3.9. AIRBORNE ACOUSTIC ENVIRONMENT

Noise is defined as unwanted sound or, more specifically, as any sound that (1) is undesirable because it interferes with communication, (2) is intense enough to damage hearing, or (3) is otherwise annoying. Human and wildlife response to sound varies according to the type and characteristics of the noise source, distance between the noise source and the receptor, sensitivity of the receptor, local environmental or atmospheric conditions, and time of day. Sound levels are typically measured in decibels (dB). When discussing noise and humans, noise levels are expressed in terms of A-weighted decibel (dBA), which is a measure of sound energy adjusted for the sensitivities of human hearing, as discussed below. This section discusses airborne noise only. Underwater noise is discussed separately for biological resources in Section 3.3, Section 3.4, and Section 3.5. In addition, a detailed description of underwater sound propagation and airborne noise source levels is provided in Appendix D.

3.9.1. Sound Characteristics

3.9.1.1. SOUND FUNDAMENTALS

Due to wide variations in sound levels, measurements are in dB, which is a unit of measure based on a logarithmic mathematical scale (e.g., a 3 dB increase corresponds to a 100 percent increase in perceived sound). Airborne noise is commonly reported using dBA, which indicates the type of filtering used in the measurement. The purpose for using A-weighted levels is to assess impacts on human receptors and thus is filtered or "shaped" to correspond to how humans hear, in the frequency range of approximately 20 hertz (Hz) to 20 kilohertz (kHz). Sound levels used to assess impacts on wildlife are typically unfiltered. Unfiltered sound pressure levels (or SPLs) are designated as "unweighted." To make comparisons between sound levels, dB sound levels are always referenced to a standard intensity at a standard distance from the source. According to the USEPA (1974), under most conditions, a 5 dB change is necessary for noise increases to be noticeable to humans. Airborne noise levels are expressed in decibels relative to a sound pressure level of 20 micropascals (dB re 20 μPa). Noise is related to the energy level of the sound waves emanating from a source. For many sources, such as construction, the energy level fluctuates over time. To address this variability, sound levels are typically measured as the average energy level over a given time period (Leq metric), which represents the average energy per unit of time that would result in the same total energy over the same time period (one hour is the standard period).

3.9.1.2. SOUND PROPAGATION

Construction noise behaves as a point-source and thus propagates in a spherical manner (that is, equally in all directions) when unobstructed, with a 6 dB decrease in sound pressure level per doubling of distance (WSDOT 2013). Structures, vegetation, and topographic conditions can affect how sound propagates through the air and act to reflect, absorb, or otherwise scatter sound energy. Two specific noise conditions exist at the LWI and SPE project sites, namely propagation over water to the west side of Hood Canal and propagation over heavily vegetated terrain on the east side of Hood Canal. In the first condition, propagation over water is considered a "hard-site" condition (WSDOT 2013); thus, no additional noise reduction factors apply. However, in the second condition two noise reduction factors apply for the topography of

the sites. The first of these is a 7.5 dB loss factor per doubling of distance in "soft-site" conditions, wherein normal, unpacked earth is the predominant soil condition. The second factor is a reduction of 10 dB for interposing dense vegetation, e.g., trees and brush, between the noise source and potential receptors. Prevailing atmospheric conditions can also affect how sound propagates in air, including wind speed, direction, air temperature, and humidity; these factors are not accounted for in the present analysis because they are variable.

3.9.1.3. NOISE-RELATED ENVIRONMENTAL STRESSORS

Ambient noise levels are made up of natural and manmade sounds. Natural sound sources include wind and precipitation, water movement such as surf and wind-generated wave noise, and wildlife. Sound levels from these sources are typically low to moderate, but can be pronounced during violent weather events. Sounds from natural sources are not considered undesirable.

The majority of the daily ambient sound on NAVBASE Kitsap Bangor that is considered noise is generated by human activities. These activities include movement of marine vessels and heavy trucks; operation of equipment (such as cranes, forklifts, and other mechanized equipment); various industrial activities occurring at the shoreline and upland facilities; and general traffic.

3.9.2. Affected Environment

3.9.2.1. EXISTING CONDITIONS

Ambient background noise in urbanized areas typically varies from 60 to 70 dBA. Cavanaugh and Tocci (1998) measured typical residential noise at 65 dBA. Noise levels on NAVBASE Kitsap Bangor vary based on location, but the minimum daytime average levels are estimated to average around 65 dBA in the residential and office park areas, as described in the literature (Cavanaugh and Tocci 1998). Residential and office park areas are located more than one mile from the LWI and SPE project sites and are acoustically screened from the project sites by hills and vegetation. Traffic on the roads is expected to produce levels between 60 and 72 dBA during daytime hours (WSDOT 2013); speeds on NAVBASE Kitsap Bangor are limited to 35 to 40 miles per hour (mph) (56 to 64 kilometers per hour, or kph) on arterials and 25 mph (40 kph) on secondary streets.

