Final

Request for Letter of Authorization for the Incidental Harassment of Marine Mammals Resulting from the Naval Magazine Indian Island Ammunition Wharf Maintenance and Pile Replacement Project

Naval Magazine Indian Island

Submitted to:
Office of Protected Resources,
National Marine Fisheries Service,
National Oceanographic and Atmospheric Administration

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Executive Summary

The United States (U.S.) Department of the Navy (Navy) is applying for a Letter of Authorization (LOA) for the incidental take of marine mammals resulting from the replacement and maintenance of the Ammunition Wharf marine structure at the Naval Magazine (NAVMAG) Indian Island between October 1, 2023 and September 31, 2028. NAVMAG Indian Island is located within the northern portion of Puget Sound, Washington. Impact and vibratory pile driving associated with the proposed activities have the potential to affect marine mammals within the waterways adjacent to NAVMAG Indian Island that could result in harassment under the Marine Mammal Protection Act (MMPA) of 1972, as amended.

Thirteen marine mammal species, Distinct Population Segments (DPSs), or stocks, have a potential to occur within the waters adjacent to NAVMAG Indian Island Ammo Wharf: Humpback whale (*Megaptera novaeangliae*) including the California/Oregon/Washington and Central North Pacific stocks (Includes the Central America, Hawaii, and Mexico DPSs), minke whale (*Balaenoptera acutorostrata*), Eastern North Pacific gray whale (*Eschrichtius robustus*), killer whales including the Southern Resident stock and West Coast transient stock (*Orcinus orca*), harbor porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*), Eastern United States Steller sea lion (*Eumetopias jubatus*), California sea lion (*Zalophus californianus*), northern elephant seal (*Mirounga angustirostris*), and Pacific harbor seal (*Phoca vitulina richardii*). Two of these species, the humpback whale and killer whale, have DPSs listed under the federal Endangered Species Act (Humpback whale Central America and Mexico DPSs, and Southern Resident killer whale DPS). The 13 species are included in the analysis of this application based on the potential for exposure to Level B behavioral harassment (harbor seals have the potential for exposure to Level A harassment from the impact pile driving) from noise associated with removing and installation of structural piles or fender piles. Damaged 24-in concrete piles will be removed by cutting and new 24-in concrete piles will be installed by jetting and impact pile driving. A small number of damaged concrete piles maybe replaced by 36-in steel piles that would be installed by vibratory and impact driving. Damaged fender piles would be removed and new fender piles (steel 14-in H piles or 18.75-in composite piles) installed using a vibratory driver.

The Navy proposes to replace defective structural concrete piles and fender piles, conduct maintenance, and repair activities on the Ammunition Wharf at NAVMAG Indian Island. Construction of the Ammunition Wharf was completed in 1979 and there are a total of 1,783 piles in the Ammunition Wharf structure; 1,391 structural piles, 306 fender piles (provides protection between vessels and the wharf), and 86 Operations Building piles.

Maintaining this structure is vital to sustaining the Navy's mission and ensuring readiness. The Navy has an ongoing waterfront inspection program to identify deficiencies in marine structures. Identified deficiencies are prioritized and then programmed for design and construction. Future waterfront inspections, as well as damage caused by severe weather events and/or incidents caused by vessels, would result in emergent marine structure repairs.

The proposed repair activities would occur over a 7-year period (October 1, 2023 through January 31, 2030); however, the Letter of Authorization (LOA) is only valid for five years, which will cover pile removal and installation over the period of October 1, 2023 through September 30, 2028. The Navy proposes to replace up to 118 piles, either structural concrete piles or fender piles. The number of replaced structural concrete piles could include up to eight structural steel piles if inspections warrant steel pile replacement and the remainder would be concrete piles. The two years following the LOA will only consist of removal and installation of concrete piles, and maintenance and repair work, no steel pile installation. General maintenance could include deck resurfacing and recoating various corroded metal components. Repair activities would be conducted on wetwell concrete spalling, piles, and quay walls.

Damaged or deteriorated components would be repaired or replaced, including brow floats, pile caps, safety ladders, cable straps, camel and camel connections, and lighting. The two years following the LOA will only consist of removal and installation of concrete piles, and maintenance and repair work, no steel pile installation.

Under the 5-year LOA, up to 110 structurally unsound structural piles or fender piles would be replaced. Structural concrete piles would be replaced with 24-in concrete piles or old fender piles would be replaced with 14-in steel H piles or 18.75-in composite piles. Fender piles are not driven to resistance or depth as are structural piles; therefore, lower vibratory power is use during removal and installation resulting in lower source sound levels compared to larger structural pile installation. Up to eight steel piles may also be installed in addition to the structural concrete piles if necessary. Existing damaged piles would be removed by cutting, vibratory removal would not be used. To minimize underwater noise impacts on marine species, water jetting would be primary method to install concrete piles and vibratory pile driving would be the primary method to install steel piles. An impact hammer may be used if substrate conditions prevent the advancement of piles to the required depth or to verify the load-bearing capacity for both concrete and steel piles. An air bubble curtain or other noise attenuating device would be used to reduce noise levels during impact driving of 36-in steel piles but would not be used for concrete piles. Marine mammal monitoring would be conducted during all cutting for pile removal, and jetting, vibratory, and impact pile driving work, and will shutdown if marine mammals come within project-specific defined distances. Pile driving duration will vary, depending on the type of pile and method used for installation; all pile driving will be conducted during the prescribed in-water work window for the NAVMAG Indian Island (October 1 to January 15; Tidal Reference Area 10, Port Townsend; USACE, 2015).

The Navy used the National Marine Fisheries Service (NMFS) promulgated thresholds for assessing impact and vibratory pile driving impacts to marine mammals, and used the practical spreading loss equation and empirically measured source levels from other similar steel pile driving projects to estimate potential marine mammal exposures to pile driving noise. Predicted Level A and Level B harassment exposures are described in detail in Section 6 (Table 6-12) and summarized in Table ES–1. Level A harassments associated with pile driving activities will be avoided for all species but harbor seals, by implementing mitigation measures described in Section 11. Conservative assumptions (including marine mammal densities, monitoring reports, surveys, and other assumptions) used to estimate the exposures are likely to overestimate the potential number of exposures.

Pursuant to MMPA Section 101(a)(5)(A), the Navy submits this application to NMFS for the authorization of incidental, but not intentional, taking of individuals of 13 marine mammal species, DPSs or stocks, during pile driving activities for the installation of structural piles between October 1, 2023 and September 31, 2028. The taking will be in the form of non- injurious temporary harassment (Level B). Takes for harbor seals may also include non-serious injury (Level A). All taking is expected to have a negligible impact on populations of these species. In addition, the taking will not have an adverse impact on the availability of these species for subsistence use.

Regulations governing the issuance of incidental take under certain circumstances are codified at 50 Code of Federal Regulations Part 216, Subpart I (Sections 216.101–216.108). Section 216.104 sets forth 14 specific items that must be addressed in requests for take pursuant to Section 101 (a)(5)(A) of the MMPA. These 14 items are addressed in Sections 1 through 14 of this LOA application.

