DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XA116

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to a Pile Replacement Project

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; proposed incidental harassment authorization; request for comments.

SUMMARY: NMFS has received an application from the U.S. Navy (Navy) for an Incidental Harassment Authorization (IHA) to take marine mammals, by harassment, incidental to construction activities as part of a pile replacement project. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an IHA to the Navy to take, by Level B Harassment only, five species of marine mammals during the specified activity.

DATES: Comments and information must be received no later than March 7, 2011.

ADDRESSES: Comments on the application should be addressed to Michael Payne, Chief, Permits, Conservation and Education Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910–3225. The mailbox address for providing e-mail comments is *ITP.Laws@noaa.gov.* NMFS is not responsible for e-mail comments sent to addresses other than the one provided here. Comments sent via e-mail, including all attachments, must not exceed a 10-megabyte file size.

Instructions: All comments received are a part of the public record and will generally be posted to *http://www.nmfs.noaa.gov/pr/permits/incidental.htm* without change. All Personal Identifying Information (*e.g.,* name, address) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

A copy of the application containing a list of the references used in this document may be obtained by writing to the address specified above, telephoning the contact listed below (*see* **FOR FURTHER INFORMATION CONTACT**), or visiting the Internet at: *http://www.nmfs.noaa.gov/pr/permits/incidental.htm.* The Navy has prepared a draft Environmental Assessment (EA) titled "Explosives Handling Wharf 1 Pile Replacement Project, Naval Base Kitsap Bangor, Silverdale, WA". This associated document, prepared in compliance with the National Environmental Policy Act (NEPA), is also available at the same Internet address. Documents cited in this notice may also be viewed, by appointment, during regular business hours, at the aforementioned address.

FOR FURTHER INFORMATION CONTACT: Ben Laws, Office of Protected Resources, NMFS, (301) 713–2289.

SUPPLEMENTARY INFORMATION:

Background

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. NMFS has defined "negligible impact" in 50 CFR 216.103 as "* * * an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival."

Section 101(a)(5)(D) of the MMPA established an expedited process by which citizens of the U.S. can apply for an authorization to incidentally take small numbers of marine mammals by harassment. Section 101(a)(5)(D) establishes a 45-day time limit for NMFS review of an application followed by a 30-day public notice and comment period on any proposed authorizations for the incidental harassment of marine mammals. Within 45 days of the close of the comment period, NMFS must either issue or deny the authorization. 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].

Summary of Request

NMFS received an application on December 16, 2010 from the Navy for the taking of marine mammals incidental to pile driving and removal in association with a pile replacement project in the Hood Canal at Naval Base Kitsap in Bangor, WA (NBKB). This pile replacement project is proposed to occur between July 16, 2011 and July 15, 2013. This IHA would cover only the initial year of this project (July 16, 2011–July 15, 2012), with a subsequent IHA necessary for completion. Pile driving and removal activities would occur only within a window from July 16–October 31, with any required impact driving occurring only from July 16–September 30. Six species of marine mammals are known from the waters surrounding NBKB: Steller sea lions (*Eumetopias jubatus*), California sea lions (*Zalophus californianus*), harbor seals (*Phoca vitulina*), killer whales (*Orcinus orca*), Dall's porpoises (*Phocoenoides dalli*), and harbor porpoises (*Phocoena phocoena*). These species may occur year-round in the Hood Canal, with the exception of the Steller sea lion. Steller sea lions are present only from fall to late spring (November–June), outside of the project's pile driving and removal window (July 16–October 31). Additionally, while the Southern Resident killer whale (listed as endangered under the Endangered Species Act [ESA]) is resident to the inland waters of Washington and British Columbia, it has not been observed in the Hood Canal in decades and was therefore excluded from further analysis. Only the five species which may be present during the project's timeline may be exposed to sound pressure levels associated with vibratory and impulsive pile driving, or pneumatic chipping, and will be analyzed in detail in this document.

The Navy proposes to complete necessary repairs and maintenance at the Explosive Handling Wharf #1 (EHW–1) facility at NBKB as part of a pile replacement project to restore and maintain the structural integrity of the wharf and ensure its continued functionality to support necessary operational requirements. The EHW–1 facility, constructed in 1977, has been compromised due to the deterioration of the wharf's existing piling sub-structure. Under the proposed action, ninety-six 24-in (0.6 m) diameter concrete piles, thirty-nine 12-in (0.3 m) diameter steel fender piles, and three 24-in diameter steel fender piles will be removed. In addition, a total of twenty-eight 30-in (0.8 m) diameter steel pipe piles will be installed and filled with concrete on the southwest corner of EHW–1. The proposed action will occur over a two year construction period scheduled to begin in July 2011, of which the first year would be authorized under this IHA. All piles will be driven with a vibratory hammer for their initial embedment depths, and select piles will be impact driven for their final 10–15 ft (3–4.6 m) for proofing, as necessary. "Proofing" involves driving a pile the last few feet into the substrate to determine the capacity of the pile. The capacity during proofing is established by measuring the resistance of the pile to a hammer that has a piston with a known weight and stroke (distance the hammer rises and falls) so that the energy on top of the pile can be calculated. The blow count in "blows per inch" is measured to verify resistance, and pile compression capacities are calculated using a known formula. Noise attenuation measures (*i.e.,* bubble curtain) will be used during all impact hammer operations. Hydroacoustic monitoring will be performed to assess effectiveness of noise attenuation measures.

For pile driving activities, the Navy used NMFS-promulgated thresholds for assessing pile driving and removal impacts (NMFS 2005b, 2009), outlined later in this document. The Navy used recommended spreading loss formulas (the practical spreading loss equation for underwater sounds and the spherical spreading loss equation for airborne sounds) and empirically-measured source levels from other 24–30 in (0.6–0.8 m) diameter pile driving and removal events to estimate potential marine mammal exposures. Predicted exposures are outlined later in this document. The calculations predict that no Level A harassments would occur associated with pile driving or construction activities, and that 2,488 Level B harassments may occur during the pile replacement project from underwater sound. No incidents of harassment were predicted from airborne sounds associated with pile driving. Some assumptions (*e.g.,* marine mammal densities) used to estimate the exposures are conservative, and may overestimate the potential number of exposures and their severity.

Description of the Specified Activity

NBKB is located on the Hood Canal approximately twenty miles (32 km) west of Seattle, Washington (*see* Figures 1–1 and 1–2 in the Navy's application). NBKB provides berthing and support services to Navy submarines and other fleet assets. The entirety of NBKB, including the land areas and adjacent water areas in the Hood Canal, is restricted from general public access. The Navy proposes a pile replacement project to maintain the structural integrity of EHW–1 and ensure its continued functionality to support operational requirements of the TRIDENT submarine program. The proposed actions with the potential to cause harassment of marine mammals within the waterways adjacent to NBKB, under the MMPA, are vibratory and impulsive pile driving operations, and vibratory and pneumatic chipping removal operations, associated with the pile replacement project. The proposed activities that would be authorized by this IHA will occur between July 16, 2011 and July 15, 2012. All in-water construction activities within the Hood Canal are only permitted during July 16–February 15 in order to protect spawning fish populations. The further restriction of in-water work window (July 16–October 31) proposed by the Navy avoids the possibility of incidental harassment of Steller sea lions. The Eastern Distinct Population Segment (DPS) of Steller sea lions, present in the Hood Canal outside of this further restriction of the in-water work window, is listed as threatened under the ESA. Impact pile driving would be further restricted to the period July 16–September 30, per ESA consultation with the U.S. Fish and Wildlife Service (USFWS).

As part of the Navy's sea-based strategic deterrence mission, the Navy Strategic Systems Programs directs research, development, manufacturing, test, evaluation, and operational support for the TRIDENT Fleet Ballistic Missile program. Maintenance and development of necessary facilities for handling of explosive materials is part of these duties. The proposed action for this IHA request includes the removal of the fragmentation barrier, walkway, and 138 steel and concrete piles at EHW–1. Of the piles requiring removal, 96 are 24-in (0.6 m) diameter hollow pre-cast concrete piles which will be excised down to the mud line. An additional three 24-in steel fender piles, and thirty-nine 12-in (0.3 m) steel fender piles, will be extracted using a vibratory hammer. Also included in the repair work is the installation of 28 new 30-in (0.8 m) diameter steel pipe piles, the construction of new cast-in-place pile caps (concrete formwork may be located below Mean Higher High Water [MHHW]), the installation of the pre-stressed superstructure, the installation of five sled-mounted cathodic protection (CP) systems, and the installation or re-installation of related appurtenances. Sound propagation data will be collected through hydroacoustic monitoring during pile installation and removal to support environmental analyses for future repair work that may be necessary to maintain the EHW–1 facility. The presence of marine mammals will also be monitored during pile installation and removal.

The EHW–1 pile replacement project has been designed to restore the structural integrity of the EHW–1 facility which has been compromised due to the deterioration of the wharf's existing piling sub-structure. Under the proposed action, ninety-six 24-in (0.6 m) diameter concrete piles, thirty-nine 12-in (0.3 m) steel fender piles, and three 24-in diameter steel fender piles will be removed. In addition, a total of twenty-eight 30-in (0.8 m) diameter steel pipe piles will be installed and filled with concrete on the southwest corner of EHW–1. The proposed action will occur over a two year construction period scheduled to begin in July 2011.

The removal and installation of piles at EHW–1 is broken up into three components described in detail below and depicted in Figure 1–3 of the Navy's application. The first component of this project would entail (*see* Section A on Figure 1–3 pf the Navy's application):

• The removal of one 24-in diameter steel fender pile and its associated fender system components at the outboard support. A fender pile, typically set beside slips or wharves, guides approaching vessels and is driven so as to yield slightly when struck in order to lessen the shock of contact. The fender system components attach the fender piles to the structure, and are above the water line.

• The installation of sixteen 30-in diameter hollow steel pipe piles (approximately 130 ft [40 m] long), with approximately 100 ft (30 m) of the pile below the Mean Lower Low Water mark.

• The construction of two cast-in-place concrete pile caps. The pile caps would be situated on the tops of the steel piles located directly beneath the structure (*see* Figure 1–4 of the Navy's application for a diagram) and function as a load transfer mechanism between the superstructure and the piles.

Concrete formwork may be located below MHHW.

- The installation of three sled mounted passive CP systems. The passive CP system is a metallic rod or anode that is attached to a metal object to protect it from corrosion. The anode is composed of a more active metal than that on which it is mounted and is more easily oxidized, thus corroding first and acting as a barrier against corrosion for the object to which it is attached. This system would be banded to the steel piles to prevent metallic surfaces of the wharf from corroding due to the saline conditions in Hood Canal.

The second component of this project would require (*see* Section B in Figure 1–3 of the Navy's application):

- The removal of two 24-in diameter steel fender piles at the main wharf and associated fender system components.
- The installation of twelve 30-in diameter hollow steel pipe piles (approximately 74–122 ft [23–37 m] long). The embedment depth of the piles would range from 30–50 ft (9–15 m).
- The construction of four concrete pile caps.
- The installation of a pre-stressed concrete superstructure. The superstructure is the pre-stressed concrete deck of the wharf found above, or supported by, the caps or sills, including the deck, girders, and stringers.
- The installation of two sled mounted passive CP systems.
- The installation or re-installation of related appurtenances, the associated parts of the superstructure that connect the superstructure to the piles. These pieces include components such as bolts, welded metal hangers and fittings, brackets, *etc.*

The final component of this project would be (*see* Section C on Figure 1–3 of the Navy's application):

- The removal of the concrete fragmentation barrier and walkway, used to get from the Wharf Apron to the Outboard Support. These structures will likely be removed by cutting the concrete into sections (potentially three or four in total) using a saw, or other equipment, and removed using a crane. The crane will lift the sections from the existing piles and place them on a barge.
- The removal of the piles supporting the fragmentation barrier including:
  - Thirty-nine 12-in diameter steel fender piles.
  - Ninety-six 24-in diameter hollow pre-cast concrete piles cut to the mud line (includes 72 at fragmentation barrier, four at walkway, four at Bent 8 outboard support, and eight at Bents 9 and 10).
- Concrete piles would be removed with a pneumatic chipping hammer or another tool capable of cutting through concrete. A pneumatic chipping hammer is similar to an electric power tool, such as a jackhammer, but uses compressed air instead of electricity. The pneumatic chipping hammer consists of a steel piston that is reciprocated in a steel barrel by compressed air. On its forward stroke the piston strikes the end of the chisel. The piston reciprocates at a rate such that the chisel edge vibrates against the concrete with enough force to fragment or splinter the pile. The concrete debris would be captured using debris curtains/sheeting and removed from the project area.

Pile removal and installation would occur between July 16 and October 31 during each year of construction, with all impact driving further restricted to July 16–September 30. The installation of the concrete pile caps and sled mounted passive CP systems is out-of-water work, on the tops of the piles themselves or attached to the wharf's superstructure. In a precautionary measure, these activities would nonetheless be limited to the in-water work window from July 16 to February 15—a window established to minimize impacts to fish.

Vibratory driving would be the preferred method for all pile installation, and would be used for removal of all steel piles. During pile installation, depending on local site conditions, it may be necessary to drive some piles for the final few feet with an impact hammer. This technique, known as proofing, may be required due to substrate refusal. As a result of consultation with USFWS under the ESA, impact pile driving, if required for proofing, will not occur on more than five days for the duration of any pile driving window during the implementation of the project, and no more than one pile may be proofed in a given day. Furthermore, impact driving or proofing would be limited to fifteen minutes per pile (up to five piles total). Based on the Navy's experience with pile replacement during previous repair cycles at the EHW–1 facility, the Navy felt that this measure could be complied with. During previous repairs at EHW–1, no use of impact driving has been required to accomplish installation. All piles driven with an impact hammer would be surrounded by a bubble curtain or other sound attenuation device over the full water column to minimize in-water noise. Vibratory pile driving is restricted to the time period between July 16 and October 31, while impact driving would only be performed between July 16 and September 30. Non-pile driving, in-water work can be performed between July 16 and February 15. The Navy will monitor hydroacoustic levels, as well as the presence and behavior of marine mammals during pile installation and removal. Under the proposed action, twenty-eight 30-in steel piles would be installed and 138 piles, steel and concrete, would be removed.

The contractor estimates that steel pile installation and removal will occur at an average rate of two piles per day. For each pile installed, the driving time is expected to be no more than one hour for the vibratory portion of the project. The impact driving portion of the project, when required, is anticipated to take approximately fifteen minutes per pile, with a maximum of five piles per construction window permitted to be impact driven. Impact pile driving will not occur on more than five days for the duration of any pile driving window and no more than one pile will be proofed in a given day. Steel piles will be extracted using a vibratory hammer. Extraction is anticipated to take approximately thirty minutes per pile. Concrete piles will be removed using a pneumatic chipping hammer or other similar concrete demolition tool. It is estimated that concrete pile removal could occur at a rate of five piles per day maximum, but removal will more likely occur at a rate of three piles per day. It is expected to take approximately two hours to remove each concrete pile with a pneumatic chipping hammer.

For steel piles, this results in a maximum of two hours of pile driving per pile or potentially four hours per day. For concrete piles, this results in a maximum of two hours of pneumatic chipping per pile, or potentially six hours per day. Therefore, while 108 days of in-water work time is proposed (July 16–October 31), only a fraction of the total work time per day will actually be spent pile driving. An average work day (two hours post-sunrise to two hours prior to sunset [civil]) ranges from six to twelve hours (for an average of approximately eight to nine hours), depending on the month. While it is anticipated that only four hours of pile driving would take place per day for steel piles, or six hours of pneumatic chipping for concrete piles, the Navy modeled potential impact as if the entire day could be spent pile driving to take into account deviations from the estimated times for pile installation and removal.

Based on the proposed action, the total time from vibratory pile driving during steel pile installation would be approximately fourteen days (28 piles at an average of two per day). The total time from impact pile driving during steel pile installation would be five days (five piles at one per day). The total time from vibratory pile driving during steel pile removal would be 21 days (42 piles at an average of two per day). The total time using a pneumatic chipping hammer during concrete pile removal would be 32 days (96 piles at an average of three per day).

Description of Noise Sources

Underwater sound levels are comprised of multiple sources, including physical noise, biological noise, and anthropogenic noise. Physical noise includes waves at the surface, earthquakes, ice, and atmospheric noise. Biological noise includes sounds produced by marine mammals, fish, and invertebrates. Anthropogenic noise consists of vessels (small and large), dredging, aircraft overflights, and construction noise. Known noise levels and frequency ranges associated with anthropogenic sources similar to those that would be used for this project are summarized in Table 1. Details of each of the sources are described in the following text.

