prevalence of rockfish in waters adjacent to NAVBASE Kitsap Bangor remains unknown. Drake et al. (2010) concluded that canary rockfish occur in low and decreasing abundances in Puget Sound. Based on historical records and habitat requirements, canary rockfish are not expected to occur in the activity area.

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 3.3.1.4.1.

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). Due to the moratorium on both sport and commercial fishing for rockfish in Hood Canal, the absence of associated recent catch records, and no recent scientific surveys of these waters, the prevalence of yelloweye rockfish in these waters remains unknown. Based on historical records and habitat requirements, yelloweye rockfish are not expected to occur in the activity area.

3.3.1.3.8. 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, coho and cutthroat, 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.

3.3.1.3.9. 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.

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).

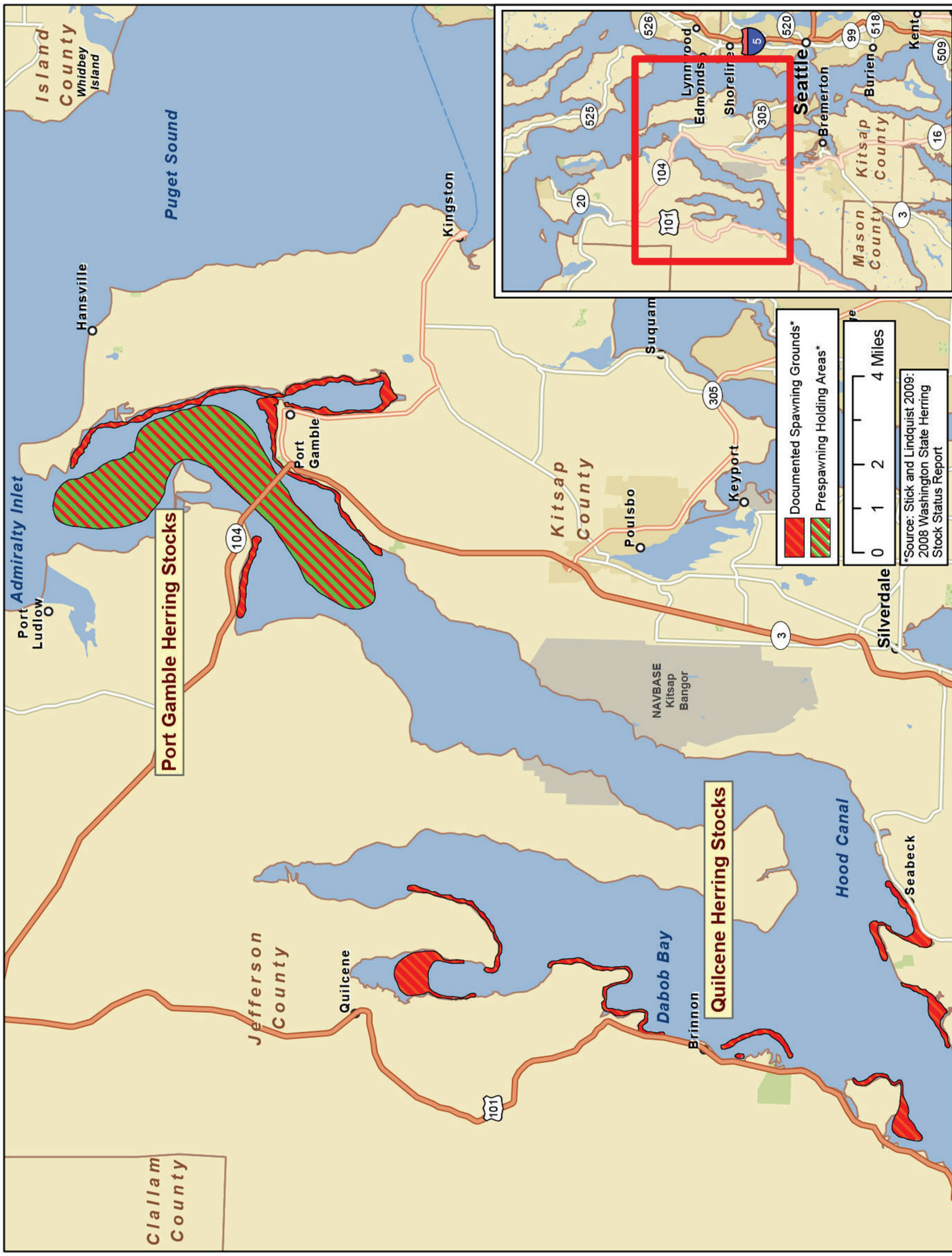


Figure 3.3–3. Port Gamble and Quilcene Bay Herring Stock Near NAVBASE Kitsap Bangor

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.

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). 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).

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.

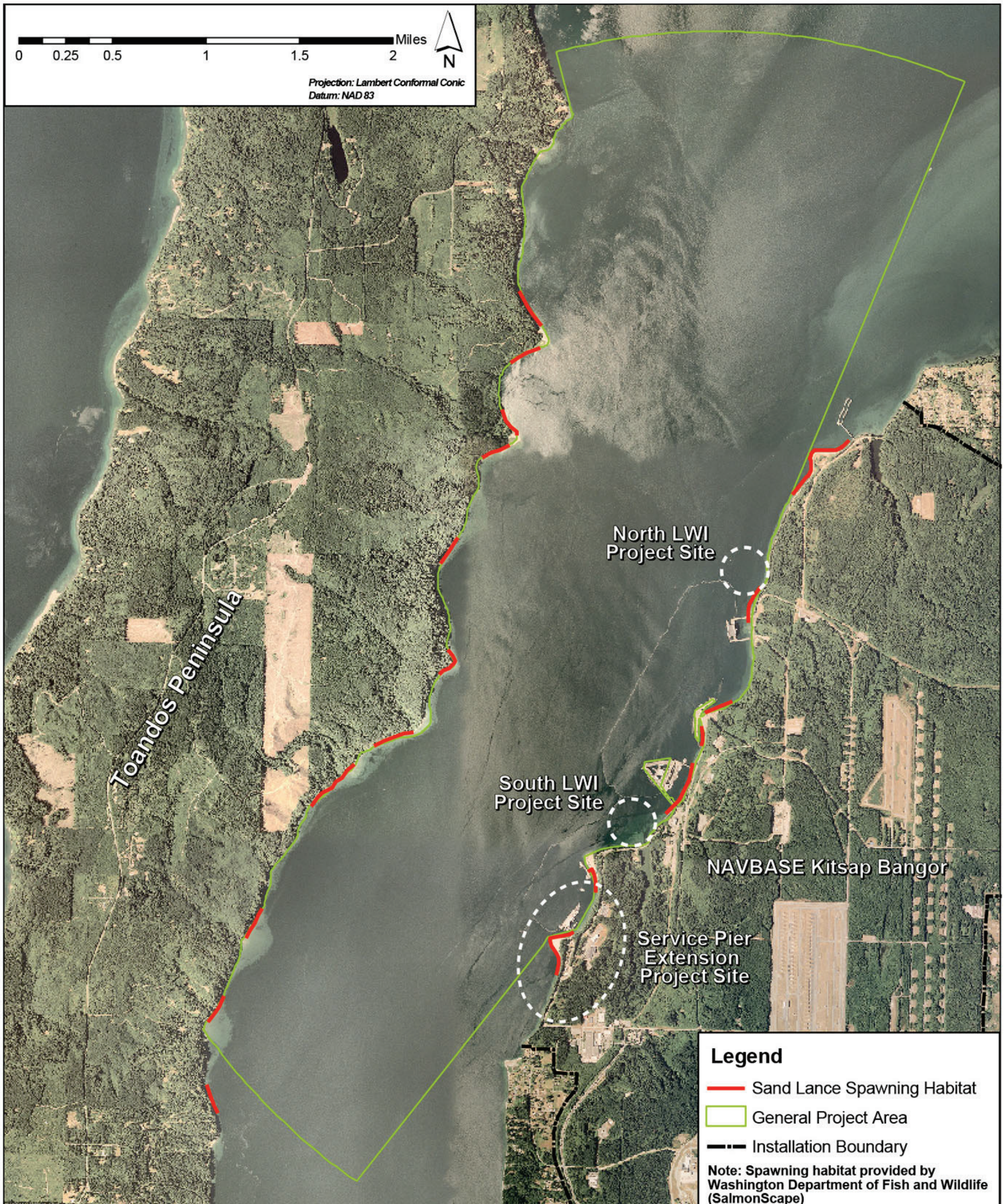


Figure 3.3–4. Pacific Sand Lance Spawning Habitat

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.

3.3.1.3.10. 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.

3.3.1.3.11. 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.

3.3.1.4. CURRENT REQUIREMENTS AND PRACTICES

3.3.1.4.1. 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 will enter into consultation 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). On January 14, 2013, NMFS proposed critical habitat for Puget Sound steelhead (78 FR 2726). 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, proposed 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 and 78 FR 2726) 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).

Proposed 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.

The proposed projects would have no effect on PCE Numbers 1, 2, 3, and 4. As a result, since no alternative for either project would affect currently occupied steelhead riverine habitat, the provisional effect determination for both projects is no effect on proposed Puget Sound steelhead critical habitat. 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 and Hood Canal Summer-Run chum salmon, or proposed 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) The 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).

3.3.1.4.2. CONSULTATION AND PERMIT COMPLIANCE STATUS

As part of the regulatory and permitting process for the projects addressed by this EIS, the Navy is preparing a Biological Assessment (BA) and EFH Assessment (EFHA) and will consult with the NMFS West Coast Region office and the USFWS Washington Fish and Wildlife Office.

3.3.1.4.3. 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, would observe an in-water juvenile salmon work window of July 16 to January 15. The Puget Sound Marine Area 13 (northern Hood Canal) in-water juvenile salmonid work window is currently July 16 to February 15, as outlined in WAC 220-110-271 and posted by the USACE Seattle District (USACE 2012). The Navy is proposing the shorter window to reflect 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 would be implemented to control runoff and siltation and minimize impacts on surface water, per the *Stormwater Management Manual for Western Washington* (WDOE 2012).
- 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 16 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 will be 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 3.3.1.4.3 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 will implement measures to prevent the discharge of construction debris into marine waters (Section 3.3.2). 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.

Physical Habitat and Barriers

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 (10 piles each for the north and south abutments) would require excavation below MHHW, and the abutment stair landings would occur below MHHW. This work would be done at low tide and is, therefore, likely to have minimal effect on fish movement in the project vicinity. In addition, each of the observation posts would be supported by seven piles in the upper intertidal zone. These 14 piles would be driven “in the dry” and, therefore, are not included in the in-water noise analysis. 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 16 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.

<u>Biological Habitat</u>

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 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; Parametrix 1994a, 1999; Anchor Environmental 2002; Romberg 2005; 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.

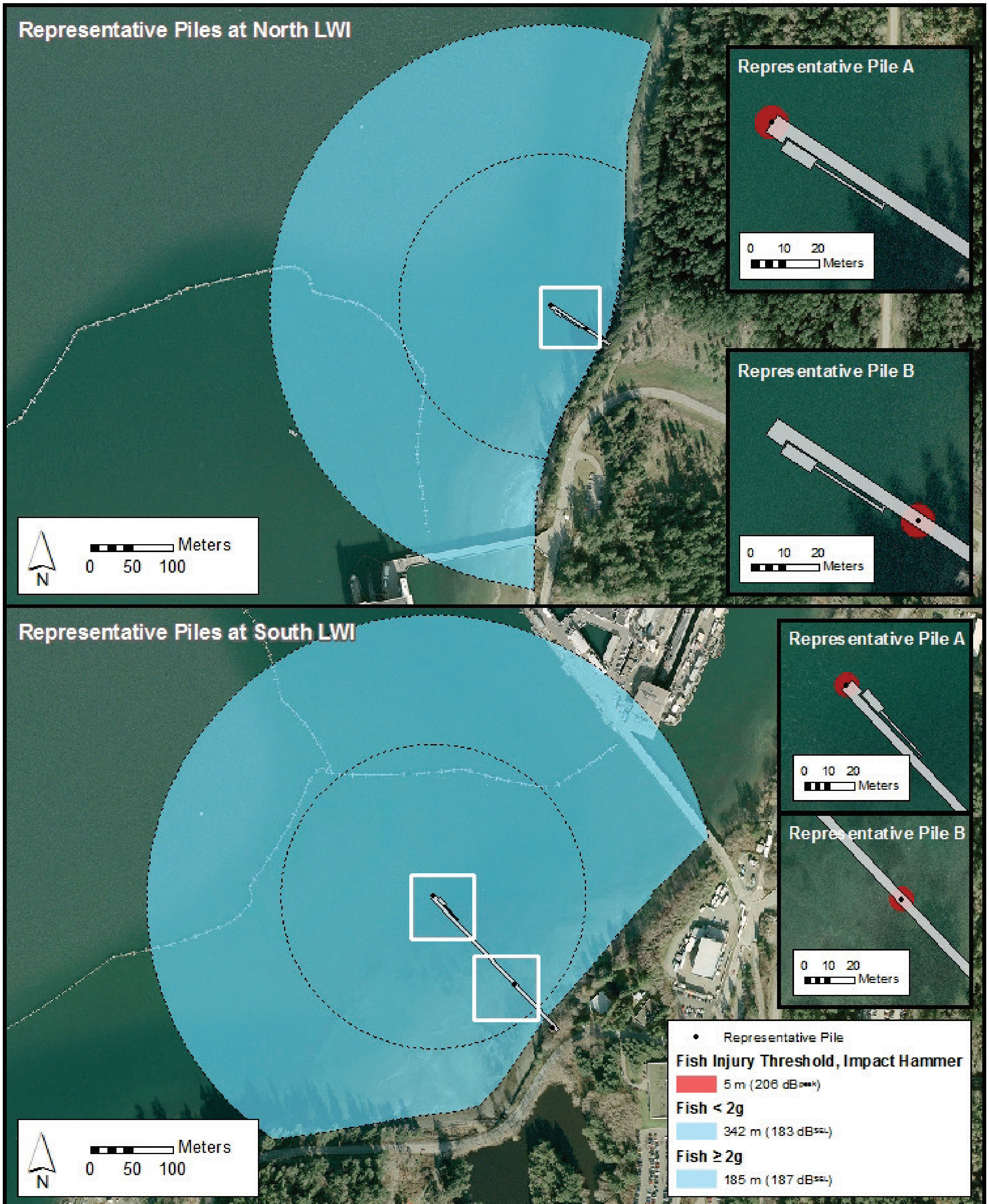


Figure 3.3-5a. Representative View for Fish Injury Threshold due to 24-inch Hollow Steel Pile Driving Noise during LWI Construction, Alternative 2

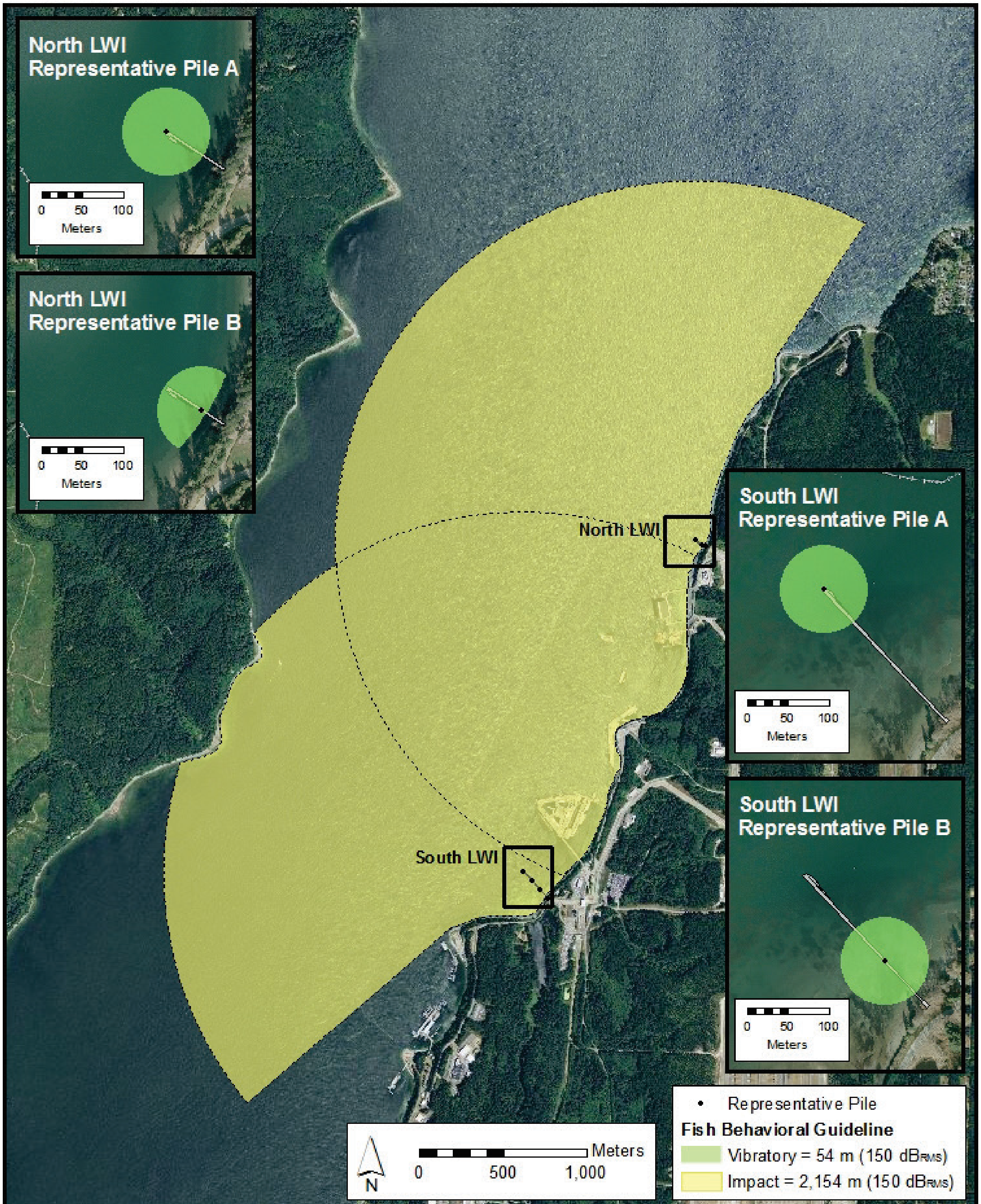


Figure 3.3-5b. Representative View for Fish Behavior Guideline due to 24-inch Hollow Steel Pile Driving Noise during LWI Construction, Alternative 2

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.

A recent study (Halvorsen et al. 2012) examining 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) found 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 ruptures to the swim bladder (Nile tilapia only) to moderate injuries including hematomas 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. 2012). 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 conditions of this study 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.

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. 2012). Halvorsen et al. (2012) 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. Therefore, 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^{2}sec 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^{2}sec SEL injury thresholds. As explained by NMFS (2012), use of the SEL thresholds is less relevant since fish are not expected to remain within the area during the entire duration of pile driving[1]. When assessing the potential for physiological impacts, the 206 dB re 1 μPa peak threshold 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. Individual fish in the vicinity may change course to avoid the ensonified area. However, as explained in NMFS (2012), it is unlikely that minor changes in behavior would preclude 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 that has a detectable effect on the physiology of individual fish relative to naturally occurring stressors, or any future effect on growth, reproduction, or general health. Therefore, avoidance behavior by individual fish during pile driving activities should be considered insignificant and discountable.

If fish remain in the vicinity of pile driving for an extended period of time, they may be vulnerable to injury or potential mortality. Mortalities would likely to be limited to small fish, which are more vulnerable to the effects of barotrauma (Yelverton et al. 1975; Fisheries Hydroacoustic Working Group 2008). However, fish close to piles when pile driving begins are expected to react by leaving the area, and any individuals approaching the piles while pile driving is ongoing 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, 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.

[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*."

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 16 to January 15) to minimize underwater noise impacts on juvenile salmonids, some adult salmonids may transit 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.

<u>Summary of Impacts and ESA-Listed Salmonid Determination</u>

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 $\mu Pa^2 sec$ 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 $\mu Pa^2 sec$ 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); these responses may resolve soon after vibratory driving ceases (NMFS 2014). 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 insignificant and discountable.

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 insignificant or discountable.

Nevertheless, construction activities for LWI Alternative 2 have the potential to affect, and therefore "may affect" Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer-run chum salmon, and bull trout. 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. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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).

Rockfish Habitat Requirements

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.

Currents

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^{o}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.

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 insignificant or discountable. No population level impacts for these species are anticipated to occur, and their continued survival would be unaffected.

Nevertheless, construction activities under LWI Alternative 2 have the potential to affect, and therefore "may affect", bocaccio, canary rockfish, and yelloweye rockfish. 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. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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 3.3.1.3.9). 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. 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. (2012) determined that fish like sand lance that do not have swim bladders may be less susceptible to injury from simulated impact pile driving noise. Because fish are expected to largely 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 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, 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 16 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 migrational 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 migrational 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 trashracks, 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.

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. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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 for this alternative, plus 120 temporary piles and 14 upper intertidal piles supporting the observation posts. 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 insignificant and 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. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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). However, Pacific sand lance spawning occurs adjacent to both the south and north LWI locations (Figure 3.3–4, Section 3.3.1.3.9) (WDFW 2013). 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, 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 much 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

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

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

Alternative 3 would place fill in the intertidal zone or include armoring of the intertidal shoreline with riprap or other material during construction of the LWI structures.

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, a shorter in-water construction duration, no temporary trestles, 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. As for Alternative 2, the observation post piles (a total of 14 – 7 at each location) would be located in the upper intertidal and driven in the dry during low tides.

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 in-water 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, a shorter in-water construction duration, no temporary trestles, 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.

Nevertheless, construction of LWI Alternative 3 may affect Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer-run chum salmon, and bull trout. No element of LWI Alternative 3 construction would extend beyond NAVBASE Kitsap Bangor boundaries and reach proposed or designated critical habitat waters. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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, a shorter in-water construction duration, no temporary trestles, 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. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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, a shorter in-water construction duration, no temporary trestles, 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. However, 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, a shorter in-water construction duration, no temporary trestles, 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 (14) 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 (0.4 acre [0.16 hectare]), which includes pile-supported piers, floating docks, and observation posts.

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.

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.

Nevertheless, operation of LWI Alternative 3 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. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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). However, Pacific sand lance spawning occurs adjacent to both the south and north LWI locations (Figure 3.3–4) (WDFW 2013b). 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
Impact	
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.
	ESA: Alternative 2 "may affect" Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bull trout, bocaccio, canary rockfish, and yelloweye rockfish. *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.
	ESA: Alternative 3 "may affect" Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bull trout, bocaccio, canary rockfish, and yelloweye rockfish. *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 3.3.1.4.3. 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 will address 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) will be prepared and submitted to the NMFS West Coast Region office. A Biological Assessment (BA) will be prepared and submitted to the NMFS West Coast Region office and the USFWS Washington Fish and Wildlife Office. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.	

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 3.3.1.4.3 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 16 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.

Physical Habitat and Barriers

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 16 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.

<u>Biological Habitat</u>

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; Parametrix 1994a, 1999; Anchor Environmental 2002; Romberg 2005; 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

<table>
<tr><th colspan="4">IMPACT DRIVING</th></tr>
<tr><th>Pile Size / Type</th><th>dB RMS
re: 1 μPa @ 33 feet (10 meters)</th><th>dB peak
re: 1 μPa @ 33 feet (10 meters)</th><th>dB SEL
re: 1 μPa^2 sec @ 33 feet (10 meters)</th></tr>
<tr><td>36-inch (90-cm)
steel pipe</td><td>194</td><td>205</td><td rowspan="2">181</td></tr>
<tr><td>24-inch (60-cm)
steel pipe</td><td>193</td><td>210</td></tr>
<tr><td>18-inch (45-cm)
square concrete</td><td>170</td><td>184</td><td>159</td></tr>
<tr><th colspan="4">VIBRATORY DRIVING</th></tr>
<tr><th>Pile Size / Type</th><th>dB RMS
re: 1 μPa @ 33 feet (10 meters)</th><th>dB peak
re: 1 μPa @ 33 feet (10 meters)</th><th>dB SEL
re: 1 μPa^2 sec @ 33 feet (10 meters)</th></tr>
<tr><td>36-inch
steel pipe</td><td>166</td><td rowspan="2">n/a</td><td rowspan="2">n/a</td></tr>
<tr><td>24-inch
steel pipe</td><td>161</td></tr>
</table>

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.