Table ES-1. Underwater Exposure Estimates by Species for All Five Years and Annually. Exposures Include Impact Or Vibratory Pile Driving Of Concrete Piles or Fender Piles (110 Piles), and If Necessary, Impact and Vibratory Driving (Eight Steel Piles)

Species	*Total Exposure Estimates For Five Years (Annual Estimates)*						
	24-in Concrete Piles and/or 14-in/18.75-in Fender Piles (Up to 22/Yr)		*36 Inch Steel Piles (Up to 2/Yr)*		*Total Level B*	*Total Level A*	*Percent of Stock/DPS For Five Years*
	Level B	*Level A*	*Level B*	*Level A*			
	Vibratory or Impact	*Impact*	*Vibratory and Impact*	*Impact*			
ESA-Listed Species							
Humpback Whale California-Oregon-Washington and Central North Pacific	0	0	5 (1)	0	5 (1)	0	0.03
Southern Resident Killer Whale[‡]	0	0	0	0	0	0	0
Non ESA-Listed Species							
Gray Whale	0	0	5 (1)	0	5 (1)	0	0.02
Minke Whale	0	0	5 (1)	0	5 (1)	0	0.55
Dall's Porpoise	15 (3)	0	15 (3)	0	30 (6)	0	0.18
Harbor Porpoise[†]	15 (3)	0	625 (125)	0	640 (128)	0	5.70
Killer Whale Transient[‡]	0	0	0	0	0	0	0
California Sea Lion	5 (1)	0	100 (20)	0	105 (21)	0	0.04
Steller Sea Lion	5 (1)	0	25 (5)	0	30 (6)	0	0.06
Northern Elephant Seal	5 (1)	0	5 (1)	0	10 (2)	0	0.01
Pacific Harbor Seal Washington Inland Stock	1,710 (342)	55 (11)	1,530 (306)	70 (14)	3,240 (648)	125 (25)	30.5
Total For All Species	**1,755 (351)**	**55 (11)**	**2,315 (463)**	**70 (14)**	**4,070 (814)**	**125 (25)**	

[†] Harbor porpoise group size is 1-3 animals; therefore, the estimates are for single harbor porpoises that would have 1-2 conspecifics.

[‡] Transient killer whales are typically found in small pods of 3-6 whales but occasionally up to 12 whales (Baird & Dill, 1996; Houghton et al., 2015); therefore, if one whale is exposed during vibratory driving of 36 inch steel piles based on species density then the entire pod would likely be exposed. However, pile driving would be delayed if killer whales are approaching or near the NAVMAG Indian Island Level B zones. NMFS, Center for Whale Research, and Orca Network track killer whales and generally known within several hours the location of killer whales if they are within the Salish Sea (including Puget Sound, Strait de Juan de Fuca, and the San Juan Islands). Therefore, killer whale takes are not likely to occur but one set of takes is listed as a precaution.

Notes: Calculated exposures are rounded up to the nearest whole number. Although no Steller sea lions or northern elephant seals were observed during previous monitoring (Navy, 2015, 2016, 2021), these species are increasingly using Puget Sound; therefore, a small number (one per year) was added to compensate for an animal that could occur near NAVMAG Indian Island or within the large vibratory Level B zone.

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List of Acronyms

BMP	Best Management Practices
CFR	Code of Federal Regulations
CV	coefficient of variation
dB	decibel
dB re 1 µPa	decibels referenced at 1 micropascal
dBA	A-weighted decibel
DPS	Distinct Population Segment
EHW-1	Explosive Handling Wharf #1
EHW-2	Explosive Handling Wharf #2
ENP	Eastern North Pacific
ESA	Endangered Species Act
Hz	hertz
IHA	Incidental Harassment Authorization
kHz	kilohertz
km	kilometer
Km^2	Kilometer squared
L_{eq}	equivalent sound level
L_{max}	maximum sound level
LMR	Living Marine Resources
LOA	Letter of Authorization
m	meter
MLLW	mean lower low water
MMPA	Marine Mammal Protection Act
MPR	Marine Structure Maintenance and Pile Replacement
NAVBASE	Naval Base
Navy	U.S. Department of the Navy
NMFS	National Marine Fisheries Service
NMSDD	Navy Marine Species Density Database
NOAA	National Oceanic and Atmospheric Administration
PSB	port security barrier
PSO	protected species observer
PTS	permanent threshold shift
RMS	root mean square
sec	second
SEL	sound exposure level
SPL	sound pressure level
TL	transmission loss
WDFW	Washington Department of Fish and Wildlife
WDOE	Washington Department of Ecology
WNP	Western North Pacific
WRA	Waterfront Restricted Area

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1 Description of Specified Activity

A detailed description of the specific activity or class of activities that can be expected to result in incidental taking of marine mammals.

1.1 Introduction

The United States (U.S.) Department of the Navy (Navy) proposes to replace defective structural concrete piles, and conduct maintenance and repair activities on the Ammunition Wharf at Naval Magazine (NAVMAG) Indian Island. Construction of the Ammunition Wharf was completed in 1979 and there is a total of 1,783 piles in the Ammunition Wharf structure; 1,391 structural piles, 306 fender piles and 86 Operations Building piles. Maintaining this structure is vital to sustaining the Navy's mission and ensuring readiness. The Navy has an ongoing waterfront inspection program to identify deficiencies in marine structures. Identified deficiencies are prioritized and then programmed for design and construction. Future waterfront inspections, as well as damage caused by severe weather events and/or incidents caused by vessels, would result in emergent marine structure repairs.

The Letter of Authorization is only valid for five years, which will cover pile removal and installation over the period of October 1, 2023 through September 30, 2028. The period not covered by the LOA will only consist of jetting of concrete piles, maintenance and repair work, no steel pile installation. Previous 24-inch concrete pile driving projects were conducted at NAVMAG Indian Island without a MMPA incidental harassment authorization because the Level B behavioral response zone was within 92 to 185 meters (m) and pile driving was shutdown if any marine mammals approached this Level B/shutdown zone (only harbor seals were observed approaching the Level B/shutdown zone) (Navy, 2015, 2016, 2021). Therefore, if installation of additional 24-inch concrete piles are required after the expiration of the five year LOA, an additional Marine Mammal Protection Act permit would not be necessary.

The Proposed Action includes removal and replacement of up to 118 structurally unsound concrete piles (replaced by up to 110 concrete piles and eight steel piles). The Navy proposes to remove damaged concrete piles and install new concrete or steel piles for the Ammunition Wharf at NAVMAG Indian Island. General maintenance could include deck resurfacing and recoating various corroded metal components. Repair activities would be conducted on wetwell concrete spalling, piles, and quay walls. Damaged or deteriorated components would be repaired or replaced, including guide piles systems, brow floats, pile caps, safety ladders, cable straps, camel and camel connections, and lighting.

Under the MMPA of 1972, as amended (16 United States Code] Section 1371(a)(5)(D)), Commander, Navy Region Northwest is requesting a 5-year Letter of Authorization (LOA) under section 101 (a)(5)(A) for pile driving and pile removal activities that are expected to result in the unintentional taking of marine mammals. The 14 specific items required for this application, as set out by 50 Code of Federal Regulations (CFR) 216.104 Submission of Requests, are provided for in Chapters 1–14 of this application. The authorization request includes three ESA-listed marine mammals; the Mexico and Central America Distinct Population Segments (DPS) of the humpback whale and the Southern Resident killer whale. The Navy is concurrently in a regional level programmatic consultation (submitted to NMFS on 25 August, 2020) with the National Marine Fisheries Service (NMFS) under Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 United States Code Section 1531 et seq.).