Under spherical spreading conditions, sound pressure levels from a point source decrease by 6 dB for every doubling of distance from the source (i.e., the sound level at 100 feet [30 meters] from a source would be one half the level at a distance of 50 feet [15 meters]). Thus, the loudest areas on the base would be along the waterfront and at the ordnance handling areas where most of the activity is taking place, such as near EHW-1 and Delta Pier. Airborne noise measurements were taken from October 19–20, 2010, within the waterfront industrial area near the project sites. During this period, daytime noise levels ranged from 60 to 104 dBA, with average values of approximately 64 dBA. Evening and nighttime levels ranged from 55 to 96 dBA, with an average level of approximately 64 dBA. Thus, daytime maximum levels were higher than nighttime maximum levels, but average nighttime and daytime levels were similar (Navy 2010). These measured noise levels are applicable to the LWI and SPE sites, which are located within the industrial waterfront at NAVBASE Kitsap Bangor. Note that an average sound pressure level is equivalent to the single level over the average time period that would contain the same total sound energy as all of the sound levels combined in that time period.

Higher noise levels are produced by a combination of sound sources including heavy trucks, forklifts, cranes, marine vessels, mechanized tools and equipment, and other sound-generating, industrial/military activities. This section discusses airborne noise only, and noise measurements are not corrected for atmospheric factors as described above unless specifically indicated. Modeling of underwater and airborne noise is detailed in Appendix D.

3.9.2.2. SENSITIVE RECEPTORS

A human sensitive noise receptor is defined as a location or facility where people involved in indoor or outdoor activities may be subject to stress or considerable interference from noise. Such locations or facilities often include residential dwellings, hospitals, nursing homes, educational facilities, and libraries. Wildlife noise receptors, including nest sites and mammal haul-out sites, are addressed in Sections 3.4, 3.5, and 3.6. On-base residential areas and daycare facilities are located several miles inland from the proposed project sites, too far to be affected by project-generated noise.

3.9.2.2.1. SENSITIVE NOISE RECEPTORS NEAR THE LWI PROJECT SITES

The nearest sensitive human noise receptors include schools and residences. Vinland Elementary School is located approximately 2 miles (3.2 kilometers) east of the north LWI project site, and Breidablik Elementary School is located approximately 4 miles (6.4 kilometers) northeast of the project site. Other sensitive noise receptors include residences in Vinland located just north of the NAVBASE Kitsap Bangor northern property boundary, approximately 1.5 miles (2.4 kilometers) from the LWI project site and residences on the west side of Hood Canal, notably in the vicinity of Thorndyke Bay, approximately 4 miles (6.4 kilometers) north of the LWI project site. Typical noise levels measured in a small-town residential neighborhood ranged from 43 to 64 dBA, with levels of 52 dBA occurring more than 50 percent of the time (Cavanaugh and Tocci 1998). Vinland and Thorndyke Bay and surrounding areas are predicted to have similar noise characteristics. Recreational users on the eastern side of Toandos Peninsula and on Hood Canal may experience elevated noise levels during construction activities.

3.9.2.2.2. SENSITIVE NOISE RECEPTORS NEAR THE SPE PROJECT SITE

The closest receptor to the SPE project site is the community of Olympic View, approximately 0.6 mile (1.0 kilometer) south of the SPE project. Because the SPE site is approximately 1.8 miles (2.9 kilometers) south of the north LWI project site, the sensitive receptors located north of the base (Vinland, the schools, and Thorndyke Bay) are approximately 1.8 miles farther from the SPE project site than from the north LWI project site, as described in the preceding paragraph.

3.9.2.3. CURRENT REQUIREMENTS AND PRACTICES

At the state level, WAC Chapter 173-60 establishes maximum allowable noise levels. Based on land-use characteristics, areas are categorized as Class A, B, or C zones (environmental designations) for the purpose of noise abatement (Table 3.9–1). This regulation applies to noise created on the base that may propagate into adjacent non-Navy properties. Industrial areas, such as along the Bangor waterfront, are considered a Class C zone; commercial and recreational areas are considered a Class B zone; and residential areas are considered a Class A zone.