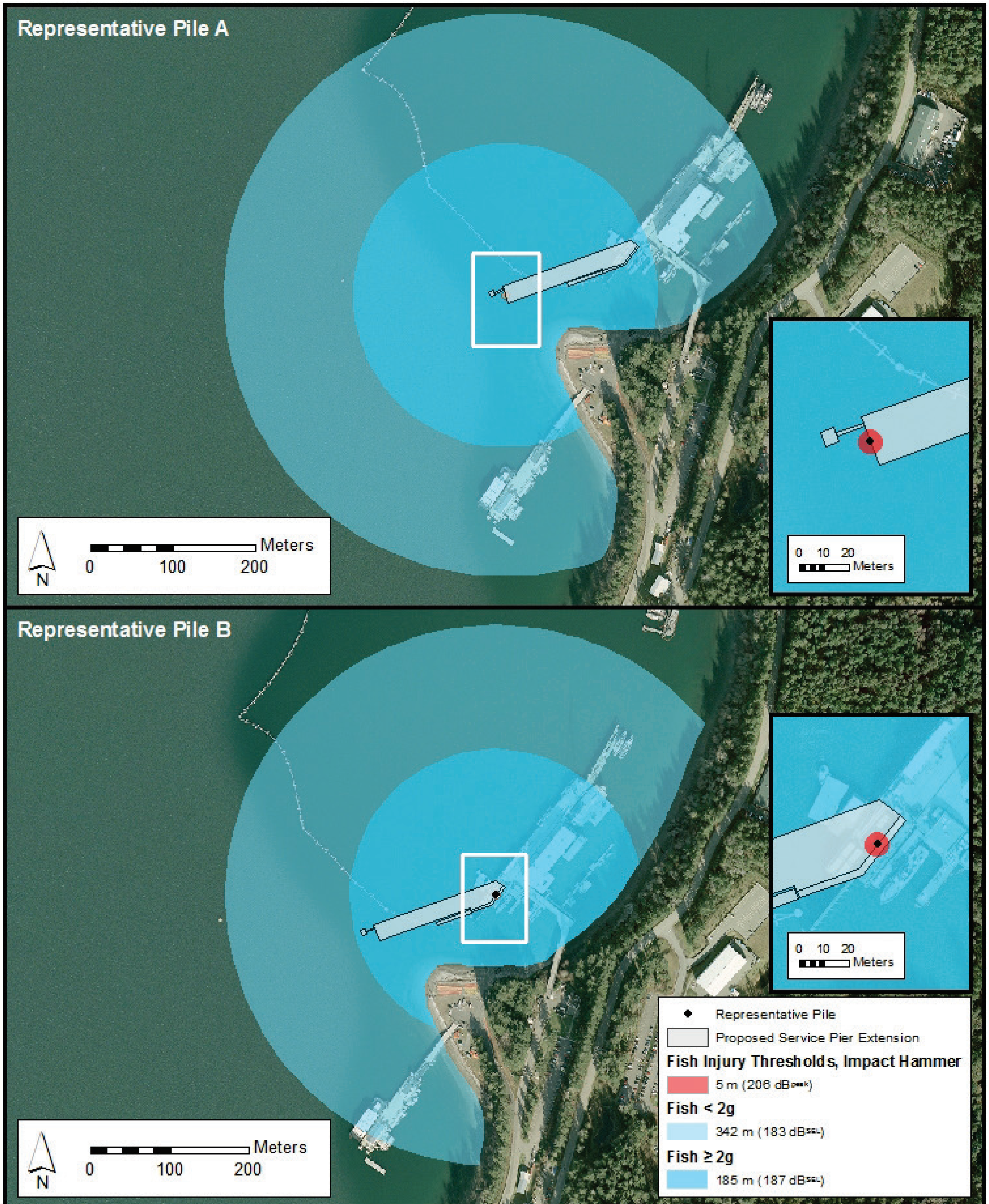


Figure 3.3-6a. Representative View for Fish Injury Threshold due to 36-inch Hollow Steel Pile Driving Noise during Construction of SPE Alternative 2

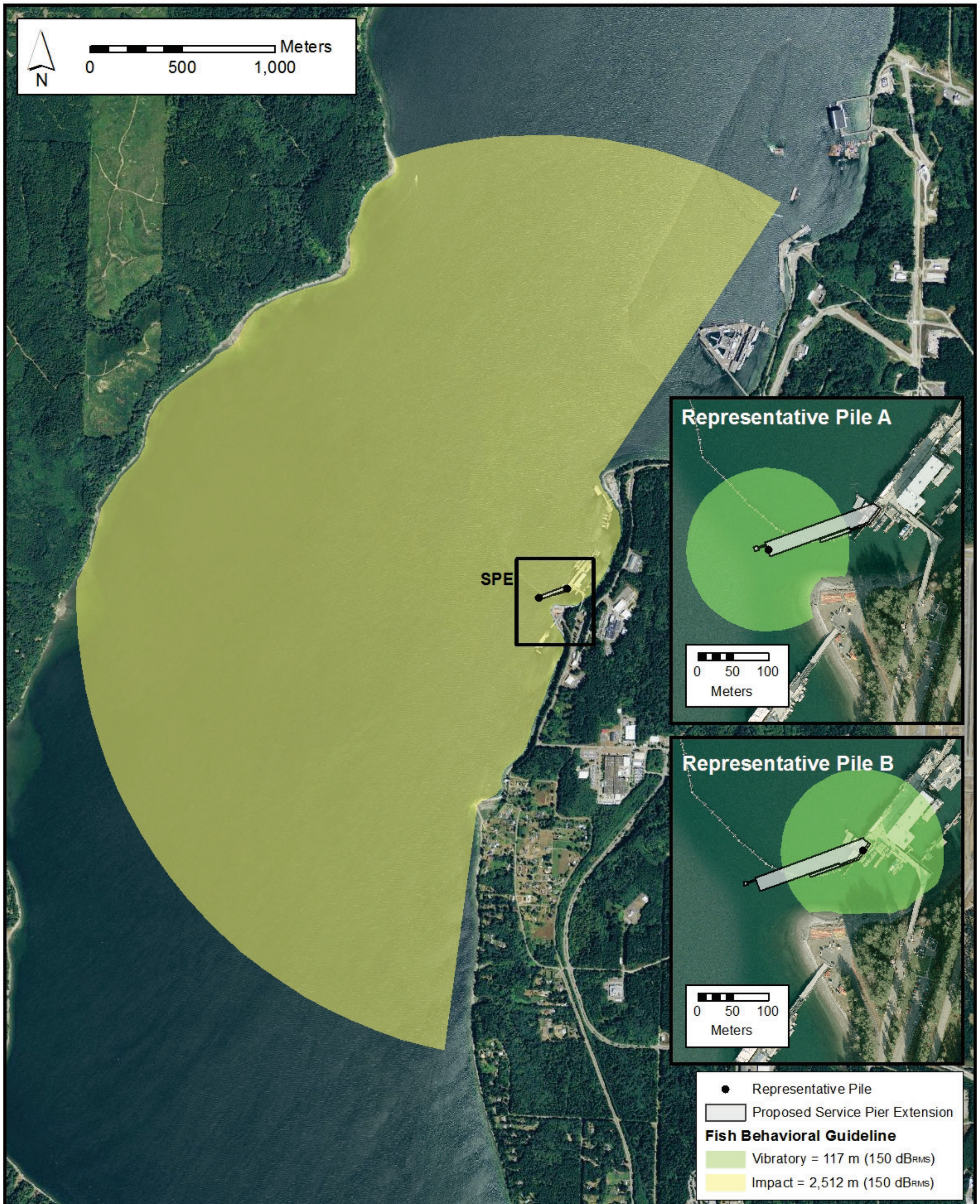


Figure 3.3-6b. Representative View for Fish Behavioral Guideline due to 36-inch Hollow Steel Pile Driving Noise during Construction of SPE Alternative 2

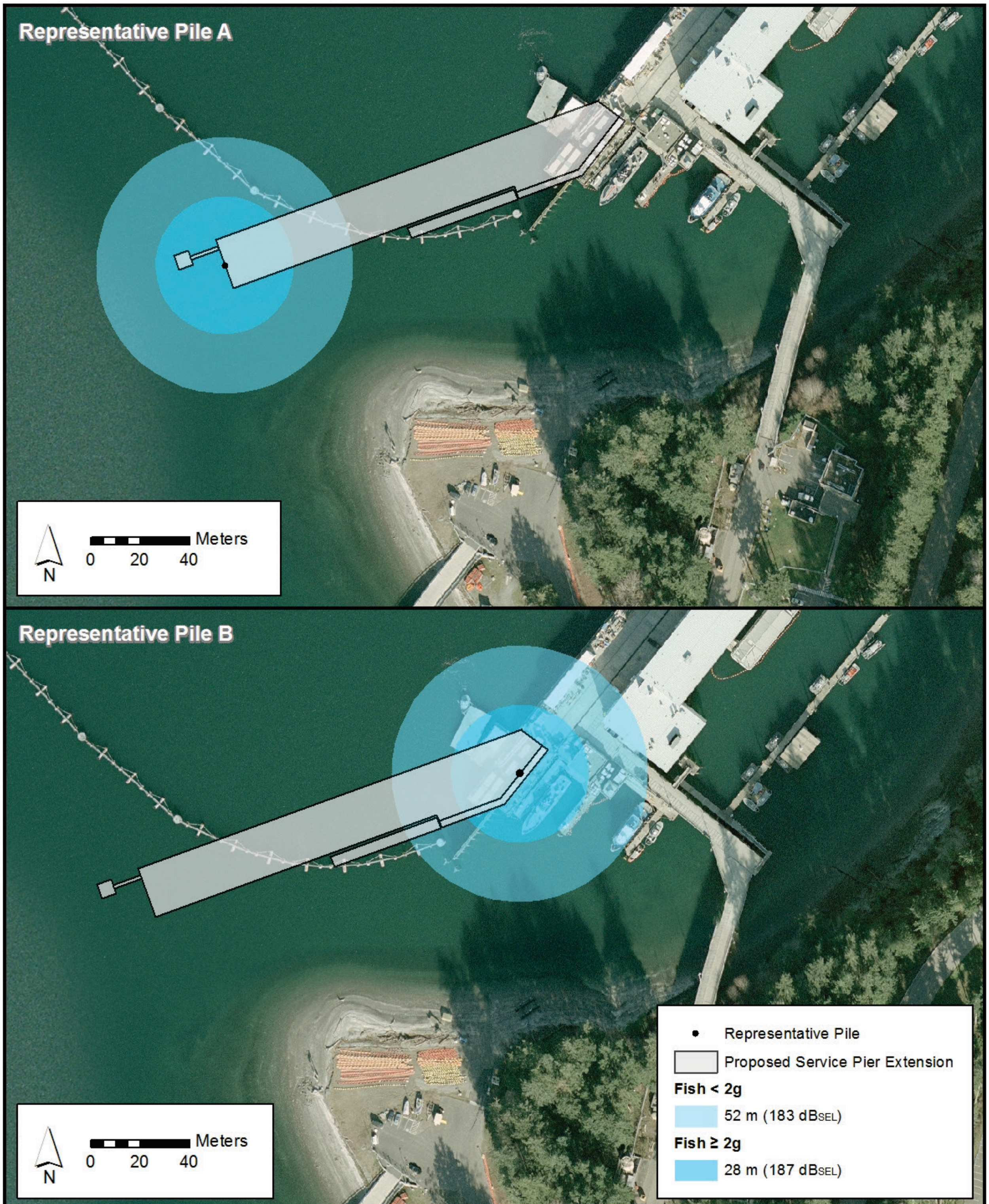


Figure 3.3-7a. Representative View for Fish Injury Guideline due to 18-inch Concrete Pile Driving Noise during Construction of SPE Alternative 2

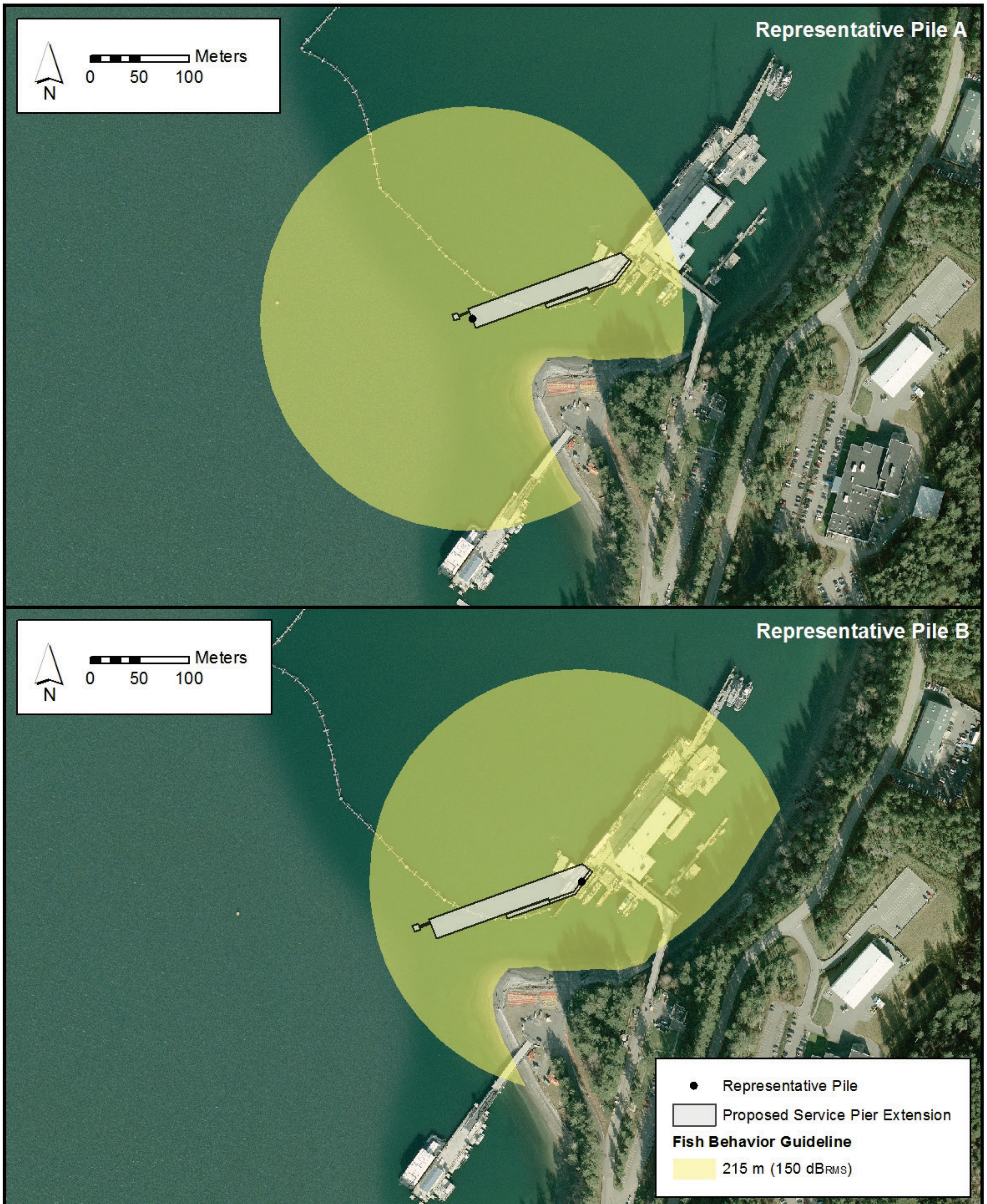


Figure 3.3-7b. Representative View for Fish Behavioral Guideline due to 18-inch Concrete Pile Driving Noise during Construction of SPE Alternative 2

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 vibratory driving ceases (NMFS 2014). 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 insignificant.

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 16 to January 15), these impacts would be minimized due to the low risk of exposure.

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 insignificant and discountable.

Nevertheless, construction activities for SPE Alternative 2 may affect Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer-run chum salmon, and bull trout. 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. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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).

Rockfish Habitat Requirements

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.

Underwater Noise

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.

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 vibratory driving ceases (NMFS 2014). 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 insignificant. 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 insignificant or discountable.

Nevertheless, construction activities under SPE Alternative 2 may affect bocaccio, canary rockfish, and yelloweye rockfish. 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. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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 3.3.1.3.9). 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 16 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 migrational 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 2012), 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.

Physical Habitat and Barriers

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.

<u>Biological Habitat</u>

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.

<u>Underwater Noise</u>

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.

Nevertheless, operation of SPE 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. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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 insignificant and discountable, and no population-level impacts are anticipated.

Nevertheless, operation of SPE Alternative 2 may affect bocaccio, canary rockfish, and yelloweye rockfish. No operational stressors associated with the proposed project are anticipated in designated critical habitats. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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). However, Pacific sand lance spawning occurs shoreward of the pier extension site (Figure 3.3–4, Section 3.3.1.3.9) (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.

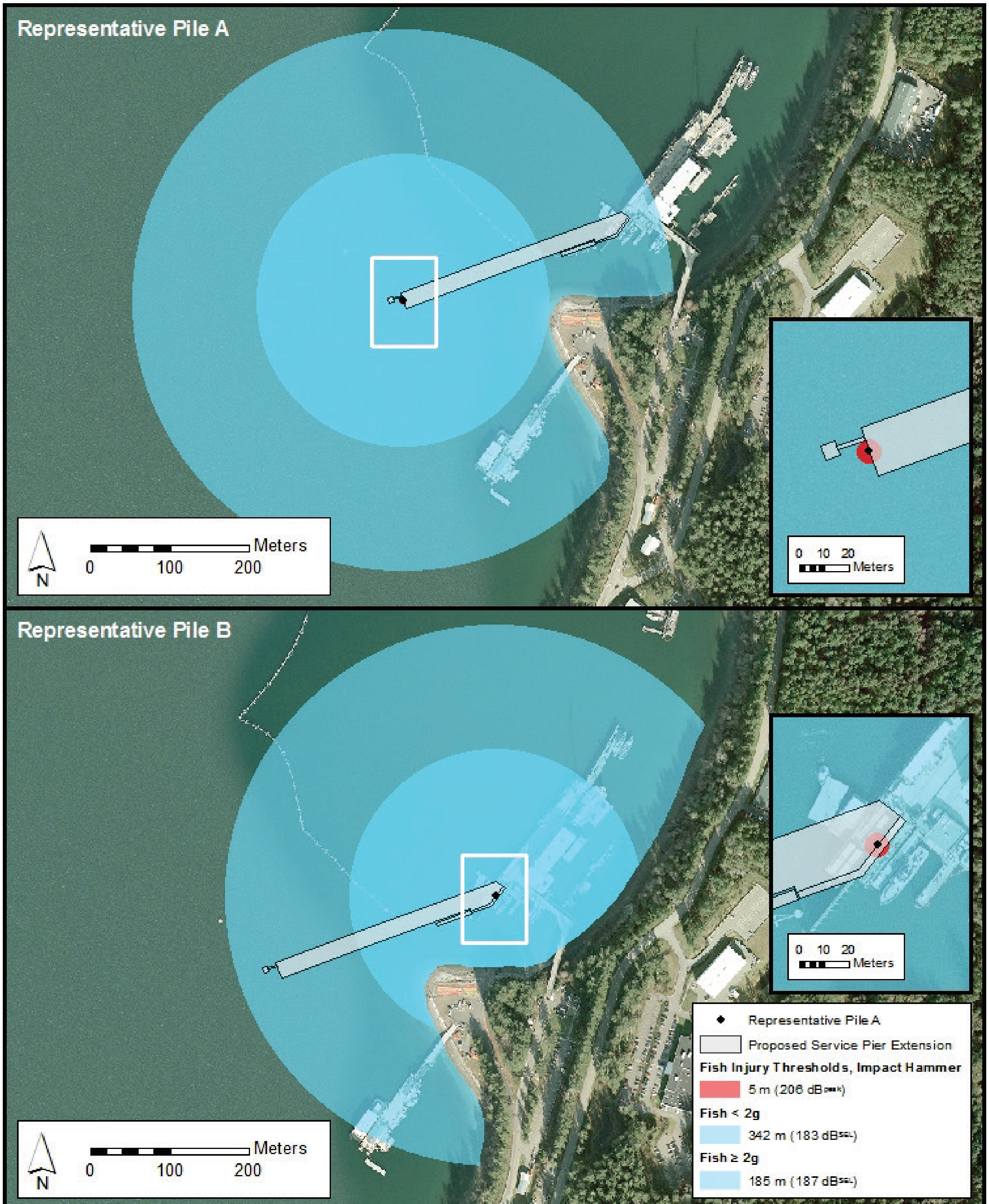


Figure 3.3-8a. Representative View for Fish Injury Threshold due to 24-inch Hollow Steel Pile Driving Noise during Construction of SPE Alternative 3

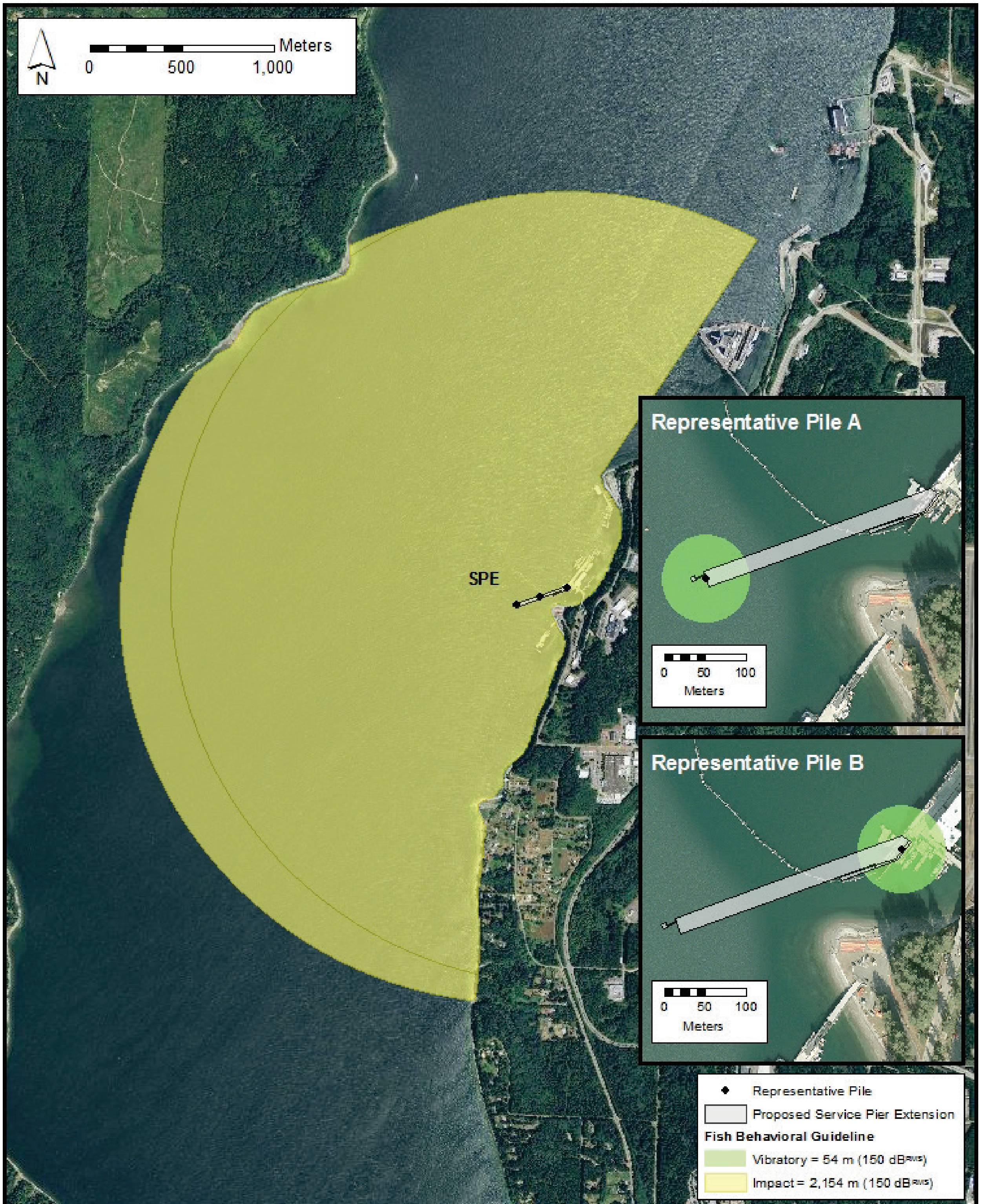


Figure 3.3-8b. Representative View for Fish Behavioral Guideline due to 24-inch Hollow Steel Pile Driving Noise during Construction of SPE Alternative 3