1.2 Background

NAVMAG Indian Island is the West Coast ammunition ordnance storage center supporting the U.S. Navy Pacific Fleet. Its primary mission is to load, offload, and provide storage and logistics management for ordnance used on Navy vessels. Construction of the Ammunition Wharf was completed in 1979 and there is a total of 1,783 piles in the Ammunition Wharf structure; 1,391 structural piles, 306 fender piles and 86 Operations Building piles.

Table 1-1. Project Components for Pile Replacement for the Ammunition Wharf

Wharf Facility (In-Water Construction)	***Construction Details***
Total Piles	Up to 118 piles installed in 5 years (may be 110 concrete piles or a combination of concrete and up to eight steel piles)
Quantity of concrete piles (24-inch)	Up to 22 per year over 5 years under the LOA
Quantity of permanent steel piles (36-inch)	Up to 2 per year (Maximum of 8) over 5 years of the LOA. (Currently no steel pile installation is planned, installation would depend on future pile inspections)
Pile Removal Method	Cutting
Pile Installation Method	Jetting and impact driving of concrete piles; Vibratory and impact driving of steel piles. No simultaneous pile driving will occur.
Quantity of piles above -30 feet MLLW	All
Quantity of piles driven per day (approximately)	Two concrete piles per day One steel pile per day
Total duration of jetting pile driving	No more than 45 minutes per day (mean =15 minutes per pile)
Total duration of impact pile driving	No more than 45 minutes per day (mean = 10 minutes for concrete piles; 15 minutes for steel piles)
Maximum duration of vibratory pile driving	No more than 30 minutes (mean = 10 minutes per steel pile)
Marine Construction Duration (including in-water restrictions)	3.5 months per year (In water work window: October 1- January 15)

The Ammunition Wharf was originally constructed using precast concrete piles. As a result of the steam curing process used at that time, an unknown quantity of piling is susceptible to a potentially catastrophic condition called Delayed Ettringite Formation (DEF). DEF is expansion and cracking of concrete associated with the delayed formation of the mineral ettringite which is a normal product of early cement hydration. DEF is a result of high early temperatures in the concrete, which prevents the normal formation of ettringite. DEF occurs rapidly and without warning.

The Navy schedules inspections on waterfront facilities as outlined in Unified Facilities Criteria 4-150-07 Maintenance of Waterfront Facilities. Inspections usually occur every three years, but due to DEF at the Ammunition Wharf, inspections for that facility occur every two years. Based on the most recent inspection in 2021, there are 161 piles (158 under Ammo Pier & three under operations building) with some appreciable level of DEF damage (most or all of those piles will be replaced). More piles with DEF damage may be detected and need to be replaced over the duration of the LOA.

From 2009 to 2016, three pile replacement cycles replaced 66 concrete piles. Informal consultation with U.S. Fish and Wildlife Service and NMFS was conducted for each of the cycles. The Navy sent a biological evaluation to both agencies, and letters of concurrence were received prior to work initiation. No MMPA Incidental Harassment Authorization application was submitted; however, the Navy conducted marine mammal monitoring with a shutdown zone of 250 m (estimated to be the Level B zone). In 2017, the Navy submitted a request for informal consultation to NMFS for continued pile driving work; however, NMFS requested that the Navy conduct a formal Section 7 consultation for future pile driving work. Impact driving of nine 24 inch concrete piles at NAVMAG Indian Island Ammunition Wharf was added to the MPR Environmental Assessment (Navy, 2019) and to the NMFS Biological Opinion for MPR (NMFS, 2019). However, there was no MMPA IHA application submitted for Ammunition Wharf. The Level B marine mammal monitoring zone of 90 m was used as a shutdown zone for pile driving to prevent takes of marine mammals.

1.3 General Description of Pile Repair and Replacement Methods

1.3.1 Demolition of Deck Portions

A wire saw or other equipment would be used to cut concrete surface decks into sections (no underwater wire saw cutting). Sections would be removed with a crane. Debris would be captured using debris curtains/sheeting and removed from a project area. Deck pieces would be placed on a barge and taken to an upland disposal site. Large concrete deck areas requiring repair would be cast-in-place with formwork and smaller areas would be repaired using hand trowels. The concrete debris would be captured using debris curtains/sheeting and removed from the project area.

1.3.2 Pile Removal

Three methods of pile removal (cutting/chipping, clamshell removal, and direct pull) may be used. However, hydraulic cutting will be the primary method of pile removal due to working under the wharf and the DEF damage to the piles. In some cases, piles may be cut at or below the mudline, with the below-mudline portion of the pile left in place.

All materials and waste will be disposed of in accordance with federal and state requirements. The Navy will evaluate if it would be possible to reclaim or recycle the materials. The four pile removal methods are described below.

1.3.3 Pile Installation

Three primary methods of pile installation for concrete and steel piles may be used (vibratory, jetting, and impact) depending on the type of pile and site conditions. Only one pile will be installed at a time, no simultaneous pile driving will occur. These methods are described below.

Jetting

The primary methods of concrete pile installation would be water jetting to within 3 m of final depth and then impact pile driving to set or proof the final 3 m. Water jetting aids the penetration of a pile into a dense sand or sandy gravel stratum. Water jetting utilizes a carefully directed and pressurized flow of water at the pile tip, which disturbs a ring of soils directly beneath it. The jetting technique liquefies the soils at the pile tip during pile placement, reducing the friction and interlocking between adjacent sub-grade soil particles around the water jet. Load-bearing piles installed with water jetting would still need to be proofed with an impact pile driver. For load-bearing structures, an impact hammer is typically required to strike a pile a number of times to ensure it has met the load-bearing specifications; this is referred to as "proofing." Load-bearing piles installed with water jetting would still need to be proofed with an impact pile driver. Jetting produces much lower sound levels (approximately 147.5 decibel (dB) Root Mean Square (RMS); NAVFAC SW, 2020) than vibratory pile driving 166 dB RMS (Navy, 2015).

Vibratory Pile Driving

A vibratory hammer may be used to install the structural steel piles and fender piles. The primary method of pile installation for steel piles would be vibratory to within 3 m of final depth and then impact pile driving to set or proof the final 3 m. The vibratory pile driver method is a technique that may be used in pile installation where the substrate allows. Use of this technique may be limited in very hard or liquefiable substrates. This process begins by placing a choker cable around a pile and lifting it into vertical position with a crane. The pile is then lowered into position and set in place at the mudline. The pile is held steady while the vibratory driver installs the pile to the required tip elevation. In some substrates, a vibratory driver may be unable to advance a pile until it reaches the required depth. In these cases, an impact hammer may be used to advance the pile to the required depth.

Impact Hammer Pile Driving

Impact hammers may be used to proof concrete piles that have been jetted to depth or steel piles that have been driven using the vibratory method. Proofing involves impact pile driving to determine if the pile has been driven to the proper load-bearing specifications within the substrate. Proofing of concrete piles at the Ammunition Wharf in 2015 and 2016 required 200-600 strikes per pile to complete (Navy 2016).

Impact hammers have a heavy piston that moves up and down striking the top of the pile and driving the pile into the substrate from the downward force of the hammer. Impact hammer pile proofing can typically take a minute or less to 30 minutes (median of 14 min; Table 5-2) depending on pile type, pile size, and conditions (i.e., bedrock, loose soils, etc.) to reach the required tip elevation.