Table 3.9–1. Washington Maximum Permissible Environmental Noise Levels (dBA Leq)

Noise Source	Receiving Property		
	A – Residential (Day/Night)	B – Commercial	C – Industrial
A – Residential	55/45	57	60
B – Commercial	57/47	60	65
C – Industrial	60/50	65	70

Source: WAC 173-60-040; dBA = A-weighted decibel; Leq = equivalent sound level

Title 10, Section 10.28.040 of the Kitsap County Code limits the maximum permissible environmental noise levels for residential zones. The hours and maximum permissible noise levels are the same as those in WAC Chapter 173-60. Sounds originating from temporary construction sites as a result of construction activity are exempt from these provisions between the hours of 7:00 a.m. and 10:00 p.m.

Washington noise regulations (WAC 173-60-040) limit the noise levels from a Class C noise source that affect a Class A receiving property to 60 dBA (daytime) and 50 dBA (nighttime) (nighttime hours are considered 10:00 p.m. to 7:00 a.m.). However, the state noise rules allow these levels to be exceeded by up to 15 dBA for certain brief periods without violating the limits. In addition, certain activities are exempt from these noise limitations:

- Sounds created by motor vehicles on public roads are exempt at all times, except for individual vehicle noise, which must meet noise performance standards set by WAC 173-60-050;
- Sounds created by motor vehicles off public roads, except when such sounds are received in residential areas;
- Sounds originating from temporary construction activities during all hours when received by industrial or commercial zones and during daytime hours when received in residential zones; and
- Sounds caused by natural phenomena and unamplified human voices.

The WAC does not specify the time duration for temporary construction activities.

3.9.3. Environmental Consequences

3.9.3.1. APPROACH TO ANALYSIS

The evaluation of impacts due to noise considers noise generated by pile driving; both impact hammer and vibratory methods; noise from other construction equipment, including noise due to earthmoving activities; and noise from vessel and boat traffic and construction equipment. Standard noise transmission models are used to estimate dissipation of noise over distance from the expected noise source locations and operating conditions. Noise analyses described herein include differences in site topography and use appropriate noise dissipation factors for noted conditions. Changes in acoustic propagation due to wind, humidity, temperature and other

atmospheric factors are not modeled. Appendix D describes the source levels and methodology used to model airborne noise propagation from pile driving.

While the Navy is not subject to local noise ordinances outside installation boundaries, potential impacts from airborne pile driving were analyzed using the WAC 173-60-040 daily allowable noise level of 60 dBA as proxy for ambient noise levels. Leq is the preferred method to describe sound levels that vary over time, resulting in a single decibel value that takes into account the total sound energy over the period of time of interest. Sound levels included in WAC 173-60-040 are assumed to have used an averaging time of 1 hour. Airborne noise levels used for acoustic modeling were measured using 1- and 10-second averaging times for impact and vibratory driving, respectively (Illingworth and Rodkin 2013). Modeling used the higher-impact driving sound levels to conservatively estimate airborne propagation distances. Due to the short duration of each strike, if the given source level is assumed to be constant throughout the hourly Leq period, then the actual Leq achieved will be overestimated, thus, this is a worst-case scenario. Modeled sound levels at the propagation distances described in this section, therefore, overestimate levels that will be reached during actual pile driving and represent a worst-case scenario.

3.9.3.2. LWI PROJECT ALTERNATIVES

Table 3.9-2 details the pile types and numbers, as well as the projected number of days of active driving for each of the LWI Action Alternatives.

Table 3.9–2. Summary of Pile Numbers and Active Driving Days (LWI)

DEIS Alternatives	Size / Type	Number	Number of Days	In-Water Work Window
LWI Alternative 2	24-inch (60-centimeter) steel	54 (north)	80	first
		202 (south)		
	24-inch steel	5 (north) (in the dry)		
		5 (south) (in the dry)		
	36-inch (90-centimeter) steel	15 (north) (in the dry)		
		16 (south) (in the dry)		
LWI Alternative 3 (Preferred Alternative)	24-inch steel	15 (north) (in the dry)	30	first
		15 (south) (in the dry)		
	30-inch (76-centimeter) steel	12 (north) (in the dry)		
		12 (south) (in the dry)		
	36-inch steel	15 (north) (in the dry)		
		16 (south) (in the dry)		

3.9.3.2.1. LWI ALTERNATIVE 1: NO ACTION

The No Action Alternative would not construct or operate the LWI project so there would be no increase in noise-generating activities and no noise impacts.

3.9.3.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

In general, sound pressure levels decrease by a factor of 2 (or 6 dB) for every doubling of distance from the source; thus, the loudest areas on the base would be near the shoreline where most of the activity is taking place, such as near EHW-1 and Delta Pier. Based on recent measurements of aboveground noise taken along the Bangor waterfront, maximum noise in this area is similar to levels observed for common construction equipment.