TABLE 1—REPRESENTATIVE NOISE LEVELS OF ANTHROPOGENIC SOURCES

Noise source	Frequency range (Hz)	Underwater noise level (dB re 1 μPa)	Reference
Small vessels	250–1,000	151 dB root mean square (rms) at 1 m (3.3 ft).	Richardson *et al.* 1995.
Tug docking gravel barge	200–1,000	149 dB rms at 100 m (328 ft)	Blackwell and Greene 2002.
Vibratory driving of 30-in (0.8 m) steel pipe pile.	10–1,500	Approximately 168 dB rms at 10 m (33 ft).	WSDOT 2010a, 2010b.
Impact driving of 30-in steel pipe pile	10–1,500	Approximately 193 dB rms at 10 m	WSDOT 2005, 2008; CALTRANS 2007; Reyff 2005.

In-water construction activities associated with the project would include impact pile driving and vibratory pile driving. The sounds produced by these activities fall into one of two sound types: Pulsed and non-pulsed. Impact pile driving produces pulsed sounds, while vibratory pile driving produces non-pulsed (or continuous) sounds. The distinction between these two general sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (*e.g.,* Ward 1997 in Southall *et al.* 2007). Please *see* Southall *et al.* (2007) for an in-depth discussion of these concepts.

Pulsed sounds (*e.g.,* explosions, gunshots, sonic booms, seismic pile driving pulses, and impact pile driving) are brief, broadband, atonal transients (ANSI 1986; Harris 1998) and occur either as isolated events or repeated in some succession. Pulsed sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a decay period that may include a period of diminishing, oscillating maximal and minimal pressures. Pulsed sounds generally have an increased capacity to induce physical injury as compared with sounds that lack these features.

Non-pulse (intermittent or continuous sounds) can be tonal, broadband, or both. Some of these non-pulse sounds can be transient signals of short duration but without the essential properties of pulses (*e.g.,* rapid rise time). Examples of non-pulse sounds include vessels, aircraft, machinery operations such as drilling or dredging, vibratory pile driving, and active sonar systems. The duration of such sounds, as received at a distance, can be greatly extended in a highly reverberant environment.

Ambient Noise

By definition, ambient noise is background noise, without a single source or point (Richardson *et al.* 1995). Ambient noise varies with location, season, time of day, and frequency. Ambient noise is continuous, but with much variability on time scales ranging from less than one second to one year (Richardson *et al.* 1995). Ambient underwater noise at the project area is widely variable over time due to a number of natural and anthropogenic sources. Sources of naturally occurring underwater noise include wind, waves, precipitation, and biological noise (*e.g.,* shrimp, fish, cetaceans). There is also human-generated noise from ship or boat traffic and other mechanical means (Urick 1983). Other sources of underwater noise at industrial waterfronts could come from cranes, generators, and other types of mechanized equipment on wharves or the adjacent shoreline.

In the vicinity of the project area, 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 83–99 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.

Airborne noise levels at NBKB vary based on location but are estimated to average around 65 dBA (A-weighted decibels) in the residential and office park areas, with traffic noise ranging from 60–80 dBA during daytime hours (Cavanaugh and Tocci 1998). The highest levels of airborne noise are produced along the waterfront and at the ordnance handling areas, where estimated noise levels range from 70–90 dBA and may peak at 99 dBA for short durations. These 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 or military activities.

Sound Thresholds

Since 1997, NMFS has used generic sound exposure thresholds to determine when an activity in the ocean that produces sound might result in impacts to a marine mammal such that a take by harassment might occur (NMFS 2005b). To date, no studies have been conducted that examine impacts to marine mammals from pile driving sounds from which empirical noise thresholds have been established. Current NMFS practice regarding exposure of marine mammals to sound is that cetaceans and pinnipeds exposed to impulsive sounds of 180 and 190 dB rms or above, respectively, are considered to have been taken by Level A (*i.e.,* injurious) harassment. Behavioral harassment (Level B) is considered to have occurred when marine mammals are exposed to sounds at or above 160 dB rms for impulse sounds (*e.g.,* impact pile driving) and 120 dB rms for continuous noise (*e.g.,* vibratory pile driving), but below injurious thresholds. For airborne noise, pinniped disturbance from haul-outs has been documented at 100 dB (unweighted) for pinnipeds in general, and at 90 dB (unweighted) for harbor seals. NMFS uses these levels as guidelines to estimate when harassment may occur.

Distance to Sound Thresholds

Underwater Sound Propagation Formula—Pile driving would generate underwater noise that potentially could result in disturbance to marine mammals transiting the project area. Transmission loss (TL) underwater is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water depth, water chemistry, and bottom composition and topography. The formula for transmission loss is:

$$TL = B * \log_{10}(R) + C * R$$

where:
B = logarithmic (predominantly spreading) loss
C = linear (scattering and absorption) loss
R = range from source in meters

For all underwater calculations in this assessment, linear loss (C) was not used (*i.e.,* C = 0) and transmission loss was calculated using only logarithmic spreading. Therefore, using practical spreading (B = 15), the revised formula for transmission loss is $TL = 15 \log_{10}(R)$.

Underwater Noise from Pile Driving—The intensity of pile driving sounds is greatly influenced by factors such as the type of piles, hammers, and the physical environment in which the activity takes place. A large quantity of literature regarding sound pressure levels recorded from pile driving projects is available for consideration. In order to determine reasonable sound pressure levels and their associated affects on marine mammals that are likely to result from pile driving at NBKB, studies with similar properties to the proposed action were evaluated. Sound levels associated with vibratory pile removal are the same as those during vibratory installation (CALTRANS 2007) and have been taken into consideration in the modeling analysis. There is a lack of empirical data regarding the acoustic output of chipping hammers. As a result, acoustic information for similar types of concrete breaking instruments, such as jackhammers and concrete saws, was also consulted. Overall, studies which met the following parameters were considered: (1) Pile size and materials: Installation—steel pipe piles (30-in diameter); Removal—steel pipe piles (12 to 24-in diameter); Removal—concrete piles (24-in diameter); (2) Hammer machinery: Installation (steel)—vibratory and impact hammer, Removal (steel)—vibratory hammer; Removal (concrete)—pneumatic chipping and/or jackhammer; and (3) Physical environment—shallow depth (less than 100 feet [30 m]).

TABLE 2—UNDERWATER SOUND PRESSURE LEVELS FROM SIMILAR IN-SITU MONITORED CONSTRUCTION ACTIVITIES

Project and location	Pile size and type	Installation method	Water depth	Measured sound pressure levels
Eagle Harbor Maintenance Facility, WA [1].	30-in (0.8 m) steel pipe pile	Impact	10 m (33 ft)	193 dB re 1 µPa (rms) at 10 m (33 ft).
Richmond-San Rafael Bridge, CA [2].	30-in steel pipe pile	Impact	4–5 m (13–16 ft)	190 dB re 1 µPa (rms) at 10 m.
Friday Harbor Ferry Terminal, WA [3].	30-in steel pipe pile	Impact	10 m	196 dB re 1 µPa (rms) at 10 m.
Various projects [4]	30-in steel CISS [5] pile	Impact	Unknown	192 dB re 1 µPa (rms) at 10 m.
			Average	approximately 193 dB re 1 µPa (rms) at 10 m.

[1] WSDOT 2008.
[2] CALTRANS 2007.
[3] WSDOT 2005.
[4] Reyff 2005.
[5] Cast-in-steel-shell.

Tables presented here detail representative pile driving sound pressure levels that have been recorded from similar construction activities in recent years. Due to the similarity of these actions and the Navy's proposed action, they represent reasonable sound pressure levels which could be anticipated and these values were used in the acoustic modeling and analysis. Table 2 represents sound pressure levels (SPLs) that may be expected during the installation of the 30-in steel pipe piles using an impact hammer, should this be required. Table 3 represents SPLs that may be expected during the installation of the 30-in steel piles using a vibratory hammer. Table 4 represents SPLs that may be expected during the removal of the 12 to 24-in steel pipe piles and the 24-in concrete pilings.

TABLE 3—UNDERWATER SOUND PRESSURE LEVELS FROM SIMILAR IN-SITU MONITORED CONSTRUCTION ACTIVITIES

Project and location	Pile size and type	Installation method	Water depth	Measured sound pressure levels
Keystone Ferry Terminal, WA [1]	30-in (0.8 m) steel pipe pile	Vibratory	5 m (15 ft)	166 dB re 1 µPa (rms) at 10 m (33 ft).
Keystone Ferry Terminal, WA [1]	30-in steel pipe pile	Vibratory	8 m (28 ft)	171 dB re 1 µPa (rms) at 10 m.
Vashon Ferry Terminal, WA [2]	30-in steel pipe pile	Vibratory	10–12 m (36–40 ft)	165 dB re 1 µPa (rms) at 10 m.

TABLE 3—UNDERWATER SOUND PRESSURE LEVELS FROM SIMILAR IN-SITU MONITORED CONSTRUCTION ACTIVITIES—Continued

Project and location	Pile size and type	Installation method	Water depth	Measured sound pressure levels
			Average	approximately 168 dB re 1 μPa (rms) at 10 m.

[1] WSDOT 2010a.
[2] WSDOT 2010b.

TABLE 4—UNDERWATER SOUND PRESSURE LEVELS FOR PILE REMOVAL FROM SIMILAR IN-SITU MONITORED CONSTRUCTION ACTIVITIES

Project and location	Pile size and type	Removal method	Water depth	Measured sound pressure levels
Unknown, CA [1]	24-in (0.6 m) steel pipe pile	Vibratory	approximately 15 m (49 ft).	165 dB re 1 μPa (rms) at 10 m (33 ft).
United Kingdom [2]	Unknown size [3]; concrete	Jackhammer	Unknown	161 dB re 1 μPa (rms) at 1 m (3.3 ft).

[1] CALTRANS 2007.
[2] Nedwell and Howell 2004.
[3] This is the only literature found for the underwater use of a jackhammer or pneumatic chipping tool. The size of the pile was not recorded. Since these tools operate to chip portions of concrete from the pile, sound output is not likely tied to the size of the pile itself as for impact and vibratory pile driving. Therefore, this data was found to be representative for this project.

Several noise reduction measures can be employed during pile driving to reduce the high source pressures associated with impact pile driving. Among these is the use of bubble curtains, cofferdams, pile caps, or the use of vibratory installation. The efficacy of bubble curtains is dependent upon a variety of site-specific factors, including environmental conditions such as water current, sediment type, and bathymetry; the type and size of the pile; and the type and energy of the hammer. For the pile replacement project, the Navy intends to employ noise reduction techniques during impact pile driving, including the use of sound attenuation systems (*e.g.,* bubble curtain). *See* "Proposed Mitigation" for more details on the impact reduction and mitigation measures proposed. The calculations of the distances to the marine mammal noise thresholds were calculated for impact installation with and without consideration for mitigation measures. Thorson and Reyff (2004) determined that a properly designed bubble curtain could provide a reduction of 5 to 20 dB. Based on information contained therein, distances calculated with consideration for mitigation assumed a 10 dB reduction in source levels from the use of sound attenuation devices, and the Navy used the mitigated distances for impact pile driving for all analysis in their application. All calculated distances to and the total area encompassed by the marine mammal noise thresholds are provided in Tables 5, 6, and 7. Calculated distance to thresholds using unmitigated impact driving is provided as reference; no unmitigated impact driving will occur. The USFWS has requested this as a measure to protect prey of the ESA-endangered marbled murrelet.

TABLE 5—CALCULATED DISTANCE(S) TO AND AREA ENCOMPASSED BY UNDERWATER MARINE MAMMAL NOISE THRESHOLDS DURING PILE INSTALLATION

Group	Threshold	No mitigation, m (ft) [1]	With mitigation, m (ft) [1]	Area, km^2 (mi^2)
Pinnipeds	Impact driving, injury (190 dB)	16 (52)	4 (13)	0.000
Cetaceans	Impact driving, injury (180 dB)	74 (243)	16 (52)	0.001 (0.000)
All	Impact driving, disturbance (160 dB)	1,585 (5,200)	342 (1,122)	0.367 (0.142)
Pinnipeds	Vibratory driving, injury	0	0	0.000
Cetaceans	Vibratory driving, injury	2 (6.6)	2	0.000
All	Vibratory driving, disturbance (120 dB)	15,849 (51,998)	[2] 15,849	[2] 789.1 (304.7)

All sound levels expressed in dB re 1 μPa rms. Practical spreading loss (15 log, or 4.5 dB per doubling of distance) used for calculations.
[1] Sound pressure levels used for calculations were: 193 dB re 1 μPa @ 10 m (33 ft) for impact and 168 dB re 1 μPa @ 10 m for vibratory.
[2] Range calculated is greater than what would be realistic. Hood Canal average width at site is 2.4 km (1.5 mi), and is fetch limited from N to S at 20.3 km (12.6 mi).

TABLE 6—CALCULATED DISTANCE(S) TO AND AREA ENCOMPASSED BY UNDERWATER MARINE MAMMAL NOISE THRESHOLDS DURING PILE REMOVAL

Group	Threshold [1]	Distance, m (ft) [2]	Area, km^2 (mi^2)
Pinnipeds	Vibratory removal, injury (190 dB)	0	0.000
Cetaceans	Vibratory removal, injury (180 dB)	1 (3.3)	0.000
All	Vibratory removal, disturbance (120 dB)	[3] 10,000 (5,200)	[3] 314.2 (121.3)
Pinnipeds	Chipping hammer, injury (190 dB)	0	0.000
Cetaceans	Chipping hammer, injury (180 dB)	0	0.000

TABLE 6—CALCULATED DISTANCE(S) TO AND AREA ENCOMPASSED BY UNDERWATER MARINE MAMMAL NOISE THRESHOLDS DURING PILE REMOVAL—Continued

Group	Threshold [1]	Distance, m (ft) [2]	Area, km^2 (mi^2)
All	Chipping hammer, disturbance (120 dB)	[3] 542 (1,778)	[3] 0.929 (0.359)

All sound levels expressed in dB re 1 µPa rms. Practical spreading loss (15 log, or 4.5 dB per doubling of distance) used for calculations.
[1] Specific criteria for pneumatic chipping hammers does not exist. These tools produce continuous sound similar to vibratory pile driving and therefore use the same criteria for the analysis of effects.
[2] Sound pressure levels used for calculations were: 165 dB re 1 µPa @ 10 m (33 ft) for vibratory and 161 dB re 1 µPa @ 1 m for chipping hammer.
[3] Range calculated is greater than what would be realistic. Hood Canal average width at site is 2.4 km (1.5 mi), and is fetch limited from N to S at 20.3 km (12.6 mi).

The calculations presented in Tables 5 and 6 assumed a field free of obstruction, which is unrealistic, because Hood Canal does not represent open water conditions (free field). Therefore, sounds would attenuate as they encounter land masses or bends in the canal. As a result, some of the distances and areas of impact calculated cannot actually be attained at the project area. The actual distances to the behavioral disturbance thresholds for impact and vibratory pile driving and pneumatic chipping may be shorter than those calculated due to the irregular contour of the waterfront, the narrowness of the canal, and the maximum fetch (furthest distance sound waves travel without obstruction [*i.e.,* line of sight]) at the project area. Table 7 shows the actual areas encompassed by the marine mammal thresholds during each stage of the EHW–1 pile replacement project. *See* Figures 6–1 through 6–4 of the Navy's application for depictions of the areas of each underwater sound threshold that are predicted to occur at the project area due to pile driving, during each stage of the project.

TABLE 7—ACTUAL AREA ENCOMPASSED BY UNDERWATER MARINE MAMMAL NOISE THRESHOLDS

Group	Threshold [1]	Area, km^2 (mi^2)
Pinnipeds	Impact driving, injury (190 dB)	0.000
Cetaceans	Impact driving, injury (180 dB)	0.001 (0.000)
All	Impact driving, disturbance (160 dB)	0.287 (0.111)
Pinnipeds	Vibratory driving, injury (190 dB)	0.000
Cetaceans	Vibratory driving, injury (180 dB)	0.000
All	Vibratory driving, disturbance (120 dB)	40.3 (15.5)
Pinnipeds	Vibratory removal, injury (190 dB)	0.000
Cetaceans	Vibratory removal, injury (180 dB)	0.000
All	Vibratory removal, disturbance (120 dB)	35.9 (13.9)
Pinnipeds	Chipping hammer, injury (190 dB)	0.000
Cetaceans	Chipping hammer, injury (180 dB)	0.000
All	Chipping hammer, disturbance (120 dB)	0.608 (0.235)

Airborne Sound Propagation Formula—Pile driving can generate airborne noise that could potentially result in disturbance to marine mammals (specifically, pinnipeds) which 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 NBKB to be exposed to airborne sound pressure levels that could result in Level B behavioral harassment. The appropriate airborne noise threshold for behavioral disturbance for all pinnipeds, except harbor seals, is 100 dB re 20 µPa rms (unweighted). For harbor seals, the threshold is 90 dB re 20 µPa rms (unweighted). A spherical spreading loss model, assuming average atmospheric conditions, was used to estimate the distance to the 100 dB and 90 dB re 20 µPa rms (unweighted) airborne thresholds. The formula for calculating spherical spreading loss is:

$$TL = 20\log r$$

where:
TL = Transmission loss
r = Distance from source to receiver

*Spherical spreading results in a 6 dB decrease in sound pressure level per doubling of distance.