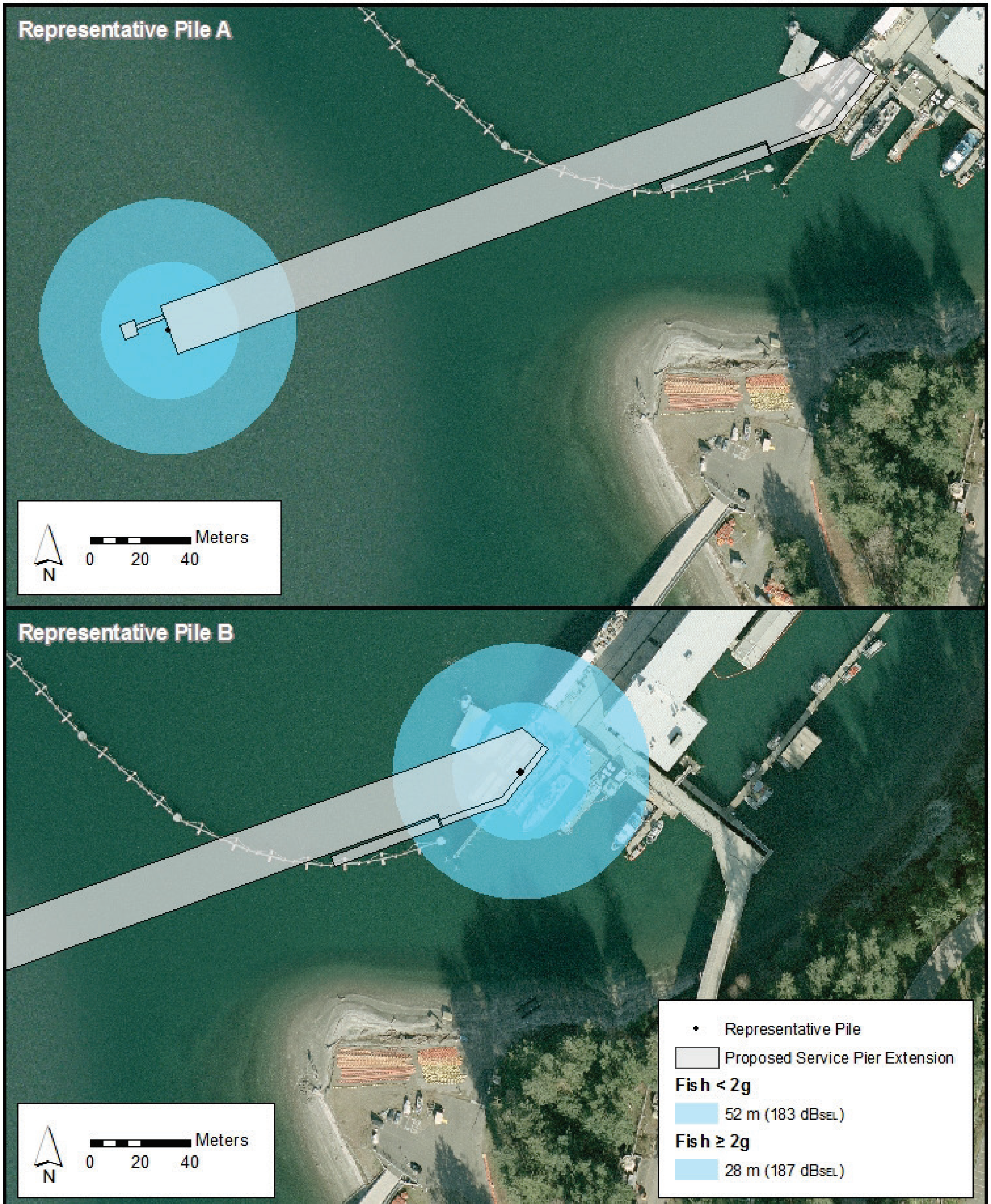


Figure 3.3-9a. Representative View for Fish Injury Guideline due to 18-inch Concrete Pile Driving Noise during Construction of SPE Alternative 3

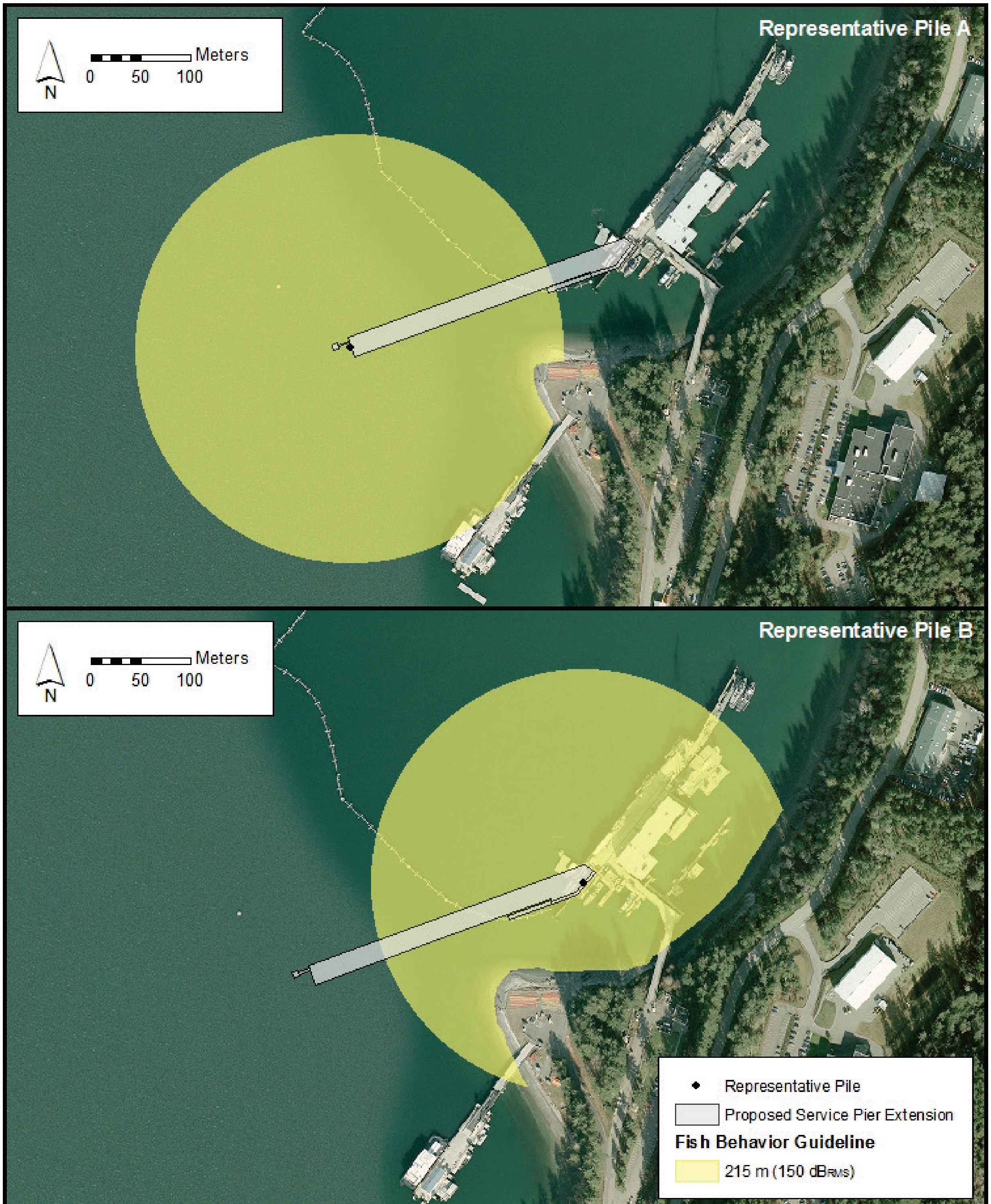


Figure 3.3-9b. Representative View for Fish Behavioral Guideline due to 18-inch Concrete Pile Driving Noise during Construction of SPE Alternative 3

<u>Summary of Impacts and ESA-Listed Salmonid Determination</u>

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 vibratory driving ceases (NMFS 2014). 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 insignificant.

Nevertheless, as with Alternative 2, construction activities under SPE Alternative 3 may affect Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer-run chum salmon; and bull trout. 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. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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.

Therefore, construction activities under SPE Alternative 3 may affect bocaccio, canary rockfish, and yelloweye rockfish. 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. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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.

Therefore, operation of SPE Alternative 3 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. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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.

Therefore, operation of SPE Alternative 3 may affect bocaccio, canary rockfish, and yelloweye rockfish. No operational stressors associated with the proposed project are anticipated in designated critical habitats. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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
Impact	
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” Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bull trout, bocaccio, canary rockfish, and yelloweye rockfish. *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.

Table 3.3–8. Summary of SPE Impacts on Fish (continued)

Alternative	Environmental Impacts on Fish
	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" Puget Sound Chinook salmon, Hood Canal summer-run chum salmon, Puget Sound steelhead, bull trout, bocaccio, canary rockfish, and yelloweye rockfish. *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 3.3.1.4.3. 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 will address 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 will be prepared and submitted to the NMFS West Coast Region office. A BA will be prepared and submitted to the NMFS West Coast Region office and the USFWS Washington Fish and Wildlife Office. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.	

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.

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.

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.

Current schedules call for construction of the two projects to not overlap but to occur sequentially, with LWI occurring first. The maximum number of days required for the LWI and SPE projects combined would be up to 285 (as low as 161 if pile driving for the two projects overlaps completely), with up to two in-water work seasons required for each project, for a total of four in-water work seasons under current schedules. 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 require for the SPE, depending on the alternative. If some of this work occurred concurrently for both LWI and SPE, the ranges to effect for pile driving noise could overlap, thus increasing the size of the total ensonified area. However, this would only be during instances when pile driving is conducted simultaneously at both sites; pile driving of the same type (e.g., impact proofing) would be relatively unlikely to occur at the same time. 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 occurs 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 migrational 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 migrational 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 of several mammalian orders that are adapted to life in the marine environment. 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. Other marine mammals such as sea otters and sirenians are not discussed in this section because they do not occur in the project area. 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 and California 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).

California sea lions and harbor seals are the most prevalent species of marine mammal in the vicinity of the Bangor waterfront. The Steller sea lion is present from fall to spring (late September to May), and the California sea lion is present from late summer to late spring (August to early June). Harbor seals are present year round in Hood Canal and occur regularly at NAVBASE Kitsap Bangor. Because these three species are predictably present at NAVBASE Kitsap Bangor during these periods, 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. 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.

Three 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 in Hood Canal and therefore is not 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, an individual was seen in Hood Canal over a three-week period in early 2012. However, since this sighting is an exception to the normal occurrence of this species in Washington inland waters, it is not included in this 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]	Late summer to late spring (August – early June)	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
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 crustaceans and zooplankton (consumed by gray whale) to fish (consumed by other 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

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 2014b

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.

surf smelt and 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 occurred 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).

Nearshore benthic habitats at the LWI project sites and the vicinity of the SPE project site support a variety of molluscs, annelid worms, and crustaceans (Section 3.2.1.1.3), some of which may be consumed by gray whales. However, based on the infrequent occurrence of gray whales in Hood Canal and the absence of any documented feeding events, the nearshore resources at the project sites do not appear to be utilized by this species.

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 81 California sea lions have been observed hauled out on docked submarines, the pontoons that support the PSB, and other structures (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; Navy 2014b). Harbor seals seldom haul out in the vicinity of NAVBASE Kitsap Bangor but 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).

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. However, neither existing structure provides a haul-out opportunity for pinnipeds. 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

The Service Pier is not accessible to pinnipeds although harbor seals occasionally haul out on nearby pontoons of the PSB.

3.4.1.1.2. THREATENED AND ENDANGERED MARINE MAMMAL SPECIES

The humpback whale has rarely been sighted in Hood Canal and is not included in the analysis. There would be no effect on the humpback whale from the Proposed Action. 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).

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 natural 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 2006), 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 2006).

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 AT THE LWI PROJECT SITES

Southern Resident killer whales have not been detected at the LWI project sites.

OCCURRENCE OF SOUTHERN RESIDENT KILLER WHALE AT THE SPE PROJECT SITE

Southern Resident killer whales have not been detected at the SPE project site.

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). There is no designated critical habitat for the species in Washington.

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) (Bhuthimethee 2008, personal communication; HDR 2012; Hart Crowser 2013; Navy 2014b). As many as 11 Steller sea lions have been reported on a given day at this location (Navy 2014b).

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 2014b), 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 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 2013 (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; HDR 2012; Hart Crowser 2013).

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 Hood Canal population has the latest pupping season in the region, with pupping typically extending from mid-July through December (Huber et al. 2001).

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 2010 (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a). Harbor seals accounted for the vast majority of marine mammal sightings during the TPP and EHW-2 construction projects (HDR 2012; Hart Crowser 2013). 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 2014b).

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 2014b). 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) from late August through early June on NAVBASE Kitsap Bangor (Agness and Tannenbaum 2009a; Tannenbaum et al. 2009a, 2011a; HDR 2012; Hart Crowser 2013; Navy 2014b).

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). Peak numbers of up to 1,000 sea lions occur in Puget Sound (including Hood Canal) during this time period (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 2013).

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., in preparation). 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 northern 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 for 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 2004). 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 2013).

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)
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 40 kHz[2] In-air: 25 Hz to 30 kHz[3]	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 2013
3. Source: Mulsow and Reichmuth 2010

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.

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 2013). 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 2013). 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 Southern Resident killer whales because of effects on their prey base. The Navy would prepare a biological assessment and request informal consultation with NMFS (West Coast Region Office) under the ESA because the proposed action would not be likely to affect this listed species. After consultation, NMFS would issue a letter of concurrence (for informal consultation) or a biological opinion (for formal consultation) that may place conditions on project construction and/or operation to minimize effects on ESA-protected species, including seasonal restrictions on construction.

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 would submit an IHA application to NMFSHQ for Level B harassment due to construction of the LWI and SPE.

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 effects determination in the following analysis is expressed in numbers of marine mammals exposed to harassment as a result of construction and operation of the LWI and SPE. The Navy will submit an application for an IHA from NMFSHQ under the MMPA [Sec. 101(a)(5)(D)], listing the estimated number of marine mammals exposed to harassment incidental to construction and operation of the project.

The ESA provides broad protection from take for listed species and their habitats, but the process of determining project effects is different from the MMPA process. For construction and operation of the LWI and SPE, the Navy is working with NMFS West Coast Region Office, including submittal of a biological assessment of the potential effects of the project on listed species and critical habitat, and also including an estimate of the exposure of listed species to project-related adverse effects and a justification of the effect determination for each species addressed. The agency will prepare a biological opinion that states, among other findings and conditions, the amount or extent of allowable incidental taking of listed species.

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 (July 16 through January 15). Harbor porpoises and transient killer whales also may occur at any time during the year. California sea lions are present during late summer and winter months, (about 5 out of the 6 months of the proposed in-water construction work), and Steller sea lions are present during fall and winter months (about 3.5 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). Some dolphin species approach vessels and are observed bow riding or jumping in the wake of a vessel (Norris and Prescott 1961; Shane et al. 1986; Würsig et al. 1998; Ritter 2002). 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) 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; adult/sub-adult 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. 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 (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. Therefore, the project's effect on Southern Resident killer whale prey base would be minimal. Nevertheless, Alternative 2 may affect Southern Resident killer whales; a final effect determination will be completed during ESA consultation and included in the Final EIS. No critical habitat for Southern Resident killer whales 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 Appendix D, 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 and observation post 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 July 16 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 D). 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 (2013) has recently developed 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 during summer 2014. 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 will 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.

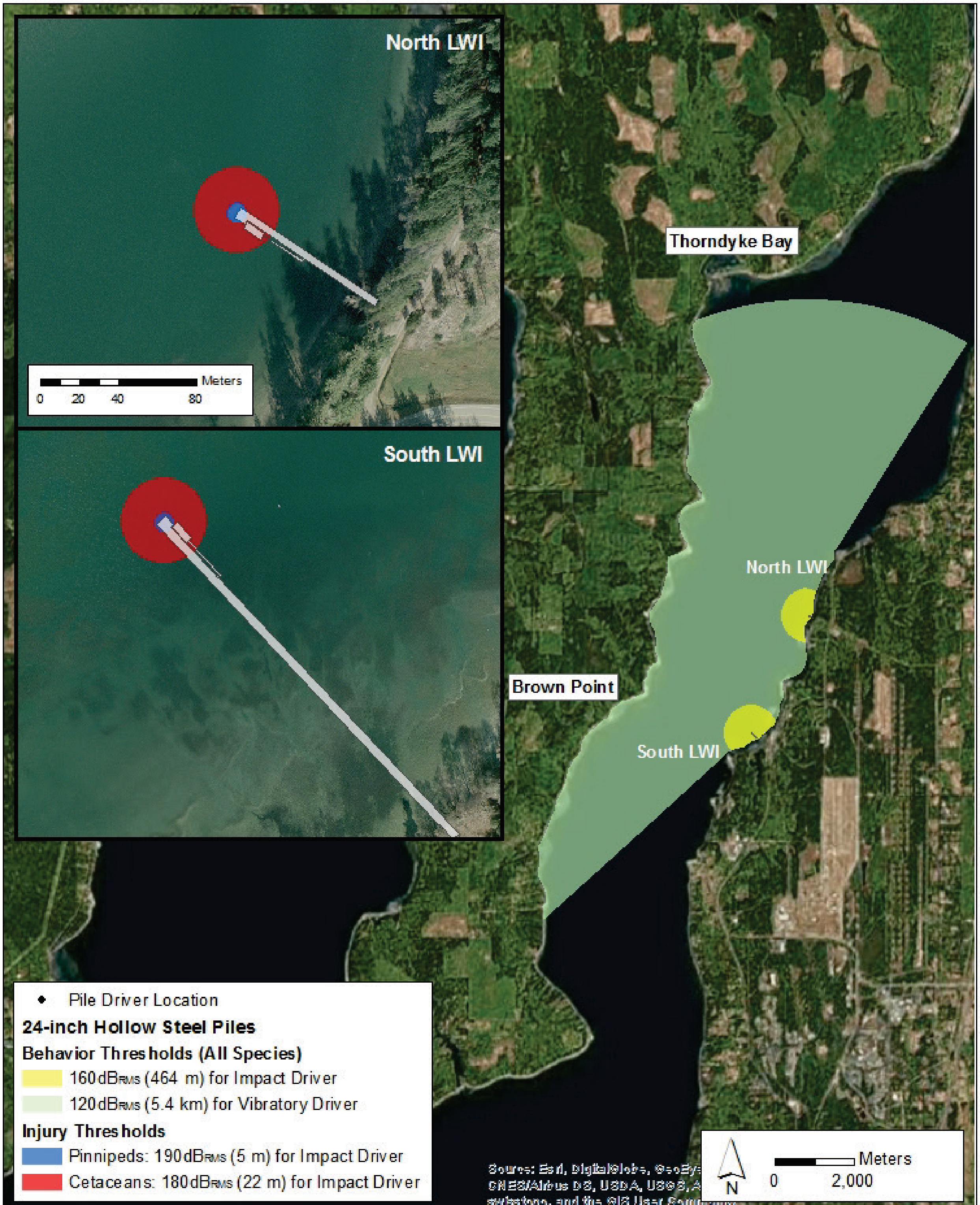


Figure 3.4-1. Representative View of Affected Areas for Marine Mammals Due to Underwater Pile Driving Noise during Construction of LWI Alternative 2

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.

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 17 24-inch steel piles driven in the dry at each 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 observation posts; 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.

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).

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.

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.

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

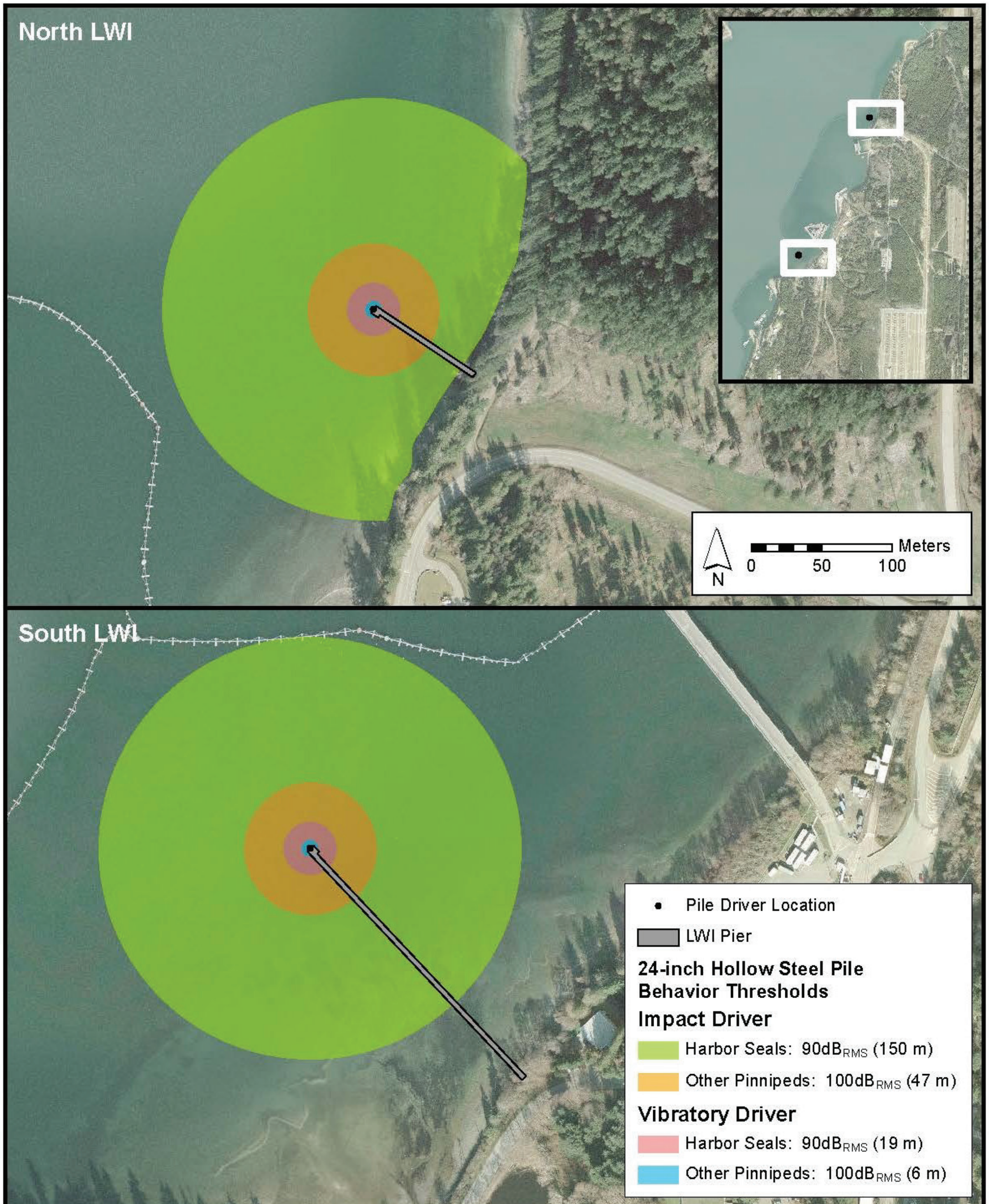


Figure 3.4-2. Representative View of Affected Areas for Marine Mammals due to Airborne Pile Driving Noise during Construction of LWI Alternative 2

forward in the noise effects analysis because its occurrence has not been confirmed in Hood Canal since 1995.