CONSTRUCTION

Construction of the LWI would involve the use of multiple types of construction equipment, many of which may be operated at the same time. Under LWI Alternative 2, maximum noise levels would be produced when driving piles using barge-mounted cranes and impact hammer pile driving equipment. Most pile driving would occur with a vibratory driver. An impact driver would be used occasionally to proof piles to ensure they are able to bear the design loads. Extensive dump truck traffic is expected during upland construction to move excavated earth and replacement fill. This would increase traffic noise transiting from the LWI project site on the Lower Base to the Upper Base and to local roadways. This noise would not be particularly disruptive to human receptors, due in part to the existing truck traffic on the base and moving in and out of the base. Equipment such as dump trucks, front end loaders, dozers, backhoes, cranes, auger drill rig, and concrete saws or jackhammers are expected to be used at both sites during upland site construction. Use of tugs and work skiffs also is anticipated to support in-water work, and in addition, barge-mounted equipment would be used to install the in-water mesh and steel plate anchors. In the absence of pile driving activity, maximum noise levels produced by construction equipment that might typically be employed at the LWI project site are 90 dBA (USDOT 2006). Presuming multiple sources of noise may be present at one time, maximum combined levels may be as high as 94 dBA. This assumes that multiple, co-located sources combined together would increase noise levels as much as 3 to 4 dB over the level of a single piece of equipment by itself. The resultant sound pressure level (SPL) from n-number of multiple sources is computed with the following relationship using principles of decibel addition:

$$CombinedSPL = 10 \cdot \log_{10}\left(10^{\frac{SPL1}{10}} + 10^{\frac{SPL2}{10}} + \ldots + 10^{\frac{SPLn}{10}}\right)$$

These maximum noise levels are intermittent in nature and not present at all times. Average ambient noise levels are expected to be in the 60 to 68 dBA range, consistent with urbanized or industrial environments where equipment is operating, and similar to the range of noise measured in-situ on Delta Pier in October 2010 (Navy 2010).

Noise propagation was modeled based on three physical environment conditions:

1. Over water, using a 6 dB loss factor per doubling of distance;

2. Over a soft site (e.g., unpaved land), using a 7.5 dB loss factor per doubling of distance; and

3. Over a soft site with dense vegetation, using a 7.5 dB loss factor with a 10 dB reduction

Based on these conditions and the proxy source levels used for acoustic modeling (Table D–8 in Appendix D), the airborne sound environment can be expected to be at ambient conditions at the distances detailed in Table 3.9–3.

Pile driving noise from both impact and vibratory pile driving could exceed allowable noise limits for the Occupational Safety and Health Administration (OSHA) (90 dBA) and Navy Occupational Safety and Health (84 dBA) for an 8-hour period. Personal protective equipment would be required for personnel working in these areas, including personnel working on the water. Personal protective equipment must be capable of reducing the noise exposure to less than 84 dBA, 8-hour time weighted average and less than 140 dB peak sound pressure level for impact or impulse noise.

On-base residential areas would not be affected by pile driving noise due to the intervening distance (4 miles [6.4 kilometers]), terrain, and vegetation (although pile driving may at times be audible above background noise levels). Recreational boaters and kayakers in Hood Canal adjacent to the project sites could be affected by pile driving noise above 60 dBA, although the floating security barrier would prevent recreational users from getting close enough to the pile driver to receive potentially harmful noise levels (84 dBA for 8 hours).

Table 3.9–3. Airborne Impact Pile Driving Noise Propagation Distance to Ambient Conditions (LWI Alternative 2)

Metric	Over Water		Soft Site, No Vegetation		Soft Site, with Vegetation	
	unweighted	A-weighted	unweighted	A-weighted	unweighted	A-weighted
Sound Level (dB RMS) at 50 ft (15 m) from driven pile	110	100	110	100	100	90
Distance to 60 dB RMS (approximate ambient conditions) from driven pile	15,561 ft (4,743 m)	4,921 ft (1,500 m)	4,921 ft (1,500 m)	1,952 ft (595 m)	1,957 ft (597 m)	771 ft (235 m)

dB = decibel; ft = feet; m = meters; RMS = root mean square

Properties with a direct line of sight to the impact pile driver would receive noise levels above local background levels over a distance of approximately 3 miles (4.7 kilometers) assuming a conservative background level of 50 dBA. Waterfront residences on the western shore south of Squamish Harbor, including those along Thorndyke Bay, would receive maximum noise levels less than 60 dBA during impact driving and would not exceed maximum daytime noise levels in WAC 173-60-040. Areas experiencing noise levels above 60 dBA during impact pile driving are shown in Figure 3.9–1. Residents at Vinland, just north of the base property line, may be able to hear impact noise during pile driving, but levels received would be below the expected background noise level of a quiet, residential neighborhood of 50 dBA due to interposing vegetation and terrain.