Because impact driving of steel piles can produce underwater noise levels harmful to fish and wildlife, piles will be advanced to the extent practicable with a vibratory driver and only impact driven when required for proofing or when a pile cannot be advanced with a vibratory driver due to hard substrate conditions (Mean of 500 strikes and 14 minutes per pile, see Section 6.9; Navy, 2014, 2016).

Attenuation

Because of the relatively low underwater noise levels associated with concrete piles, bubble curtains would not be proposed for impact installation of concrete piles. However, if the use of 36 inch steel piles becomes necessary, a bubble curtain will be used for all impact driving of steel piles to attenuate noise.

A bubble curtain is usually a ring or series of stacked rings that are placed around a pile along the pile's entire length under water. The rings are made of tubing which has small puncture holes through which compressed air is pumped. As the compressed air bubbles flow from the tubing, they create an air barrier that impedes the sound produced during pile driving. The bottom ring of the bubble curtain rests on the substrate around the pile, and it is likely that the bubbling action at the bottom ring would create turbidity in the immediate area while the bubble curtain is active.

1.3.4 Pile Repair

Wetwell Repair

A wetwell is a reinforced concrete encasement for a sanitary sewer lift station pump. Repairs would occur by removing failed and delaminated concrete. The reinforced steel substructure would then be repaired and new concrete applied. Large areas requiring concrete would be cast-in-place with formwork and smaller areas would be performed using hand trowels. The concrete debris would be captured using debris curtains/sheeting and removed from the project area.

Recoat Piles and Mooring Fittings

Piles and mooring fittings would be cleaned prior to coating. All coatings would be applied to dry surfaces and limited to areas above mean sea level (2 m mean lower low water). Coatings would be inorganic, non-toxic, and free of volatile organic compounds.

Passive Cathodic Protection System

A passive cathodic protection system is a metallic rod (anode) attached to a metal object to protect it from corrosion. The more easily oxidized metal of the anode corrodes first, protecting the primary structure from corrosion damage. These would be banded to newly installed steel piles to reduce the rate of corrosion of the metallic surfaces due to saline conditions.

Repair or Replacement of Pile Caps

Pile caps are situated on the tops of piles located directly beneath a structure and function as a load transfer mechanism between the superstructure and the piles. Replacement concrete pile caps may be cast-in-place. Concrete framework may be located below mean higher high water. The concrete debris would be captured using curtains/sheeting and removed from the project area.

Concrete Repairs

Concrete repairs are required when concrete becomes chipped, scaled or flaked. Concrete repair involves removal of damaged sections and installation of new concrete. Concrete debris would be captured using curtains/sheeting and removed from the project area.

Mooring Foundation and Substructure Repair

Repairs may involve removal and replacement of concrete mooring foundations and concrete substructure on piers, wharfs, and quay walls. Work may include preservation of rebar, and injection of epoxy as required.

Repair or Replacement of Components

Structural and non-structural components of waterfront structures would be repaired or replaced as required. Replacement of components would involve removal of existing components and installation of new components. Components may include, but are not limited to:

- Cross bracing members;
- Fender components, including but not limited to camels, chocks, and whalers;
- Hand rails;
- Splash guards;
- Safety ladders;
- Electrical conduit and wiring;
- Light poles;
- Guide pile systems for floats. These systems are used to secure a floating dock or barge to a pile but allow the floating dock or barge to move up and down with tidal changes; and
- Brows or gangways. Brows are small, movable, bridge-like structures used to board or leave a vessel.

Rewrap/Replace Steel Cable Straps on Dolphins

Dolphins are groups of piles used to guide vessels and hold them in place while docked or berthed. Straps are used to hold pile groupings together.

1.4 Best Management Practices and Mitigation and Minimization Measures

General Best Management Practices (BMPs), mitigation, and minimization measures that will be implemented as appropriate for all in-water activities are described in Chapter 11 of this application. The Navy uses BMPs during pile installation activities to avoid and minimize potential environmental impacts. Additional minimization measures have been added to protect marine mammals, Endangered Species Act (ESA)-listed species, and designated critical habitats. These measures include vibratory installation of piles where possible, noise attenuation and performance measures for impact pile driving, and marine mammal monitoring as described in Chapter 11.

2 Dates, Duration, and Specified Geographic Region

2.1 Dates and Duration of Activities

Pile repair and replacement activities would occur over a 7-year period beginning October 1, 2023 except for steel pile installation, which would only be conducted from October 1, 2023 through September 30, 2028 under the LOA. Timing restrictions (or "in-water work windows") would be complied with to avoid conducting activities when juvenile salmonids are most likely to be present (USACE, 2015). The timing restrictions are typically imposed by the United States Army Corps of Engineers, United States Fish and Wildlife Service, and NMFS to protect ESA-listed salmonid species. In addition, the shorter work window was agreed to per discussions between NAVMAG Indian Island and NMFS. In water pile driving work would only occur from October 1 to January 15. No in-water work will begin until the Navy has received all required permits and approvals.

2.2 Geographic Region of Activities

NAVMAG Indian Island is located near Port Hadlock in Jefferson County, Washington, southeast of Port Townsend, at the northeast corner of the Olympic Peninsula (Figure 2-1). The island is approximately 8 kilometers (km) long and 2 km wide, and comprises approximately 11 km square (km^2). Indian Island is located between Port Townsend Bay and Kilisut Harbor. The federal government owns the island and provides an easement on a small portion of the southern extent of the island to Washington State Department of Transportation for access to Marrowstone Island along State Route 116. NAVMAG Indian Island is the West Coast ammunition ordnance storage center supporting the U.S. Navy Pacific Fleet.

2.3 Project Location Description

NAVMAG Indian Island occupies approximately 19 km of shoreline within Port Townsend Bay. There are two pier/wharf structures located at the NAVMAG Indian Island, the Ammunition Wharf and the Small Craft Pier, but only the Ammunition Wharf activities are addressed in this LOA. Its primary mission is to load, offload, and provide storage and logistics management for ordnance used on Navy vessels. There is one designated Naval Restricted Area at NAVMAG Indian Island identified in 33 CFR 334.1270(a). Pursuant to 33 CFR 334.1270 (b), "No person, vessel, craft, article or thing shall enter the area [identified in 33 CFR 334.1270(a)] without permission from the enforcing agency [in this case, Commander, Navy Region Northwest]. The restriction shall apply during periods when ship loading and/or pier operations preclude safe entry. The periods will be identified by flying a red flag from the ship and/or pier."

2.3.1 Marine and Bathymetric Setting

NAVMAG Indian Island is located in Port Townsend Bay in Puget Sound (Figure 2-1).

The shoreline character is varied, ranging from accretionary sand spits and tidal mud flats to steep, slowly eroding bluffs. Offshore gradients are slight in most nearshore tidal zones, with steeper offshore slopes dropping to 18 m depths to the south and west.

2.3.2 Tides, Circulation, and Currents

Tidal activity consists of two unequal highs and lows each tidal day of 24.8 hours. The diurnal range of tides or the difference in height between Mean Higher High Water (MHHW) and MLLW is 2.6 m for Port Townsend (NOAA 2020).