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 technical report documenting the processes and background data on densities for the Northwest region within the NMSDD is still in development. The calculations presented in this section rely on NMSDD data for marine mammals that occur in Hood Canal (Table 3.4–8), with the exception of Steller sea lions and California sea lions, for which site-specific abundance data are available from monitoring at NAVBASE Kitsap Bangor (see Tables 3.4–9 and 3.4–11, respectively; Navy 2014b), and transient killer whales (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.
- 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).

---

[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).

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 mid-April (Bhuthimethee 2008, personal communication; Navy 2014b). Most detections of Steller sea lions in Hood Canal have been individuals hauled out on submarines docked at Delta Pier (Navy 2014b). They have been present along the Bangor waterfront in less than 54 percent of surveys during any month since the survey effort began in April 2008 (Navy 2014b) (Table 3.4–9).

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 daily 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 2013. The abundance trend for Steller sea lions at Delta Pier has increased since they were first detected in November 2008.

Table 3.4–9. Steller Sea Lions Observed at NAVBASE Kitsap Bangor, April 2008–December 2013

Month	Number of Surveys with SSL Present	Number of Surveys	Frequency of SSL Occurrence at Survey Sites[1]	Daily Maximum Number	Monthly Average of Maximum Number Observed per Survey
January	12	47	0.26	3	1.5
February	7	51	0.14	2	1.4
March	12	47	0.26	3	1.8
April	21	69	0.30	6	2.3
May	6	73	0.08	6	1.5
June	0	73	0.00	0	0.0
July	0	67	0.00	0	0.0
August	0	67	0.00	0	0.0
September	2	58	0.03	5	0.8
October	30	69	0.43	9	3.7
November	37	65	0.57	11	5.7
December	18	54	0.33	4	2.6
Totals	145	740	Average 0.20	N/A	**2.0 (in-water work window only, 2008–2013)**

Source: Navy 2014b

SSL = Steller sea lion

1. Frequency of occurrence is defined as the number of surveys with Steller sea lions present divided by the number of surveys conducted.

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 2.0 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.

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.

Table 3.4–10. Number of Potential Exposures of Marine Mammals, 24-inch (60-centimeter) Steel Piles, LWI Alternative 2

Species	Underwater Behavioral Harassment	Airborne Behavioral Harassment
	All Species (120 dB RMS)	Harbor Seal (100 dB RMS), Other Pinnipeds (90 dB RMS)
Steller sea lion	160	0
California sea lion	2,680	0
Harbor seal	18,083	0
Harbor porpoise	336	N/A
Transient killer whale	11[1]	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

1. Transient killer whales remain in Hood Canal for extended periods on the rare occasions when they are present. Only 15 days of the pile driving in-water work window overlaps with documented sightings of transient killer whales in Hood Canal. Therefore, only 15 pile driving days were used in the calculation to determine potential exposures.

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 occur as a result of underwater rather than in-air exposures. Therefore, zero exposure to airborne pile driving noise was estimated 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 2014b). During the in-water construction period (July 16 to January 15), the largest daily attendance averaged for each month ranged from 1 to 71 individuals. The largest monthly average (71 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 0.77 (i.e., 77 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 daily 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 16 to January 15. The average of the monthly maximum number present during the in-water work window was approximately 33.5 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 33.5 individual California sea lions, the noise exposure formula above predicts 2,680 exposures to underwater noise within the behavioral harassment threshold for vibratory pile installation over the 80 days of pile driving.

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 occur as a result of underwater rather than in-air exposures. Therefore, zero exposure to airborne pile driving noise was estimated for California sea lions, and the total number of exposures over the entire pile driving period for this alternative is estimated to be 2,680 (all underwater) (Table 3.4–10).

Table 3.4–11. California Sea Lions Observed at NAVBASE Kitsap Bangor, April 2008–December 2013

Month	Number of Surveys with CSL Present	Number of Surveys	Frequency of CSL Occurrence at Survey Sites[1]	Daily Maximum Number	Monthly Average of Maximum Number Observed per Survey
January	36	47	0.77	44	31.0
February	44	51	0.86	48	39.2
March	45	47	0.96	82	53.3
April	57	69	0.83	66	43.2
May	58	73	0.79	54	24.5
June	17	73	0.23	17	7.4
July	1	67	0.01	3	0.5
August	12	67	0.18	5	2.2
September	34	58	0.59	35	22.8
October	65	69	0.94	88	57.8
November	65	65	1.00	122	70.5
December	44	54	0.81	69	49.6
Totals	478	740	Average 0.65	N/A	**33.5 (in-water work window only, 2008–2013)**

Source: Navy 2014b

CSL = California sea lion

1. Frequency of occurrence is defined as the number of surveys with California sea lions present divided by the number of surveys conducted.

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. The approximate correction factor for this count using haul-out probability from Figure 4 in London et al. 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, it yields a population estimate of 3,555 animals. This is the appropriate estimate of the Hood Canal harbor seal population size based upon published survey data and haul-out behavior.

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 226.05 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 2014b): (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 18,083 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 18,083 (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 4.2 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 336 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 336 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 small group may occur within the LWI behavioral disturbance ZOI. Based on the two sightings of transient killer whales that have occurred within Hood Canal (138.4 square miles [358.4 square kilometers]), the average pod size was 8.5 individuals. This results in an average density of 0.06 individuals/square mile (0.02 individuals/square kilometer).

The density used in the underwater sound exposure analysis was 0.06 individuals/square mile (0.02 individuals/square kilometer). Exposures to underwater pile driving noise were calculated using the formula in Section 3.4.2.2.2, under Underwater Noise, with the exception of number of pile driving days. Based on the documented residence times in Hood Canal, the groups remained in Hood Canal for an average of 116 days, with both sightings beginning in January. Since the in-water construction window ends on January 15 and does not pick back up until July, there are only 15 days of overlap in potential occurrence. Using a density of 0.06 individuals/square mile (0.02 individuals/square kilometer) and 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]), approximately 0.7 individual transient killer whales may experience sound pressure levels on a given day that would qualify as behavioral harassment. Over the 15 days of pile driving (that overlap with the in-water work window), the noise exposure formula above predicts 11 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]). Thus, the total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 11 individuals (all underwater) (Table 3.4-10).

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 and observation posts 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, in the overall context of the Hood Canal harbor seal and sea lion population ranges, the area affected by Alternative 3 would be too small to represent a significant impact on population numbers and distribution. As discussed for Alternative 2, the effect of Alternative 3 on the Southern Resident killer whale prey base would be insignificant, and not likely to adversely affect this species.

NOISE

As described in Section 2.1.1.3.3, Alternative 3 would require pile driving for the LWI abutments and observation posts. A total of 17 24-inch (60-centimeter) hollow steel piles would be driven at each LWI site, all of which 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 34 land-installed piles for Alternative 2 compared with 34 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 24-inch (60-centimeter) hollow steel piles, the thresholds for airborne impact pile driving noise would be reached at 492 feet (150 meters) for harbor seals and 154 feet (47 meters) for other pinnipeds (Table 3.4–12). Thresholds for vibratory pile driving would occur at shorter distances from the driven pile (62 feet [19 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]	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 for vibratory driver for 24-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

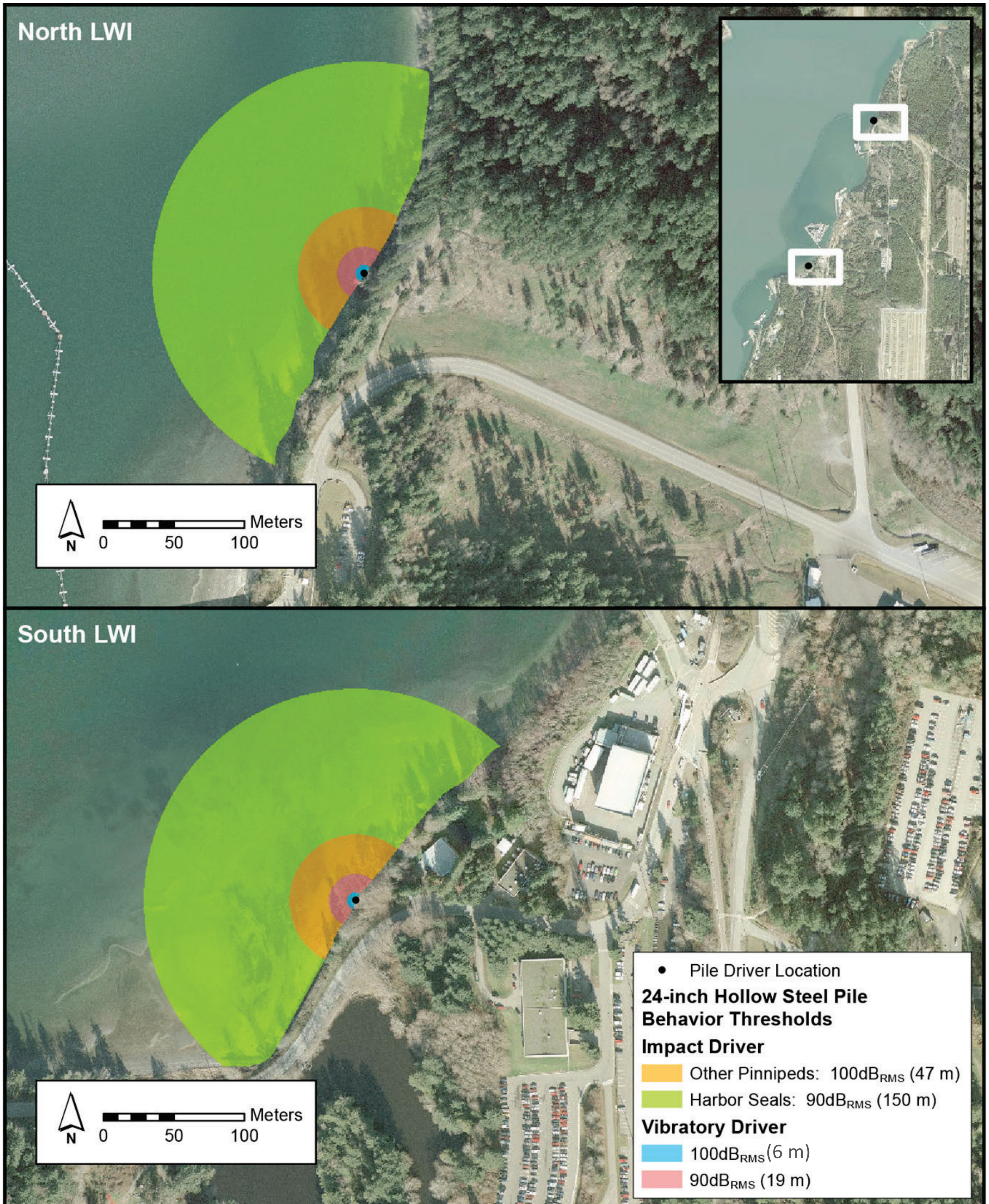


Figure 3.4-3. Representative View of Affected Areas for Marine Mammals due to Airborne Pile Driving Noise during LWI Construction, Alternative 3

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 (0.0016 acre [0.0006 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.

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.

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
Impact	
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 Southern Resident killer whale is “may affect”.
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. *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 Southern Resident killer whale is “may affect”.
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 will consult with the NMFS West Coast Region Office on the Southern Resident killer whale under the ESA. Final effect determinations for the Southern Resident Killer whale and its critical habitat will be completed during consultation and included in the Final EIS.	

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 16 through January 15). Harbor porpoise and transient killer whales also may occur at any time during the year. California sea lions are present from late summer through the winter months (about 5 out of the 6 months of in-water construction work), and Steller sea lions are present during fall through winter months (about 3.5 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 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). 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. Nevertheless, Alternative 3 may affect this species; a final effect determination will be completed during ESA consultation and included in the Final EIS. No critical habitat for Southern Resident killer whales 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 (2013) 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.

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.

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 will 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.

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.

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.

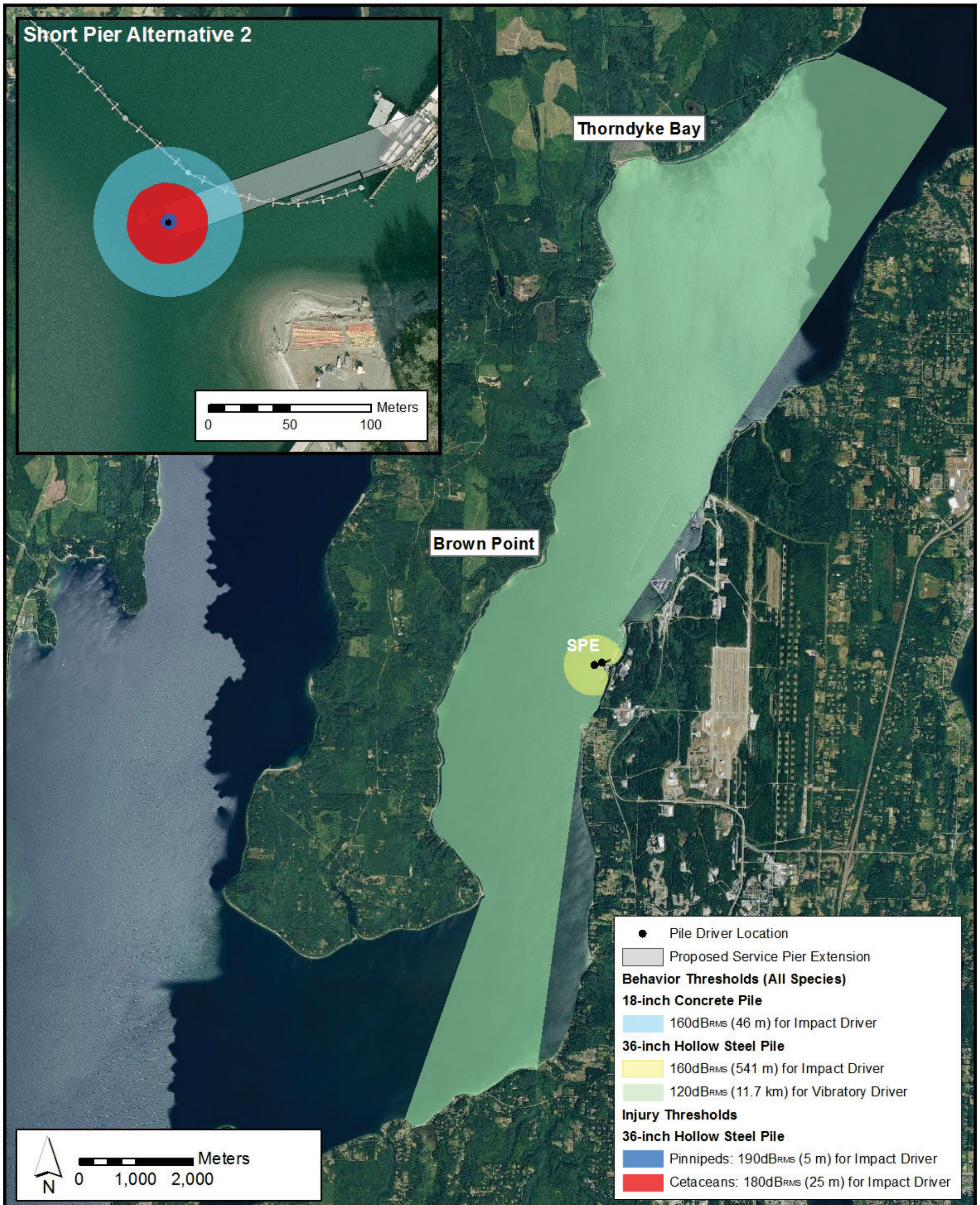


Figure 3.4-4. Representative View of Affected Areas for Marine Mammals due to Underwater Pile Driving Noise during Construction of SPE Alternative 2

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).

Impact pile driving noise 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.

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.

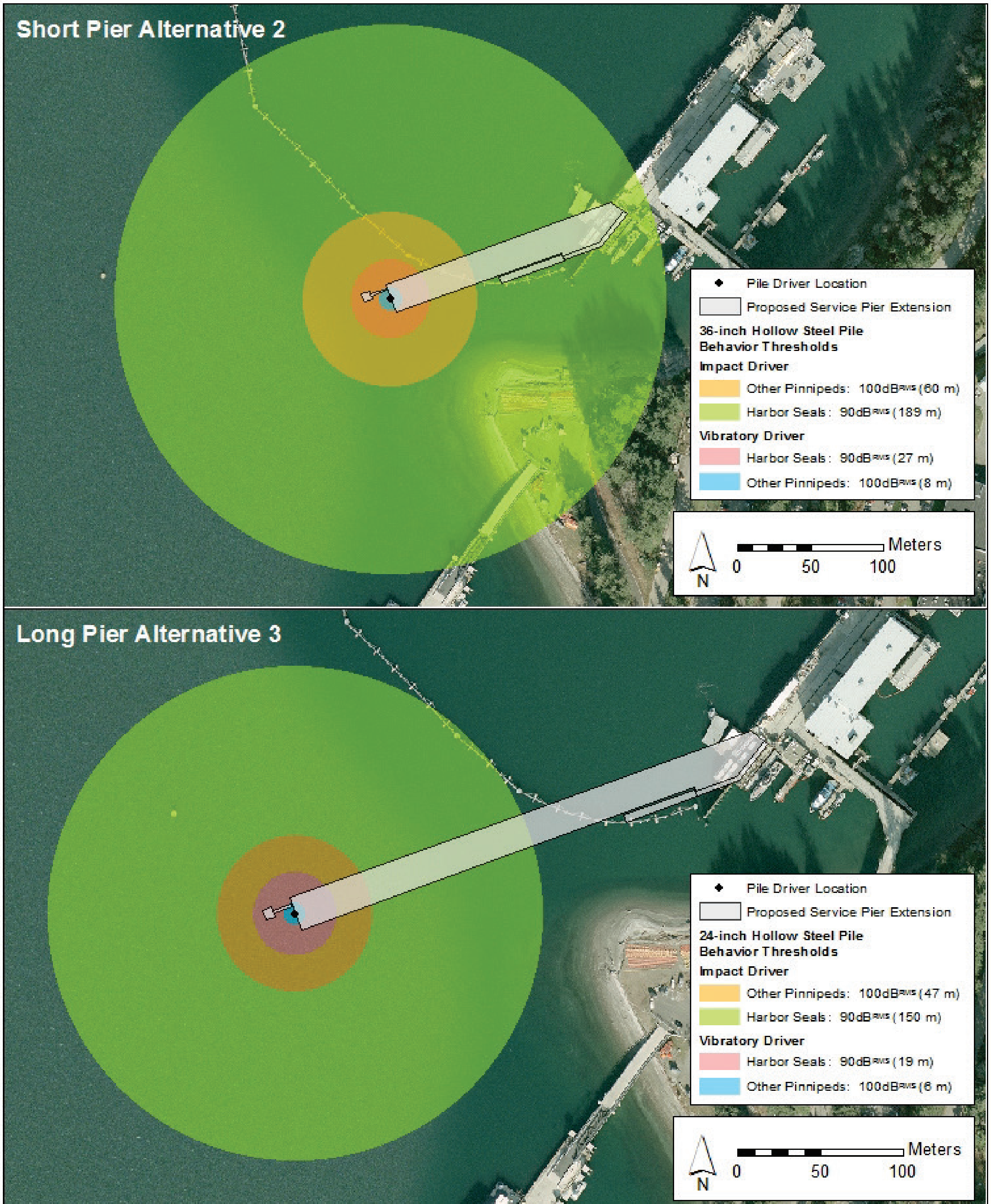


Figure 3.4-5. Representative View of Affected Areas for Marine Mammals due to Airborne Pile Driving Noise during Construction of SPE Alternatives 2 and 3

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.

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 technical report documenting the processes and background data for the densities for the Northwest region within the NMSDD is still in development. The calculations presented in this section rely on NMSDD data for all marine mammals that occur in Hood Canal (Table 3.4–17), with the exception of Steller sea lions and California sea lions, for which site-specific abundance data are available from monitoring at NAVBASE Kitsap Bangor (see Tables 3.4–18 and 3.4–20, respectively; Navy 2014b) and transient killer whale (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) will 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 mid-April (Bhuthimethee 2008, personal communication; Navy 2014b). Most detections of Steller sea lions in Hood Canal have been individuals hauled out on submarines docked at Delta Pier (Navy 2014b). They have been present along the Bangor waterfront in less than 54 percent of surveys during any month since the survey effort began in April 2008 (Navy 2014b) (Table 3.4–18).

Table 3.4–18.Steller Sea Lions Observed at NAVBASE Kitsap Bangor, April 2008–December 2013

Month	Number of Surveys with SSL Present	Number of Surveys	Frequency of SSL Occurrence at Survey Sites[1]	Daily Maximum Number	Monthly Average of Maximum Number Observed per Survey
January	12	47	0.26	3	1.5
February	7	51	0.14	2	1.4
March	12	47	0.26	3	1.8
April	21	69	0.30	6	2.3
May	6	73	0.08	6	1.5
June	0	73	0.00	0	0.0
July	0	67	0.00	0	0.0
August	0	67	0.00	0	0.0
September	2	58	0.03	5	0.8
October	30	69	0.43	9	3.7
November	37	65	0.57	11	5.7
December	18	54	0.33	4	2.6
Totals	145	740	Average 0.20	N/A	**2.0 (in-water work window only, 2008–2013)**

Source: Navy 2014b

SSL = Steller sea lion

1. Frequency of occurrence is defined as the number of surveys with Steller sea lions present divided by the number of surveys 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 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 daily 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 2013. 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 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 2.0 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, 36-inch (90-centimeter) Steel Piles and 18-inch (45-centimeter) Concrete Piles, 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	4,188	1,206	0
Harbor seal	49,575	2	0
Harbor porpoise	938	0	N/A
Transient killer whale	18[1]	0[1]	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

1. Transient killer whales remain in Hood Canal for extended periods on the rare occasions when they are present. Only 15 days of each pile driving in-water work season overlap with documented sightings of transient killer whales in Hood Canal. Therefore, only 15 pile driving days for each in-water work season were used in the calculation to determine potential exposures.

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, pinniped takes would occur as a result of underwater exposures rather than in-air exposures. No pile driving noise source levels were available for 18-inch (45-centimeter) concrete pile in this analysis. Since underwater source levels for 18-inch concrete pile were much lower than 36-inch (90-centimeter) steel pile source levels and the ZOI for pinnipeds is very small, it is likely that concrete piles would produce zero exposures to behavioral harassment due to airborne noise. Therefore, the total number of exposures 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 will 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 16 to January 15), the largest daily attendance averaged for each month ranged from 1 to 71 individuals. The largest monthly average (71 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 0.77 (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 16 to January 15. From April 2008 through December 2013 the average of the monthly maximum number present during the in-water work window was approximately 33.5 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 33.5 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 4,188 exposures 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 1,206 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). Zero exposure to airborne pile driving noise was estimated for California sea lions, and the total number of exposures over the entire pile driving period for this alternative is estimated to be 5,394 (all underwater) (Table 3.4–19).

Table 3.4–20. California Sea Lions Observed at NAVBASE Kitsap Bangor, April 2008–December 2013

Month	Number of Surveys with CSL Present	Number of Surveys	Frequency of CSL Occurrence at Survey Sites[1]	Daily Maximum Number	Monthly Average of Maximum Number Observed per Survey
January	36	47	0.77	44	31.0
February	44	51	0.86	48	39.2
March	45	47	0.96	82	53.3
April	57	69	0.83	66	43.2
May	58	73	0.79	54	24.5
June	17	73	0.23	17	7.4
July	1	67	0.01	3	0.5
August	12	67	0.18	5	2.2
September	34	58	0.59	35	22.8
October	65	69	0.94	88	57.8
November	65	65	1.00	122	70.5
December	44	54	0.81	69	49.6
Totals	478	740	Average 0.65	N/A	**33.5 (in-water work window only, 2008–2013)**

Source: Navy 2014b

CSL = California sea lion

1. Frequency of occurrence is defined as the number of surveys with Steller sea lions present divided by the number of surveys 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.