Figure 3.9-1. Areas Experiencing Airborne Noise Levels of 60 dBA or Greater During Impact Pile Driving, LWI Project

Most pile driving activity would occur with a vibratory driver.

Table 3.9–4 details estimated received noise levels during vibratory pile driving activity for the three terrain conditions described above.

Properties within a direct line-of-sight of a vibratory pile driver may hear vibratory pile driving noise above the background noise on a quiet day. However, at no time would vibratory pile driving noise exceed 60 dBA (the maximum daytime allowable noise level specified in WAC 173-60-040) at any off-base location, including Vinland, local schools, or local residents on the western shore of Hood Canal. Kayakers or boaters located in Hood Canal within 1,385 feet (422 meters) of a vibratory pile driver may receive noise levels above 60 dBA but would not receive noise levels sufficient to cause injury (84 dBA for 8 hours).

Table 3.9–4. Airborne Vibratory Pile Driving Noise Propagation Distance to Ambient Conditions (LWI Alternative 2)

Metric	Over Water		Soft Site, No Vegetation		Soft Site, with Vegetation	
	unweighted	A-weighted	unweighted	A-weighted	unweighted	A-weighted
Sound Level (dB RMS) at 50 ft (15 m) from driven pile	92	89	92	89	82	79
Distance to 60 dB RMS (approximate ambient conditions) from driven pile	1,959 ft (597 m)	1,385 ft (422 m)	938 ft (286 m)	712 ft (217 m)	374 ft (114 m)	285 ft (87 m)

dB = decibel; ft. = feet; m = meters; RMS = root mean square

OPERATION/LONG-TERM IMPACTS

Operation of LWI Alternative 2 would result in a modest increase in airborne noise due to in-air noise of waves breaking on in-water structures during times of windy weather, which would be highly localized to areas directly adjacent to the pier and structures. There would be no increase in vessel or vehicle traffic. Therefore, operation of this alternative would not increase airborne noise levels above existing conditions at either LWI site location.

3.9.3.2.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

CONSTRUCTION

Airborne noise levels generated by construction of Alternative 3 would be the same as for Alternative 2, but the duration of noise generation would be less for Alternative 3. Table 3.9-2 details the number and type of piles, as well as the number of active driving days, for LWI Alternative 3. Pile driving noise would extend approximately the same distances inland as for

Alternative 2 (Tables 3.9–3 and 3.9–4), though distances over water may be smaller based on the abutments' proposed shoreline location. General construction noise would occur for approximately two years for both alternatives. Because Alternative 3 does not include construction of a pier, general construction noise, which excludes pile driving noise, would be at lower levels than for Alternative 2. Upland construction for Alternative 3 would be the same as for Alternative 2, so the level and duration of noise from upland construction would be the same for the two alternatives. Construction noise would be audible in adjacent areas of Hood Canal, which are used for recreation, and on the far side of the Canal, but WAC limits would not be exceeded in residential areas.

OPERATION/LONG-TERM IMPACTS

Operation/long-term noise impacts for Alternative 3 would be the same as described above for Alternative 2: minor and very localized.

3.9.3.2.4. SUMMARY OF LWI IMPACTS

Impacts due to airborne noise associated with construction and operation of the LWI project, along with mitigation and consultation and permit status, are summarized in Table 3.9–5.

Table 3.9–5. Summary of LWI Impacts Due to Airborne Noise

Alternative	Environmental Impacts Due to Airborne Noise
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-supported Pier	*Construction:* Pile driving (no more than 80 days) would increase noise levels in residential and recreational areas (with a conservative assumed ambient noise level of 50 dBA) over a line-of-sight distance of approximately 3 miles [4.7 kilometers]. WAC limits would not be exceeded in residential or school areas. Pile driving noise would exceed OSHA and Navy limits at the construction sites, requiring protective equipment. Non-pile-driving noise from typical construction activity would not adversely affect sensitive receptors off NAVBASE Kitsap Bangor. *Operation/Long-term Impacts:* Minor and highly localized to pier and PSBs.
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* Pile driving (no more than 30 days) would increase noise levels in residential and recreational areas (with a conservative assumed ambient noise level of 50 dBA) over a line-of-sight distance of approximately 3 miles [4.7 kilometers]. WAC limits would not be exceeded in residential or school areas. Pile driving noise would exceed OSHA and Navy limits at the construction sites, requiring protective equipment. Non-pile-driving noise from typical construction activity would not adversely affect sensitive receptors off NAVBASE Kitsap Bangor. *Operation/Long-term Impacts:* Minor and highly localized to PSBs.
Mitigation: The Navy would notify the public about upcoming construction activities and noise at the beginning of construction activities. Construction activities would not be conducted during the hours of 10:00 p.m. to 7:00 a.m.; in addition, pile driving would occur only during daylight hours. Appendix C (Mitigation Action Plan) details mitigation measures.	
Consultation and Permit Status: No consultations or permits are required.	