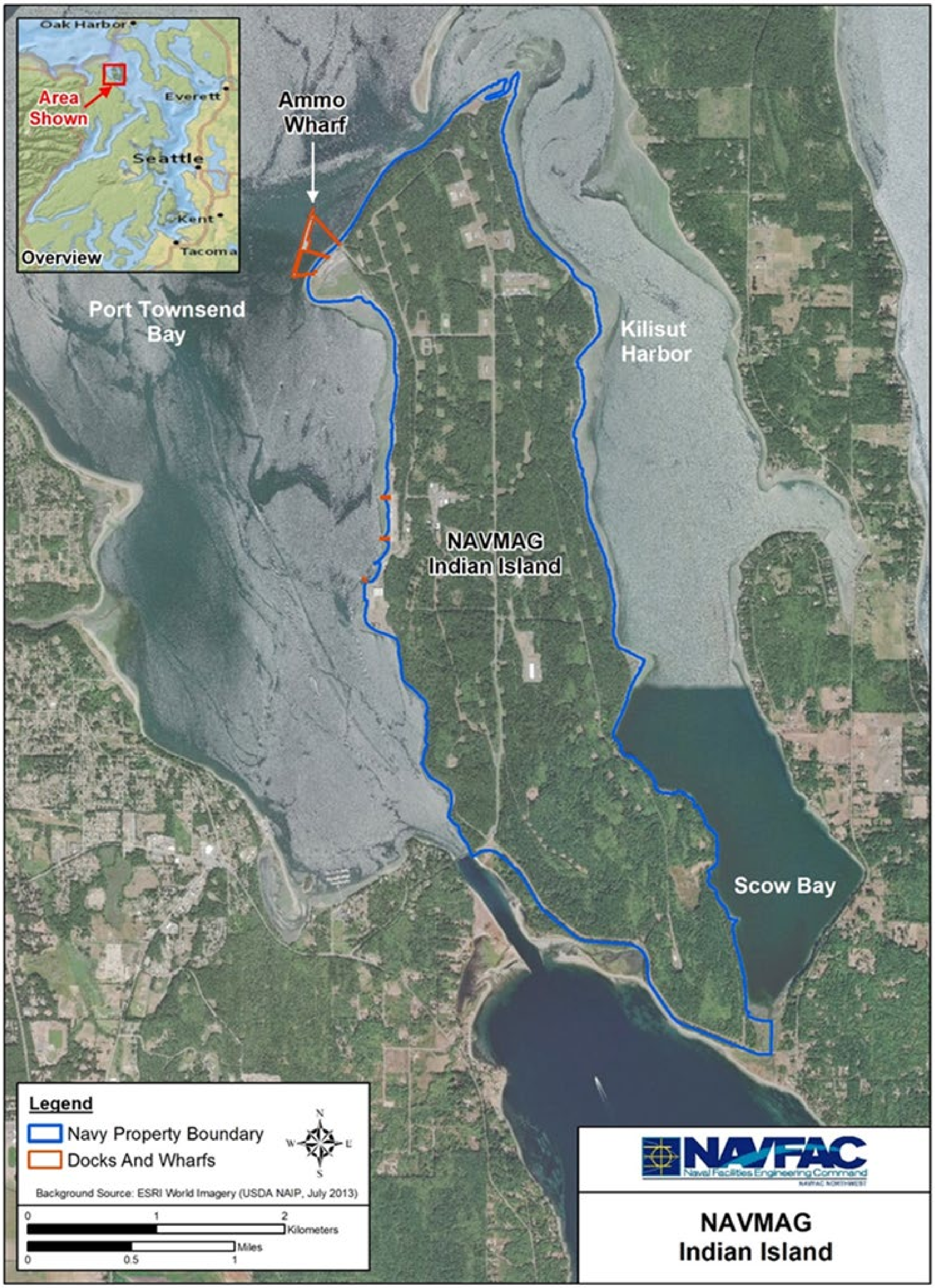

Figure 2-1. Location of Ammunition Wharf on Naval Magazine Indian Island.

2.3.3 Water Quality

NAVMAG Indian Island's Ammunition Wharf is located in the northeastern portion of Port Townsend Bay. WDOE has established designated uses for Port Townsend Bay as follows: extraordinary (aquatic life uses); primary contact (recreation); shellfish harvesting; and wildlife habitat, commerce and navigation, boating, and aesthetics (miscellaneous uses) (WAC 173-201A-612).

The Washington State Department of Ecology (WDOE) has measured and classified some of the waters surrounding NAVMAG Indian Island as Category 1 – "meets tested standards" - on the 2004 Clean Water Act (CWA) Section 303(d) list of impaired water bodies. WDOE has a long-term water quality monitoring station near Walan Point (Station PTH005). A review of the monitoring data shows that water quality is generally good at the station's location. Dissolved Oxygen (DO) levels lower than 5 mg/L (according to WDOE, the DO level that begins to have a negative effect to marine species) were recorded twice: once in February 1998, and once in October 2000, measured at depths between -12.5 m (41 feet) to –21.0 m (69 feet) below surface level (WDOE 2020).

2.3.4 Sediments

The beaches and nearshore areas of NAVMAG Indian Island have a very high percentage of sediments supplied by erosion of coastal bluffs and not by rivers and streams. Marine sediments in the nearshore areas surrounding NAVMAG Indian Island are characterized as unconsolidated silt and clay, with hard sandy bottom. No marine sediments at or near the Ammunition Wharf are assessed or listed in the latest WDOE 303(d) impaired list (WDOE, 2020). Marine sediments south of the project area have been listed as Category 2, sediments of concerns, for benzoic acid, benzyl alcohol, and phenol. While these sediments have exceeded Sediment Management Standards at least once in previous samplings, no action is required.

2.3.5 Ambient Sounds

Underwater ambient sound in Puget Sound is comprised of sounds produced by a number of natural and anthropogenic sources and varies both geographically and temporally. Natural sound sources include wind, waves, precipitation, and biological sources such as shrimp, fish, and cetaceans. These sources produce sound in a wide variety of frequency ranges (Urick, 1983; Richardson et al., 1995) and can vary over both long (days to years) and short (seconds to hours) time scales. In shallow waters, precipitation may contribute up to 35 dB to the existing sound level, and increases in wind speed of 5 to 10 knots can cause a 5 dB increase in ambient ocean sound between 20 hertz (Hz) and 100 kilohertz (kHz) (Urick, 1983).

Human-generated sound is a significant contributor to the ambient acoustic environment at commercial and naval ports. Normal naval port activities include vessel traffic from large ships, support vessels and security boats, and loading and maintenance operations, which all generate underwater sound (Urick 1983). Other sources of human-generated underwater sound not specific to the Navy include sounds from echo sounders on commercial and recreational vessels, industrial ship noise, and noise from recreational boat engines. Ship and small boat noise comes from propellers and other on-board rotating equipment.

There are no sound measurements for the waters around NAVMAG Indian Island; however, underwater ambient sound has been recorded and measured at NAVBASE Kitsap Bangor near Marginal Wharf. The major contributors to the average background noise between 100 Hz and 20 kHz were wind-driven wave action and manmade noise sources from small boat traffic and industrial noise emanating from the waterfront work areas (Slater, 2009). The average broadband (100 Hz–20 kHz) sound level was 114 dB referenced at 1 micropascal (re 1 μPa) root mean square (RMS). Peak spectral noise from industrial activity was noted below 300 Hz, with a maximum level of 110 dB RMS in the 125 Hz band. From 300 Hz to 5 kHz, average received levels ranged between 83 and 99 dB RMS, although small powerboats generated peak narrowband source levels of 150 to 165 dB in the 350 to 1,200 Hz region. Wind-driven wave sound dominated the background sound at 5 kHz and above. In general, ambient noise one-third octave levels flattened above 10 kHz. Precipitation was not noted during this study, but would be expected to increase average broadband noise levels as much as 20 dB above average levels noted in deeper water.