Airborne Sound from Pile Installation and Removal—As was discussed for underwater noise from pile driving, the intensity of pile driving sounds is greatly influenced by factors such as the type of piles, hammers, and the physical environment in which the activity takes place. In order to determine reasonable airborne sound pressure levels and their associated effects on marine mammals that are likely to result from pile driving at NBKB, studies with similar properties to the proposed action, as described previously, were evaluated. Table 8 details representative pile driving and removal activities that have occurred in recent years. Due to the similarity of these actions and the Navy's proposed action, they represent reasonable sound pressure levels which could be anticipated.

TABLE 8—AIRBORNE SOUND PRESSURE LEVELS FROM SIMILAR IN-SITU MONITORED CONSTRUCTION ACTIVITIES

Project and location	Pile size and type	Method	Water depth	Measured sound pressure levels
Northstar Island, AK [1]	42-in (1.1 m) steel pipe pile	Impact	Approximately 12 m (40 ft).	97 dB re 20 µPa (rms) at 160 m (525 ft).
Friday Harbor Ferry Terminal, WA [2].	24-in (0.6 m) steel pipe pile	Impact	Approximately 10 m (33 ft).	112 dB re 20 µPa (rms) at 49 m (160 ft).

TABLE 8—AIRBORNE SOUND PRESSURE LEVELS FROM SIMILAR IN-SITU MONITORED CONSTRUCTION ACTIVITIES—Continued

Project and location	Pile size and type	Method	Water depth	Measured sound pressure levels
Wahkiakum Ferry Terminal [3]	18-in (0.5 m) steel pipe pile	Vibratory removal.	Approximately 3–4 m (10–12 ft).	87.5 dB re 20 μPa (rms) at 15 m (50 ft).
Keystone Ferry Terminal, WA [3]	30-in (0.8 m) steel pipe pile	Vibratory installation.	Approximately 9 m (30 ft).	98 dB re 20 μPa (rms) at 11 m (36 ft).
Unknown [4]	Unknown [5], Concrete	Chipping Hammer.	Unknown	92 dB re 20 μPa (rms) at 10 m (33 ft).

[1] Blackwell *et al.* 2004.
[2] WSDOT 2005.
[3] WSDOT 2010c.
[4] Cheremisinoff 1996.
[5] This is the only known data for airborne noise from use of a chipping hammer. The size of the pile was not recorded. However, since these tools operate to chip portions of concrete from the pile, sound outputs are not tied to the size of the pile. Therefore, this data was found to be representative for this project.

Based on in-situ recordings from similar construction activities, the maximum airborne noise levels that would result from impact and vibratory pile driving are estimated to be 120 dB re 20 μPa (rms) at 15 m (50 ft) and 98 dB re 20 μPa (rms) at 11 m (36 ft), respectively (Blackwell *et al.* 2004; WSDOT 2005, 2010c). Values for impact driving from the Northstar Island and Friday Harbor projects were averaged. The maximum airborne noise level that would result from vibratory removal and pneumatic chipping are estimated to be 92 dB re 20 μPa (rms) at 15 m (50 ft) and 92 dB re 20 μPa (rms) at 33 ft (10 m), respectively. The values from projects using vibratory hammers (Wahkiakum Ferry and Keystone Ferry) were averaged to obtain a representative value for vibratory removal. This is because the largest steel piles to be removed at EHW–1 are 24-in diameter; a representative value was obtained by averaging data from 30-in and 18-in diameter piles. The distances to the airborne thresholds were calculated with the airborne transmission loss formula presented previously. All calculated distances to and the total area encompassed by the airborne marine mammal noise thresholds are provided in Table 9.

TABLE 9—CALCULATED DISTANCES TO AND AREA ENCOMPASSED BY THE MARINE MAMMAL NOISE THRESHOLDS IN-AIR FROM PILE DRIVING

Species	Threshold	Airborne behavioral disturbance	
		Distance in m (ft)	Area in km² (mi²)
Pinnipeds (except harbor seal)	100 dB re 20 μPa rms (impact disturbance)	159 (522)	0.079 (0.031)
Harbor seal	90 dB re 20 μPa rms (impact disturbance)	501 (1,643)	0.789 (0.305)
Pinnipeds (except harbor seal)	100 dB re 20 μPa rms (vibratory disturbance; installation).	9 (30)	0.000
Harbor seal	90 dB re 20 μPa rms (vibratory disturbance; installation).	29 (95)	0.029 (0.003)
Pinnipeds (except harbor seal)	100 dB re 20 μPa rms (vibratory disturbance; removal).	7 (23)	0.000
Harbor seal	90 dB re 20 μPa rms (vibratory disturbance; removal).	20 (66)	0.001 (0.000)
Pinnipeds (except harbor seal)	100 dB re 20 μPa rms (pneumatic chipping)	4 (13)	0.000
Harbor seal	90 dB re 20 μPa rms (pneumatic chipping)	13 (43)	0.001 (0.000)

All SPLs are reported re 20 μPa rms (unweighted).

All airborne distances are less than those calculated for underwater sound thresholds, with the exception of the behavioral disturbance distances from impact pile driving for harbor seals. This disturbance zone radius is 501 m, whereas the disturbance zone radius for underwater noise from impact driving (160-dB) is only 342 m (*see* Table 5). Therefore, the monitoring buffer zone for behavioral disturbance will be expanded to encompass this distance for harbor seals. For all other activities, protective measures are in place out to the distances calculated for the underwater thresholds, and the distances for the airborne thresholds will be covered fully by mitigation and monitoring measures in place for underwater sound thresholds. Aside from the aforementioned case, all construction noise associated with the project would not extend beyond the buffer zone for underwater sound that would be established to protect seals and sea lions. No haul-outs or rookeries are located within these radii. *See* figures 6–5 through 6–10 of the Navy's application for depictions of the actual distances for each airborne sound threshold that are predicted to occur at the project area due to pile driving.

Description of Marine Mammals in the Area of the Specified Activity

There are six marine mammal species, three cetaceans and three pinnipeds, which may inhabit or transit through the waters nearby NBKB in the Hood Canal. These include the transient killer whale, harbor porpoise, Dall's porpoise, Steller sea lion, California sea lion, and the harbor seal. While the Southern Resident killer whale is resident to the inland waters of Washington and British Columbia, it has not been observed in the Hood Canal in decades, and therefore was excluded from further analysis. The Steller sea lion is the only marine mammal that occurs within the Hood Canal which is listed under the ESA; the Eastern DPS is listed as threatened. As noted previously, and in Table 10, Steller sea lions are not present in the project area during the proposed project timeframe for pile driving (July 16–October 31). Steller sea lions will not be discussed in detail. All marine mammal species are protected under the MMPA. This section summarizes the population status and abundance of these species, followed by detailed life history information. Table 10 lists the marine mammal species that occur in the vicinity of NBKB and their estimated densities within the project area during the proposed timeframe.

TABLE 10—MARINE MAMMALS PRESENT IN THE HOOD CANAL IN THE VICINITY OF NBKB

Species	Stock abundance [1]	Relative occurrence in Hood Canal	Season of occurrence	Density in warm season [3] (individuals/km [2])
Steller sea lion				
Eastern U.S. DPS	50,464 [2]	Rare to occasional use	Fall to late spring (Nov-mid April).	N/A
California sea lion				
U.S. Stock	238,000	Common	Fall to late spring (Aug–May)	[4]0.410
Harbor seal				
WA inland waters stock	14,612 (CV = 0.15)	Common	Year-round; resident species in Hood Canal.	[5]1.31
Killer whale				
West Coast transient stock	314	Rare to occasional use	Year-round	[6]0.038
Dall's porpoise				
CA/OR/WA stock	48,376 (CV = 0.24)	Rare to occasional use	Year-round	[7]0.043
Harbor porpoise				
WA inland waters stock	10,682 (CV = 0.38)	Rare to occasional use	Year-round	[7]0.011

[1] NMFS marine mammal stock assessment reports at: *http://www.nmfs.noaa.gov/pr/sars/species.htm.*
[2] Average of a given range.
[3] Warm season refers to the period from May–Oct.
[4] DoN 2010a.
[5] Jeffries *et al.* 2003; Huber *et al.* 2001.
[6] London 2006.
[7] Agness and Tannenbaum 2009a.

California Sea Lion

Species Description—California sea lions are members of the Otariid family (eared seals). The species, *Zalophus californianus,* includes three subspecies: *Z. c. wollebaeki* (in the Galapagos Islands), *Z. c. japonicus* (in Japan, but now thought to be extinct), and *Z. c. californianus* (found from southern Mexico to southwestern Canada; referred to here as the California sea lion) (Carretta *et al.* 2007). The California sea lion is sexually dimorphic. Males may reach 1,000 lb (454 kg) and 8 ft (2.4 m) in length; females grow to 300 lb (136 kg) and 6 ft (1.8 m) in length. Their color ranges from chocolate brown in males to a lighter, golden brown in females. At around five years of age, males develop a bony bump on top of the skull called a sagittal crest. The crest is visible in the dog-like profile of male sea lion heads, and hair around the crest gets lighter with age.

Population Abundance—The U.S. stock of California sea lions may occur in the marine waters nearby NBKB. The stock is estimated at 238,000 and the minimum population size of this stock is 141,842 individuals (Carretta *et al.* 2007). These numbers are from counts during the 2001 breeding season of animals that were ashore at the four major rookeries in southern California and at haul-out sites north to the Oregon/California border. Sea lions that were at-sea or hauled-out at other locations were not counted (Carretta *et al.* 2007). An estimated 3,000 to 5,000 California sea lions migrate to waters of Washington and British Columbia during the non-breeding season from September to May (Jeffries *et al.* 2000). Peak numbers of up to 1,000 California sea lions occur in Puget Sound (including Hood Canal) during this time period (Jeffries *et al.* 2000).

Distribution—The geographic distribution of California sea lions includes a breeding range from Baja California, Mexico to southern California. During the summer, California sea lions breed on islands from the Gulf of California to the Channel Islands and seldom travel more than about 31 mi (50 km) from the islands (Bonnell *et al.* 1983). The primary rookeries are located on the California Channel Islands of San Miguel, San Nicolas, Santa Barbara, and San Clemente (Le Boeuf and Bonnell 1980; Bonnell and Dailey 1993). Their distribution shifts to the northwest in fall and to the southeast during winter and spring, probably in response to changes in prey availability (Bonnell and Ford 1987).

The non-breeding distribution extends from Baja California north to Alaska for males, and encompasses the waters of California and Baja California for females (Reeves *et al.* 2008; Maniscalco *et al.* 2004). In the non-breeding season, an estimated 3,000–5,000 adult and sub-adult males migrate northward along the coast to central and northern California, Oregon, Washington, and Vancouver Island from September to May (Jeffries *et al.* 2000) and return south the following spring (Mate 1975; Bonnell *et al.* 1983). Along their migration, they are occasionally sighted hundreds of miles offshore (Jefferson *et al.* 1993). Females and juveniles tend to stay closer to the rookeries (Bonnell *et al* 1983).

Peak abundance in the Puget Sound is September to May. Although there are no regular California sea lion haul-outs within the Hood Canal (Jeffries *et al.* 2000), they often haul out at several opportune areas. They are known to utilize man-made structures such as piers, jetties, offshore buoys, and oil platforms (Riedman 1990). California sea lions in the Puget Sound sometimes haul out on log booms and Navy submarines, and are often seen rafted off river mouths (Jeffries *et al.* 2000; DoN 2001). As many as forty California sea lions have been observed hauled out at

NBKB on manmade structures (*e.g.,* submarines, floating security fence, barges) (Agness and Tannenbaum 2009a; Tannenbaum *et al.* 2009a; Walters 2009). California sea lions have also been observed swimming in the Hood Canal in the vicinity of the project area on several occasions and likely forage in both nearshore marine and inland marine deeper waters (DoN 2001a).

Behavior and Ecology—California sea lions feed on a wide variety of prey, including many species of fish and squid (Everitt *et al.* 1981; Roffe and Mate 1984; Antonelis *et al.* 1990; Lowry *et al.* 1991). In the Puget Sound region, they feed primarily on fish such as Pacific hake (*Merluccius productus*), walleye pollock (*Theragra chalcogramma*), Pacific herring (*Clupea pallasii*), and spiny dogfish (*Squalus acanthias*) (Calambokidis and Baird 1994). In some locations where salmon runs exist, California sea lions also feed on returning adult and out-migrating juvenile salmonids (London 2006). Sexual maturity occurs at around four to five years of age for California sea lions (Heath 2002). California sea lions are gregarious during the breeding season and social on land during other times.

Acoustics—On land, California sea lions make incessant, raucous barking sounds; these have most of their energy at less than 2 kHz (Schusterman *et al.* 1967). Males vary both the number and rhythm of their barks depending on the social context; the barks appear to control the movements and other behavior patterns of nearby conspecifics (Schusterman 1977). Females produce barks, squeals, belches, and growls in the frequency range of 0.25–5 kHz, while pups make bleating sounds at 0.25–6 kHz. California sea lions produce two types of underwater sounds: Clicks (or short-duration sound pulses) and barks (Schusterman *et al.* 1966, 1967; Schusterman and Baillet 1969). All underwater sounds have most of their energy below 4 kHz (Schusterman *et al.* 1967).

The range of maximal hearing sensitivity underwater is between 1–28 kHz (Schusterman *et al.* 1972). Functional underwater high frequency hearing limits are between 35–40 kHz, with peak sensitivities from 15–30 kHz (Schusterman *et al.* 1972). The California sea lion shows relatively poor hearing at frequencies below 1 kHz (Kastak and Schusterman 1998). Peak hearing sensitivities in air are shifted to lower frequencies; the effective upper hearing limit is approximately 36 kHz (Schusterman 1974). The best range of sound detection is from 2–16 kHz (Schusterman 1974). Kastak and Schusterman (2002) determined that hearing sensitivity generally worsens with depth—hearing thresholds were lower in shallow water, except at the highest frequency tested (35 kHz), where this trend was reversed. Octave band noise levels of 65–70 dB above the animal's threshold produced an average temporary threshold shift (TTS; discussed later in "Potential Effects of the Specified Activity on Marine Mammals") of 4.9 dB in the California sea lion (Kastak *et al.* 1999).

Harbor Seal

Species Description—Harbor seals, which are members of the Phocid family (true seals), inhabit coastal and estuarine waters and shoreline areas from Baja California, Mexico to western Alaska. For management purposes, differences in mean pupping date (*i.e.,* birthing) (Temte 1986), movement patterns (Jeffries 1985; Brown 1988), pollutant loads (Calambokidis *et al.* 1985) and fishery interactions have led to the recognition of three separate harbor seal stocks along the west coast of the continental U.S. (Boveng 1988). The three distinct stocks are: (1) Inland waters of Washington (including Hood Canal, Puget Sound, and the Strait of Juan de Fuca out to Cape Flattery), (2) outer coast of Oregon and Washington, and (3) California (Carretta *et al.* 2007). The inland waters of Washington stock is the only stock that is expected to occur within the project area.

The average weight for adult seals is about 180 lb (82 kg) and males are slightly larger than females. Male harbor seals weigh up to 245 lb (111 kg) and measure approximately 5 ft (1.5 m) in length. The basic color of harbor seals' coat is gray and mottled but highly variable, from dark with light color rings or spots to light with dark markings (NMFS 2008c).

Population Abundance—Estimated population numbers for the inland waters of Washington, including the Hood Canal, Puget Sound, and the Strait of Juan de Fuca out to Cape Flattery, are 14,612 individuals (Carretta *et al.* 2007). The minimum population is 12,844 individuals. The harbor seal is the only species of marine mammal that is consistently abundant and considered resident in the Hood Canal (Jeffries *et al.* 2003). The population of harbor seals in Hood Canal is a closed population, meaning that they do not have much movement outside of Hood Canal (London 2006). The abundance of harbor seals in Hood canal has stabilized, and the population may have reached its carrying capacity in the mid-1990s with an approximate abundance of 1,000 harbor seals (Jeffries *et al.* 2003).

Distribution—Harbor seals are coastal species, rarely found more than 12 mi (20 km) from shore, and frequently occupy bays, estuaries, and inlets (Baird 2001). Individual seals have been observed several miles upstream in coastal rivers. Ideal harbor seal habitat includes haul-out sites, shelter during the breeding periods, and sufficient food (Bjorge 2002). Haul-out areas can include intertidal and subtidal rock outcrops, sandbars, sandy beaches, peat banks in salt marshes, and man-made structures such as log booms, docks, and recreational floats (Wilson 1978; Prescott 1982; Schneider and Payne 1983; Gilber and Guldager 1998; Jeffries *et al.* 2000). Human disturbance can affect haul-out choice (Harris *et al.* 2003).