OSHA = Occupational Safety and Health Administration; WAC = Washington Administrative Code

3.9.3.3. SPE PROJECT ALTERNATIVES

Table 3.9–6 details the pile types and numbers, as well as the projected number of days of active driving for each of the LWI Action Alternatives.

Table 3.9–6. Summary of Pile Numbers and Active Driving Days (SPE)

DEIS Alternatives	Size / Type	Number	Number of Days	In-Water Work Window
SPE Alternative 2 (Preferred Alternative)	36-inch (90-centimeter) steel	230	125	first
	24-inch (60-centimeter) steel	50		
	18-inch (45-centimeter) concrete	105	36	second
SPE Alternative 3	24-inch steel	500	155	first
	18-inch concrete	160	50	second

3.9.3.3.1. SPE ALTERNATIVE 1: NO ACTION

The No Action Alternative would not construct or operate the SPE project so there would be no increase in noise-generating activities and no noise impacts.

3.9.3.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

CONSTRUCTION

The principal source of airborne noise during construction of SPE Alternative 2 would be driving of 36- and 24-inch (90- and 60-centimeter) steel piles, and 18-inch (45-centimeter concrete piles) using a combination of impact and vibratory driving methods. Because sound levels for the smaller concrete piles are expected to be significantly lower than those of the larger steel piles, data for 36-inch steel piles are analyzed under this Alternative, representing the largest anticipated ranges to effect for any type / size of pile driven during the first or second in-water work window. As described above for the LWI, airborne noise propagation was modeled based on three physical environment conditions. Based on these conditions and the proxy source levels used for acoustic modeling (Table D–8 in Appendix D), the airborne sound environment can be expected to be at ambient conditions at the distances detailed in Tables 3.9–7 and 3.9–8, and Figure 3.9–2.

As described above under LWI Alternative 2, pile driving noise from both impact and vibratory pile driving could exceed allowable noise limits for the Occupational Safety and Health Administration (OSHA) (90 dBA) and Navy Occupational Safety and Health (84 dBA) for an 8-hour period. Personal protective equipment would be required for personnel working in these areas, including personnel working on the water. Personal protective equipment must be capable of reducing the noise exposure to less than 84 dBA, 8-hour time weighted average and less than 140 dB peak sound pressure level for impact or pulsed noise.

Residents at Vinland, just north of the base property line, may be able to hear impact noise during pile driving, but levels received would be below the expected background noise level of a quiet, residential neighborhood of 50 dBA due to interposing vegetation and terrain. Properties

with a direct line of sight to the pile driver in the community of Olympic View, which is located approximately 0.6 mile (1.0 kilometer) south of the project site, would experience noise levels of approximately 64 dBA from impact pile driving and 60 dBA for vibratory driving. Properties in Olympic View without line of sight to the pile driver would experience lower noise levels. The WAC 173-60-40 permissible noise level for residential areas affected by industrial activities is 60 dBA in the daytime and 50 dBA at night. However, temporary construction noise during the daytime is exempt from these limits. Nevertheless, residents of Olympic View may be able to hear pile driving noise above background levels, and so could be adversely affected. These pile driving impacts would occur for no more than 125 days during normal construction hours over the first in-water work window, and 36 days during the second in-water work window.