Ambient sound measurements from NAVBASE Kitsap Bangor are well within the range of levels reported for a number of sites within the greater Puget Sound region (95–135 dB RMS) (Carlson et al., 2005; Veirs & Veirs, 2005) and with less vessel traffic, NAVMAG Indian Island is likely within this range as well. Nearshore broadband measurements near ferry terminals in Puget Sound resulted in median sound levels (50 percent cumulative distribution function) between 107 and 133 dB RMS (Laughlin, 2015).

2.3.6 Airborne Sound

Airborne sound at NAVMAG Indian Island is produced by common industrial equipment, including trucks, cranes, compressors, generators, pumps, and other equipment that might typically be employed along industrial waterfronts. Sound levels are highly variable based on the types and operational states of equipment at the recording location, and sound levels may even vary within a single installation, with some piers very loud and others relatively quiet. Data from airborne ambient sound measurements are currently only available for a short period of time at NAVBASE Kitsap Bangor. Since these are the only available data the Navy has used these data to estimate ambient sound levels at a broad scale for all of the project areas.

Airborne sound measurements were taken at Delta Pier within the waterfront industrial area at NAVBASE Kitsap Bangor during a 2-day period in October 2010. During this period, daytime sound levels ranged from 60 A-weighted decibel (dBA) to 104 dBA, with average values of approximately 64 dBA. Evening and nighttime levels ranged from 64 to 96 dBA, with an average level of approximately 64 dBA. Thus, daytime maximum levels were higher than nighttime maximum levels, but average nighttime and daytime levels were similar (Navy, 2010). Additional measurements, taken during the Navy's Test Pile Program located near EHW-1 at NAVBASE Kitsap Bangor, indicated an average airborne ambient sound level of 55 dBA (Illingworth & Rodkin, 2012). Maximum sound levels from the 2010 recordings were produced by a combination of sources including heavy trucks, forklifts, cranes, marine vessels, mechanized tools and equipment, and other sound-generating industrial/military activities. Maximum sound levels were intermittent in nature and not present at all times. Based on the sound levels measured at the highly industrial location at Delta Pier, the Navy estimated that maximum airborne sound levels at pier locations with a high level of industrial activity may reach as high as 104 dBA due to trucks, forklifts, cranes, and other industrial activities. Sound levels will vary by time and location, but average background sound levels are expected to range from approximately 55 dBA (average from Test Pile Program at NAVBASE Kitsap Bangor) to 64 dBA (average levels measured at Delta Pier at NAVBASE Kitsap Bangor) (Navy, 2010; Illingworth & Rodkin, 2012).

3 Species and Numbers of Marine Mammals

Thirteen marine mammal species, DPSs and stocks, managed by NMFS have a reasonable potential to occur within Puget Sound near Indian Island (Table 3-1). A reasonable potential was defined as species with any regular or seasonal occurrence in Puget Sound since 2010 that could occur within the farthest extent of the Action Area (out to 13.6 km for vibratory steel pile driving). The likelihood of encountering each of these species is presented qualitatively in Table 3-2. Two of these species have DPSs listed under the ESA: the Central America and Mexico humpback whale DPSs (*Megaptera novaeangliae*) and the Southern Resident killer whale (*Orcinus* orca). Stock abundance and ESA status of these species are listed in Table 3–1. Section 3.2 provides the species population abundance and Section 4 contains life history information for each species.

Several dolphin species, including Pacific white-sided dolphins, bottlenose dolphin, common dolphin, and Risso's dolphin, have been observed in small numbers or as single animals in Puget Sound on occasion. These species are rare in Puget Sound and are not expected to occur near NAVMAG Indian Island; therefore, they are not carried forward in this application. None of these species is listed under the ESA although they are protected under the MMPA.

3.1 Estimates of On-Site Abundance

Estimating potential marine mammal occurrence over time and space can be challenging. Prior Navy marine mammal Incidental Harassment Authorization (IHA) and Letter of Authorization (LOA) applications in Puget Sound relied on density estimates for some or all species exposure estimates. Analyses based on species density assume that marine mammals are uniformly distributed within a given area at any given point in time (Navy, 2019). This assumption is rarely true for marine mammal species in Puget Sound because many of the species are not resident, but occur occasionally or seasonally transiting through portions of Puget Sound (Table 3-1). Additionally, most species are not distributed evenly but occur in groups or in feeding aggregations. Distribution of individuals or groups does not occur uniformly in space but is biased by areas of greater importance, such as areas of high prey abundance, haul out sites, or areas with lower predation risk, etc. For example, density estimates near haul-outs or foraging locations would be expected to be a function of distance from the attracting area and number of animals utilizing the haul-out or foraging location.

To characterize potential species occurrence, this application utilized density information available for Puget Sound, and recent research and survey information conducted on-site or in Puget Sound. The Navy also discussed species occurrence with local species experts and reviewed incidental sighting reports from the Orca Network (Whidbey Island, WA) and Center for Whale Research (Friday Harbor, WA) for verified or reasonably verified species presence, as well as information on seasonal, intermittent, or unusual species occurrences. Based on a review of this information, the Navy separated species into three groups to predict numbers present during the in-water work period:

- Species with rare or infrequent occurrence in all or part of Puget Sound;
- Species with likely occurrence, but no site-specific survey information; and
- Species with site-specific survey information.

In the case of species with rare or infrequent occurrence in all or part of Puget Sound, the Navy reviewed historical temporal and spatial distribution to predict potential numbers of animals during the in-water work period.

1 **Table 3-1. Marine Mammals Potentially Present in Puget Sound**

Species and Stock	Stock	ESA/MMPA Status	Occurrence In Action Area	Stock Abundance	Potential Biological Removal	Annual Mortality/ Serious Injury	Stock Status Factors	Critical Habitat Within the Project Area
ESA-Listed Species								
Humpback Whale (*Megaptera novaengliae*)	California/Oregon/ Washington (Mexico DPS & Central American DPS)	California/Oregon/ Washington Stock: Depleted and Strategic Central America DPS: Endangered Mexico DPS: Threatened	Rare	4,973 (CV = 0.05)	28.7	≥ 48.3	Strategic	None Proposed, but not within the Action Area
Killer whale (*Orcinus orca*)	Eastern North Pacific Southern Resident	Endangered 70 FR 699903 Depleted and Strategic	Rare Year-round More likely in Spring through fall	72 (No CV)	0.13	0	Strategic	Yes However, critical habitat does not include the Port Townsend/Indian Island/Walan Point naval restricted area (79 FR 69054 and 73 FR 78633)
Non ESA-Listed Species								
Mysticetes								
Gray Whale (*Eschrichtius robustus*)	Eastern North Pacific	N/A	Rare	26,960 (CV = 0.05)	801	131	None	N/A
Humpback Whale	Central North Pacific (Hawaii DPS)	N/A	Rare (only a small percentage would be from the Hawaii DPS)	10,103 (CV = 0.30)	83	9.5	Strategic (Stock)	N/A