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). 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, pinniped takes would occur as a result of underwater exposures rather than in-air exposures.

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. The approximate correction factor for this count using haul-out probability from Figure 4 in London et al. 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, it yields a population estimate of 3,555 animals.

This is the appropriate estimate of the Hood Canal harbor seal population size based upon published survey data and haul-out behavior.

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 396.6 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 2014b): (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 49,575 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 two 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 49,577 (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 occur as a result of underwater exposures rather than in-air 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 7.5 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 938 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 938 (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 the SPE project in the event that a small group may occur within the LWI behavioral disturbance ZOI. Based on the two sightings of transient killer whales that have occurred within Hood Canal (138.4 square miles [358.4 square kilometers]), the average pod size was 8.5 individuals. This results in an average density of 0.06 individuals/square mile (0.02 individuals/square kilometer).

The density used in the underwater sound exposure analysis was 0.06 individuals/square mile (0.02 individuals/square kilometer). Exposures to underwater pile driving noise were calculated using the formula in Section 3.4.2.2.2, under Underwater Noise, with the exception of number of pile driving days. Based on the documented residence times in Hood Canal, the groups remained in Hood Canal for an average of 116 days, with both sightings beginning in January. Since the in-water construction window ends on January 15 and does not pick back up until July, there are only 15 days of overlap in potential occurrence for each in-water work season.

Based on a density value of 0.06 individuals/square mile (0.02 individuals/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 1.2 individual transient killer whales may experience sound pressure levels on a given day that would qualify as behavioral harassment. Over the 15 days of pile driving of 36-inch (90-centimeter) steel piles (that overlap with the species occurrence), the noise exposure formula above predicts 18 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 15 days of concrete pile driving (that overlap with the species occurrence), 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 18 (all underwater) (Table 3.4–19).

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.

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.

Nevertheless, Alternative 3 may affect the ESA-listed Southern Resident killer whale; a final effect determination will be completed during ESA consultation.

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.

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.

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.

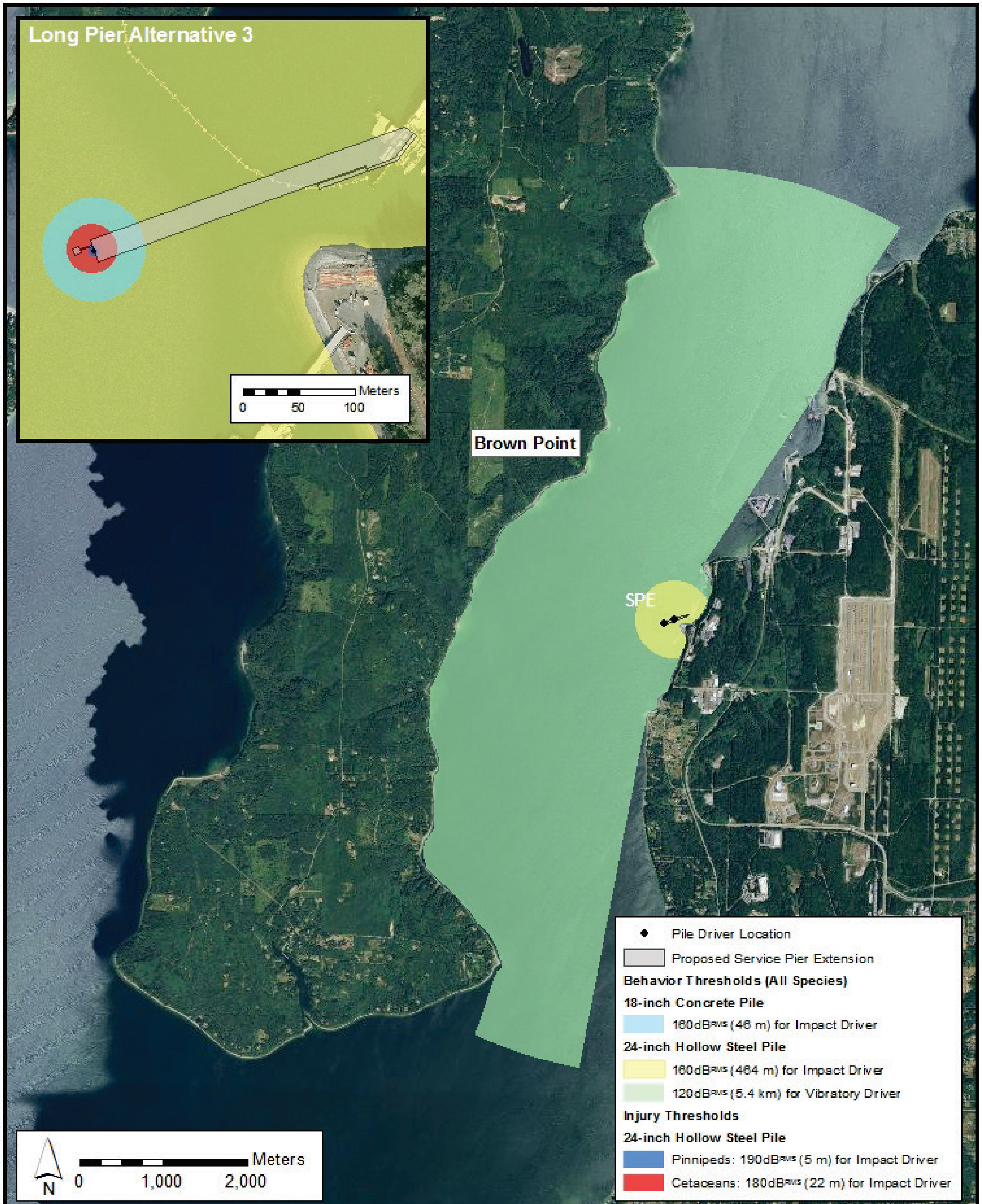


Figure 3.4-6. Representative View of Affected Areas for Marine Mammals due to Underwater Pile Driving Noise during Construction of SPE Alternative 3

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	4,188	1,206	5,394	5,193	1,675	6,868
Harbor seal	49,575	2	49,577	30,578	3	30,581
Harbor porpoise	938	0	938	558	0	558
Transient killer whale	18[1]	0	18	3[1]	0	3
Total	**54,969**	**1,280**	**56,249**	**36,642**	**1,778**	**38,420**

dB = decibel; RMS = root mean square

1. Transient killer whales remain in Hood Canal for extended periods on the rare occasions when they are present. Only 15 days of each pile driving in-water work season overlap with documented sightings of transient killer whales in Hood Canal.

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).

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, pinniped takes would occur as a result of underwater exposures rather than in-air 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 2.0 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 occur as a result of underwater exposures rather than in-air exposures. Since zero exposure to airborne pile driving noise was estimated for Steller sea lions, 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 33.5 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 5,193 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 1,675 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 occur as a result of underwater exposures rather than in-air exposures. Since zero exposure to airborne pile driving noise was estimated for California sea lions, and the total number of exposures over the entire pile driving period for this alternative is estimated to be 6,868 (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 197.3 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 2014b): (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 30,578 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 three 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 occur as a result of underwater exposures rather than in-air exposures. Therefore, the total number of exposures to potential behavioral harassment over the entire pile driving period for this alternative is estimated to be 30,581 (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 3.6 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 558 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 558 (Table 3.4–22).

Transient Killer Whale

The density used in the underwater sound exposure analysis was 0.06 individuals/square mile (0.02 individuals/square kilometer). Exposures to underwater pile driving noise were calculated using the formula in Section 3.4.2.2.2, under Underwater Noise, with the exception of number of pile driving days. Based on the documented residence times in Hood Canal, the groups remained in Hood Canal for an average of 116 days, with both sightings beginning in January. Since the in-water construction window ends on January 15 and does not pick back up until July, there are only 15 days of overlap in potential occurrence for each in-water work season.

Based on a density value of 0.06 individuals/square mile (0.02 individuals/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 0.2 individual transient killer whales may experience sound pressure levels on a given day that would qualify as behavioral harassment. Over the 15 days of pile driving of 24-inch (60-centimeter) steel piles (that overlap with the species occurrence), the noise exposure formula above predicts 3 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 15 days of concrete pile driving (that overlap with the species occurrence), 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 3 (all underwater) (Table 3.4–22).

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
Impact	
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 Southern Resident killer whale is “may affect”.
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 will occur if a marine mammal approaches the zone. *ESA:* Effect determination for the Southern Resident killer whale is “may affect”.
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 will submit an IHA application to NMFSHQ for the construction of the SPE project. The Navy will consult with the NMFS West Coast Region Office on the Southern Resident killer whale under the ESA. Final effect determinations for the Southern Resident Killer Whale and its critical habitat will be completed during consultation and included in the Final EIS.	

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	72–100	322–570
California sea lion	4,188–7,873	1,206–1,675	5,394–9,548
Harbor seal	30,578–67,658	2-3	30,580–67661
Harbor porpoise	558–1,274	0	558-1,274
Transient killer whale	3–26	0	3-26
Total	**35,577–77,301**	**1,280–1,778**	**36,857–79,079**

dB = decibel

This page is intentionally blank.

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

<table>
<tr><th colspan="2">Habitat Type</th><th>Habitat Values</th><th>Characteristic Species</th></tr>
<tr><td colspan="2">Estuaries</td><td>Estuarine habitat has value for foraging, loafing, social interaction, and brood-rearing activities for a variety of marine waterfowl and seabirds.</td><td rowspan="2">Killdeer, sandpiper species, glaucous-winged gull, other gull species, raptors, great blue heron</td></tr>
<tr><td rowspan="2">Nearshore Marine</td><td>Intertidal Zone</td><td>Intertidal habitat has value for foraging activities of shorebirds and gulls, in addition to nesting habitat for breeding shorebirds (killdeer).</td></tr>
<tr><td>Subtidal Zone</td><td>Subtidal habitat has value for foraging, loafing, social interaction, and brood-rearing activities for a variety of marine waterfowl and seabirds.</td><td>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</td></tr>
<tr><td colspan="2">Marine Deeper Water</td><td>Deeper water habitat has value for foraging, loafing, and social interactions of marine waterfowl and seabirds.</td><td>Surf scoter, white-winged scoter, Barrow’s goldeneye, common goldeneye, double-crested and pelagic cormorants, pigeon guillemot, marbled murrelet, and glaucous-winged gull</td></tr>
<tr><td colspan="2">Manmade Structures</td><td>Manmade structures have value for roosting activities of select seabirds, and foraging of marine waterfowl and seabirds on the underwater piles of structures.</td><td>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</td></tr>
</table>

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 directly be compared 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 7 24-inch piles (observation post piles) would be driven in-the-dry from the shore, and 10 24-inch piles (abutment piles) would be driven on shore at both the north and south sites, respectively. 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 16 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

dB=decibel; re 1 µPa = referenced at 1 micropascal; sec = second; SEL= sound exposure level

Table 3.5–6. LWI Alternative 2 Calculated Ranges to Effect

	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.

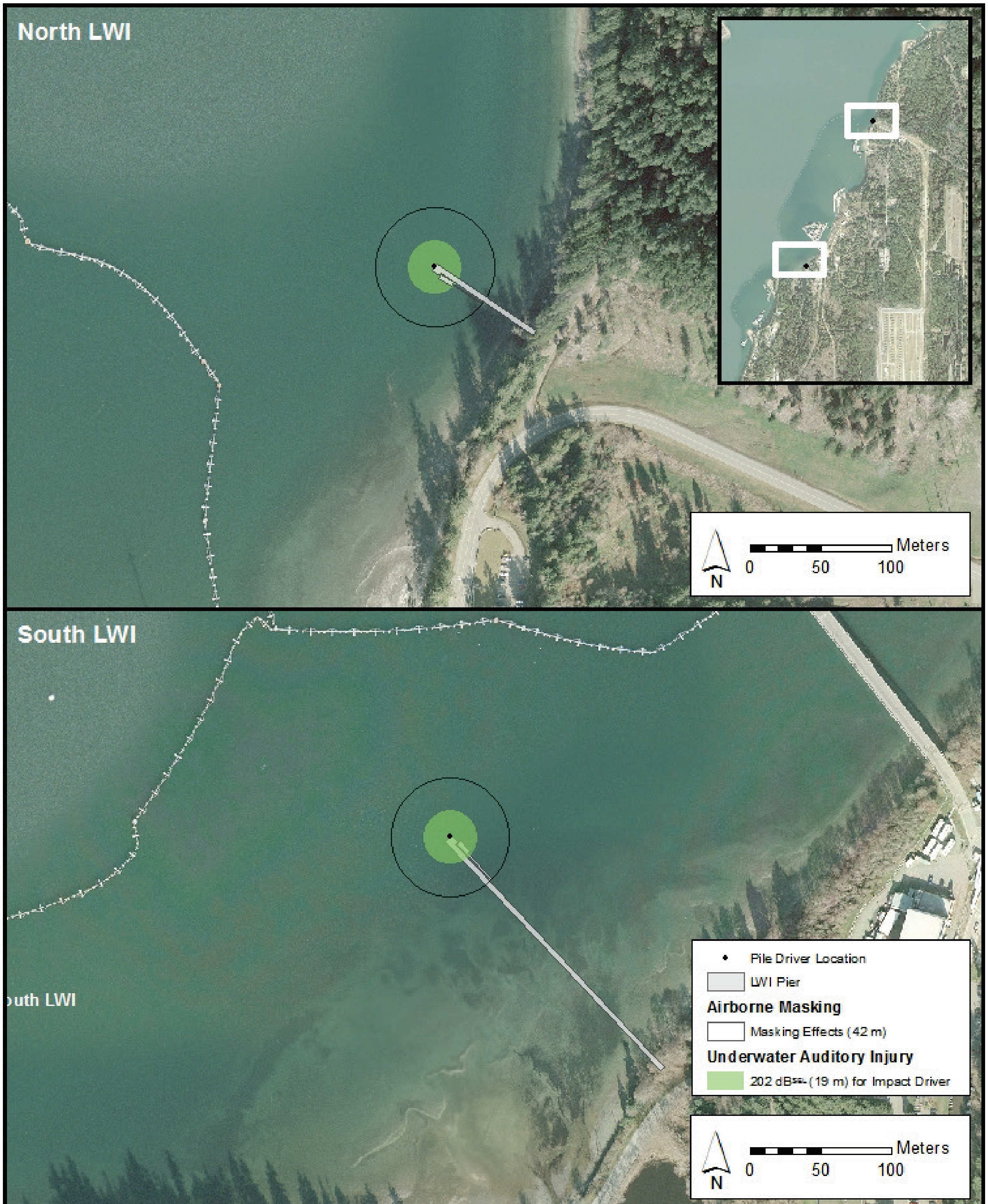


Figure 3.5-1. Representative View of Affected Areas for Marbeled Murrelet due to Underwater and Airborne Pile Driving Noise during Construction of LWI Alternative 2

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 would be associated with impact proofing of steel piles (Table 3.5-5). Airborne noise from vibratory driving is estimated to be 89 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, stairways, and observation posts; 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. 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). 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. As with underwater noise, the method of calculating masking distance is detailed in Appendix D.

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, construction activities under LWI Alternative 2 may affect marbled murrelets. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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, observation posts, 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 0.05 acre [0.02 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, operation of LWI Alternative 2 may affect marbled murrelets. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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 and observation posts described for LWI Alternative 2, 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 and observation posts. A total of 17 24-inch (60-centimeter) hollow steel piles would be driven at each LWI site, all of which 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 (34 land-installed piles for Alternative 3 compared with 136 permanent in-water piles, 120 temporary in-water piles, and 34 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, construction activities under LWI Alternative 3 may affect marbled murrelets. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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 (0.061 acre [0.024 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, operation of LWI Alternative 3 may affect marbled murrelets. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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
Impact	
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.
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.

Table 3.5–7. Summary of LWI Impacts on Marine Birds (continued)

Alternative	Environmental Impacts on Marine Birds
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 will consult with USFWS Washington Fish and Wildlife Office on the marbled murrelet under the ESA. Effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.	

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.

3.5.2.3.1. 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 Alterative 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 one potential nest tree may be removed.

Figure 3.5-3. Proposed SPE Parking Lot Area

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.

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. SPE Alternative 2 Calculated Ranges to Effect

	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.

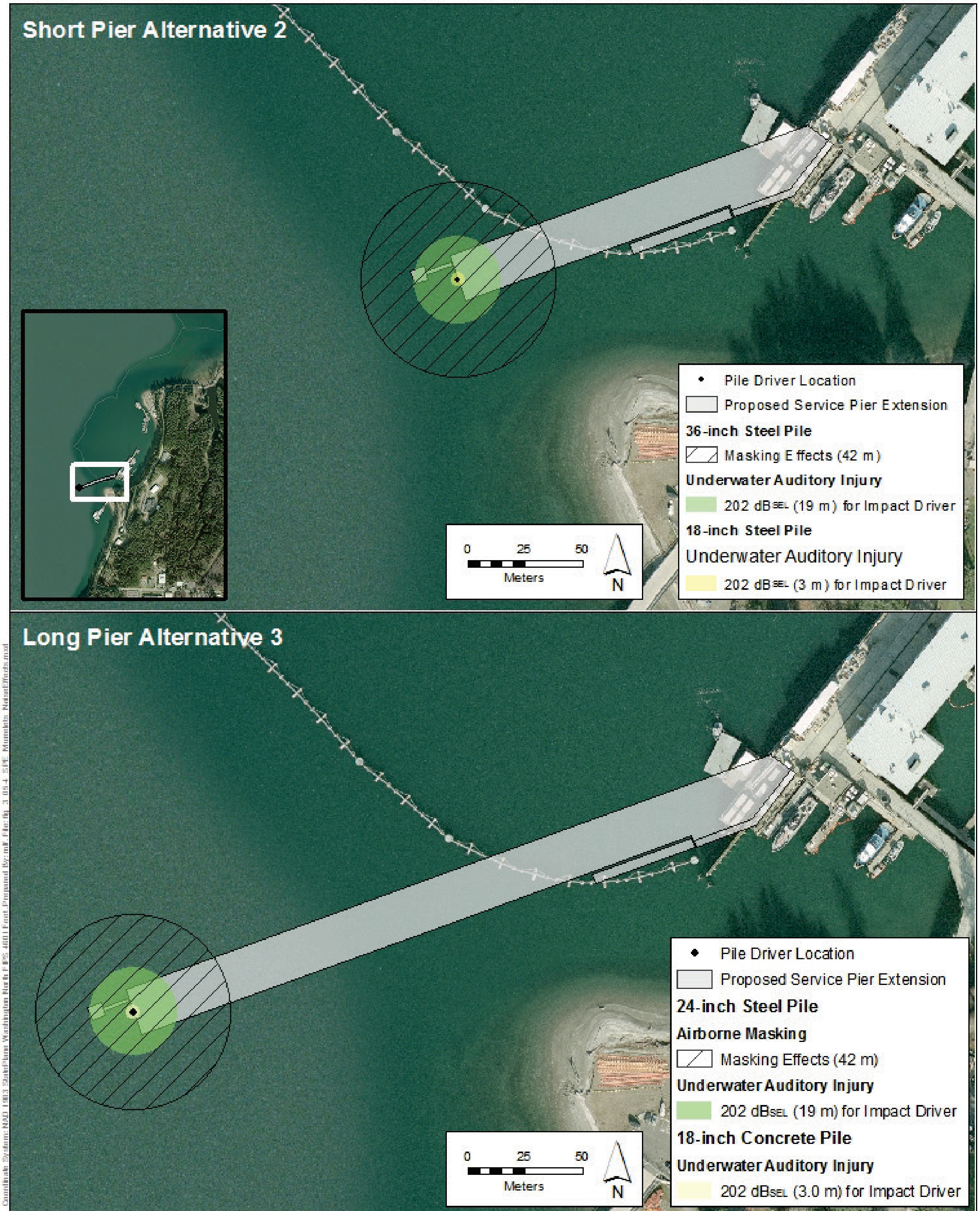


Figure 3.5-4. Representative View of Affected Areas for Marbled Murrelets due to Underwater and Airborne Pile Driving Noise during Construction of SPE Alternatives 2 and 3

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.

PHYSIOLOGICAL AND BEHAVIORAL IMPACTS OF NOISE

Because 36- and 24-inch 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 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 observation posts; 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; 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, construction activities under SPE Alternative 2 may affect marbled murrelets. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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 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, operation of SPE Alternative 2 may affect marbled murrelets. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

3.5.2.3.2. 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, construction activities under SPE Alternative 3 may affect marbled murrelets. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

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 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, operation of SPE Alternative 3 may affect marbled murrelets. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.

3.5.2.3.3. 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
Impact	
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.
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.
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.	
Consultation and Permit Status: The Navy will consult with USFWS Washington Fish and Wildlife Office on the marbled murrelet under the ESA. Effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS.	

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 require for the SPE, depending on the alternative. While unlikely, some of this work could occur concurrently for both LWI and SPE. Based on the small size of the estimated range to effects for established thresholds and guidelines for marbled murrelets, no overlap of the two ensonified areas would occur. Once construction is completed, underwater noise during operations would return to levels similar to existing conditions.

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

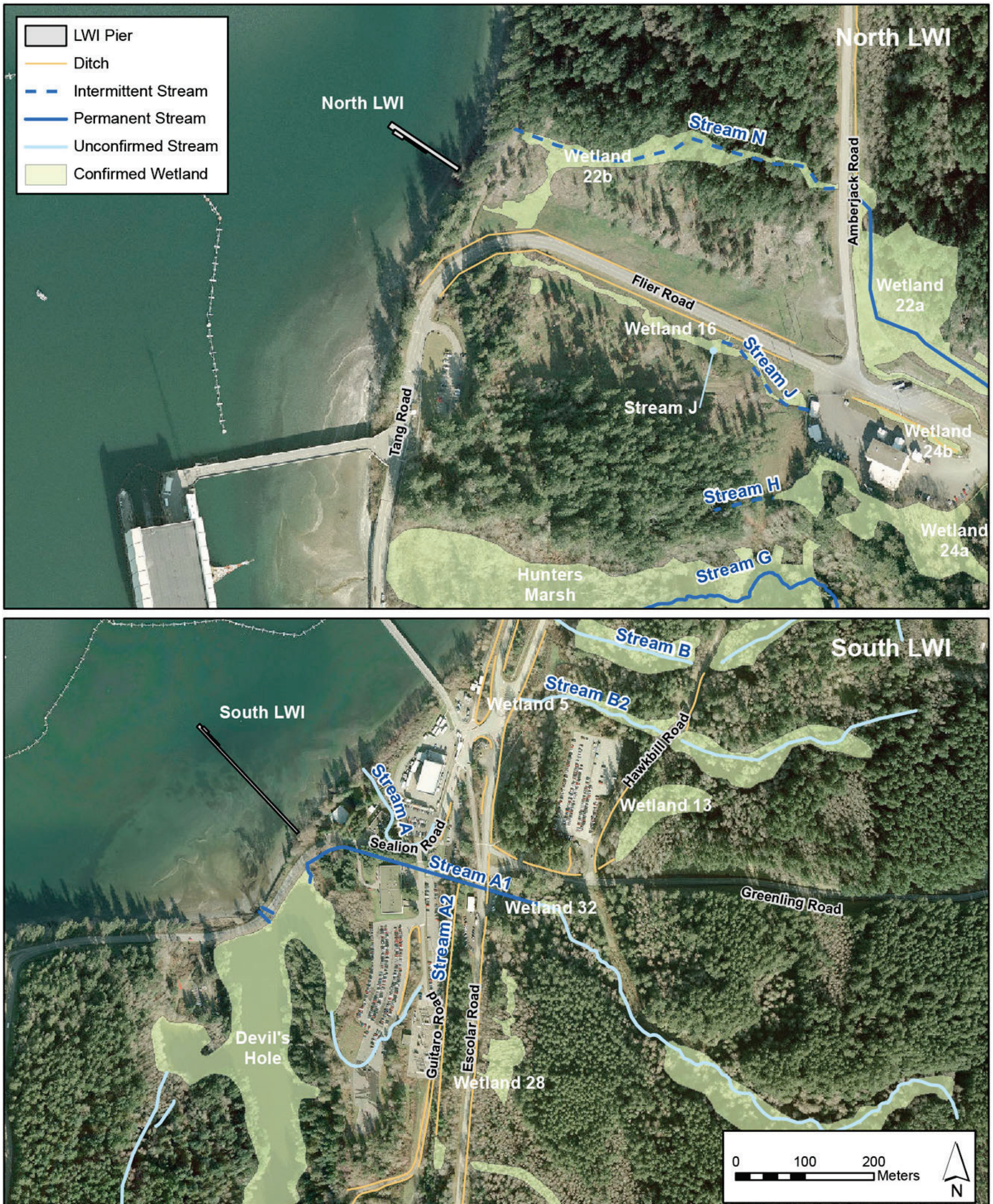
TERRESTRIAL VEGETATION AND HABITATS IN THE VICINITY OF THE LWI PROJECT SITES

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 2014c). 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 will 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.