Table 3.9–7. Airborne Impact Pile Driving Noise Propagation Distance to Ambient Conditions (SPE Alternative 2)

Metric	Over Water		Soft Site, No Vegetation		Soft Site, with Vegetation	
	unweighted	A-weighted	unweighted	A-weighted	unweighted	A-weighted
Sound Level (dB RMS) at 50 ft (15 m) from driven pile	112	100	112	100	102	90
Distance to 60 dB RMS (approximate ambient conditions) from driven pile	19,521 ft (5,950 m)	4,921 ft (1,500 m)	5,906 ft (1,800 m)	1,952 ft (595 m)	2,297 ft (700 m)	771 ft (235 m)

dB = decibel; ft = feet; m = meters; RMS = root mean square

Table 3.9–8. Airborne Vibratory Pile Driving Noise Propagation Distance to Ambient Conditions (SPE Alternative 2)

Metric	Over Water		Soft Site, No Vegetation		Soft Site, with Vegetation	
	unweighted	A-weighted	unweighted	A-weighted	unweighted	A-weighted
Sound Level (dB RMS) at 50 ft (15 m) from driven pile	95[1]	96[1]	95	96	85	86
Distance to 60 dB RMS (approximate ambient conditions) from driven pile	2,772 ft (845 m)	3,117 ft (950 m)	1,234 ft (376 m)	1,362 ft (415 m)	492 ft (150 m)	535 ft (163 m)

dB = decibel; ft = feet; m = meters; RMS = root mean square; [1]data derived from EHW-2 acoustic monitoring report; Appendix A details proxy source level selection and values

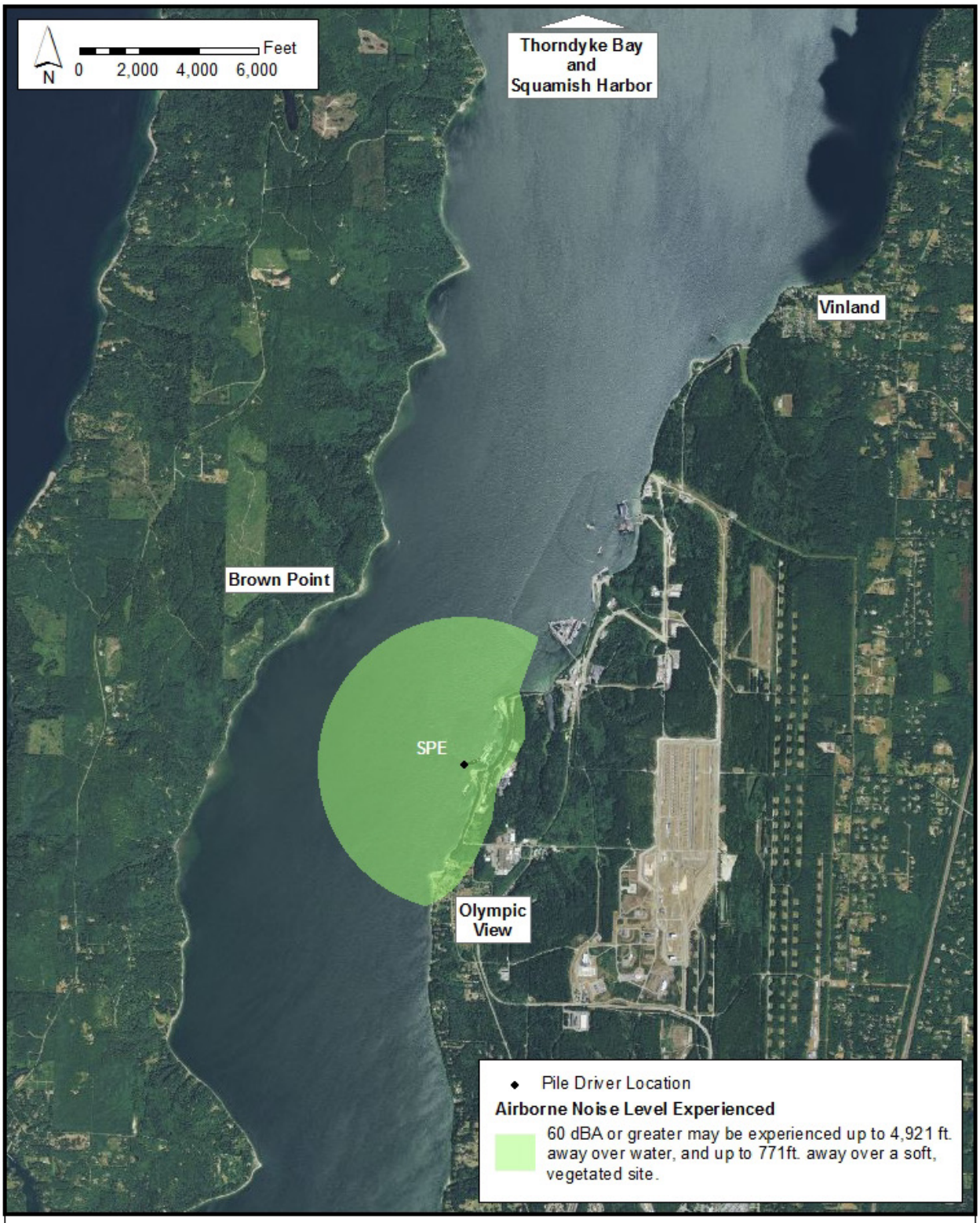

Figure 3.9-2. Areas Experiencing Airborne Noise Levels of 60 dBA or Greater During Impact Pile Driving, SPE Project

Recreational boaters and kayakers in Hood Canal adjacent to the project sites could be affected by pile driving noise above 60 dBA, although the floating security barrier would prevent recreational users from getting close enough to the pile driver to receive potentially harmful noise levels (84 dBA for 8 hours).