Species and Stock	Stock	ESA/MMPA Status	Occurrence In Action Area	Stock Abundance	Potential Biological Removal	Annual Mortality/ Serious Injury	Stock Status Factors	Critical Habitat Within the Project Area
Minke whale (*Balaenoptera acutorostrata*)	California/Oregon/ Washington	N/A	Rare	915 (CV = 0.792)	4.1	≥ 0.59	None	N/A
Odontocetes								
Dall's porpoise (*Phocoenoides dalli*)	California/Oregon/ Washington	N/A	Rare	16,498 (CV = 0.61)	172	0.3	None	N/A
Harbor porpoise (*Phocoena phocoena*)	Washington Inland Waters	N/A	Likely	11,233 (CV = 0.37)	66	≥ 7.2	None	N/A
Killer whale (*Orcinus orca*)	West Coast Transient	N/A	Likely (Year Round)	243 (No CV)	2.4	0	None	N/A
Pinnipeds								
California sea lion (*Zalophus californianus*)	United States	N/A	Likely August - early June	257,606 (No CV)	14,011	≥ 321	None	N/A
Steller sea lion (*Eumetopias jubatus*)	Eastern United States	N/A	Rare	43,201 (No CV)	2,592	112	None	N/A
Northern elephant seal (*Mirounga angustirostris*)	California Breeding	N/A	Rare	187,386 (No CV)	4,882	8.8	None	N/A

Species and Stock	Stock	ESA/MMPA Status	Occurrence In Action Area	Stock Abundance	Potential Biological Removal	Annual Mortality/ Serious Injury	Stock Status Factors	Critical Habitat Within the Project Area
Pacific Harbor seal (*Phoca vitulina richardii*)	Washington Northern Inland Waters	N/A	Likely Haul-out nearby at Rat Island	11,036* (CV = 0.15)	Unknown	9.8	None	N/A

Stock delineations and abundance are from Carretta et al., 2015, 2020, 2021 and Muto et al., 2020. Carretta et al., 2022 is the most recent Stock Assessment Report for the Pacific; Muto et al., 2020 is the most recent Stock Assessment Report for Alaska as the 2021 Report has not been released.

Rare = The distribution of the species is near enough to the area that the species could occur there, or there are a few confirmed sightings. Likely = Confirmed and regular sightings of the species in the area year-round, Seasonal = Confirmed and regular sightings of the species in the area on a seasonal basis.

*This estimate is older than eight years (Jeffries et al., 2003); therefore, NMFS does not consider this a current estimate for the stock.

1

3.2 ESA-Listed marine Mammals

3.2.1 Humpback Whale (*Megaptera novaengliae*), California/Oregon/Washington (includes the Mexico and Central America DPSs)

A large-scale photo-identification sampling study of humpback whales was conducted from 2004 to 2006 throughout the North Pacific (Calambokidis et al., 2008; Barlow et al., 2011). The SPLASH (Structure of Populations, Levels of Abundance, and Status of Humpbacks) Project was designed to sample all known North Pacific feeding and breeding populations. Overall humpback whale abundance in the North Pacific, based on the SPLASH Project, was estimated at 21,808 individuals (coefficient of variation [CV] = 0.04) confirming that this population of humpback whales has continued to increase and is now greater than some pre-whaling abundance estimates (Barlow et al., 2011). Data indicate that the North Pacific population has been increasing at a rate of between 5.5 and 6.0 percent per year, approximately doubling every ten years (Calambokidis et al., 2008).

One stock is currently recognized along the U.S. West Coast, which includes animals that appear to be part of two separate feeding groups. The California/Oregon/Washington stock of humpback whales includes animals from both the California-Oregon and Washington-southern British Columbia feeding groups (Carretta et al., 2016). The current best abundance estimate for the California/Oregon/Washington stock is 2,900 (CV = 0.05) based on mark-recapture estimates (Carretta et al., 2020). NMFS reclassified the humpback whale into 14 DPSs (81 FR 62260) in 2016. Three of the DPSs have the potential to occur in the vicinity of Puget Sound. The Mexico and Central America DPSs are considered depleted under the MMPA (81 FR 62260). The Central America (Endangered) and Mexico (Threatened) DPSs are likely to occur within the project area.

3.2.2 Killer whale (*Orcinus orca*), Eastern North Pacific Southern Resident

Among the genetically distinct assemblages of killer whales in the northeastern Pacific, the Eastern North Pacific Southern Resident stock is one of two that may occur in the Action Area. The Southern Resident killer whale (SRKW) is listed as endangered under the ESA in 2005 (70 FR 69903). In 1993, the three pods (K, J, and L pods) comprising this stock totaled 96 killer whales (Ford et al., 1994). The population increased to 99 whales in 1995 and then declined to 79 whales in 2001. Two calves have been born in 2020 and appear to be doing well; therefore, the current population is 72 killer whales (Carretta et al., 2022).

3.3 Non ESA-Listed Marine Mammals

3.3.1 Gray Whale (*Eschrichtius robustus*), Eastern North Pacific

The most recent estimate of abundance for the Eastern North Pacific population is from 2010/2011 surveys and is 26,960 (CV = 0.05) whales (Carretta et al., 2020). The eastern population is increasing, despite an unusually large number of gray whales that stranded along the coast from Mexico to Alaska in 1999 and 2000 (Gulland et al., 2005) although a recent unusual mortality event occurred from 2019 to 2021 (NMFS, 2021). The current abundance estimate for the Pacific Coast Feeding Group, described in greater detail in Section 4.2.1.1, is 243 whales (CV = 0.08; Calambokidis et al., 2017; Carretta et al., 2020).

3.3.2 Humpback Whale, Central North Pacific (Hawaii DPS)

The most recent estimate of abundance for the Central North Pacific population is from 2010/2011 surveys and is 10,103 whales (CV = 0.30; Muto et al., 2020). In addition to the ESA-listed Mexico and Central American DPSs occurring in Puget Sound, the non-ESA listed Hawaii DPS, which is part of the Central North Pacific stock, would also occur in Puget Sound waters.

3.3.3 Minke Whale (*Balaenoptera acutorostrata*), California/Oregon/Washington

The abundance estimate for the California/Oregon/Washington stock of minke whales is 636 whales (CV = 0.72) (Barlow, 2016 as presented in Carretta et al., 2017, 2020). Based on ship surveys conducted in the summer and fall from 1991 to 2008, 147 minke whales (CV = 0.68) are estimated to occur in waters off Washington and Oregon (Barlow, 2010). Two minke whales were seen during 1996 aerial surveys in Washington and British Columbia inland waters (Calambokidis et al., 1997), but no abundance estimates were made. Minke whales are occasionally sighted within the Salish Sea area including Puget Sound but do not occur regularly (Orca Network, 2020).

3.3.4 Dall's porpoise (*Phocoenoides dalli*), California/Oregon/Washington

The abundance for the California, Oregon, and Washington stock is 25,750 individuals (CV = 0.45) (Barlow, 2016 as presented in Carretta et al., 2020). Based on ship surveys conducted in the summer and fall from 1991 to 2008, 27,010 Dall's porpoise (CV = 0.29) were estimated in waters off Washington and Oregon (Barlow, 2010). Additional numbers of Dall's porpoise occurred in the inland waters of Washington State, but the most recent estimate, obtained in 1996, was 900 porpoises (CV = 0.40; Calambokidis et al., 1997) is not included in the overall estimate of abundance for this stock due to the need for more current information. In addition, harbor porpoises have been increasing in Puget Sound while Dall's porpoises have virtually disappeared (Evenson et al., 2016).