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 will consult with USACE on jurisdictional determination for waters of the U.S. affected by the project and will submit a Section 404 permit application (LWI only) for work within affected waters. Construction in the coastal zone is also regulated by the CZMA. In accordance with the CZMA, the Navy will prepare and submit a CCD to WDOE.

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, observation posts, 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 0.18 acre (0.074 hectare) and 0.14 acre (0.056 hectare) of land supporting forested and shrub vegetation adjacent to the shoreline would be disturbed during construction of the north and south LWI locations, respectively (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 0.063 acre (0.026 hectare) of new impervious surface, and an additional 0.1 acre (0.04 hectare) would be converted to permanent pervious surface such as aggregate pathways. A total of 0.16 acre (0.066 hectare) would be revegetated with native species.

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. Pile driving would be intermittent and performed largely with a vibratory driver, which produces lower 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 2014c) 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 birds such as gulls and crows, but they would have no wires strung to or from them so 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 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 0.32 acre (0.13 hectare) of upland vegetation (from abutment construction). Permanent loss of 0.16 acre (0.064 hectare) of vegetation; revegetation of 0.16 acre (0.066 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 0.32 acre (0.13 hectare) of upland vegetation (from abutment construction). Permanent loss of 0.16 acre (0.064 hectare) of vegetation; revegetation of 0.16 acre (0.066 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 will submit a request for water quality certification to WDOE and will prepare and submit a CCD to WDOE. 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. The Navy is seeking guidance on whether consultation is required under the MBTA and Bald and Golden Eagle Protection Act. 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 will consult with 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 will 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 will 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 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.

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 2014c) 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 consult with the USFWS Washington Fish and Wildlife Office on ESA-listed marbled murrelet and any other ESA-listed terrestrial wildlife species that may be detected on NAVBASE Kitsap Bangor. The Navy will coordinate with USFWS on the MBTA and the Bald and Golden Eagle Protection Act. 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 4.2 acres (1.7 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 4.2 acres (1.7 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 are not expected to overlap. If such overlap did occur, there is a potential for increased noise levels in areas roughly equidistant between the south LWI project site and the SPE project site. Considering the intervening headland and forest vegetation, however, this effect is expected to be minimal for terrestrial wildlife species. Therefore, increased wildlife disturbance is unlikely. 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).

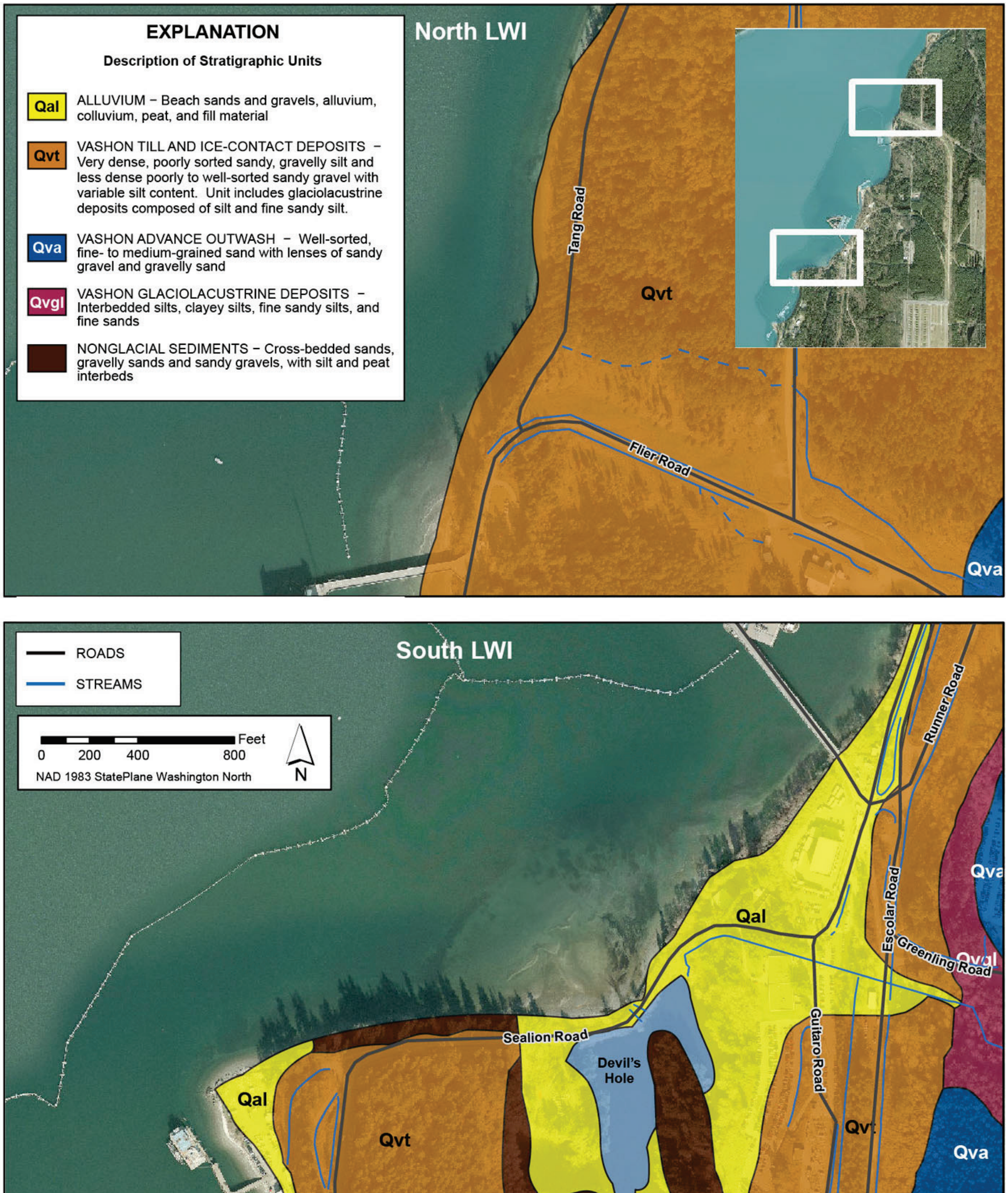
GEOLOGIC CONDITIONS WITHIN THE LWI UPLAND PROJECT AREAS

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).

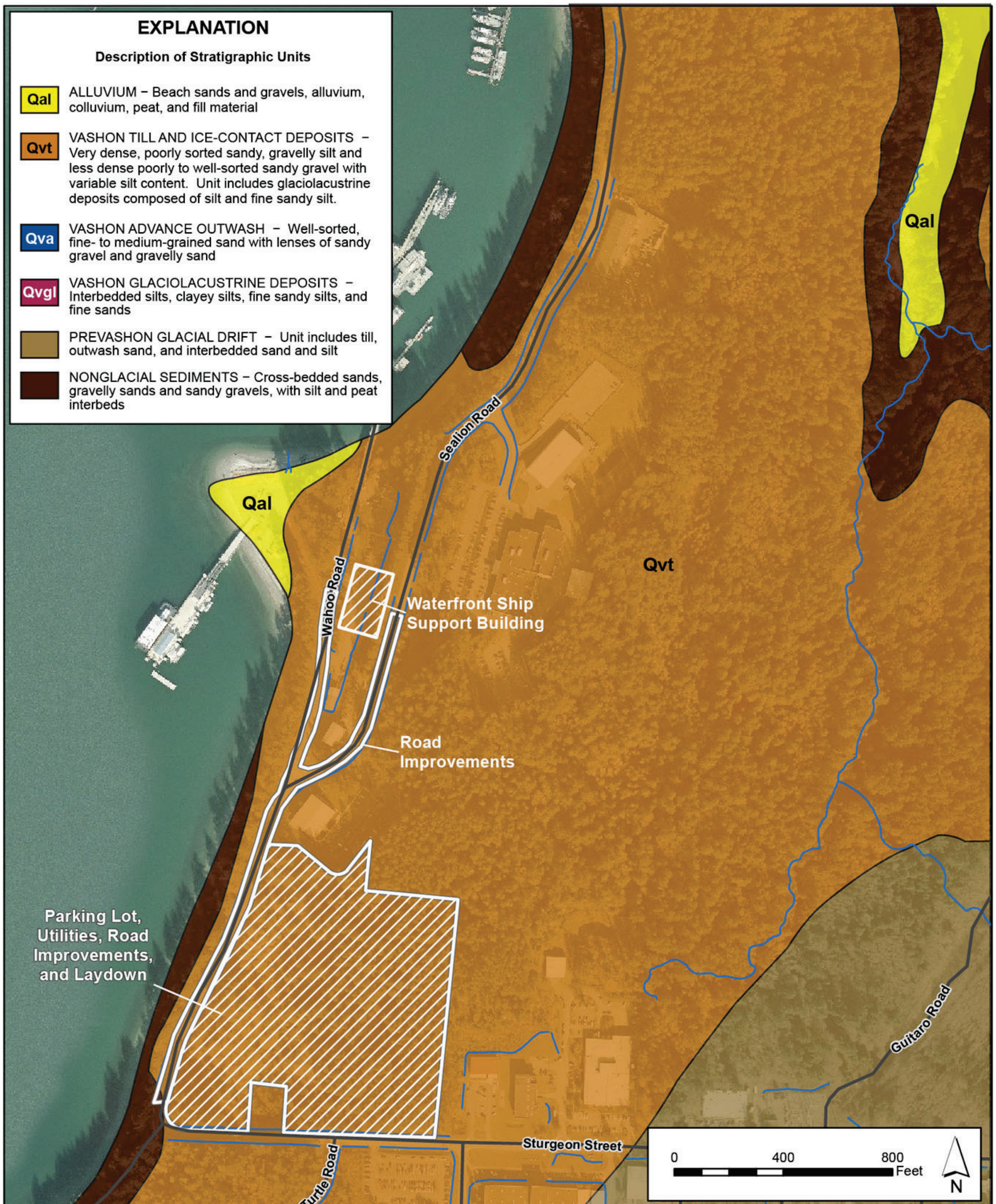
GEOLOGIC CONDITIONS WITHIN THE SPE UPLAND PROJECT AREA

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).



Geology information from: Kahle 1998

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).

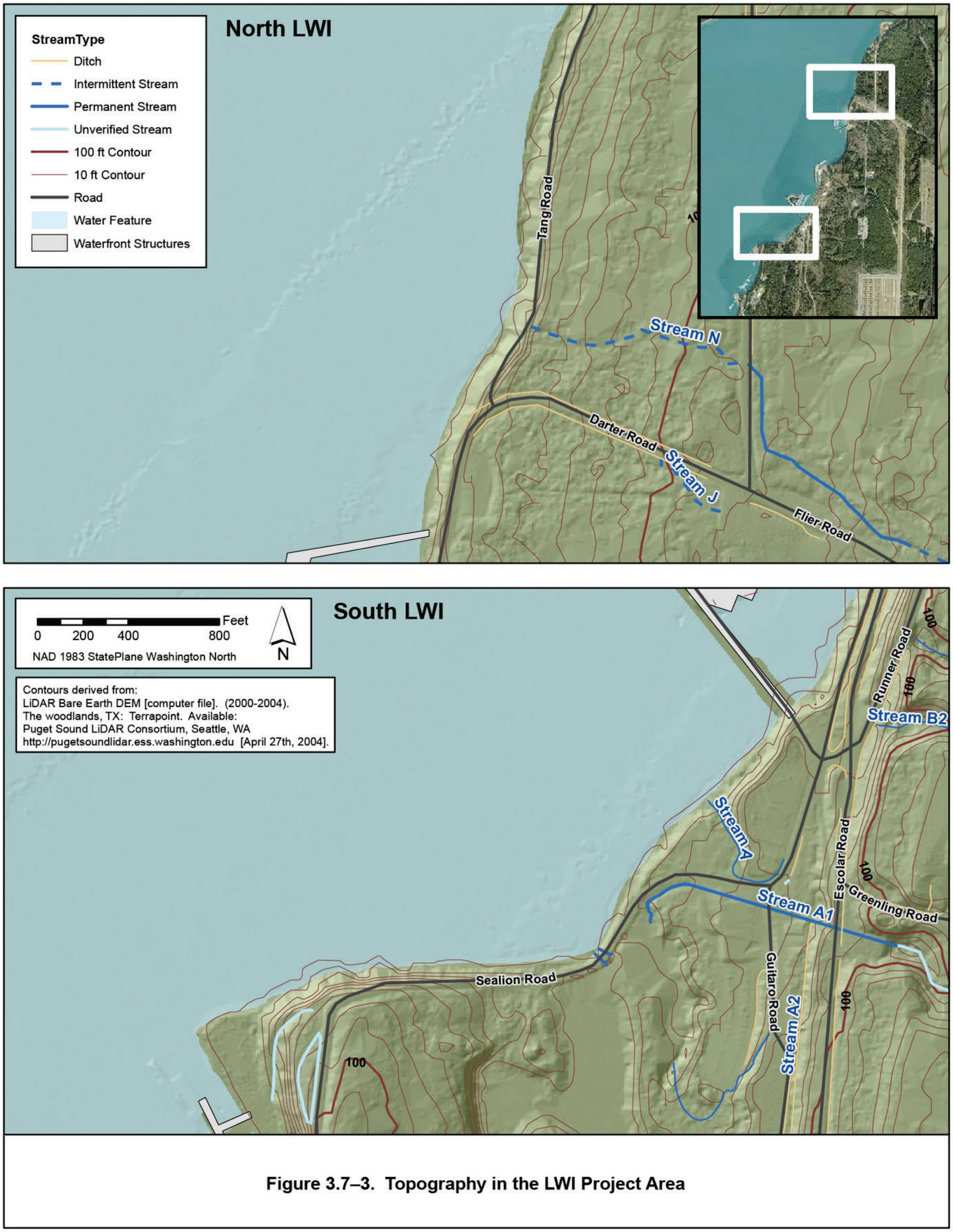


Figure 3.7–3. Topography in the LWI Project Area

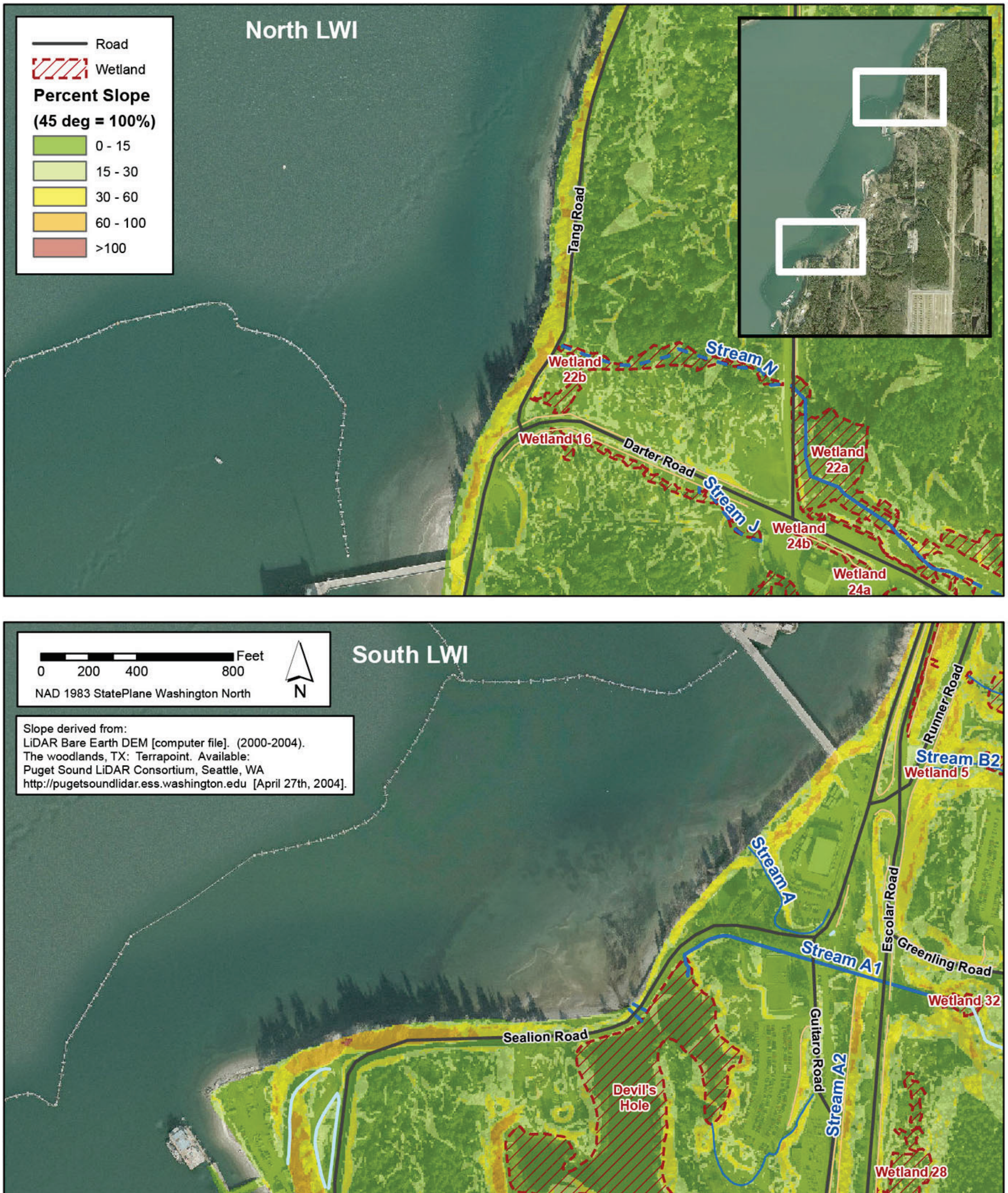


Figure 3.7–4. Surface Water Features and Slope near the LWI Project Sites

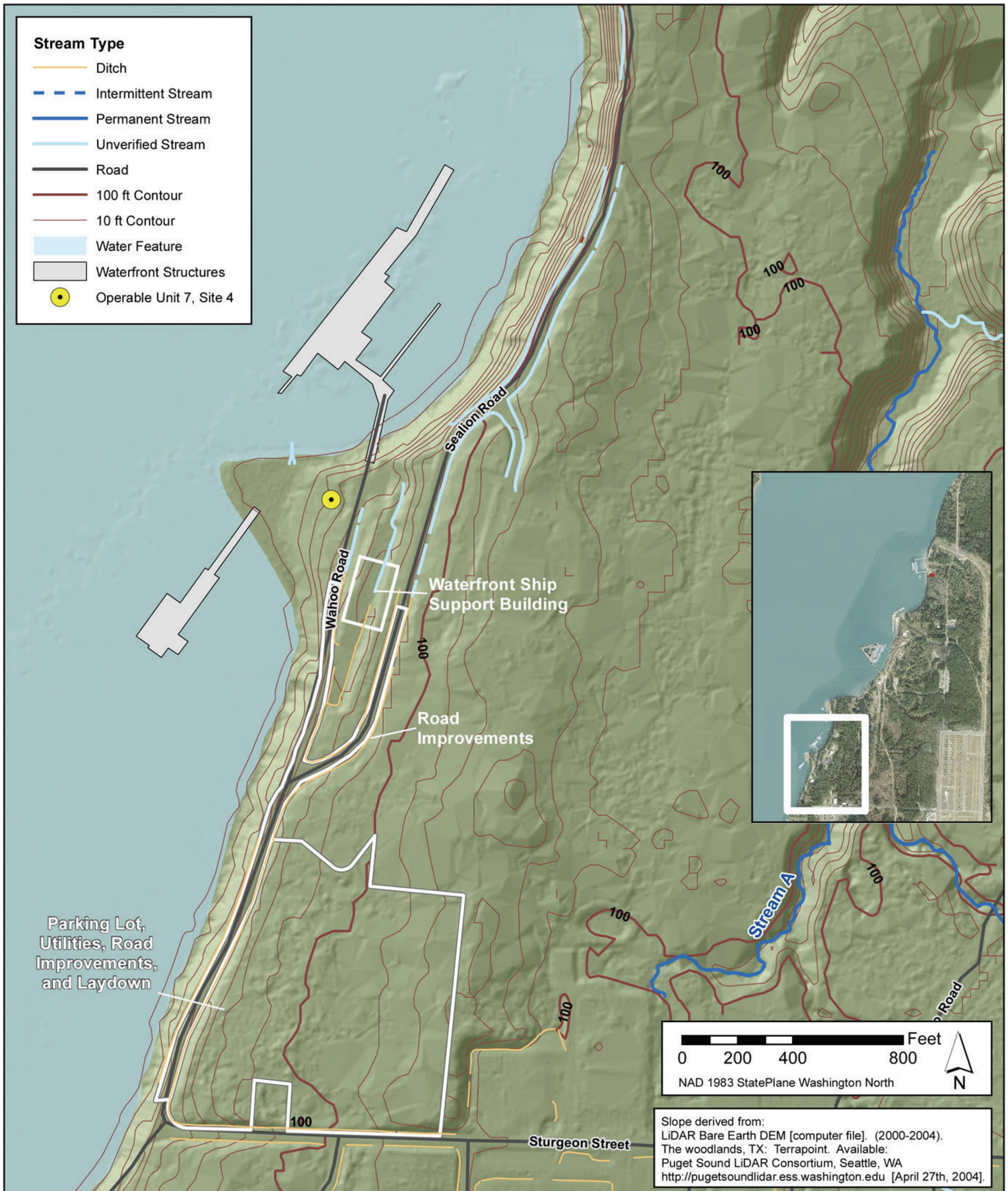


Figure 3.7–5. Topography in the SPE Project Area

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).