Harbor seals occur throughout Hood Canal and are seen relatively commonly in the area. They are year-round, non-migratory residents, and pup (*i.e.,* give birth) in Hood Canal. Surveys in the Hood Canal from the mid-1970s to 2000 show a fairly stable population between 600–1,200 seals (Jeffries *et al.* 2003). Harbor seals have been observed swimming in the waters along NBKB in every month of surveys conducted from 2007–2010 (Agness and Tannenbaum 2009b; Tannenbaum *et al.* 2009b). On the NBKB waterfront, harbor seals have not been observed hauling out in the intertidal zone, but have been observed hauled-out on man-made structures such as the floating security fence, buoys, barges, marine vessels, and logs (Agness and Tannebaum 2009a; Tannenbaum *et al.* 2009a). The main haul-out locations for harbor seals in Hood Canal are located on river delta and tidal exposed areas at Quilcene, Dosewallips, Duckabush, Hamma Hamma, and Skokomish River mouths (*see* Figure 4–1 of the Navy's application), with the closest haul-out area to the project area being ten miles (16 km) southwest of NBKB at Dosewallips River mouth (London 2006).

Behavior and Ecology—Harbor seals are typically seen in small groups resting on tidal reefs, boulders, mudflats, man-made structures, and sandbars. Harbor seals are opportunistic feeders that adjust their patterns to take advantage of locally and seasonally abundant prey (Payne and Selzer 1989; Baird 2001; Bjørge 2002). The harbor seal diet consists of fish and invertebrates (Bigg 1981; Roffe and Mate 1984; Orr *et al.* 2004). Although harbor seals in the Pacific Northwest are common in inshore and estuarine waters, they primarily feed at sea (Orr *et al.* 2004) during high tide. Researchers have found that they complete both shallow and deep dives during hunting depending on the availability of prey (Tollit *et al.* 1997). Their diet in Puget Sound consists of many of the prey resources that are present in the nearshore and deeper waters of NBKB, including hake, herring and adult and out-migrating juvenile salmonids. Harbor seals in Hood Canal are known to feed on returning adult salmon, including ESA-threatened summer-run chum (*Oncorhynchus keta*). Over a five-year study of harbor seal predation in the Hood Canal, the average percent escapement of summer-run chum consumed was eight percent (London 2006).

Harbor seals mate at sea and females give birth during the spring and summer, although the pupping season varies by latitude. In coastal and inland regions of Washington, pups are born from April through January. Pups are generally born earlier in the coastal areas and later in the Puget Sound/Hood Canal region (Calambokidis and Jeffries 1991; Jeffries *et al.* 2000). Suckling harbor seal pups spend as much as forty percent of their time in the water (Bowen *et al.* 1999).

Acoustics—In air, harbor seal males produce a variety of low-frequency (less than 4 kHz) vocalizations, including snorts, grunts, and growls. Male harbor seals produce communication sounds in the frequency range of 100–1,000 Hz (Richardson *et al.* 1995). Pups make individually unique calls for mother recognition that contain multiple harmonics with main energy below 0.35 kHz (Bigg 1981; Thomson and Richardson 1995). Harbor seals hear nearly as well in air as underwater and had lower thresholds than California sea lions (Kastak and Schusterman 1998). Kastak and Schusterman (1998) reported airborne low frequency (100 Hz) sound detection thresholds at 65.4 dB re 20 μPa for harbor seals. In air, they hear frequencies from 0.25–30 kHz and are most sensitive from 6–16 kHz (Richardson 1995; Terhune and Turnbull 1995; Wolski *et al.* 2003).

Adult males also produce underwater sounds during the breeding season that typically range from 0.25–4 kHz (duration range: 0.1 s to multiple seconds; Hanggi and Schusterman 1994). Hanggi and Schusteman (1994) found that there is individual variation in the dominant frequency range of sounds between different males, and Van Parijs *et al.* (2003) reported oceanic, regional, population, and site-specific variation that could be vocal dialects. In water, they hear frequencies from 1–75 kHz (Southall *et al.* 2007) and can detect sound levels as weak as 60–85 dB re 1 μPa within that band. They are most sensitive at frequencies below 50 kHz; above 60 kHz sensitivity rapidly decreases.

Killer Whale

Species Description—Killer whales are members of the Delphinid family and are the most widely distributed cetacean species in the world. Killer whales have a distinctive color pattern, with black dorsal and white ventral portions. They also have a conspicuous white patch above and behind the eye and a highly variable gray or white saddle area behind the dorsal fin. The species shows considerable sexual dimorphism. Adult males develop larger pectoral flippers, dorsal fins, tail flukes, and girths than females. Male adult killer whales can reach up to 32 ft (9.8 m) in length and weigh nearly 22,000 lb (10,000 kg); females reach 28 ft (8.5 m) in length and weigh up to 16,500 lb (7,500 kg).

Based on appearance, feeding habits, vocalizations, social structure, and distribution and movement patterns there are three types of populations of killer whales (Wiles 2004; NMFS 2005). The three distinct forms or types of killer whales recognized in the North Pacific Ocean are: (1) Resident, (2) Transient, and (3) Offshore. The resident and transient populations have been divided further into different subpopulations based mainly on genetic analyses and distribution; not enough is known about the offshore whales to divide them into subpopulations (Wiles 2004). Only transient killer whales are known from the project area.

Transient killer whales occur throughout the eastern North Pacific, and have primarily been studied in coastal waters. Their geographical range overlaps that of the resident and offshore killer whales. The dorsal fin of transient whales tends to be more erect (straighter at the tip) than those of resident and offshore whales (Ford and Ellis 1999; Ford *et al.* 2000). Saddle patch pigmentation of transient killer whales is restricted to two patterns, and never has the large areas of black pigmentation intruding into the white of the saddle patch that is seen in resident and offshore types. Transient-type whales are often found in long-term stable social units that tend to be smaller than resident social groups (*e.g.,* fewer than ten whales); these social units do not seem as permanent as matrilines are in resident type whales. Transient killer whales feed nearly exclusively on marine mammals (Ford and Ellis 1999), whereas resident whales primarily eat fish. Offshore whales are presumed to feed primarily on fish, and have been documented feeding on sharks.

Within the transient type, association data (Ford *et al.* 1994; Ford and Ellis 1999; Matkin *et al.* 1999), acoustic data (Saulitis 1993; Ford and Ellis 1999) and genetic data (Hoelzel *et al.* 1998, 2002; Barrett-Lennard 2000) confirms that three communities of transient whales exist and represent three discrete populations: (1) Gulf of Alaska, Aleutian Islands, and Bering Sea transients, (2) AT1 transients (Prince William Sound, AK; listed as depleted under the MMPA), and (3) West Coast transients. Among the genetically distinct assemblages of transient killer whales in the northeastern Pacific, only the West Coast transient stock, which occurs from southern California to southeastern Alaska, may occur in the project area.

Population Abundance—The West Coast transient stock is a trans-boundary stock, with minimum counts for the population of transient killer whales coming from various photographic datasets. Combining these counts of cataloged transient whales gives a minimum number of 314 individuals for the West Coast transient stock (Allen and Angliss 2010). However, the number in Washington waters at any one time is probably fewer than twenty individuals (Wiles 2004).

Distribution—The geographical range of transient killer whales includes the northeast Pacific, with preference for coastal waters of southern Alaska and British Columbia (Krahn *et al.* 2002). Transient killer whales in the eastern North Pacific spend most of their time along the outer coast, but visit Hood Canal and the Puget Sound in search of harbor seals, sea lions, and other prey. Transient occurrence in inland waters appears to peak during August and September (Morton 1990; Baird and Dill 1995; Ford and Ellis 1999) which is the peak time for harbor seal pupping, weaning, and post-weaning (Baird and Dill 1995). In 2003 and 2005, small groups of transient killer whales (eleven and six individuals, respectively) visited Hood Canal to feed on harbor seals and remained in the area for significant periods of time (59 and 172 days, respectively) between the months of January and July.

Behavior and Ecology—Transient killer whales show greater variability in habitat use, with some groups spending most of their time foraging in shallow waters close to shore while others hunt almost entirely in open water (Felleman *et al.* 1991; Baird and Dill 1995; Matkin and Saulitis 1997). Transient killer whales feed on marine mammals and some seabirds, but apparently no fish

(Morton 1990; Baird and Dill 1996; Ford *et al.* 1998; Ford and Ellis 1999; Ford *et al.* 2005). While present in Hood Canal in 2003 and 2005, transient killer whales preyed on harbor seals in the subtidal zone of the nearshore marine and inland marine deeper water habitats (London 2006). Other observations of foraging transient killer whales indicate they prefer to forage on pinnipeds in shallow, protected waters (Heimlich-Boran 1988; Saulitis *et al.* 2000). Transient killer whales travel in small, matrilineal groups, but they typically contain fewer than ten animals and their social organization generally is more flexible than that of resident killer whales (Morton 1990, Ford and Ellis 1999). These differences in social organization probably relate to differences in foraging (Baird and Whitehead 2000). There is no information on the reproductive behavior of killer whales in this area.

Acoustics—Killer whales produce a wide variety of clicks and whistles, but most of their sounds are pulsed, with frequencies ranging from 0.5–25 kHz (dominant frequency range: 1–6 kHz) (Thomson and Richardson 1995; Richardson *et al.* 1995). Source levels of echolocation signals range between 195–224 dB re 1 μPa-m peak-to-peak (p-p), dominant frequencies range from 20–60 kHz, with durations of about 0.1 s (Au *et al.* 2004). Source levels associated with social sounds have been calculated to range between 131–168 dB re 1 μPa-m and vary with vocalization type (Veirs 2004).

Both behavioral and auditory brainstem response technique indicate killer whales can hear in a frequency range of 1–100 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).

Dall's Porpoise

Species Description—Dall's porpoises are members of the Phocoenid (porpoise) family and are common in the North Pacific Ocean. They can reach a maximum length of just under 8 ft (2.4 m) and weigh up to 480 lb (218 kg). Males are slightly larger and thicker than females, which reach lengths of just under 7 ft (2.1 m) long. The body of Dall's porpoises is a very dark gray or black in coloration with variable contrasting white thoracic panels and white 'frosting' on the dorsal fin and tail that distinguish them from other cetacean species. These markings and colorations vary with geographic region and life stage, with adults having more distinct patterns.

Based on NMFS stock assessment reports, Dall's porpoises within the Pacific U.S. Exclusive Economic Zone are divided into two discrete, noncontiguous areas: (1) Waters off California, Oregon, and Washington, and (2) Alaskan waters (Carretta *et al.* 2008). Only individuals from the CA/OR/WA stock may occur within the project area.

Population Abundance—The NMFS population estimate, recently updated in 2008 for the CA/OR/WA stock, is 48,376 (CV = 0.24) which is based on vessel line transect surveys by Barlow and Forney (2007) and Forney (2007) (Carretta *et al.* 2008). The minimum population is considered to be 39,709. Additional numbers of Dall's porpoises occur in the inland waters of Washington, but the most recent estimate was obtained in 1996 (900 animals; CV = 0.40; Calambokidis *et al.* 1997) and is not included in the overall estimate of abundance for this stock due to the need for more up-to-date information.

Distribution—The Dall's porpoise is found from northern Baja California, Mexico, north to the northern Bering Sea and south to southern Japan (Jefferson *et al.* 1993). The species is only common between 32–62°N in the eastern North Pacific (Morejohn 1979; Houck and Jefferson 1999). North-south movements in California, Oregon, and Washington have been suggested. Dall's porpoises shift their distribution southward during cooler-water periods (Forney and Barlow 1998). Norris and Prescott (1961) reported finding Dall's porpoises in southern California waters only in the winter, generally when the water temperature was less than 15 °C (59 °F). Seasonal movements have also been noted off Oregon and Washington, where higher densities of Dall's porpoises were sighted offshore in winter and spring and inshore in summer and fall (Green *et al.* 1992).

In Washington, they are most abundant in offshore waters. They are year-round residents in Washington (Green *et al.* 1992), but their distribution is highly variable between years, likely due to changes in oceanographic conditions (Forney and Barlow 1998). Dall's porpoises are observed throughout the year in the Puget Sound north of Seattle (Osborne *et al.* 1998) and are seen occasionally in southern Puget Sound. Dall's porpoises may also occasionally occur in Hood Canal (Jeffries 2006, personal communication). Nearshore habitats used by Dall's porpoises could include the marine habitats found in the inland marine waters of the Hood Canal. A Dall's porpoise was observed in the deeper water at NBKB in summer 2008 (Tannenbaum *et al.* 2009a).

Behavior and Ecology—Dall's porpoises can be opportunistic feeders but primarily consume schooling forage fish. They are known to eat squid, crustaceans, and fishes such as blackbelly eelpout (*Lycodopsis pacifica*), herring, pollock, hake, and Pacific sandlance (*Ammodytes hexapterus*) (Walker *et al.* 1998). Groups of Dall's porpoises generally include fewer than ten individuals and are fluid, probably aggregating for feeding (Jefferson 1990, 1991; Houck and Jefferson 1999). Dall's porpoises become sexually mature at three and a half to eight years of age (Houck and Jefferson 1999) and give birth to a single calf after ten to twelve months. Breeding and calving typically occurs in the spring and summer (Angell and Balcomb 1982). In the North Pacific, there is a strong summer calving peak from early June through August (Ferrero and Walker 1999), and a smaller peak in March (Jefferson 1989). Resident Dall's porpoises breed in Puget Sound from August to September.

Acoustics—Only short duration pulsed sounds have been recorded for Dall's porpoises (Houck and Jefferson 1999); this species apparently does not whistle often (Richardson *et al.* 1995). Dall's porpoises produce short duration (50–1,500 μs), high-frequency, narrow band clicks, with peak energies between 120–160 kHz (Jefferson 1988). There is no published data on the hearing abilities of this species.

Harbor Porpoise

Species Description—Harbor porpoises belong to the Phocoenid (porpoise) family and are found extensively along the Pacific U.S. coast. Harbor porpoises are small, with males reaching average lengths of approximately 5 ft (1.5 m); Females are slightly larger with an average length of 5.5 ft (1.7 m). The average adult harbor porpoise weighs between 135–170 lb (61–77 kg). Harbor porpoises have a dark grey coloration on their backs, with their belly and throats white. They have a dark grey chin patch and intermediate shades of grey along their sides.

Recent preliminary genetic analyses of samples ranging from Monterey, CA to Vancouver Island, BC indicate that there is small-scale subdivision within the U.S. portion of this range (Chivers *et al.* 2002). Although geographic structure exists along an almost continuous distribution of harbor porpoises from California to Alaska, stock boundaries are difficult to draw because any rigid line is generally arbitrary from a biological perspective.

Nevertheless, based on genetic data and density discontinuities identified from aerial surveys, NMFS identifies eight stocks in the Northeast Pacific Ocean. Pacific coast harbor porpoise stocks include: (1) Monterey Bay, (2) San Francisco-Russian River, (3) northern California/southern Oregon, (4) Oregon/Washington coastal, (5) inland Washington, (6) Southeast Alaska, (7) Gulf of Alaska, and (8) Bering Sea. Only individuals from the Washington Inland Waters stock may occur in the project area.

Population Abundance—Aerial surveys of the inland waters of Washington and southern British Columbia were conducted during August of 2002 and 2003 (J. Laake, unpubl. data). These aerial surveys included the Strait of Juan de Fuca, San Juan Islands, Gulf Islands, and Strait of Georgia, which includes waters inhabited by the Washington Inland Waters stock of harbor porpoises as well as harbor porpoises from British Columbia. An average of the 2002 and 2003 estimates of abundance in U.S. waters resulted in an uncorrected abundance of 3,123 (CV = 0.10) harbor porpoises in Washington inland waters (J. Laake, unpubl. data). When corrected for availability and perception bias, the estimated abundance for the Washington Inland Waters stock of harbor porpoise is 10,682 (CV = 0.38) animals (Carretta *et al.* 2008). The minimum population estimate is 7,841.

Distribution—Harbor porpoises are generally found in cool temperate to subarctic waters over the continental shelf in both the North Atlantic and North Pacific (Read 1999). This species is seldom found in waters warmer than 17 °C (63 °F; Read 1999) or south of Point Conception (Hubbs 1960; Barlow and Hanan 1995). Harbor porpoises can be found year-round primarily in the shallow coastal waters of harbors, bays, and river mouths (Green *et al.* 1992). Along the Pacific coast, harbor porpoises occur from Monterey Bay, California to the Aleutian Islands and west to Japan (Reeves *et al.* 2002). Harbor porpoises are known to occur in Puget Sound year round (Osmek *et al.* 1996, 1998; Carretta *et al.* 2007), and may occasionally occur in Hood Canal (Jeffries 2006, pers. comm.). Harbor porpoise observations in northern Hood Canal have increased in recent years (Calambokidis 2010, pers. comm.). A harbor porpoise was seen in deeper water at NBKB during 2010 field observations (SAIC 2010, staff obs.).