Areas experiencing noise levels above 60 dBA during impact pile driving are shown in Figure 3.9–2. Residential properties at the closest point (1.4 miles [2.2 kilometers]) on the western shore of Hood Canal with a direct line of sight to the impact pile driver could receive noise levels of approximately 56 dBA; however, this level would be quickly attenuated by vegetation and structures. Non-pile driving construction noise would be similar to existing levels along the Bangor waterfront and would not adversely affect off-base areas or sensitive receptors.

OPERATION/LONG-TERM IMPACTS

During operations, the number of operational actions would increase from existing levels but the noise levels generated would be similar to existing levels. The increase in the number of operational actions would result in noise-generating activities being more persistent and less intermittent than at present. This change in noise would not be audible at off-base areas or by sensitive receptors. Recreational users on Hood Canal may experience slightly more frequent operational noise associated with activities at the Service Pier.

3.9.3.3.3. SPE Alternative 3: Long Pier

SPE Alternative 3 would involve installation of 24-inch (60-centimeter) steel pipe piles and 18-inch (45-centimeter) concrete piles (Table 3.9–6). Therefore, the distances at which airborne noise is expected to return to ambient conditions are as previously detailed in Tables 3.9–3 and 3.9–4. Pile driving noise would occur over a maximum of 205 days, rather than 161 days for Alternative 2.

3.9.3.3.4. Summary of SPE Impacts

Impacts due to airborne noise associated with construction and operation of the SPE project, along with mitigation and consultation and permit status, are summarized in Table 3.9–9.

Table 3.9–9. Summary of SPE Impacts Due to Airborne Noise

Alternative	Environmental Impacts Due to Airborne Noise
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	*Construction:* Pile driving (no more than 161 days) would increase noise levels in residential and recreational areas (with a conservative assumed ambient noise level of 50 dBA) over a line-of-sight distance of approximately 3 miles [4.7 kilometers]. Pile driving noise would be audible in the community of Olympic View, and could potentially exceed WAC residential limits at properties with a direct line of sight to the impact pile driver. Temporary construction noise is exempt from WAC limits. Pile driving noise would exceed OSHA and Navy limits at the construction sites, requiring protective equipment. Non-pile-driving noise from typical construction activity would not adversely affect sensitive receptors off NAVBASE Kitsap Bangor. *Operation/Long-term Impacts:* Slight increase in the frequency but not the level of operational noise.
SPE Alternative 3: Long Pier	*Construction:* Pile driving (no more than 205 days) would increase noise levels in residential and recreational areas (with a conservative assumed ambient noise level of 50 dBA) over a line-of-sight distance of approximately 3 miles [5 kilometers]. Pile driving noise would be audible in the community of Olympic View, and could potentially exceed WAC residential limits at properties with a direct line of sight to the impact pile driver. Temporary construction noise is exempt from WAC limits. Pile driving noise would exceed OSHA and Navy limits at the construction sites, requiring protective equipment. Non-pile-driving noise from typical construction activity would not adversely affect sensitive receptors off NAVBASE Kitsap Bangor. *Operation/Long-term Impacts:* Slight increase in the frequency but not the level of operational noise.
Mitigation: The Navy would notify the public about upcoming construction activities and noise at the beginning of construction activities. Construction activities would not be conducted during the hours of 10:00 p.m. to 7:00 a.m.; in addition, pile driving would occur only during daylight hours. Appendix C (Mitigation Action Plan) details mitigation measures.	
Consultation and Permit Status: No consultations or permits are required.	

OSHA = Occupational Safety and Health Administration; WAC = Washington Administrative Code

3.9.3.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

Construction activities for the LWI and SPE projects would not overlap. Therefore, construction noise from the two projects would not be additive, but would occur over a maximum of four years rather than the two-year period for either project alone. Therefore, resulting noise disturbance impacts to nearby residential and recreational areas would occur for up to four years for a total of up to 285 days of pile driving.

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