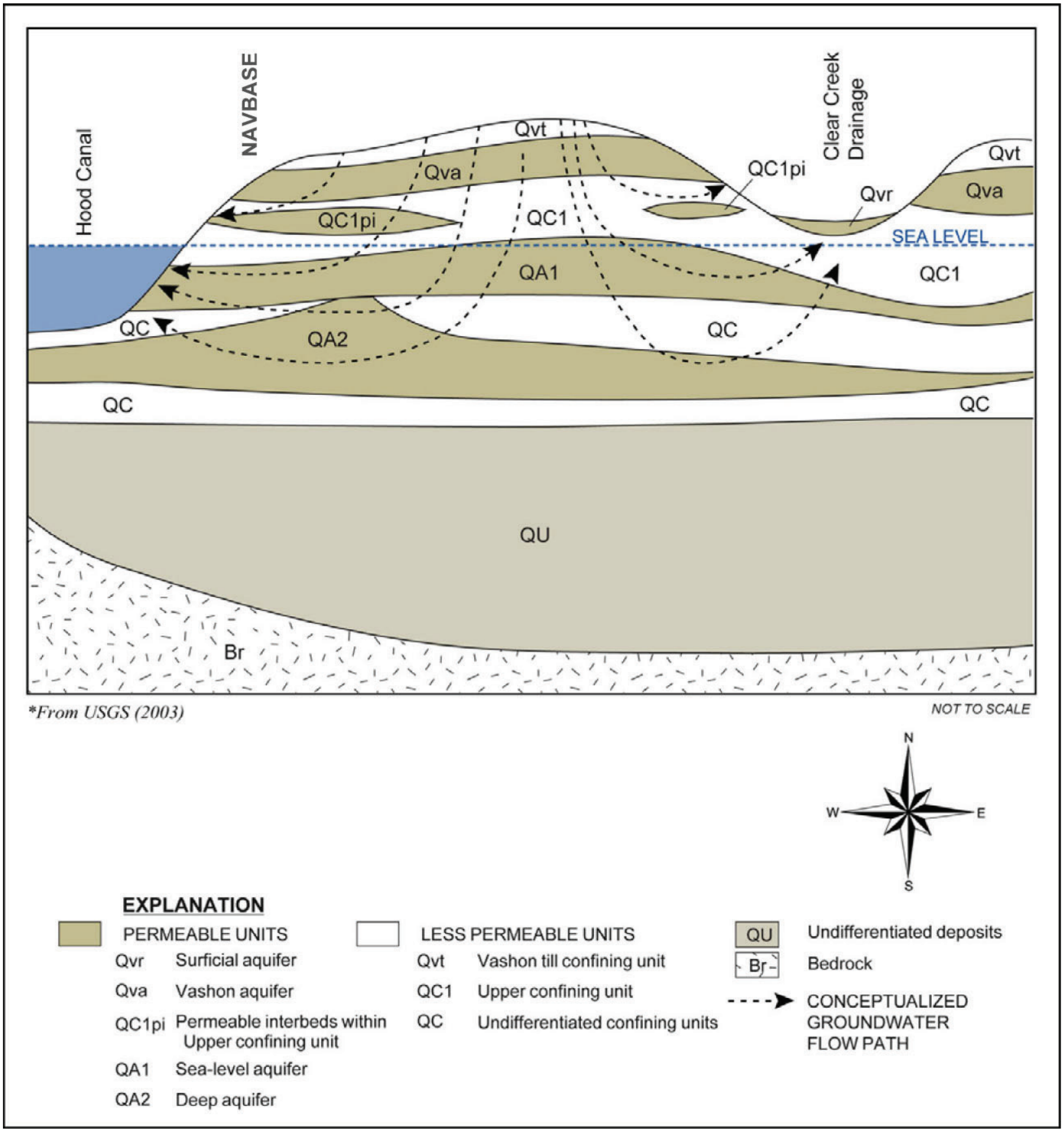


Figure 3.7–7. Conceptual Model of Hydrologic Conditions on NAVBASE Kitsap Bangor

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 22.24.010). 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 2012) 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 2008 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 2012) 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 will be taken with respect to aquatic resources. The Navy will submit a JARPA to USACE and other regulatory agencies, requesting permits under CWA Sections 401 and 402 (LWI and SPE projects), and Section 404 (LWI project only). The Navy will consult with USACE on waters of the U.S. affected by the project and will submit a Section 404 permit application for work within affected waters. 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 will prepare and submit 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 would be implemented for construction and operation.
- Measures to control stormwater would 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 would 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 would be used to control dust generation during earthmoving and hauling activities.
- Following construction, areas disturbed by construction and not occupied by new impervious surface would be revegetated with native species. Areas within the WSE cleared areas would be revegetated with grass seed mix and maintained as per WSE requirements.
- Gravel would be installed at construction area access points to prevent tracking of soil onto paved roads.
- Additional BMPs would be implemented to control runoff and siltation and minimize impacts to surface water per the *Stormwater Management Manual for Western Washington* (WDOE 2012).

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 will be revegetated with native species upon completion.

Clearing and grading for vegetation removal and excavation for abutment and observation post 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 north LWI abutment would disturb approximately 0.18 acre (0.074 hectare) of land and would require excavation of approximately 4,200 cubic yards (3,211 cubic meters) of soil and fill of 4,680 cubic yards (3,578 cubic meters). Construction of the south LWI abutment would disturb approximately 0.14 acre (0.056 hectares) of land and would require excavation of approximately 900 cubic yards (688 cubic meters) of soil and fill of 1,000 cubic yards (765 cubic meters). Therefore, the total disturbance of soils would be 0.32 acre (0.13 hectare). 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 site has been used for staging for other construction projects and is highly disturbed. 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 0.063 acre (0.024 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. The excavated soil would be replaced with new backfill material that would be brought on site. Trucking and handling 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 2012). 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 identical to those of Alternative 2. Impacts on these resources for construction and long-term operation are considered to be identical 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
Impact	
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Piers	*Construction:* Temporary disturbance of a total of 0.32 acre (0.13 hectare) of soils due to site clearing, grading, hauling, excavation and filling. 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 0.063 acre (0.026 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 0.32 acre (0.13 hectare) of soils due to site clearing, grading, hauling, excavation, and filling. 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 0.063 acre (0.026 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 will submit a JARPA to USACE and other regulatory agencies, requesting permits under CWA Sections 401, 402, and 404. The Navy will consult with USACE on waters of the U.S. affected by the project and will submit a Section 404 permit application for work within affected wetlands. 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 will prepare and 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; 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 and utility work, concrete work for the Waterfront Ship Support Building, a utility pad for a shoreside emergency generator, and a 421-car parking lot.

All new SPE facilities would be built to meet requirements of the WDOE Stormwater Management Manual 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 and utility 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, electrical power, 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 such as utility work 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 2012). 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 will 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
Impact	
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 and utility pad. 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 and utility pad. 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. Alternative 2 is the Least Environmentally Damaging Practicable Alternative according to the CWA Section 404(b)(1) guidelines. In accordance with the CZMA, the Navy will prepare and 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 4.2 acres (1.7 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 acres (2.8 hectares) of new impervious surface, for which stormwater controls would minimize impacts.

This page is intentionally blank.

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.

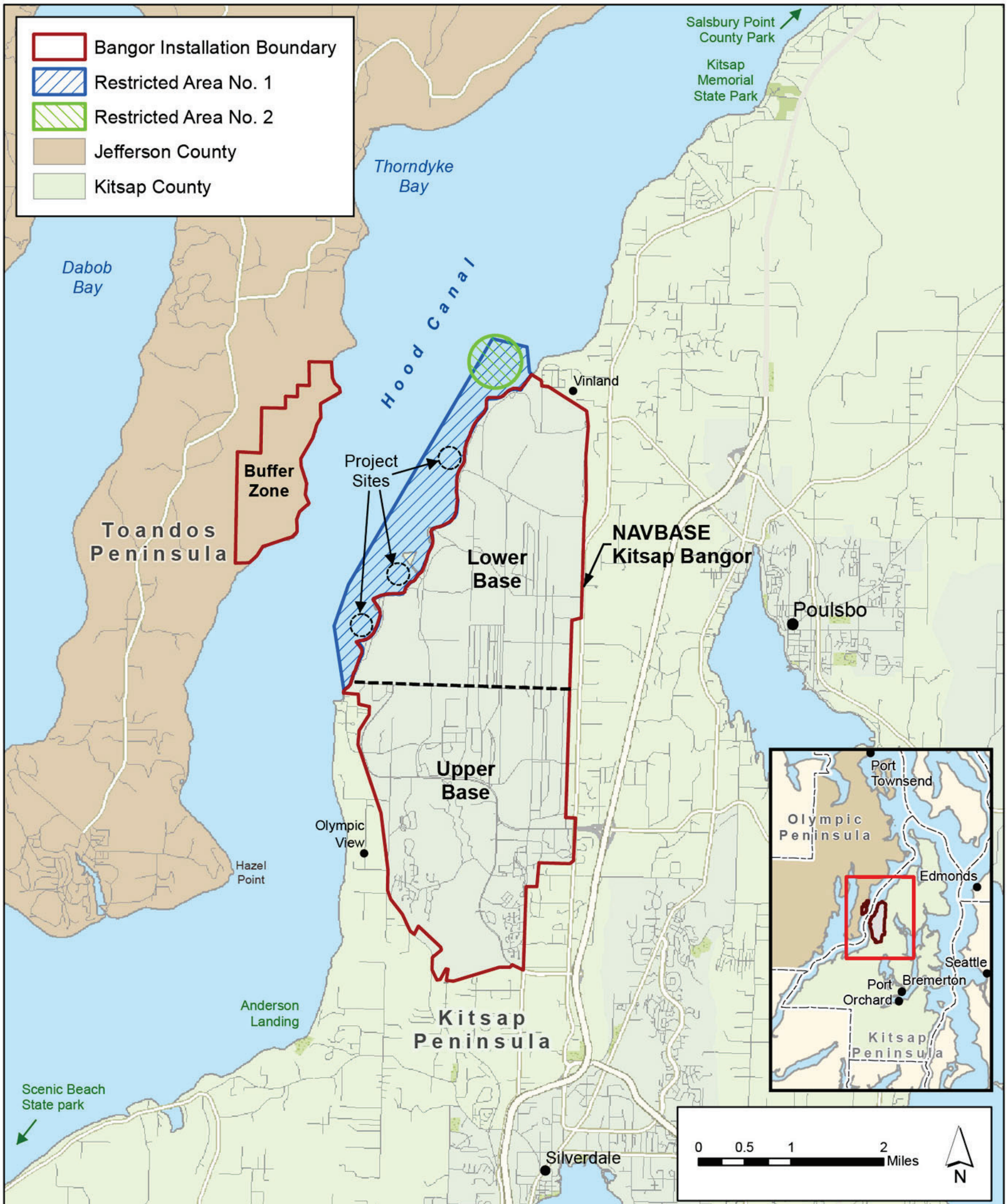


Figure 3.8–1. Communities and Public Use Areas in the Vicinity of NAVBASE Kitsap Bangor

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 16, 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
Impact	
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 will 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 will 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 16 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.

The relocation of the two SEAWOLF Class submarines from NAVBASE Kitsap Bremerton to NAVBASE Kitsap Bangor would reduce the number of submarines traveling through Rich Passage, therefore reducing any potential interference with recreational/private boating in public waterways.

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
Impact	
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 will 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 will 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 are not expected to 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. If the construction periods for the two projects were to overlap, for recreational users, concurrent pile driving for the two projects could result in noise exposure levels up to 3 dB greater than for an individual project in areas equidistant between the two project sites. 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 Washington Administrative Code's (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 which takes into account the total sound energy over the period of time of interest. It was assumed that sound levels included in WAC 173-60-040 used an averaging time of one 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. Because of the short duration of each strike, assuming the given source level as a constant throughout the hourly Leq period will overestimate the actual Leq achieved and thus represent 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
		82 (south)		
		120 (south - temporary only)		
	24-inch steel	17 (north) (in the dry)		
		17 (south) (in the dry)		
LWI Alternative 3	**24-inch steel**	**17 (north) (in the dry)**	**30**	**first**
		17 (south) (in the dry)		

bold denotes preferred Alternative

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 Alterative 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
Impact	
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 will 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	**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

bold denotes preferred Alternative

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. NAVBASE Kitsap Bremerton includes the industrial Puget Sound Naval Shipyard. Therefore, cessation of SEAWOLF operations at that site is expected to result in a negligible reduction in airborne noise.

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
Impact	
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 will 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 are not expected to 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. Considering the duration of pile driving for the various alternatives, LWI Alternative 2 (Pile-Supported Pier) would make a greater contribution to combined noise than LWI Alternative 3 (PSB Modifications), while SPE Alternative 3 (Long Pier) would make a greater contribution to combined noise impacts than SPE Alternative 2 (Short Pier). The worst-case number of days of pile driving, the principal source of construction noise for these projects, would be 285 (80 for LWI and 205 for SPE). If pile driving for the two projects were to overlap, noise levels would in increased by approximately 3 dB in areas roughly equidistant between the two pile driving sites. This would not include any residential areas but could include recreational areas on Hood Canal and wildlife habitat.

This page is intentionally blank.

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 is in consultation 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 observation posts, 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)

LWI Alternative 3 would be the same as 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.

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. The abutments and observation posts would be the same as for Alternative 2. There would be a minimal increase in the industrial appearance (including lighting) of the waterfront, but this would be less than for Alternative 2.

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.

Vessels passing by would have closer, more direct views of the LWI structures; however, the visual character of the PSBs 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
Impact	
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 is in consultation 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 and American Indian resources. 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, shoreside emergency generator facility, and roadway and utility 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
Impact	
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 LWI would not affect aesthetics significantly, mitigation measures are not necessary.	
Consultation and Permit Status: The Navy is in consultation 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, observation posts, 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, shoreside emergency generator facility, roadway and utilities 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.

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 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). The presence of the pier structures and observation post stairs 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. 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).

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 and loss of access under the observation post stairs 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. 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.

Table 3.11–8. Summary of LWI Impacts on Socioeconomics

Alternative	Environmental Impacts on Socioeconomics
Impact	
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.

Table 3.11–8. Summary of LWI Impacts on Socioeconomics (continued)

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

Socioeconomics is a resource potentially affected by the transfer of SEAWOLF Class submarines from NAVBASE Kitsap Bremerton to NAVBASE Kitsap Bangor. The SPE proposed action consolidates SEAWOLF-related activities currently occurring at NAVBASE Kitsap Bremerton to NAVBASE Kitsap Bangor. These two installations are located about 12.4 miles (23 travel minutes) apart. No new personnel would be associated with the proposed action. The primary workplace of 322 existing personnel, including submarine crews, would change from Bremerton to Bangor; however, because of the proximity of the two bases (approximately 20 miles [32 kilometers]) and the fact that the affected personnel are currently assigned to NAVBASE Kitsap, very few of the affected personnel would be expected to change their residence. Therefore, the short-term (several years) economic effect would be minimal. Over the long term, new SEAWOLF personnel might be expected to locate closer to Bangor than at present, resulting in minor effects on school enrollments and localized commercial activity. Since the two facilities are part of the same base and located in the same county, there would be little overall economic effect in the long term.

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

Operations under SPE Alternative 3 would be similar to those included under Alternative 2. Therefore, impacts on socioeconomic conditions from the operation of the SPE under Alternative 3 would be the same as that described under SPE Alternative 2.

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
Impact	
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.

This page is intentionally blank.

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
Impact	
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 of 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
Impact	
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): 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 actions (State of Washington Department of Archaeology & Historic Preservation [DAHP] January 13, 2014). 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 Navy is seeking concurrence from the SHPO with their 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 Navy is seeking concurrence from the SHPO on the lack of NRHP eligibility of these historic–era sites.

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

[1] The NHPA was recodifed 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.

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 locations 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). Those resources that are not intact buildings or structures are treated as historic archaeological sites rather than as architecture and have not been evaluated at this time; an inventory and development of a pre-Navy context would inform the Navy's decision on NRHP eligibility.

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 the SHPO concurred (letter dated July 20, 2011) with the Navy that two are eligible for listing in the NRHP. Although Delta Pier and EHW-1 are in the APE, neither would experience physical or structural changes. However, the proposed action does occur within the viewshed of Delta Pier and EHW-1. 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

Architectural inventory of the SPE proposed project location recorded 18 built resources (Cardno TEC 2013). 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 in the SPE APE (proposed parking lot), will be evaluated for NRHP eligibility per the pre-Navy settlement context currently being developed by the Navy.

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 is in consultation with the SHPO regarding the potential effect of the LWI structure and the SPE construction 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; the SHPO has not yet concurred. The Navy is in consultation with Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, Lower Elwha Klallam, and Suquamish Tribes 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 is seeking concurrence from the SHPO 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.

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

*As of December 2014, SHPO had not concurred with the Navy's determinations of 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 is consulting with the SHPO, seeking concurrence with the determination of no adverse effect on EHW-1 and Delta (or Refit) Pier. 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)). NAVBASE Kitsap Bangor initiated consultation concerning this project with the Washington SHPO and the Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, Lower Elwha Klallam, and Suquamish Tribes in September 2012.

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 is seeking concurrence from the SHPO 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.

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 is consulting with the SHPO, seeking concurrence with the determination of no adverse effect on EHW-1 and Delta (or Refit) Pier. 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)). NAVBASE Kitsap Bangor has initiated consultation concerning this project with the Washington SHPO and the Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, Lower Elwha Klallam, and Suquamish Tribes in September 2012.

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
Impact	
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 Consultation with SHPO and 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 (Table 3.13–4).

Table 3.13–4. NRHP-Eligible Buildings/Structures Located in the SPE 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

*As of December 2014, SHPO had not concurred with the Navy's determinations of effect.

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.

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)). NAVBASE Kitsap Bangor has initiated consultation concerning this project with the Washington SHPO and the Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, Lower Elwha Klallam, and Suquamish Tribes.

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 3.13–5.

Table 3.13–5. Summary of SPE Impacts on Cultural Resources

Alternative	Environmental Impacts on Cultural Resources
Impact	
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 Consultation with SHPO and 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

3.14.1. Affected Environment

The Navy consults with federally recognized American Indian tribes on actions with the potential to impact protected tribal resources, tribal rights, or American Indian lands. The following tribes have tribal treaty rights in the project area: Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, Lower Elwha Klallam, and Suquamish Tribes.

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 unique 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.

TREATIES OF POINT NO POINT AND POINT ELLIOT

The Treaty of Point No Point, "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 Suquamish secured the "right of taking fish at usual and accustomed grounds" in the Treaty of Point Elliot, signed on January 22, 1855. Usual and accustomed (U&A) fishing grounds for the Point No Point signatories encompass the waters and shorelines of Hood Canal and its tributaries, which include NAVBASE Kitsap Bangor (Point No Point Treaty Council [PNPTC] 2010). Rights to resources in these areas were reaffirmed in the 1974 Boldt Decision and supplemental rulings (see discussion below). The Supreme Court of the United States has recognized that the treaty right includes a right of access within all of the tribes' U&A fishing areas (*United States v. Winans,* 198 U.S. 371 (1905)).

The Boldt Decision also includes Hood Canal within the Suquamish U&A (*United States v. Washington,* 459 F.Supp. 1020, 1049 [W.D. Wash. 1975]):

> The usual and accustomed fishing places of the Suquamish Tribe include the marine waters of Puget Sound from the northern tip of Vashon Island to the Fraser River including Haro and Rosario Straits, the streams draining into the western side of this portion of Puget Sound and also Hood Canal.

The primacy of Skokomish fishing rights in the waters of Hood Canal over those of other tribes granted rights under this treaty, particularly the Suquamish, was affirmed under a 1985 ruling by the Ninth Circuit Court of Appeals (*United States v. Skokomish Indian Tribe*, 764 F.2d 670 [9th Cir. 1985]). As a result of the ruling, the secondary rights of the Suquamish were also established. 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.

Through the PNPTC, four local tribes developed agreements with NAVBASE Kitsap Bangor regarding access to traditional resource areas within the base: the Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes. Today, the PNPTC includes only the Jamestown S'Klallam Tribe and the Port Gamble S'Klallam Tribe.

UNITED STATES V. WASHINGTON STATE

Known as the Boldt Decision after the presiding United States 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, Port Gamble S'Klallam, Jamestown S'Klallam, Lower Elwha Klallam, and Suquamish Tribes have U&A grounds that include the project location.

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]).

3.14.1.1.2. American Indian Use of NAVBASE Kitsap Bangor

American Indian history in Puget Sound and their use of the project area is summarized in Section 3.13.1.1.1.

3.14.1.1.3. Traditional Resources

The Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, Lower Elwha Klallam, and Suquamish Tribes have identified shellfish and fisheries salmon as traditional resources located on or near NAVBASE Kitsap Bangor. In the cooperative agreement of 1997, signed between the Navy and the PNPTC (Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes), the parties agreed during the term of the agreement to harvest intertidal shellfish at one of five beaches at NAVBASE Kitsap Bangor. Prior to increased waterfront security measures on NAVBASE Kitsap Bangor, five beaches were designated for shellfish harvesting. Four of these beaches were used for recreational shellfish harvesting by NAVBASE Kitsap Bangor residents. The fifth beach, south of Delta Pier, was identified in the 1997 agreement with the PNPTC to be used for tribal shellfish harvesting. Currently, all beaches are closed to NAVBASE Kitsap Bangor residents, but the tribes can still access the beach south of Delta Pier.

The areas wherein traditional resources may be affected include the LWI and SPE project sites, other areas at NAVBASE Kitsap Bangor that are directly affected by construction, or those resources and areas identified through consultation that are of interest to the tribes and that might be affected by the proposed action (i.e., shellfish and shellfish beaches, and fisheries).

TRADITIONAL RESOURCES AT THE LWI PROJECT SITES

The Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, and Lower Elwha Klallam Tribes continue to harvest shellfish at the beach south of Delta Pier, and this beach has been identified as an area of traditional resource use. The south LWI project site lies in the northern portion of this beach. The north and south LWI project areas are otherwise in restricted areas that are not used by tribes. The species composition and timing of the tribal shellfish harvest is governed by the PNPTC, which develops "annual shellfish management plans for each species and geographic region within the usual and accustomed fishing area of the PNPTC tribes. These plans are developed jointly with the state of Washington" (PNPTC 2013). Normal Navy operations continue to the extent necessary during shellfish harvesting times with the result that ambient noise includes sound from land and sea traffic, operating machinery, and voices. Tribal fisheries are also regulated by the PNPTC and in the vicinity of the LWI project sites are focused on salmonid species (discussed in Section 3.3).

TRADITIONAL RESOURCES AT THE SPE PROJECT SITE

No tribal shellfishing occurs within the SPE project site. Salmonid species that may be present are discussed in Section 3.3. No other known traditional resources are located in the SPE project site.

3.14.1.2. CURRENT REQUIREMENTS AND PRACTICES

3.14.1.2.1. DoD Policy and SECNAVINST

On 21 October 1998, the 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 subsistence resources such as shellfish and fisheries), tribal rights (such as access to fisheries), and American Indian lands before decisions are made by the services.

In 2005, the Navy updated its policy for consultation with federally recognized Indian tribes. 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.

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, the Archaeological Resources Protection Act, NAGPRA, 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*.

3.14.1.2.3. Government-to-Government Consultation

In accordance with DoD policy and Navy instructions, the Navy has invited and is in government-to-government consultations regarding the proposed action with federally recognized American Indian tribes that use resources in the vicinity of the project area, including the Skokomish, Port Gamble S'Klallam, Jamestown S'Klallam, Lower Elwha Klallam, and Suquamish Tribes.

3.14.2. Environmental Consequences

3.14.2.1. APPROACH TO ANALYSIS

The evaluation of impacts on a traditional resource considers whether the resource itself is affected or if there is a change in access to the resource. Impacts may be clearly identified, as when a known traditional resource is directly affected or access is changed. However, consultation with interested and affected American Indians is necessary to identify and evaluate the extent of any adverse effects and to develop appropriate mitigations.

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 regulations and existing laws, and there would be no impact on American Indian traditional resources.

3.14.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

CONSTRUCTION

The north LWI project site does not include any known American Indian traditional resources; thus, proposed construction within the north LWI project site is unlikely to affect traditional resources. The south LWI project site is located at the north end of a tribal shellfishing beach at the mouth of Devil's Hole. Access would be restricted from the immediate construction zone. During construction of the south LWI, there would be temporary loss of access (up to 2 years) to shellfish beds, including an estimated 0.68 acre (0.28 hectare) of oyster beds due to the presence of equipment and construction activities. For safety purposes, access to shellfish beds in the immediate construction zone would be restricted during construction for up to 2 years. Recovery of harvestable shellfish in the temporarily disturbed areas is expected within 3 years after in-water construction activities have ceased. These impacts would be mitigated through continued government-to-government consultation and execution of a Memorandum of Agreement that is currently under development. Although current conditions include ambient noise from everyday military activities, construction noise would include noise from pile driving, which could be considered an effect on the setting for traditional resource harvesting activities near the south LWI project site.

Tribal fisheries in the vicinity of the LWI project site and the specific project sites (i.e., where construction will 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 16 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.

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. This would not result in a net loss of tribal resources, but it could increase the time allocated for tribes to exercise their fishing rights. 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, and no significant impacts on the overall quantity of available adult salmon and steelhead in Hood Canal are expected during construction of the proposed project.