Behavior and Ecology—Harbor porpoises are non-social animals usually seen in small groups of two to five animals. Little is known about their social behavior. Harbor porpoises can be opportunistic foragers but primarily consume schooling forage fish (Osmek *et al.* 1996; Bowen and Siniff 1999; Reeves *et al.* 2002). Along the coast of Washington, harbor porpoises primarily feed on herring, market squid (*Loligo opalescens*) and eulachon (*Thaleichthys pacificus*) (Gearin *et al.* 1994). Females reach sexual maturity at three to four years of age 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).

Acoustics—Harbor porpoise vocalizations include clicks and pulses (Ketten 1998), as well as whistle-like signals (Verboom and Kastelein 1995). The dominant frequency range is 110–150 kHz, with source levels of 135–177 dB re 1 μPa-m (Ketten 1998). Echolocation signals include one or two low-frequency components in the 1.4–2.5 kHz range (Verboom and Kastelein 1995).

A behavioral audiogram of a harbor porpoise indicated the range of best sensitivity is 8–32 kHz at levels between 45–50 dB re 1 μPa-m (Andersen 1970); however, auditory-evoked potential studies showed a much higher frequency of approximately 125–130 kHz (Bibikov 1992). The auditory-evoked potential method suggests that the harbor porpoise actually has two frequency ranges of best sensitivity. More recent psycho-acoustic studies found the range of best hearing to be 16–140 kHz, with a reduced sensitivity around 64 kHz (Kastelein *et al.* 2002). Maximum sensitivity occurs between 100–140 kHz (Kastelein *et al.* 2002).

Potential Effects of the Specified Activity on Marine Mammals

NMFS has determined that pile driving, as outlined in the project description, has the potential to result in behavioral harassment of California sea lions, harbor seals, harbor porpoises, Dall's porpoises, and killer whales that may be swimming, foraging, or resting in the project vicinity while pile driving is being conducted. Pile driving could potentially harass those pinnipeds that are in the water close to the project site, whether their heads are above or below the surface.

Marine Mammal Hearing

The primary effect on marine mammals anticipated from the specified activities will result from exposure of animals to underwater sound. Exposure to sound can affect marine mammal hearing. When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Based on available behavioral data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data, Southall *et al.* (2007) designate functional hearing groups for marine mammals and estimate the lower and upper frequencies of functional hearing of the groups. The functional groups and the associated frequencies are indicated below (though animals are less sensitive to sounds at the outer edge of their functional range and most sensitive to sounds of frequencies within a smaller range somewhere in the middle of their functional hearing range):

- Low frequency cetaceans (thirteen species of mysticetes): Functional hearing is estimated to occur between approximately 7 Hz and 22 kHz;
- Mid-frequency cetaceans (32 species of dolphins, six species of larger toothed whales, and nineteen species of beaked and bottlenose whales): Functional hearing is estimated to occur between approximately 150 Hz and 160 kHz;
- High frequency cetaceans (six species of true porpoises, four species of river dolphins, two members of the genus *Kogia,* and four dolphin species of the genus *Cephalorhynchus*): Functional hearing is estimated to occur between approximately 200 Hz and 180 kHz; and
- Pinnipeds in water: Functional hearing is estimated to occur between approximately 75 Hz and 75 kHz, with the greatest sensitivity between approximately 700 Hz and 20 kHz.

As mentioned previously in this document, two pinnipeds and three cetacean species are likely to occur in the proposed project area. Of the three cetacean species likely to occur in the project area, two are classified as high frequency cetaceans (Dall's and harbor porpoises) and one is classified as a mid-frequency cetacean (killer whales) (Southall *et al.* 2007).

Underwater Noise Effects

Potential Effects of Pile Driving Noise—The effects of sounds from pile driving might result in one or more of the following: Temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, and masking (Richardson *et al.* 1995; Gordon *et al.* 2004; Nowacek *et al.* 2007; Southall *et al.* 2007). The effects of pile driving on marine mammals are dependent on several factors, including the size, type, and depth of the animal; the depth, intensity, and duration of the pile driving sound; the depth of the water column; the substrate of the habitat; the standoff distance between the pile and the animal; and the sound propagation properties of the environment. Impacts to marine mammals from pile driving activities are expected to result primarily from acoustic pathways. As such, the degree of effect is intrinsically related to the received level and duration of the sound exposure, which are in turn influenced by the distance between the animal and the source. The further away from the source, the less intense the exposure should be. The substrate and depth of the habitat affect the sound propagation properties of the environment. Shallow environments are typically more structurally complex, which leads to rapid sound attenuation. In addition, substrates that are soft (*e.g.,* sand) will absorb or attenuate the sound more readily than hard substrates (*e.g.,* rock) which may reflect the acoustic wave. Soft porous substrates would also likely require less time to drive the pile, and possibly less forceful equipment, which would ultimately decrease the intensity of the acoustic source.

In the absence of mitigation, impacts to marine species would be expected to result from physiological and behavioral responses to both the type and strength of the acoustic signature (Viada *et al.* 2008). The type and severity of behavioral impacts are more difficult to define due to limited studies addressing the behavioral effects of impulsive sounds on marine mammals. Potential effects from impulsive sound sources can range in severity, ranging from effects such as behavioral disturbance, tactile perception, physical discomfort, slight injury of the internal organs and the auditory system, to mortality (Yelverton *et al.* 1973; O'Keefe and Young 1984; DoN 2001b).

Hearing Impairment and Other Physical Effects—Marine mammals exposed to high intensity sound repeatedly or for prolonged periods can experience hearing threshold shift (TS), which is the loss of hearing sensitivity at certain frequency ranges (Kastak *et al.* 1999; Schlundt *et al.* 2000; Finneran *et al.* 2002, 2005). TS can be permanent (PTS), in which case the loss of hearing sensitivity is not recoverable, or temporary (TTS), in which case the animal's hearing threshold will recover over time (Southall *et al.* 2007). Marine mammals depend on acoustic cues for vital biological functions, (*e.g.,* orientation, communication, finding prey, avoiding predators); thus, TTS may result in reduced fitness in survival and reproduction, either permanently or temporarily. However, this depends on both the frequency and duration of TTS, as well as the biological context in which it occurs. TTS of limited duration, occurring in a frequency range that does not coincide with that used for recognition of important acoustic cues, would have little to no effect on an animal's fitness. Repeated noise exposure that leads to TTS could cause PTS. PTS, in the unlikely event that it occurred, would constitute injury, but TTS is not considered injury (Southall *et al.* 2007). It is unlikely that the project would result in any cases of temporary or especially permanent hearing impairment or any significant non-auditory physical or physiological effects for reasons discussed later in this document. Some behavioral disturbance is expected, but it is likely that this would be localized and short-term because of the short project duration.

Several aspects of the planned monitoring and mitigation measures for this project (*see* the "Proposed Mitigation" and "Proposed Monitoring and Reporting" sections later in this document) are designed to detect marine mammals occurring near the pile driving to avoid exposing them to sound pulses that might, in theory, cause hearing impairment. In addition, many cetaceans are likely to show some avoidance of the area where received levels of pile driving sound are high enough that hearing impairment could potentially occur. In those cases, the avoidance responses of the animals themselves will reduce or (most likely) avoid any possibility of hearing impairment. Non-auditory physical effects may also occur in marine mammals exposed to strong underwater pulsed sound. It is especially unlikely that any effects of these types would occur during the present project given the brief duration of exposure for any given individual and the planned monitoring and mitigation measures. The following subsections discuss in somewhat more detail the possibilities of TTS, PTS, and non-auditory physical effects.

Temporary Threshold Shift—TTS is the mildest form of hearing impairment that can occur during exposure to a strong sound (Kryter 1985). While experiencing TTS, the hearing threshold rises, and a sound must be stronger in order to be heard. In terrestrial mammals, TTS can last from minutes or hours to days (in cases of strong TTS). For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the sound ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals, and none of the published data concern TTS elicited by exposure to multiple pulses of sound. Available data on TTS in marine mammals are summarized in Southall *et al.* (2007).

Given the available data, the received level of a single pulse (with no frequency weighting) might need to be approximately 186 dB re 1 μPa^2-s (*i.e.,* 186 dB sound exposure level [SEL] or approximately 221–226 dB pk-pk) in order to produce brief, mild TTS. Exposure to several strong pulses that each have received levels near 190 dB re 1 μPa rms (175–180 dB SEL) might result in cumulative exposure of approximately 186 dB SEL and thus slight TTS in a small odontocete, assuming the TTS threshold is (to a first approximation) a function of the total received pulse energy. Levels greater than or equal to 190 dB re 1 μPa rms are expected to be restricted to radii no more than 5 m (16 ft) from the pile driving. For an odontocete closer to the surface, the maximum radius with greater than or equal to 190 dB re 1 μPa rms would be smaller.

The above TTS information for odontocetes is derived from studies on the bottlenose dolphin (*Tursiops truncatus*) and beluga whale (*Delphinapterus leucas*). There is no published TTS information for other species of cetaceans. However, preliminary evidence from a harbor porpoise exposed to pulsed sound suggests that its TTS threshold may have been lower (Lucke *et al.* 2009). To avoid the potential for injury, NMFS has determined that cetaceans should not be exposed to pulsed underwater noise at received levels exceeding 180 dB re 1 μPa rms. As summarized above, data that are now available imply that TTS is unlikely to occur unless odontocetes are exposed to pile driving pulses stronger than 180 dB re 1 μPa rms.

Permanent Threshold Shift—When PTS occurs, there is physical damage to the sound receptors in the ear. In severe cases, there can be total or partial deafness, while in other cases the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter 1985). There is no specific evidence that exposure to pulses of sound can cause PTS in any marine mammal. However, given the possibility that mammals close to pile driving activity might incur TTS, there has been further speculation about the possibility that some individuals occurring very close to pile driving might incur PTS. Single or occasional occurrences of mild TTS are not indicative of permanent auditory damage, but repeated or (in some cases) single exposures to a level well above that causing TTS onset might elicit PTS.

Relationships between TTS and PTS thresholds have not been studied in marine mammals but are assumed to be similar to those in humans and other terrestrial mammals. PTS might occur at a received sound level at least several decibels above that inducing mild TTS if the animal were exposed to strong sound pulses with rapid rise time. Based on data from terrestrial mammals, a precautionary assumption is that the PTS threshold for impulse sounds (such as pile driving pulses as received close to the source) is at least 6 dB higher than the TTS threshold on a peak-pressure basis and probably greater than 6 dB (Southall *et al.* 2007). On an SEL basis, Southall *et al.* (2007) estimated that received levels would need to exceed the TTS threshold by at least 15 dB for there to be risk of PTS. Thus, for cetaceans, Southall *et al.* (2007) estimate that the PTS threshold might be an M-weighted SEL (for the sequence of received pulses) of approximately 198 dB re 1 μPa^2-s (15 dB higher than the TTS threshold for an impulse). Given the higher level of sound necessary to cause PTS as compared with TTS, it is considerably less likely that PTS could occur.

Non-auditory Physiological Effects—Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage (Cox *et al.* 2006; Southall *et al.* 2007). Studies examining such effects are limited. In general, little is known about the potential for pile driving to cause auditory impairment or other physical effects in marine mammals. Available data suggest that such effects, if they occur at all, would presumably be limited to short distances from the sound source and to activities that extend over a prolonged period. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.* 2007) or any meaningful quantitative predictions of the numbers (if any) of marine mammals that might be affected in those ways. Marine mammals that show behavioral avoidance of pile driving, including some odontocetes and some pinnipeds, are especially unlikely to incur auditory impairment or non-auditory physical effects.

Measured source levels from impact pile driving can be as high as 214 dB re 1 μPa at 1 m (3.3 ft). Although no marine mammals have been shown to experience TTS or PTS as a result of being exposed to pile driving activities, captive bottlenose dolphins and beluga whales exhibited changes in behavior when exposed to strong pulsed sounds (Finneran *et al.* 2000, 2002, 2005). The animals tolerated high received levels of sound before exhibiting aversive behaviors. Experiments on a beluga whale showed that exposure to a single watergun impulse at a received level of 207 kPa (30 psi) p-p, which is equivalent to 228 dB p-p re 1 μPa, resulted in a 7 and 6 dB TTS in the beluga whale at 0.4 and 30 kHz, respectively. Thresholds returned to within 2 dB of the pre-exposure level within four minutes of the exposure (Finneran *et al.* 2002). Although the source level of pile driving from one hammer strike is expected to be much lower than the single watergun impulse cited here, animals being exposed for a prolonged period to repeated hammer strikes could receive more noise exposure in terms of SEL than from the single watergun impulse (estimated at 188 dB re 1 μPa^2-s) in the aforementioned experiment (Finneran *et al.* 2002). However, in order for marine mammals to experience TTS or PTS, the animals have to be close enough to be exposed to high intensity noise levels for a prolonged period of time. Based on the best scientific information available, these SPLs are far below the thresholds that could cause TTS or the onset of PTS.

Disturbance Reactions

Disturbance includes a variety of effects, including subtle changes in behavior, more conspicuous changes in activities, and displacement. Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (Richardson *et al.* 1995; Wartzok *et al.* 2004; Southall *et al.* 2007; Weilgart 2007). 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, its auditory sensitivity, its biological and social status (including age and sex), and its behavioral state and activity at the time of exposure.

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al.* 2003/04). 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 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; NRC 2003; Wartzok *et al.* 2003/04).

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 pulsed sound sources (typically seismic guns or acoustic harassment devices, but also including pile driving) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds 2002; CALTRANS 2001, 2006; *see also* Gordon *et al.* 2004; Wartzok *et al.* 2003/04; Nowacek *et al.* 2007). Responses to continuous noise, such as vibratory pile installation, have not been documented as well as responses to pulsed sounds.

With both types of pile driving, it is likely that the onset of pile driving could result in temporary, short term changes in an animal's typical behavior and/or avoidance of the affected area. These behavioral changes may include (Richardson *et al.* 1995): changing durations of surfacing and dives, number of blows per surfacing, or moving direction and/or speed; reduced/increased vocal activities; changing/cessation of certain behavioral activities (such as socializing or feeding); visible startle response or aggressive behavior (such as tail/fluke slapping or jaw clapping); avoidance of areas where noise sources are located; and/or flight responses (*e.g.,* pinnipeds flushing into water from haul-outs or rookeries). Pinnipeds may increase their haul-out time, possibly to avoid in-water disturbance (CALTRANS 2001, 2006). Since pile driving will likely only occur for a few hours a day, over a short period of time, it is unlikely to result in permanent displacement. Any potential impacts from pile driving activities could be experienced by individual marine mammals, but would not be likely to cause population level impacts, or affect the long-term fitness of the species.

The biological significance of many of these behavioral disturbances is difficult to predict, especially if the detected disturbances appear minor. However, the consequences of behavioral modification could be expected to be biologically significant if the change affects growth, survival, or reproduction. Significant behavioral modifications that could potentially lead to effects on growth, survival, or reproduction include:

• Drastic changes in diving/surfacing patterns (such as those thought to be causing beaked whale stranding due to exposure to military mid-frequency tactical sonar);
• Habitat abandonment due to loss of desirable acoustic environment; and
• Cessation of feeding or social interaction.

The onset of behavioral disturbance from anthropogenic noise depends on both external factors (characteristics of noise sources and their paths) and the specific characteristics of the receiving animals (hearing, motivation, experience, demography) and is difficult to predict (Southall *et al.* 2007).

Auditory Masking

Natural and artificial sounds can disrupt behavior by masking, or interfering with, a marine mammal's ability to hear other sounds. Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher levels. Chronic exposure to excessive, though not high-intensity, noise could cause masking at particular frequencies for marine mammals that utilize sound for vital biological functions. Masking can interfere with detection of acoustic signals such as communication calls, echolocation sounds, and environmental sounds important to marine mammals. Therefore, under certain circumstances, marine mammals whose acoustical sensors or environment are being severely masked could also be impaired from maximizing their performance fitness in survival and reproduction. If the coincident (masking) sound were man-made, it could be potentially harassing if it disrupted hearing-related behavior. It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which occurs during the sound exposure. Because masking (without resulting in TS) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect.

The frequency range of the potentially masking sound is important in determining any potential behavioral impacts. Because noise generated from in-water pile driving is mostly concentrated at low frequency ranges, it may have less effect on high frequency echolocation sounds made by porpoises. However, lower frequency man-made noises are more likely to affect detection of communication calls and other potentially important natural sounds such as surf and prey noise. It may also affect communication signals when they occur near the noise band and thus reduce the communication space of animals (*e.g.,* Clark *et al.* 2009) and cause increased stress levels (*e.g.,* Foote *et al.* 2004; Holt *et al.* 2009).

Masking has the potential to impact species at population, community, or even ecosystem levels, as well as at individual levels. Masking affects both senders and receivers of the signals and can potentially have long-term chronic effects on marine mammal species and populations. Recent research suggests that low frequency ambient sound levels have increased by as much as 20 dB (more than three times in terms of SPL) in the world's ocean from pre-industrial periods, and that most of these increases are from distant shipping (Hildebrand 2009). All anthropogenic noise sources, such as those from vessel traffic, pile driving, and dredging activities, contribute to the elevated ambient noise levels, thus intensifying masking. However, the sum of noise from the proposed activities is confined in an area of inland waters (Hood Canal) that is bounded by landmass; therefore, the noise generated is not expected to contribute to increased ocean ambient noise.

The most intense underwater sounds in the proposed action are those produced by impact pile driving. Given that the energy distribution of pile driving covers a broad frequency spectrum, sound from these sources would likely be within the audible range of California sea lions, harbor seals, transient killer whales, harbor porpoises, and Dall's porpoises. Impact pile driving activity is relatively short-term, with rapid pulses occurring for approximately fifteen minutes per pile. The probability for impact pile driving resulting from this proposed action masking acoustic signals important to the behavior and survival of marine mammal species is likely to be negligible. Vibratory pile driving is also relatively short-term, with rapid oscillations occurring for approximately one and a half hours per pile. It is possible that vibratory pile driving resulting from this proposed action may mask acoustic signals important to the behavior and survival of marine mammal species, but the short-term duration and limited affected area would result in a negligible impact from masking. Any masking event that could possibly rise to Level B harassment under the MMPA would occur concurrently within the zones of behavioral harassment already estimated for vibratory and impact pile driving, and which have already been taken into account in the exposure analysis.

Airborne Noise Effects

Marine mammals that occur in the project area could be exposed to airborne sounds associated with pile driving that have the potential to cause harassment, depending on their distance from pile driving activities. Airborne pile driving noise would have less impact on cetaceans than pinnipeds because noise from atmospheric sources does not transmit well underwater (Richardson *et al.* 1995); thus, airborne noise would only be an issue for hauled-out pinnipeds in the project area. Most likely, airborne sound would cause behavioral responses similar to those discussed above in relation to underwater noise. For instance, anthropogenic sound could cause hauled-out pinnipeds to exhibit changes in their normal behavior, such as reduction in vocalizations, or cause them to temporarily abandon their habitat and move further from the source. Studies by Blackwell *et al.* (2004) and Moulton *et al.* (2005) indicate a tolerance or lack of response to unweighted airborne sounds as high as 112 dB peak and 96 dB rms.

Anticipated Effects on Habitat

The proposed activities at NBKB will not result in permanent impacts to habitats used directly by marine mammals, such as haul-out sites, but may have potential short-term impacts to food sources such as forage fish and salmonids. There are no rookeries or major haul-out sites within 10 km (6.2 mi), foraging hotspots, or other ocean bottom structure of significant biological importance to marine mammals that may be present in the marine waters in the vicinity of the project area. Therefore, the main impact issue associated with the proposed activity will be temporarily elevated noise levels and the associated direct effects on marine mammals, as discussed previously in this document. The most likely impact to marine mammal habitat occurs from pile driving effects on likely marine mammal prey (*i.e.,* fish) near NBKB and minor impacts to the immediate substrate during installation and removal of piles during the pile replacement project.

Pile Driving Effects on Potential Prey (Fish)

Construction activities will produce both pulsed (*i.e.,* impact pile driving) and continuous (*i.e.,* vibratory pile driving) sounds. Fish react to sounds which are especially strong and/or intermittent low-frequency sounds. Short duration, sharp sounds can cause overt or subtle changes in fish behavior and local distribution. Hastings and Popper (2005, 2009) identified several studies that suggest fish may relocate to avoid certain areas of noise energy. Additional studies have documented effects of pile driving (or other types of continuous sounds) on fish, although several are based on studies in support of large, multiyear bridge construction projects (Scholik and Yan 2001, 2002; Govoni *et al.* 2003; Hawkins 2005; Hastings 1990, 2007; Popper *et al.* 2006; Popper and Hastings 2009). Sound pulses at received levels of 160 dB re 1 μPa may cause subtle changes in fish behavior. SPLs of 180 dB may cause noticeable changes in behavior (Chapman and Hawkins 1969; Pearson *et al.* 1992; Skalski *et al.* 1992). SPLs of sufficient strength have been known to cause injury to fish and fish mortality (CALTRANS 2001; Longmuir and Lively 2001). The most likely impact to fish from pile driving activities at the project area would be temporary behavioral avoidance of the area. The duration of fish avoidance of this area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. In general, impacts to marine mammal prey species are expected to be minor and temporary due to the short timeframe for the pile replacement project. However, adverse impacts may occur to a few species of rockfish (bocaccio [*Sebastes paucispinis*] and yelloweye [*S. ruberrimus*] and canary [*S. pinniger*] rockfish) and salmon (chinook [*Oncorhynchus tshawytscha*] and summer run chum) which may still be present in the project area despite operating in a reduced work window in an attempt to avoid important fish spawning time periods. Impacts to these species could result from potential impacts to their eggs and larvae.

Pile Driving Effects on Potential Foraging Habitat

In addition, the area likely impacted by the pile replacement project is relatively small compared to the available habitat in the Hood Canal. Avoidance by potential prey (*i.e.,* fish) of the immediate area due to the temporary loss of this foraging habitat is also possible. The duration of fish avoidance of this area after pile driving stops is unknown, but a rapid return to normal recruitment, distribution and behavior is anticipated. Any behavioral avoidance by fish of the disturbed area would still leave significantly large areas of fish and marine mammal foraging habitat in the Hood Canal and nearby vicinity.

Given the short daily duration of noise associated with individual pile driving and removal, the short duration of the entire pile replacement project, and the relatively small areas being affected, pile driving and removal activities associated with the proposed action are not likely to have a permanent, adverse effect on any fish habitat, or populations of fish species. Therefore, pile driving and removal is not likely to have a permanent, adverse effect on marine mammal foraging habitat at the project area.

Proposed Mitigation

In order to issue an incidental take authorization (ITA) under Section 101(a)(5)(D) of the MMPA, NMFS must, where applicable, set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses (where relevant).

The modeling results for zones of influence (ZOIs; *see* "Estimated Take by Incidental Harassment") were used to develop mitigation measures for pile driving and removal activities at NBKB. The ZOIs effectively represent the mitigation zone that would be established around each pile to prevent Level A harassment to marine mammals. While the ZOIs vary between the different diameter piles and types of installation or removal methods, the Navy is proposing to establish mitigation zones for the maximum zone of influence for all pile driving conducted in support of the pile replacement project. In addition to the measures described later, the Navy will employ the following standard mitigation measures:

(a) Conduct briefings between construction supervisors and crews, marine mammal monitoring team, acoustical monitoring team, and Navy staff prior to the start of all pile driving activity, and when new personnel join the work, in order to explain responsibilities, communication procedures, marine mammal monitoring protocol, and operational procedures.

(b) Comply with applicable equipment noise standards of the U.S. Environmental Protection Agency and ensure that all construction equipment has noise control devices no less effective than those provided on the original equipment.

(c) For in-water heavy machinery work other than pile driving (if it exists; *e.g.,* standard barges, tug boats, barge-mounted excavators, or clamshell equipment used to place or remove material), if a marine mammal comes within 50 m (164 ft), operations shall cease and vessels shall reduce speed to the minimum level required to maintain steerage and safe working conditions.

Shutdown and Buffer Zone

The following measures will apply to the Navy's mitigation through shutdown and buffer zones:

(a) The Navy will implement a minimum shutdown zone of 50 m (164 ft) radius around all pile driving and removal activity. Shutdown zones typically include all areas where the underwater SPLs are anticipated to equal or exceed the Level A (injury) harassment criteria for marine mammals (180-dB isopleth for cetaceans; 190-dB isopleth for pinnipeds). In this case, piledriving sounds are expected to attenuate below 180 dB at distances of 16 m or less, but the 50-m shutdown is intended to further avoid the risk of direct interaction between marine mammals and the equipment.

(b) The buffer zone shall include all areas where the underwater SPLs are anticipated to equal or exceed the 160-dB harassment isopleths, or where the airborne SPLs are anticipated to equal or exceed the 100-dB isopleths (for pinnipeds in general) or 90-dB isopleth (for harbor seals). The radius of this zone will be 501 m (1,644 ft) at the start of pile driving work, but may be adjusted according to empirical, site-specific data after the project begins. The buffer zone distance was set at the largest Level B behavioral disturbance zone calculated for impact pile driving, which was based on the calculations for airborne noise for harbor seals. The largest underwater disturbance threshold (160-dB) was 342 m (1,122 ft). The size of the 120-dB buffer zone for vibratory pile driving makes monitoring impracticable (*see* "Sound Thresholds"; Tables 5–6; 9).

(c) The shutdown and buffer zones will be monitored throughout the time required to drive a pile. If a marine mammal is observed entering the buffer zone, a "take" would be recorded and behaviors documented. However, that pile segment would be completed without cessation, unless the animal approaches or enters the shutdown zone, at which point all pile driving activities would be halted.

(d) All buffer and shutdown zones will initially be based on the distances from the source that are predicted for each threshold level. However, in-situ acoustic monitoring will be utilized to determine the actual distances to these threshold zones, and the size of the shutdown and buffer zones will be adjusted accordingly based on received sound pressure levels.

Visual Monitoring

Impact Installation—Monitoring will be conducted for a minimum 50 m (164 ft) shutdown zone and a 501 m (1,644 ft) buffer zone (Level B harassment) surrounding each pile for the presence of marine mammals before, during, and after pile driving activities. The buffer zone was set at the largest Level B behavioral disturbance zone calculated for impact pile driving, based on the disturbance calculations for airborne noise for harbor seals. Monitoring will take place from thirty minutes prior to initiation through thirty minutes post-completion of pile driving activities.

Vibratory Installation—Monitoring will be conducted for a minimum 50 m (164 ft) shutdown zone. The 120-dB disturbance criterion predicts an affected area of 40.3 km^2 (16 mi^2). Due to the impracticality of effectively monitoring such a large area, the Navy intends to monitor a buffer zone equivalent to the size of the Level B disturbance zone for impact pile driving (501 m) surrounding each pile for the presence of marine mammals before, during, and after pile driving activities. Sightings occurring outside this area will still be recorded and noted as a take, but detailed observations outside this zone will not be possible, and it would be impossible for the Navy to account for all individuals occurring in such a zone with any degree of certainty. Monitoring will take place from thirty minutes prior to initiation through thirty minutes post-completion of pile driving activities.

Vibratory and Chipping Removal—Monitoring will be conducted for a minimum 50 m (164 ft) shutdown zone. As discussed previously, predicted Level A harassment zones are subsumed by the minimum shutdown zone. As with vibratory installation, the 120-dB disturbance criterion predicts affected areas that are impracticable to effectively monitor, and the Navy intends to monitor a buffer zone equivalent to the size of the Level B disturbance zone for impact pile driving (501 m) surrounding each pile for the presence of marine mammals before, during, and after pile driving activities. Monitoring protocols will be identical to those discussed for pile installation.

The following additional measures will apply to visual monitoring:

(a) Monitoring will be conducted by qualified observers. A trained observer will be placed from the best vantage point(s) practicable (*e.g.,* from a small boat, the pile driving barge, on shore, or any other suitable location) to monitor for marine mammals and implement shut-down or delay procedures when applicable by calling for the shut-down to the hammer operator.

(b) Prior to the start of pile driving activity, the shutdown and safety zones will be monitored for thirty minutes to ensure that they are clear of marine mammals. Pile driving or removal will only commence once observers have declared the shutdown zone clear of marine mammals; animals will be allowed to remain in the buffer zone (*i.e.,* must leave of their own volition) and their behavior will be monitored and documented.

(c) If a marine mammal approaches or enters the shutdown zone during the course of pile driving or removal operations, pile driving will be halted and delayed until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or thirty minutes have passed without re-detection of the animal.

Sound Attenuation Devices

Sound attenuation devices will be utilized during all impact pile driving operations. Impact pile driving is only expected to be required to proof, or drive the last 10–15 ft (3–4.6 m) of each pile, and any required proofing will be limited to five days total, no more than one pile per day, and no more than fifteen minutes per pile. Past experience has shown that proofing is rarely required at the EHW–1 location. The Navy plans to use a bubble curtain as mitigation for in-water sound during construction activities. Bubble curtains absorb sound, attenuate pressure waves, exclude marine life from work areas, and control the migration of debris, sediments and process fluids.

Acoustic Measurements

Acoustic measurements will be used to empirically verify the proposed shutdown and buffer zones. For further detail regarding the Navy's acoustic monitoring plan *see* "Proposed Monitoring and Reporting".

Timing Restrictions

The Navy has set timing restrictions for pile driving activities to avoid in-water work when ESA-listed fish populations are most likely to be present. The in-water work window for avoiding negative impacts to fish species is July 16–February 15. Further, the Navy has narrowed its work window to avoid times of year when ESA-listed Steller sea lions may be present at the project area. Therefore, all pile driving would only occur between July 16–October 31 of the approved in-water work window from July 16 through February 15 to minimize the number of fish exposed to underwater noise and other disturbance, and to avoid times when Steller sea lions are expected to be present. In consultation with the USFWS, the Navy has further limited impact pile driving to July 16–September 30.

Soft Start

The use of a soft-start procedure is believed to provide additional protection to marine mammals by warning, or providing marine mammals a chance to leave the area prior to the hammer operating at full capacity. The pile replacement project will utilize soft-start techniques (ramp-up and dry fire) recommended by NMFS for impact and vibratory pile driving. The soft-start requires contractors to initiate noise from vibratory hammers for fifteen seconds at reduced energy followed by a one-minute waiting period. This procedure will be repeated two additional times. For impact driving, contractors will be required to provide an initial set of three strikes from the impact hammer at forty percent energy, followed by a one minute waiting period, then two subsequent three strike sets. No soft-start procedures exist for pneumatic chipping hammers.

Daylight Construction

Pile driving will only be conducted between two hours post-sunrise through two hours prior to sunset (civil twilight).

Mitigation Effectiveness

It should be recognized that although marine mammals will be protected from Level A harassment by the utilization of a bubble curtain and protected species observers (PSOs) monitoring the near-field injury zones, mitigation may not be 100 percent effective at all times in locating marine mammals in the buffer zone. The efficacy of visual detection depends on several factors including the observer's ability to detect the animal, the environmental conditions (visibility and sea state), and monitoring platforms.

All observers utilized for mitigation activities will be experienced biologists with training in marine mammal detection and behavior. Due to their specialized training the Navy expects that visual mitigation will be highly effective. Trained observers have specific knowledge of marine mammal physiology, behavior, and life history, which may improve their ability to detect individuals or help determine if observed animals are exhibiting behavioral reactions to construction activities.

The Puget Sound region, including the Hood Canal, only infrequently experiences winds with velocities in excess of 25 kt (Morris *et al.* 2008). The typically light winds afforded by the surrounding highlands coupled with the fetch-limited environment of the Hood Canal result in relatively calm wind and sea conditions throughout most of the year. The pile replacement project site has a maximum fetch of 8.4 mi (13.5 km) to the north, and 4.2 mi (6.8 km) to the south, resulting in maximum wave heights of from 2.85–5.1 ft (0.9–1.6 m) (Beaufort Sea State (BSS) between two and four), even in extreme conditions (30 kt winds) (CERC 1984). Visual detection conditions are considered optimal in BSS conditions of three or less, which align with the conditions that should be expected for the pile replacement project at NBKB.

Observers will be positioned in locations which provide the best vantage point(s) for monitoring. This will likely be an elevated position, providing a better range of viewing angles. Also, the shutdown and buffer zones have relatively small radii to monitor, which should improve detectability.

NMFS has carefully evaluated the applicant's proposed mitigation measures and considered a range of other measures in the context of ensuring that NMFS prescribes the means of effecting the least practicable impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another: (1) The manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals; (2) the proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and (3) the practicability of the measure for applicant implementation, including consideration of personnel safety, and practicality of implementation.

Based on our evaluation of the applicant's proposed measures, as well as other measures considered by NMFS, NMFS has preliminarily determined that the proposed mitigation measures provide the means of effecting the least practicable impact on marine mammal species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to issue an ITA for an activity, Section 101(a)(5)(D) of the MMPA states that NMFS must, where applicable, set forth "requirements pertaining to the monitoring and reporting of such taking". The MMPA implementing regulations at 50 CFR 216.104(a)(13) indicate that requests for ITAs must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area.

Acoustic Measurements

The Navy will conduct acoustic monitoring for impact driving of steel piles in order to determine the actual distances to the 190-, 180-, and 160-dB (re 1 μPa rms) isopleths and to determine the relative effectiveness of the bubble curtain system at attenuating noise underwater. The Navy will also conduct acoustic monitoring for vibratory pile driving and removal, and for removal with a pneumatic chipping hammer, in order to determine the actual distance to the 120-dB isopleth for behavioral harassment relative to background levels. The monitoring plan addresses both underwater and airborne sounds from the pile replacement project. At a minimum, the methodology will include:

(1) A stationary hydrophone placed at mid-water depth and 10 m (33 ft) from the source pile to measure the effectiveness of the bubble curtain system; a weighted tape measure will be used to determine the depth of the water. The hydrophone will be attached to a nylon cord or steel chain if current is swift enough, to maintain a constant distance from the pile. The nylon cord or chain will be attached to a float or tied to a static line at the surface 10 m from the piles.