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. 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, including tribal divers engaged in resource harvest, 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.

OPERATION/LONG-TERM IMPACTS

Following recovery of the shellfish beds temporarily lost due to construction, approximately 0.043 acre (0.017 hectare) of shellfish beds would be permanently lost after being displaced by the LWI pier and observation post stairs, resulting in an impact on tribal harvest of shellfish. Tribal access to these beds in general would continue, although subject to increased security checks. 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 beds 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. Any long-term impact on tribal harvests would be mitigated through continued government-to-government consultation and execution of a Memorandum of Agreement that is currently under development. No other direct impacts would be anticipated for shellfish harvest areas or fisheries as a result of operation and maintenance of the LWI. 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 to impacts from Alternative 2 except that there would be no in-water pile driving and related impacts to tribal fisheries or scuba divers. Proposed construction within the north LWI project site would have no effect on known traditional resources. For the south LWI project site, access at the north end of a tribal shellfishing beach at the mouth of Devil's Hole would be restricted from the immediate construction zone. During construction of the south LWI, there would be temporary loss of access to an estimated 0.64 acre (0.26 hectare) of shellfish beds due to the presence of equipment and construction activities for up to 2 years. As with Alternative 2, access to shellfish beds in the immediate construction zone would be restricted during construction, for safety purposes. These impacts would be mitigated through continued government-to-government consultation and execution of a Memorandum of Agreement that is currently under development. Although current conditions include ambient noise from everyday military activities, construction noise would include noise from pile driving for abutments, which could be considered an effect on the setting for traditional resource harvesting activities near the south LWI project site.

Tribal fisheries in the vicinity of the LWI project site and the specific project sites are focused on salmonid species. As discussed in Section 3.3.2.2 and 3.14.2.2.2, construction within the in-water work window (between July 16 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.

OPERATION/LONG-TERM IMPACTS

Following construction, after up to 2 years, tribes would again have access to the shellfish beds, but with the permanent loss of an estimated 0.043 acre (0.017 hectare) due to displacement of existing shellfish beds by LWI structures (the area disturbed by the PSB pontoon feet and the area lost to access under the observation post stairs). Recovery of harvestable shellfish in the temporarily disturbed areas is expected within 3 years after in-water construction activities have ceased. Tribal access to these beds would continue during recovery, although subject to increased security checks. LWI Alternative 3 is not expected to alter water flow or along-shore sediment transport (Section 3.1.2.2.3) to the extent that shellfish beds 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. Any long-term impact on tribal harvests would be mitigated through continued government-to-government consultation and execution of a Memorandum of Agreement that is currently under development. No other direct impacts would be anticipated for shellfish harvest areas or fisheries as a result of operation and maintenance of the LWI. The presence of the PSBs 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 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 3.14–1.

Table 3.14–1. Summary of LWI Impacts on American Indian Resources

Alternative	Environmental Impacts on American Indian Resources
Impact	
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Pier	*Construction:* Restricted access for up to 2 years to the immediate construction zone during construction. 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. Possible construction noise impact. No significant impacts on the overall quantity of available adult salmon and steelhead in Hood Canal are expected with construction. *Operation/Long-term Impacts:* Long-term permanent loss of shellfish beds (0.043 acre, 0.017 hectare), up to $2,208 per year. Tribal access to shellfish beds will return to pre-construction arrangements, but with increased security checks. Minimal effect on tribal salmon harvest.
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* Restricted access for up to 2 years to the immediate construction zone during construction. No other changes to tribal access to traditional resources. Temporary loss of 0.64 acre (0.26 hectare) of tribal shellfish harvesting area near the south LWI. Possible construction noise impact. No significant impacts on the overall quantity of available adult salmon and steelhead in Hood Canal are expected with construction. *Operation/Long-term Impacts:* Long-term permanent loss of shellfish beds (0.043 acre, 0.017 hectare), up to $2,208 per year. Tribal access to shellfish beds will return to pre-construction arrangements, but with increased security checks. No effect on tribal salmon harvest.
Mitigation: Current practices for recognizing American Indian treaty and consultation rights are described in Section 3.14.1.2. Under either alternative, and in accordance with NHPA and other federal policies, the Navy has invited and is in government-to-government consultation with American Indian tribes regarding impacts on traditional resources and any necessary mitigation measures. Mitigations would be included in a Memorandum of Agreement that is currently under development.	
Consultation and Permit Status: The Navy will continue consultation on a government-to-government basis with affected tribes. No permits are required.	

NHPA = National Historic Preservation Act

3.14.2.3. SPE PROJECT ALTERNATIVES

Because the activities associated with the SPE project alternatives are not within shellfish beds, there will 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. Consequently, there would be no effect on salmon, or loss of resources. The Navy would continue to manage its traditional resources in accordance with Navy regulations and existing laws.

3.14.2.3.2. SPE Alternative 2: Short Pier (Preferred)

CONSTRUCTION

This alternative would have minimal impact on American Indian traditional resources. As discussed 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 salmonid species (salmon and steelhead) but minimal at the population level. This impact would not be sufficient to result in population level impacts on salmon or impacts on tribal harvest of salmon. Impacts are discussed in greater detail in Section 3.3.2.3.

OPERATION/LONG-TERM IMPACTS

This alternative would have minimal impact on American Indian traditional resources. As discussed in Section 3.3.2.3, the presence of SPE Alternative 2 structures would have minimal impacts on salmonid species and would not be sufficient to result in population level impacts on salmon or impacts on tribal harvest of salmon.

3.14.2.3.3. SPE Alternative 3: Long Pier

CONSTRUCTION

The impacts of SPE Alternative 3 would be similar to those of SPE Alternative 2, including the same project features on land but a larger footprint for the pier and associated overwater portion. This alternative would have minimal impact on American Indian traditional resources. 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.

OPERATION/LONG-TERM IMPACTS

This alternative would have minimal impact, similar to SPE Alternative 2, on American Indian 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 tribal harvest of salmon.

3.14.2.3.4. Summary of SPE Impacts

Impacts on American Indian 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 3.14–2.

Table 3.14–2. Summary of SPE Impacts on American Indian Resources

Alternative	Environmental Impacts on American Indian Resources
Impact	
SPE Alternative 1: No Action	No Impact
SPE Alternative 2: Short Pier (Preferred)	*Construction:* Minimal Impact on salmon with no impact on tribal salmon harvest. No impact on tribal shellfish harvest. *Operations:* No impact on tribal salmon or shellfish harvest.
SPE Alternative 3: Long Pier	*Construction:* Minimal Impact on salmon with no impact on tribal salmon harvest. No impact on tribal shellfish harvest. *Operations:* No impact on tribal salmon or shellfish harvest.
Mitigation: Current practices for recognizing American Indian treaty and consultation rights are described in Section 3.14.1.2. Under either alternative, and in accordance with NHPA and other federal policies, the Navy has invited and is in government-to-government consultation with American Indian tribes regarding impacts on traditional resources and any necessary mitigation measures. Mitigations would be included in a Memorandum of Agreement that is currently under development.	
Consultation and Permit Status: The Navy will continue consultation on a government-to-government basis with affected tribes. No permits are required.	

NHPA = National Historic Preservation Act

3.14.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

Construction of the LWI and SPE (all alternatives) may have a minimal impact on Hood Canal adult salmon and steelhead, which are tribal 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 impacts 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 small area of shellfish beds within the construction zones, with some permanent loss due to displacement by LWI structures. Recovery in the temporarily disturbed shellfish areas is expected within 3 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 there would be no permanent loss of access. However, use of the shellfish areas would be subject to increased security checks.

In accordance with NHPA and other federal policies, the Navy has invited and is in government-to-government consultation with American Indian tribes regarding impacts on traditional resources and any necessary mitigation measures. Mitigations would be included in a Memorandum of Agreement that is currently under development.

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 will 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

NOTE:

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 (July 16, 2016, to January 15, 2017, and July 16, 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 will 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)		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%

NOTE:

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 will 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 (July 16, 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
Impact	
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[1]

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 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

[1] The following analysis of traffic impacts is based on construction of the SPE project occurring between July 2016 and July 2018. Prior to publication of this DEIS, the construction schedule for SPE has been changed to July 2018 through July 2020. A revised traffic analysis based on the latest construction schedule will be included in the Final EIS.

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

	2016	2017	2018
Non-Project Traffic	13,526	13,689	13,853
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	13,684	13,847	14,011

1. The daily average number of construction workers is a conservative estimate based on the maximum workers onsite during the 808-day construction period.

Table 3.15–13. Daily Average Traffic Volumes on NW Trigger Avenue for SPE Alternative 2

	2016	2017	2018
Non-Project Traffic	12,570	12,721	12,873
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	12,728	12,879	13,031

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. Marine-based construction equipment would be present within the project area for two in-water work seasons (July 16, 2016, to January 15, 2017, and July 16, 2017, to January 15, 2018). 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.

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

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		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	11.6	B	11.7	B	11.8	B	12.6	B	12.8	B	12.9	B	13.0
Trigger & Trident	B	19.8	C	23.6	C	23.8	C	24.0	B	10.2	B	11.9	B	12.0	B	12.0
Trigger & Escolar	A	5.5	A	6.9	A	7.0	A	7.0	D	37.9	D	39.3	D	42.3	D	44.1
Trigger & Sturgeon	B	11.1	B	14.1	B	14.2	B	14.3	B	10.0	B	10.6	B	10.9	B	11.3

NOTE:

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		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)		Density (veh/mile/lane)
Trigger north of Thresher	A	7.8	A	8.8	A	8.9	A	9.0	A	6.7	A	7.6	A	7.7	A	7.9
Trident east of Trigger	A	7.2	A	8.3	A	8.4	A	8.5	A	6.9	A	7.9	A	8.0	A	8.1
Trigger north of Trident	B	14.8	B	17.3	B	17.5	B	17.7	B	13.0	B	15.3	B	15.5	B	15.7
Trigger east of Escolar	B	14.3	C	18.3	C	18.5	C	18.7	B	14.7	B	17.3	B	17.5	B	17.7
Trigger south of Sturgeon	A	2.3	A	3.8	A	3.8	A	3.9	A	3.5	A	4.9	A	4.9	A	5.0

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%)
Sturgeon west of Trigger	C	67.3%	D	72.8%	D	72.8%	D	72.9%	D	71.9%	D	73.9%	D	73.9%	D	74.0%
Sealion north of Sturgeon	C	62.1%	C	69.1%	C	69.1%	D	69.2%	C	66.1%	D	72.0%	D	72.2%	D	72.2%

NOTE:

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

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 will 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, utility upgrades that include an emergency power generator, 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. With the completion of the project, 322 new employees would be added as submarine crews and to support the shore-based maintenance activities. This in turn would generate additional trips, with the new employee traffic accessing the proposed parking lot from Sturgeon Street. Increased operational traffic would exacerbate existing peak-hour delays at both the Trident/Luoto and Trigger gates and adjacent regional roadways in the long term, as well as at OA Gate. There would be a corresponding decrease in operational traffic at NAVBASE Kitsap Bremerton, resulting in positive impacts on traffic and circulation conditions at that base.

Road improvements to accommodate changes in traffic patterns along Wahoo and Sealion roads as well as repairs to existing roads damaged from construction activity would be included under this alternative.

Homeporting of two additional SEAWOLF Class submarines at the Service Pier would result in approximately two additional one-way transits of these submarines per month, resulting in two additional openings of the Hood Canal Bridge. 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. Increased small support vessel traffic at 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.

Marine vessel traffic is a resource potentially affected by removal of two SEAWOLF Class submarine from NAVBASE Kitsap Bremerton. There would be a corresponding decrease in marine vessel traffic in water bodies leading to and from NAVBASE Kitsap Bremerton, primarily Rich Passage. This is expected to have a minimal positive impact on vessel traffic in Rich Passage.

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
Impact	
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:* Exacerbation of existing peak-hours delays at both base gates and adjacent regional roadways.
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:* Exacerbation of existing peak-hours delays at both base gates and adjacent regional roadways.
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.	

3.15.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

Current schedules indicate that construction of the LWI and SPE projects would not overlap but would occur sequentially, with LWI occurring first. 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, rather than 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 would generate very little operational traffic, the combined operational traffic impacts of the two projects would not be substantially different from the impacts of the SPE project alone.

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 February 18, 2010, the Council on Environmental Quality (CEQ) issued for public comment draft guidance ‘‘Consideration of the Effects of Climate Change and Greenhouse Gas Emissions,” which is the first time that guidance has been issued on how federal agencies should evaluate the effects of climate change and GHG emissions for NEPA documentation (CEQ 2010). 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 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 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.

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

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.

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.

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.

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

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
Impact	
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

The removal of two SEAWOLF Class submarines and support crew from NAVBASE Kitsap Bremerton would not produce any substantial changes to existing operational emissions at NAVBASE Kitsap Bangor. Two new facilities totaling 52,100 square feet (4,840 square meters) are being added. These would be part of the operational changes for SPE Alternative 2. Therefore, this alternative would produce an increase of less than one 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
Impact	
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

This page is intentionally blank.

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. 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 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 16 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 8,000 square feet (743 square meters) below MHHW. The abutment stair landings and observation post piles would lie below MHHW, with a total area of approximately 68 square feet (6 square meters). 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 either alternative, the observation posts 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. 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 ESA-listed salmonids, rockfish, marbled murrelets, and Southern Resident killer whales. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS. The Navy is currently in preliminary consultation with the NMFS West Coast Region office and USFWS Washington Fish and Wildlife Office under the ESA, is in preliminary consultation with the NMFS West Coast Region office under the MSA, and is working with NMFS HQ on the MMPA compliance process.

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 will seek permits from USACE for fill associated with the abutment stair landings, and a Section 401 water quality certification from WDOE. In accordance with the CZMA, the Navy will submit a CCD to WDOE.

Impacts of both alternatives on the upland environment would be similar and include approximately 0.32 acre (0.13 hectare) of vegetation clearing, construction traffic, air pollutant emissions, and pile driving and conventional construction noise. With the exception of 0.16 acre (0.064 hectare) of new impervious surface and 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 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 likely not be adversely affected. 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). The Navy has invited and is in 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.

Neither alternative would have population-level effects on salmon stocks harvested by the tribes. 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 3.17–1. 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 • Very 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 and observation posts of approximately 2,128 sq ft (198 sq m) of habitat (not vegetated) • Limited shading by pier and observation post stair grating not expected to have significant impacts on vegetation or invertebrates • Benthic habitat loss of approximately 6,000 sq ft (557 sq m) under piles, steel plate anchors, and stair concrete pads • 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 68 sq ft (6 sq m) under observation post piles and abutment stair concrete pads

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 measures under development)	• 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 measures under development)
Threatened and Endangered Species	No change	• May affect ESA-listed Puget Sound Chinook, Puget Sound steelhead, Hood Canal summer-run chum salmon, bull trout, bocaccio, canary rockfish, yelloweye rockfish, marbled murrelet, and Southern Resident killer whale • Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS • 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 ESA-listed Puget Sound Chinook, Puget Sound steelhead, Hood Canal summer-run chum salmon, bull trout, bocaccio, canary rockfish, yelloweye rockfish, marbled murrelet, and Southern Resident killer whale • Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS • 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)
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 • Measures and practices to be implemented to offset construction and habitats (measures proposed for pile driving noise; others to be developed on consultation with NMFS)	• 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 • Measures and practices to be implemented to offset construction and habitats (measures proposed for pile driving noise; others to be developed on consultation with NMFS)

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 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: 2,680 – Harbor seal: 18,083 – Transient killer whale: 11 – Harbor porpoise: 336 • Measures and practices to be implemented to offset above impacts (measures proposed for pile driving noise; others to be developed in consultation with NMFS)	• 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 above 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 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; others to be 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 (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 pile driving noise; others to be developed in consultation with USFWS) • No incidental takes of MBTA-protected birds are anticipated

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)
Terrestrial Biological Resources	No change	• Approximately 0.32 acre (0.13 hectare) of vegetation cleared • Revegetation of 0.16 acre (0.066 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 0.32 acre (0.13 hectare) of vegetation cleared • Revegetation of 0.16 acre (0.066 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 7,080 sq ft (658 sq m) • Approximately 2,760 sq ft (256 sq m) of new impervious surface • Permanent disturbance of shoreline geology and soils at abutment	• Temporary disturbance of approximately 7,080 sq ft (658 sq m) • Approximately 2,760 sq ft (256 sq m) of new impervious surface • Permanent disturbance of shoreline geology and soils at abutment
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

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)
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 (oysters and clams) beds for commercial harvest. Mitigation included in Memorandum of Agreement (MOA) between Navy and tribes, currently under development.	• 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 tribes, currently under development.
Environmental Justice and Protection of Children	No change	• No disproportionate effects from construction on minority disadvantaged populations or children	• No disproportionate effects from construction 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 • In consultation with SHPO and affected tribes; mitigation measures developed in consultation with SHPO, applied to offset impacts. MOA under development	• Effect, not adverse, on Delta Pier and EHW-1 • Low potential for disturbance of archaeological or NAGPRA resources during construction • In consultation with SHPO and affected tribes; mitigation measures developed in consultation with SHPO, applied to offset impacts. MOA under development

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)
American Indian Traditional Resources	No change	• Restricted access to shellfish harvest area within the immediate construction zone during construction • Temporary (projected 5 years) loss of approximately 0.68 acre (0.28 hectare) of tribal shellfish 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 • Possible visual impact • In consultation with affected tribes; mitigation measures would be developed to offset impacts; MOA under development	• Restricted access to shellfish harvest area within the immediate construction zone during construction • Temporary (projected 4 years) loss of approximately 0.64 acre (0.26 hectare) of tribal shellfish 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 • Possible visual impact • In consultation with affected tribes; mitigation measures would be developed to offset impacts; MOA under development
Traffic	No change	• Increased vehicle traffic during construction (24 months), which will exacerbate 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; barge trips scheduled to avoid commuting hours to maximum extent	• Increased vehicle traffic during construction (24 months), which will exacerbate 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; 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; 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

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, anchors, and/or stair concrete pads in shallow water (< 30 feet)	6,000 square feet (557 square meters)	68 square feet (6 square meters)	Mitigation for loss of aquatic resources will be provided in accordance with the Compensatory Mitigation Rule. A final Mitigation Action Plan demonstrating no net loss of aquatic resources will be submitted to the USACE as part of the permit application process.
Over-water area (shading) in shallow water[2]	17,220 square feet (1,600 square meters)	4,080 square feet (379 square meters)	Mitigation will be provided to compensate for loss of habitat function and value.
Eelgrass covered by steel plate anchors and piles	1,039 square feet (96 square meters)	N/A	Mitigation will be included as a component of the mitigation for aquatic resources.
Eelgrass covered by buoy mooring anchors or degraded by PSB and buoy grounding	N/A	580 square feet (54 square meters)	Mitigation will be included as a component of the mitigation for aquatic resources.
Fill in waters of the U.S. (shoreline abutment stair landings)	24 square feet (2 square meters)	24 square feet (2 square meters)	Mitigation for loss of aquatic resources[3] will be provided in accordance with the Compensatory Mitigation Rule. A final Mitigation Action Plan demonstrating no net loss of aquatic resources will be submitted to the USACE as part of the permit application process.
Excavation in waters of the U.S. (shoreline abutments)	8,000 square feet (740 square meters)	8,000 square feet (740 square meters)	Mitigation for loss of aquatic resources[3] will be provided in accordance with the Compensatory Mitigation Rule. A final Mitigation Action Plan demonstrating no net loss of aquatic resources will be submitted to USACE as part of the permit application process.
Total[4]	25,220 square feet (2,343 square meters)	12,080 square feet (1,120 square meters)	

N/A = not applicable; PSB = port security barrier; USACE = U.S. Army Corps of Engineers

1. Table shows approximate impacts considering all alternatives. Final mitigation requirements for the selected alternative would be determined through the CWA permitting process.
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, and no effect on tribal shellfish beds. 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 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 16 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 ESA-listed salmonids and rockfish, marbled murrelets, and Southern Resident killer whales. Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS. The Navy is currently in preliminary consultation with the NMFS West Coast Region office and USFWS Washington Fish and Wildlife Office under the ESA, is in preliminary consultation with the NMFS West Coast Region office under the MSA, and is working with NMFS HQ on the MMPA compliance process.

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. One tree 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.

Pursuant to the CWA, the Navy will seek a Section 401 water quality certification from WDOE. In accordance with the CZMA, the Navy will submit a CCD to WDOE. The remaining features of the project including the piles and over-water or in-water structures would be permitted by USACE under Section 10 of the Rivers and Harbors Act. In accordance with the CZMA, the Navy will submit a CCD to 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. 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 or have a population-level effect on salmon stocks harvested by the tribes. The Navy has invited and is in 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.

Construction and operational 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; operational traffic impacts would be the same for both alternatives. On-base construction traffic impacts would be minimal; new operational traffic could impact traffic flow on some base roads. 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. 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 3.17–3. 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 very 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 very 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; compensation measures under development)	• 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; compensation measures under development)

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 ESA-listed Puget Sound Chinook, Puget Sound steelhead, Hood Canal summer-run chum salmon, bull trout, bocaccio, canary rockfish, yelloweye rockfish, marbled murrelet, and Southern Resident killer whale • Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS. • 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 ESA-listed Puget Sound Chinook, Puget Sound steelhead, Hood Canal summer-run chum salmon, bull trout, bocaccio, canary rockfish, yelloweye rockfish, marbled murrelet, and Southern Resident killer whale • Final effect determinations for ESA-listed species and critical habitat will be completed during the consultation process and included in the Final EIS. • 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)
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 and habitats (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 and habitats (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: 5,394 – Harbor seal: 49,577 – Transient killer whale: 18 – Harbor porpoise: 938 • 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: 6,868 – Harbor seal: 30,581 – Transient killer whale: 3 – Harbor porpoise: 558 • 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	• Local beneficial economic impacts totaling $171 million from construction activities • No impacts to commercial or recreational fishing
Environmental Justice and Protection of Children	No change	• No disproportionate effects from construction on minority disadvantaged populations or children	• No disproportionate effects from construction on minority disadvantaged populations or children
Cultural Resources	No change	• No Impact; low potential for disturbance of archaeological deposits or NAGPRA items • In consultation with SHPO and affected tribes; MOA under development	• No Impact; low potential for disturbance of archaeological deposits or NAGPRA items • In consultation with SHPO and affected tribes; MOA under development
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 • No impact on tribal shellfish harvest • In consultation with affected tribes; MOA under development • Practices and measures developed in consultation with federally recognized American Indian tribes to offset minimal impacts	• Minimal construction (short-term) impact on salmon with no resulting impact on tribal salmon harvest; no long-term impact • No impact on tribal shellfish harvest • In consultation with affected tribes; MOA under development • Practices and measures developed in consultation with federally recognized American Indian tribes to offset minimal impacts

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
Traffic		• Construction and operations traffic would exacerbate existing peak-hour delays at both base gates • Operations traffic would affect traffic flow on some base roads • Increased marine vessel traffic during two in-water work seasons • Substantial increase in openings of Hood Canal Bridge; barge trips scheduled to avoid commuting hours to maximum extent possible	• Construction and operation traffic would exacerbate existing peak-hour delays at both base gates (longer construction period than Alternative 2) • Operations traffic would affect traffic flow on some base roads • Increased marine vessel traffic during two in-water work seasons (longer period than Alternative 2) • Substantial increase in openings of Hood Canal Bridge (over longer period than Alternative 2); barge trips scheduled to avoid commuting hours to maximum extent possible
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; 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

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 will be provided in accordance with the Compensatory Mitigation for Losses of Aquatic Resources, Final Rule. A final Mitigation Action Plan demonstrating no net loss of aquatic resources will be submitted to the USACE as part of the permit application process.
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 will be provided in accordance with the Compensatory Mitigation for Losses of Aquatic Resources, Final Rule. A final Mitigation Action Plan demonstrating no net loss of aquatic resources will be submitted to the USACE as part of the permit application process.

MLLW = mean lower low water; USACE = U.S. Army Corps of Engineers

1. Table shows approximate impacts considering all alternatives. 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.