(2) All hydrophones will be calibrated at the start of the action and will be checked at the beginning of each day of monitoring activity.

(3) For each monitored location, a two-hydrophone setup will be used, with the first hydrophone at mid-depth and the second hydrophone at approximately 1 m (3.3 ft) from the bottom in order to evaluate site specific attenuation and propagation characteristics that may be present throughout the water column.

(4) In addition to determining the area encompassed by the 190-, 180-, 160-, and 120-db rms isopleths for marine mammals, hydrophones would also be placed at other distances as appropriate to accurately capture spreading loss occurring at the EHW–1 project area.

(5) For airborne recordings, a stationary hydrophone will be placed at 50 ft (15 m) from the source for initial reference recordings.

(6) For airborne measurements, in addition to determining the area encompassed by the 100 and 90 dB rms isopleths for pinnipeds and harbor seals, hydrophones will be placed at other distances as appropriate to accurately capture spreading loss occurring at the EHW–1 project area.

(7) Ambient conditions, both airborne and underwater, would be measured at the project site in the absence of construction activities to determine background sound levels. Ambient levels are intended to be recorded over the frequency range from 10 Hz to 20 kHz. Ambient conditions will be recorded for one minute every hour of the work day, for one week of each month of the pile replacement project.

(8) Sound levels associated with soft-start techniques will also be measured.

(9) Underwater sound pressure levels would be continuously monitored during the entire duration of each pile being driven. Sound pressure levels will be monitored in real time. Sound levels will be measured in Pascals, which are easily converted to decibel units.

(10) Airborne levels would be recorded as unweighted, as well as in dBA, and the distance to marine mammal thresholds would be measured.

(11) The effectiveness of using a bubble curtain system with a vibratory hammer will be tested during the driving of two vibratory piles. The on/off regime described in Table 11 will be utilized during the pile installation:

TABLE 11—SCHEDULE FOR TESTING EFFECTIVENESS OF SOUND ATTENUATION DEVICE

Pile driving timeframe	Sound attenuation device condition
Initial 30 s	Off.
Next minute (minimum)	On.
Middle of pile driving segment. 30 s	Off.
Next minute (minimum)	On.
Final 30 s	Off.

(12) Environmental data will be collected, including, but not limited to: wind speed and direction, air temperature, humidity, surface water temperature, water depth, wave height, weather conditions and other factors

that could contribute to influencing the airborne and underwater sound levels (*e.g.,* aircraft, boats).

(13) The chief inspector will supply the acoustics specialist with the substrate composition, hammer model and size, hammer energy settings and any changes to those settings during the piles being monitored, depth of the pile being driven, and blows per foot for the piles monitored.

(14) Post-analysis of the sound level signals will include determination of absolute peak overpressure and under pressure levels recorded for each pile, rms value for each absolute peak pile strike, rise time, average duration of each pile strike, number of strikes per pile, SEL of the absolute peak pile strike, mean SEL, and cumulative SEL (accumulated SEL = single strike SEL + 10*log (number of hammer strikes) and a frequency spectrum both with and without mitigation, between 10–20,000 Hz for up to eight successive strikes with similar sound levels.

Visual Marine Mammal Observations

The Navy will collect sighting data and behavioral responses to construction for marine mammal species observed in the region of activity during the period of activity. All observers will be trained in marine mammal identification and behaviors. NMFS requires that the observers have no other construction related tasks while conducting monitoring.

Methods of Monitoring—The Navy will monitor the shutdown zone and safety (buffer) zone before, during, and after pile driving. Based on NMFS requirements, the Marine Mammal Monitoring Plan would include the following procedures for impact pile driving:

(1) MMOs would be located at the best vantage point(s) in order to properly see the entire shutdown zone and safety zone. This may require the use of a small boat to monitor certain areas while also monitoring from one or more land based vantage points.

(2) During all observation periods, observers would use binoculars and the naked eye to search continuously for marine mammals.

(3) To verify the required monitoring distances, the zones would be clearly marked with buoys or other suitable aquatic markers.

(4) If the shut down or safety zones are obscured by fog or poor lighting conditions, pile driving or removal would not be initiated until all zones are visible.

(5) The shut down and safety zones around the pile will be monitored for the presence of marine mammals before, during, and after any pile driving or removal activity.

Pre-Activity Monitoring—The shutdown and buffer zones will be monitored for thirty minutes prior to initiating the soft start for pile driving or removal. If marine mammal(s) are present within the shut down zone prior to pile driving or removal, or during the soft start, the start of pile driving would be delayed until the animal(s) leave the shut down zone. Pile driving would resume only after the PSO has determined, through sighting or by waiting approximately thirty minutes, that the animal(s) has moved outside the shutdown zone.

During Activity Monitoring—The shutdown and buffer zones will also be monitored throughout the time required to drive or remove a pile. If a marine mammal is observed entering the buffer zone, a "take" would be recorded and behaviors documented. However, that pile segment would be completed without cessation, unless the animal enters or approaches the shutdown zone, at which point all pile driving activities will be halted. Pile driving can only resume once the animal has left the shutdown zone of its own volition or has not been re-sighted for a period of thirty minutes.

Post-Activity Monitoring—Monitoring of the shutdown and buffer zones would continue for thirty minutes following the completion of pile driving.

Data Collection

NMFS requires that the PSOs use NMFS-approved sighting forms. In addition to the following requirements, the Navy will note in their behavioral observations whether an animal remains in the project area following a Level B taking (which would not require cessation of activity). This information will ideally make it possible to determine whether individuals are taken (within the same day) by one or more types of pile driving (*i.e.,* impact and vibratory). NMFS requires that, at a minimum, the following information be collected on the sighting forms:

(1) Date and time that pile driving begins or ends;

(2) Construction activities occurring during each observation period;

(3) Weather parameters identified in the acoustic monitoring (*e.g.,* wind, humidity, temperature);

(4) Tide state and water currents;

(5) Visibility;

(6) Species, numbers, and, if possible, sex and age class of marine mammals;

(7) Marine mammal behavior patterns observed, including bearing and direction of travel, and if possible, the correlation to sound pressure levels;

(8) Distance from pile driving activities to marine mammals and distance from the marine mammals to the observation point;

(9) Locations of all marine mammal observations; and

(10) Other human activity in the area.

Reporting

A draft report would be submitted to NMFS within 45 days of the completion of acoustic measurements and marine mammal monitoring. The results would be summarized in graphical form and include summary statistics and time histories of impact sound values for each pile. A final report would be prepared and submitted to NMFS within thirty days following receipt of comments on the draft report from NMFS. At a minimum, the report shall include:

(1) Size and type of piles;

(2) A detailed description of the SAS or bubble curtain, including design specifications;

(3) The impact or vibratory hammer force used to drive and extract the piles;

(4) A description of the monitoring equipment;

(5) The distance between hydrophone(s) and pile;

(6) The depth of the hydrophone(s);

(7) The depth of water in which the pile was driven;

(8) The depth into the substrate that the pile was driven;

(9) The physical characteristics of the bottom substrate into which the piles were driven;

(10) The ranges and means for peak, rms, and SELs for each pile;

(11) The results of the acoustic measurements, including the frequency spectrum, peak and rms SPLs, and single-strike and cumulative SEL with and without the attenuation system;

(12) The results of the airborne noise measurements including dBA and unweighted levels;

(13) A description of any observable marine mammal behavior in the immediate area and, if possible, the correlation to underwater sound levels occurring at that time;

(14) Results, including the detectability of marine mammals, species and numbers observed, sighting rates and distances, behavioral reactions within and outside of safety zones; and

(15) A refined take estimate based on the number of marine mammals observed in the safety and buffer zones. This may be reported as one or both of the following: a rate of take (number of marine mammals per hour), or take based on density (number of individuals within the area).

Estimated Take by Incidental Harassment

With respect to the activities described 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].

All anticipated takes would be by Level B harassment, involving temporary changes in behavior. The proposed mitigation and monitoring measures are expected to minimize the possibility of injurious or lethal takes such that take by Level A harassment, serious injury or mortality is considered remote. However, as noted earlier, there is no specific information demonstrating that injurious or lethal "takes" would occur even in the absence of the planned mitigation and monitoring measures.

If a marine mammal responds to an underwater sound by changing its behavior or moving a small distance, the response may or may not rise to the level of "taking", or affect the stock or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on animals or on the stock or species could potentially be significant (Lusseau and Bejder 2007; Weilgart 2007). Given the many uncertainties in predicting the quantity and types of impacts of noise on marine mammals, it is common practice to estimate how many mammals are likely to be present within a particular distance of a given activity, or exposed to a particular level of sound. This practice potentially overestimates the numbers of marine mammals taken. For example, during the past ten years, killer whales have been observed within the project area twice. While a pod of killer whales could potentially visit again during the project timeframe, and thus be "taken", it is more likely that they will not.

The proposed project area is not believed to be particularly important habitat for marine mammals, nor is it considered an area frequented by marine mammals, although harbor seals are year-round residents of Hood Canal. Therefore, behavioral disturbances that could result from anthropogenic noise associated with the proposed activities are expected to affect only a small number of marine mammals on an infrequent basis.

The Navy is requesting authorization for the potential taking of small numbers of California sea lions, harbor seals, transient killer whales, Dall's porpoises, and harbor porpoises in the Hood Canal that may result from pile driving during construction activities associated with the pile replacement project described previously in this document. The takes requested are expected to have no more than a minor effect on individual animals and no effect on the populations of these species. Any effects experienced by individual marine mammals are anticipated to be limited to short-term disturbance of normal behavior or temporary displacement of animals near the source of the noise.

Description of Take Calculation

The take calculations presented here rely on the best data currently available for marine mammal populations in the Hood Canal, as discussed in preceding sections. The formula was developed for calculating take due to impact pile driving and applied to each group-specific noise impact threshold. The formula is founded on the following assumptions:

(a) Each species population is at least as large as any previously documented highest population estimate.

(b) All pilings to be installed would have a noise disturbance distance equal to the piling that causes the greatest noise disturbance (*i.e.,* the piling furthest from shore).

(c) Pile driving could potentially occur every day of the in-water work window. However, it is estimated no more than a few hours of pile driving will occur per day. An average of two steel piles will be installed and removed per day or an average of three concrete piles will be removed per day.

(d) Some degree of mitigation (*i.e.,* sound attenuation system, *etc.*) will be utilized, as discussed previously.

(e) An individual can only be taken once per method of installation during a 24 hr period. The calculation for marine mammal takes is estimated by:

Take estimate = (n * ZOI) * days of total activity

where:
n = density estimate used for each species/season
ZOI = noise threshold zone of influence (ZOI) impact area; the area encompassed by all locations where the sound pressure levels equal or exceed the threshold being evaluated
n * ZOI produces an estimate of the abundance of animals that could be present in the area for exposure

The ZOI impact area is the estimated range of impact to the noise criteria. The distances (actual) specified in Tables 5–6 and 9 were used to calculate ZOI around each pile. All impact pile driving take calculations were based on the estimated threshold ranges using a bubble curtain with 10 dB attenuation as a mitigation measure (*see* "Underwater Noise from Piledriving"). The ZOI impact area took into consideration the possible affected area of the Hood Canal from the pile driving site furthest from shore with attenuation due to land shadowing from bends in the canal. Because of the close proximity of some of the piles to the shore, the narrowness of the canal at the project area, and the maximum fetch, the ZOIs for each threshold are not necessarily spherical and may be truncated.

While pile driving can occur any day throughout the in-water work window, only a fraction of that time is actually spent pile driving. On days when pile driving occurs, it could take place for thirty minutes, or up to several hours. The contractor estimates that steel pile installation could occur at a maximum rate of four piles per day; however, it is more likely that an average of two piles will be installed and removed per day. The contractor estimates that a maximum of five concrete piles can be removed per day, with an average of three being removed per day. For each pile installed, vibratory pile driving is expected to be no more than one hour. The impact driving portion of the project is anticipated to take approximately fifteen minutes per pile, with a maximum of one pile per day, and five piles in total allowed. All steel piles will be extracted using a vibratory hammer. Extraction is anticipated to take approximately thirty minutes per pile. Concrete piles will be removed using a pneumatic chipping hammer or other similar concrete demolition tool, and it is expected to take approximately two hours to remove each concrete pile. For steel piles, this results in a maximum of two hours of pile driving per pile or potentially four hours per day. For concrete piles, this results in a maximum of two hours of pneumatic chipping per pile, or potentially six hours per day.

Therefore, while 108 days of in-water work time is proposed, only a fraction of the total work time per day will actually be spent pile driving. An average work day (two hours post-sunrise to two hours prior to sunset) is approximately eight to nine hours, depending on the month. While it is anticipated that only four hours of pile driving would be needed per day for steel piles, or six hours of pneumatic chipping for concrete piles, to take into account deviations from the estimated times for pile installation and removal the Navy modeled potential impacts as if the entire day could be spent pile driving.

Based on the proposed action, the total pile driving time from vibratory pile driving during installation would be approximately fourteen days (28 piles at an average of two per day). The total pile driving time from vibratory pile driving during steel pile removal would be 21 days (42 piles at an average of two per day). The total pile driving time for utilizing a pneumatic chipping hammer during concrete pile removal would be 32 days (96 piles at an average of three per day). Therefore, impacts for installation, steel pile removal, and concrete pile removal were modeled as if these actions were to occur throughout the duration of 14, 21, and 32 days, respectively. During installation, there is the potential for the contractor to need to utilize an impact hammer to proof a select number of piles, although past repairs on the EHW–1 pier have never required the use of an impact pile driver. However, if the use of an impact hammer is required, impact pile driving will occur on no more than five piles, with only one pile being impact driven per day. Therefore, impact pile driving during installation was modeled as occurring for five 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. Of note in these exposure estimates, mitigation methods other than the use of a sound attenuation device (*i.e.,* visual monitoring and the use of shutdown zones) were not quantified within the assessment and successful implementation of this mitigation is not reflected in exposure estimates. Results from acoustic impact exposure assessments should be regarded as conservative estimates that are strongly influenced by limited biological data. While the numbers generated from the pile driving exposure calculations provide conservative overestimates of marine mammal exposures for consultation with NMFS, the short duration and limited geographic extent of the pile replacement project would further limit actual exposures.

California Sea Lion

California sea lions are present in the Hood Canal almost year-round with the exception of mid-June through August. The Navy conducted year round waterfront surveys for marine mammals at NBKB in 2008 and 2009 (DoN 2010a). During these surveys, the daily maximum number of California sea lions hauled out for the months July-October (the timeframe of the pile replacement project), were 0, 0, 12, and 47 in 2008 and 0, 1, 32, and 44 in 2009, respectively. The monthly average of the maximum number of California sea lions observed per day was seventeen individuals. Females are rarely observed north of the California-Oregon border (NMFS 2008c); therefore only adult and sub-adult males are expected in the Hood Canal. Breeding rookeries are in California; therefore pups are not expected to be present in the Hood Canal.

California sea lions are not likely to be present at the project site during the entire period of work (*i.e.,* are infrequent visitors during July-August). However, because the proportion of pile driving that could occur in a given month is dependent on several factors (*e.g.,* availability of materials, weather) the Navy assumed that pile driving operations could occur at any time in the construction window. Therefore, exposures were calculated using the monthly average of the maximum number of California sea lions observed per day (seventeen individuals), divided by the area encompassed by the maximum fetch at the project site (41.5 km^2 [16 mi^2]) and the formula given previously. Table 12 depicts the number of acoustic harassments that are estimated from vibratory and impact pile driving and removal, and pneumatic chipping, both underwater and in-air for each season. The modeling indicated that zero California sea lions were likely to be exposed to sound in the 160-dB zone. However, the Navy feels that, based on the abundance of this species in the waters along NBKB and including their presence at nearby haul-outs, it is possible that an individual could pass through this zone in transit to or from a haul-out. Therefore, the Navy is requesting a behavioral harassment take of California sea lion by impact pile driving each day of pile driving, for a total of five takes over the course of the proposed action.

Harbor Seal

Harbor seals are present in the Hood Canal year-round and would be expected at the project site. Harbor seal numbers increase from January through April and then decrease from May through August as the harbor seals move to adjacent bays on the outer coast of Washington for the pupping season. Harbor seals are the most abundant marine mammal in the Hood Canal. Jeffries *et al.* (2003) did a stock assessment of harbor seals in the Hood Canal in 1999 and counted 711 harbor seals hauled out. This abundance was adjusted using a correction factor of 1.53 to account for seals in the water and not counted to provide a population estimate of 1,088 harbor seals in the Hood Canal. The Navy conducted boat surveys of the waterfront area in 2008 from July to September (Agness and Tannenbaum 2009a). Harbor seals were sighted during every survey and were found in all marine habitats including near and hauled-out on man-made objects such as piers and buoys. During most of the year, all age and sex classes (except newborn pups) could occur in the project area throughout the period of construction activity. From April through mid-July, female harbor seals haul out on the outer coast of Washington at pupping sites to give birth. Since there are no known pupping sites in the vicinity of the project, harbor seal pups are not expected to be present during pile driving. The main haul-out locations for harbor seals in Hood Canal are located on river delta and tidal exposed areas at Quilcene, Dosewallips, Duckabush, Hamma Hamma, and Skokomish River mouths, with the closest haul-out area to the project area being 10 mi (16 km) southwest of NBKB at Dosewallips River mouth (London 2006). Please *see* Figure 4–1 of the Navy's application for a map of haul-out locations in relation to the project area.

Research by Huber *et al.* (2001) indicates that approximately 35 percent of harbor seals are in the water at any one time. Exposures were calculated using a density derived from the number of harbor seals that are present in the water at any one time (35 percent of 1,088, or approximately 381 individuals), divided by the area of the Hood Canal (291 km^2 [112 mi^2]) and the formula presented previously.

While Huber *et al.*'s (2001) data suggest that harbor seals typically spend 65 percent of their time hauled out, the Navy's waterfront surveys found that it is extremely rare for harbor seals to haul out in the vicinity of the test pile project area. Therefore, the only population of harbor seals that could potentially be exposed to airborne sounds are those that are in-water but at the surface. Based on the diving cycle of tagged harbor seals near the San Juan Islands, the Navy estimates that seals are on the surface approximately 16.4 percent of their total in-water duration (Suryan and Harvey 1998). Therefore, by multiplying the percentage of time spent at the surface (16.4 percent) by the total in-water population of harbor seals at any one time (approximately 381 individuals), the population of harbor seals with the potential to experience airborne impacts (approximately 63 individuals) can be obtained. Airborne exposures were calculated using a density derived from the maximum number of harbor seals available at the surface (approximately 63 individuals), divided by the area of the Hood Canal (291 km^2) and the formula presented previously. Table 12 depicts the number of acoustic harassments that are estimated from vibratory and impact pile driving and removal, and from pneumatic chipping, both underwater and in-air for each season. The modeling indicated that zero harbor seals were likely to be exposed to sound in the 160-dB zone. However, the Navy feels that, based on the abundance of this species in the waters along NBKB and including their presence at nearby haul-outs, it is possible that an individual could pass through this zone in transit to or from a haul-out. Therefore, the Navy is requesting a behavioral harassment take of harbor seal by impact pile driving each day of pile driving, for a total of five takes over the course of the proposed action.

Killer Whales

Transient killer whales are uncommon visitors to Hood Canal. Transients may be present in the Hood Canal anytime during the year and traverse as far as the project site. Resident killer whales have not been observed in Hood Canal, but transient pods (six to eleven individuals per event) were observed in Hood Canal for lengthy periods of time (59–172 days) in 2003 (January-March) and 2005 (February-June), feeding on harbor seals (London 2006).

These whales used the entire expanse of Hood Canal for feeding. Subsequent aerial surveys suggest that there has not been a sharp decline in the local seal population from these sustained feeding events (London 2006). Based on this data, the density for transient killer whales in the Hood Canal for January to June is 0.038/km^2 (0.015/mi^2; eleven individuals divided by the area of the Hood Canal [291 km^2]). Since this timeframe overlaps the period in which the pile replacement project will occur (July-October), this density was used for all exposure calculations. Exposures were calculated using the formula presented previously. Table 12 depicts the number of acoustic harassments that are estimated from vibratory and impact pile driving for each season. The modeling indicated that zero killer whales were likely to be exposed to sound in the 160-dB zone. However, while transient killer whales are rare in the Hood Canal, when these animals are present they occur in pods, so their density in the project area is unlikely to be uniform, as was modeled. If they are present during impact pile driving it is possible that one or more individuals within a pod could travel through the behavioral harassment zone. Therefore, the Navy is requesting nine behavioral takes of transient killer whales—based on the average size of pods seen previously in the Hood Canal—by impact pile driving over the course of the proposed action.

Dall's Porpoise

Dall's porpoises may be present in the Hood Canal year-round and could occur as far as the project site. Their use of inland Washington waters, however, is mostly limited to the Strait of Juan de Fuca. The Navy conducted boat surveys of the waterfront area in 2008 from July to September (Agness and Tannenbaum 2009a). During one of the surveys a Dall's porpoise was sighted in August in the deeper waters off Carlson Spit.

In the absence of an abundance estimate for the entire Hood Canal, a seasonal density (warm season only) was derived from the waterfront survey by the number of individuals seen divided by total number of kilometers of survey effort (six surveys with approximately 3.9 km^2 [1.5 mi^2] of effort each), assuming strip transect surveys. In absence of any other survey data for the Hood Canal, this density is assumed to be throughout the project area. Exposures were calculated using the formula presented previously. Table 12 depicts the number of acoustic harassments that are estimated from vibratory and impact pile driving for each season. The modeling indicated that zero Dall's porpoises were likely to be exposed to sound in the 160-dB zone. Dall's porpoises are rare in the Hood Canal; only one animal, seen in deep waters offshore from the base, has been seen in the project area in the past few years. However, it is possible that additional animals exist or that this single individual could pass through the behavioral harassment zone for impulse sounds (160-dB) while transiting along the waterfront. Therefore, the Navy is requesting a single behavioral harassment take of a Dall's porpoise by impact pile driving over the course of the proposed action.

Harbor Porpoise

Harbor porpoises may be present in the Hood Canal year-round; however, their presence is rare. During waterfront surveys of NBKB over the past two years (2008–present) only one harbor porpoise has been seen in 24 surveys.

The Navy conducted boat surveys of the waterfront area from July to September over the past few years (2008–present) (Agness and Tannenbaum 2009a). During one of the surveys a single harbor porpoise was sighted in the deeper waters offshore from the waterfront. In the absence of an abundance estimate for the entire Hood Canal, a seasonal density (warm season only) was derived from the waterfront survey by the number of individuals seen divided by total number of kilometers of survey effort (24 surveys with approximately 3.9 km^2 [1.5 mi^2] of effort each), assuming strip transect surveys. In the absence of any other survey data for the Hood Canal, this density is assumed to be throughout the project area. Exposures were calculated using the formula presented previously; Table 12 depicts the number of acoustic harassments that are estimated from vibratory and impact pile driving for each season. The modeling indicated that zero harbor porpoises were likely to be exposed to sound in the 120–dB zone. However, while harbor porpoises are rare, one has been sighted in surveys over the last few years in the deep waters offshore from the base. It is possible this offshore region is encapsulated within the disturbance zone during vibratory pile installation and removal due to the large size (40.3 [15.6] and 35.9 km^2 [13.9 mi^2], respectively). Therefore, based on the possibility that this animal could be present in the offshore waters during every day of construction, the Navy is requesting a single behavioral take of harbor porpoise by vibratory pile driving each day of pile driving, for a total of 35 takes over the course of the proposed action (fourteen during installation and 21 during removal). The area of disturbance during pneumatic chipping is comparatively small (0.608 km^2 [0.23 mi^2]); thus, the Navy does not feel harbor porpoises are likely to occur in this area and is not requesting take for pneumatic chipping.

Potential takes could occur if individuals of these species move through the area on foraging trips when pile driving or removal is occurring. Individuals that are taken could exhibit behavioral changes such as increased swimming speeds, increased surfacing time, or decreased foraging. Most likely, individuals may move away from the sound source and be temporarily displaced from the areas of pile driving or removal. Potential takes by disturbance would have a negligible short-term effect on individuals and would not result in population-level impacts.

TABLE 12—NUMBER OF POTENTIAL WARM SEASON (MAY–OCT) EXPOSURES OF MARINE MAMMALS WITHIN VARIOUS ACOUSTIC THRESHOLD ZONES

Species	Density	Underwater			Airborne	Total (percent of stock or population [3])
		Impact injury threshold [1]	Impact disturbance threshold (160 dB)	Vibratory disturbance threshold (120 dB)	Impact & vibratory disturbance threshold [2]	
California sea lion	0.410	0	*5	553	0	558 (0.2)
Harbor seal	1.31	0	*5	1,761	[4] 0	1,766 (12.1)
Killer whale	0.038	0	*9	49	N/A	58 (18.5)
Dall's porpoise	0.043	0	*1	70	N/A	71 (0.1)
Harbor porpoise	0.011	0	0	*35	N/A	35 (0.3)
Total	....	0	20	2,468	0	2,488

* *See* species descriptions for discussion of these estimates.
[1] Acoustic injury threshold for impact pile driving is 190 dB for pinnipeds and 180 dB for cetaceans.
[2] Acoustic disturbance threshold is 100 dB for California sea lions and 90 dB for harbor seals. The airborne exposure calculations assume that 100% of the in-water densities were available at the surface to be exposed to airborne sound.
[3] *See* Table 10 for stock or population numbers.
[4] Airborne densities were based on the percentage (16.4 percent) of in-water density available at the surface to be exposed (Suryan and Harvey 1998).

During the project timeframe, which occurs entirely in the May to October warm season, there is the potential for twenty Level B disturbance takes (160-dB, impulse sound) of various species from impact pile driving operations, and an additional 2,468 Level B disturbance takes (120-dB, continuous sound) of various species from vibratory pile driving, vibratory removal, and pneumatic chipping due to underwater sound. The following species and numbers of Level B disturbance takes could occur due to underwater sound as a result of impact pile driving operations: five California sea lions, five harbor seals, nine transient killer whales, and one Dall's porpoise. The following species and numbers of Level B disturbance takes could occur due to underwater sound as a result of vibratory pile driving operations: 553 California sea lions, 1,761 harbor seals, 49 transient killer whales, seventy Dall's porpoises, and 35 harbor porpoises. Due to their lack of presence within the project area during the timeframe for the pile replacement project (July 16–Oct 31), no Steller sea lions would be harassed. Lastly, no species of pinnipeds are expected to be exposed to airborne sound pressure levels that would cause harassment.

Negligible Impact and Small Numbers Analysis and Preliminary Determination

NMFS has defined "negligible impact" in 50 CFR 216.103 as "* * * an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival." In making a negligible impact determination, NMFS considers a variety of factors, including but not limited to: (1) The number of anticipated mortalities; (2) the number and nature of anticipated injuries; (3) the number, nature, intensity, and duration of Level B harassment; and (4) the context in which the take occurs.

Pile driving activities associated with the pile replacement project, as outlined previously, have the potential to disturb or displace small numbers of marine mammals. Specifically, the proposed activities may result in take, in the form of Level B harassment (behavioral disturbance) only, from airborne or underwater sounds generated from pile driving. Level A harassment is not anticipated given the methods of installation and measures designed to minimize the possibility of injury to marine mammals. Specifically, vibratory hammers will be the primary method of installation, which are not expected to cause injury to marine mammals due to the relatively low source levels (less than 190 dB). Pile removal activities, whether vibratory removal of steel piles or pneumatic chipping of concrete piles, produce sound levels lower than those produced by vibratory installation. Also, no impact pile driving will occur without the use of a noise attenuation system (*e.g.,* bubble curtain), and pile driving will either not start or be halted if marine mammals approach the shutdown zone (described previously in this document). Furthermore, the pile driving activities analyzed are similar to other nearby construction activities within the Hood Canal, such as test piles driven in 2005 for the Hood Canal Bridge (SR–104) constructed by the Washington Department of Transportation, which have taken place with no reported injuries or mortality to marine mammals.

NMFS has preliminarily determined that the impact of the previously described pile replacement project may result, at worst, in a temporary modification in behavior (Level B harassment) of small numbers of marine mammals. No mortality or injuries are anticipated as a result of the specified activity, and none are proposed to be authorized. Additionally, animals in the area are not expected to incur hearing impairment (*i.e.,* TTS or PTS) or non-auditory physiological effects. For pinnipeds, the absence of any major rookeries and only a few isolated haul-out areas near or adjacent to the project site means that potential takes by disturbance will have an insignificant short-term effect on individuals and would not result in population-level impacts. Similarly, for cetacean species the absence of any regular occurrence adjacent to the project site means that potential takes by disturbance will have an insignificant short-term effect on individuals and would not result in population-level impacts. Due to the nature, degree, and context of behavioral harassment anticipated, the activity is not expected to impact rates of recruitment or survival. While modeling indicates that the specified activities could potentially take, by harassment only, as many as 58 transient killer whales (18.5 percent of the regional stock), it is extremely unlikely that 58 individual whales would be exposed to sound associated with the project. Rather, the estimated 58 takes represents a single group of nine whales that could potentially be exposed to sound on multiple days, if present. As such, the possible repeated exposure of a small group of individuals does not present the deleterious effect on the regional stock that is suggested by the figure of 18.5 percent. This activity is expected to result in a negligible impact on the affected species or stocks. None of the species for which take authorization is requested are either ESA-listed or considered depleted under the MMPA.

For reasons stated previously in this document, the negligible impact determination is also supported by the likelihood that, given sufficient "notice" through mitigation measures including soft start, marine mammals are expected to move away from a noise source that is annoying prior to its becoming potentially injurious, and the likelihood that marine mammal detection ability by trained observers is high under the environmental conditions described for Hood Canal, enabling the implementation of shut-downs to avoid injury, serious injury, or mortality. As a result, no take by injury or death is anticipated, and the potential for temporary or permanent hearing impairment is very low and will be avoided through the incorporation of the proposed mitigation measures.

While the number of marine mammals potentially incidentally harassed will depend on the distribution and abundance of marine mammals in the vicinity of the survey activity, the number of potential harassment takings is estimated to be small relative to regional stock or population number, and has been mitigated to the lowest level practicable through incorporation of the proposed mitigation and monitoring measures mentioned previously in this document.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the mitigation and monitoring measures, NMFS preliminarily finds that the proposed pile replacement project will result in the incidental take of small numbers of marine mammal, by Level B harassment only, and that the total taking from the activity will have a negligible impact on the affected species or stocks.

Impact on Availability of Affected Species or Stock for Taking for Subsistence Uses

No Tribal subsistence hunts are held in the vicinity of the project area; thus, temporary behavioral impacts to individual animals would not affect any subsistence activity. Further, no population or stock level impacts to marine mammals are anticipated or authorized. As a result, no impacts to the availability of the species or stock to the Pacific Northwest treaty Tribes are expected as a result of the proposed activities. Therefore, no relevant subsistence uses of marine mammals are implicated by this action.

Endangered Species Act (ESA)

There is one marine mammal species that is listed as endangered under the ESA with confirmed or possible occurrence in the study area: the Eastern DPS of the Steller sea lion. However, as described previously, the pile driving and removal activities associated with the project will occur from July 16–October 31 only, a time at which Steller sea lions are not present in the project area. The Navy conducted an informal consultation with the NWRO under Section 7 of the ESA; the NWRO concurred that there would be no presence of ESA-listed marine mammals during the project and that formal consultation was not required.

National Environmental Policy Act (NEPA)

In December 2010, the Navy prepared a draft EA, which has been posted on the NMFS Web site (*see* **ADDRESSES**) concurrently with the publication of this proposed IHA and public comments have been solicited. NMFS will review the draft EA and the public comments received and subsequently either adopt it or prepare its own NEPA document before making a determination on the issuance of an IHA.

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to authorize the take of marine mammals incidental to the Navy's pile replacement project, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated.

Dated: January 31, 2011.

James H. Lecky,

Director, Office of Protected Resources, National Marine Fisheries Service.

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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XA124

Takes of Marine Mammals Incidental to Specified Activities; Marine Geophysical Survey in the Pacific Ocean off Costa Rica, April Through May, 2011

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; proposed incidental harassment authorization; request for comments.

SUMMARY: NMFS has received an application from Lamont-Doherty Earth Observatory (L–DEO), a part of Columbia University, for an Incidental Harassment Authorization (IHA) to take marine mammals, by harassment, incidental to conducting a marine geophysical survey in the eastern tropical Pacific (ETP) Ocean off Costa Rica, April through May, 2011. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an IHA to L–DEO to incidentally harass, by Level B harassment only, 19 species of marine mammals during the specified activity.

DATES: Comments and information must be received no later than March 7, 2011.

ADDRESSES: Comments on the application should be addressed to P. Michael Payne, Chief, Permits, Conservation and Education Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910. The mailbox address for providing e-mail comments is *ITP.Cody@noaa.gov.* NMFS is not responsible for e-mail comments sent to addresses other than the one provided here. Comments sent via e-mail, including all attachments, must not exceed a 10-megabyte file size.

All comments received are a part of the public record and will generally be posted to *http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications* without change. All Personal Identifying Information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information.

A copy of the application containing a list of the references used in this document may be obtained by writing to the above address, telephoning the