3.3.5 Harbor porpoise (*Phocoena phocoena*), Washington Inland Waters

Aerial surveys of the inland marine waters of Washington were conducted throughout the year from 2013 to 2015, and in the Strait of Juan de Fuca and the San Juan Islands (and some adjacent Canadian waters) in April 2015 (Smultea et al., 2015; Jefferson et al., 2016). These surveys encompassed waters inhabited by the Washington Inland Waters stock of harbor porpoise, as well as, harbor porpoises from British Columbia. Estimated abundance for Puget Sound was 2,269 porpoises (CV = 0.38; Smultea et al., 2017). The highest densities were detected in North Puget Sound (Admiralty Inlet, East Whidbey, and South Whidbey sub-regions) and the lowest in the Vashon and Bainbridge sub-regions, and Hood Canal. An abundance estimate for the Washington Inland Waters stock is 11,233 individuals (CV = 0.37) (Carretta et al., 2020).

3.3.6 Killer whale (*Orcinus orca*), West Coast Transient

A minimum abundance estimate for the West Coast Transient stock is 243 whales based on photographic data (Fisheries and Oceans Canada, 2009; Allen & Angliss, 2013, Muto et al., 2020). This estimate is considered conservative and does not include whales from southeastern Alaska and California that are provisionally classified as part of the stock (Muto et al., 2020).

3.3.7 California sea lion (*Zalophus californianus*), United States

A complete population count of California sea lions is not possible because not all age and sex classes are ashore at the same time during field surveys. In lieu of counting all sea lions, pups are counted during the breeding season (because this is the only age class that is ashore in its entirety), and the number of births is estimated from the pup count. The size of the population is then estimated from the number of births and the proportion of pups in the population. The current population estimate for the U.S. stock of California sea lions is 257,606 (Carretta et al., 2020).

3.3.8 Steller sea lion (*Eumetopias jubatus*), Eastern United States

The Eastern stock was estimated by NMFS in the Recovery Plan for the Steller Sea Lion to number between 45,000 to 51,000 animals (NMFS, 2008). This stock has been increasing approximately 3 percent per year over the entire range since the late 1970s (NMFS, 2012a). The most recent population estimate for the Eastern stock based is 43,201 sea lion (Muto et al., 2020).

3.3.9 Northern elephant seal (*Mirounga angustirostris*), California Breeding

A complete population count of elephant seals is not possible because not all age classes are ashore at the same time. Instead, pups are counted during the breeding season (because this is the only age class that is ashore in its entirety), and the number of births is estimated from the pup count. The size of the population is then estimated from the number of births and the proportion of pups in the population. Based on the estimated 40,684 pups born in California in 2010, the California stock is approximately 179,000 seals (Carretta et al., 2020). Based on trends in pup counts, northern elephant seal colonies continued to grow in California through 2005, but are currently stable or slowly decreasing in Mexico (Stewart et al., 1994 as cited in Carretta et al., 2013).

3.3.10 Pacific Harbor seal (*Phoca vitulina richardii*), Washington Northern Inland Waters

Aerial surveys of harbor seals in Washington inland waters were conducted during the pupping season in 1999; during which time the total numbers of hauled-out seals (including pups) were counted. In 1999, the mean count of harbor seals occurring in Washington’s inland waters was 9,550 (CV = 0.14) animals. Using a correction factor to account for animals in the water, which are missed during aerial surveys, Jeffries et al. (2003) reported population estimates of 11,036 (7,213 x 1.53; CV = 0.15) for the Washington Northern Inland Waters stock; 1,088 (711 x 1.53; CV = 0.15) for the Hood Canal stock; and 1,568 (1,025 x 1.53; CV = 0.15) for the Southern Puget Sound stock of harbor seals (Jeffries et al., 2003). However, because the most recent abundance estimate is greater than eight years old (Jeffries et al, 2003), there is no current estimate of abundance listed in the NMFS Stock Assessment Report (Carretta et al., 2020).

4 Affected Species Status and Distribution

4.1 ESA-Listed marine Mammals

4.1.1 Humpback Whale, California/Oregon/Washington

4.1.1.1 Status and Management

Humpback whales are listed as depleted under the MMPA and endangered under the ESA. Critical habitat has not been designated for humpback whales. A number of take reduction and recovery plans, as well as research and monitoring efforts are currently in place for the humpback whale.

The stock structure of humpback whales was defined by the NMFS based on feeding areas because of the species' fidelity to feeding grounds (Carretta et al., 2014). NMFS designated four stocks in the North Pacific:

- Central North Pacific stock—consisting of winter and spring populations of the Hawaiian Islands that migrate to feeding areas from southeast Alaska to the Alaska Peninsula (includes the non ESA-listed Hawaii DPS);
- Western North Pacific stock—consisting of winter and spring populations off Asia that migrate to feeding areas off Russia, the Aleutian Islands, and the Bering Sea;
- California/Oregon/Washington stock—consisting of winter and spring populations in coastal Central America (Endangered Central America DPS) and coastal Mexico (Threatened Mexico DPS) that migrate to feed off the West Coast of the United States; and
- American Samoa stock—with feeding areas largely undocumented, but occurring as far south as the Antarctic Peninsula.

The California/Oregon/Washington stock occurs within Puget Sound and consists of the ESA-listed Mexico and Central America DPSs. NMFS reclassified the humpback whale into 14 DPSs (81 FR 62260) in 2016. Two of the ESA-listed DPSs have the potential to occur in the vicinity of NAVMAG Indian Island—the Mexico DPS, listed as threatened, and the Central America DPS, listed as endangered (81 FR 62260). Both DPSs are considered depleted under the MMPA (81 FR 62260). The abundance estimate for the Mexico DPS is 3,264 whales (CV = 0.06) and the abundance estimate for the Central America DPS is 411 whales (CV = 0.30). Calambokidis et al. (2017) estimated the Washington-Southern British Columbia population at 526 whales (CV = 0.23) although there was no estimate of the percentage of whales in the Inland Waters.

Critical habitat have been proposed for the humpback whale in the Northeastern Pacific; however, the proposed critical habitat does not extend into Puget Sound or to the area around NAVMAG Indian Island (84 FR 54354).

The California/Oregon/Washington humpback whale stock occurs within Puget Sound and partially or fully coincides with the ESA-listed Mexico and Central America DPSs. The humpback whale DPSs were generally defined by NMFS based on breeding areas (81 FR 62260); while the stock structure was based on feeding areas because of the species' fidelity to feeding grounds (Carretta et al., 2014). NMFS proposed to conduct a review of humpback whale stock delineations to determine whether any stocks should be realigned with the recently established DPSs (81 FR 62260).

In addition to the Central America and Mexico DPSs occurring in Puget Sound, the non ESA-listed Hawaii DPS (Section 4.2.2) within the Central North Pacific stock may also occur in small numbers. However, the different DPS are only distinguishable by DNA sampling or photo ID.

4.1.1.2 Distribution

Humpback whales are distributed worldwide in all major oceans and most seas. They are typically found during the summer on high-latitude feeding grounds and during the winter in the tropics and subtropics around islands, over shallow banks, and along continental coasts where calving occurs (Calambokidis et al., 2008; Barlow et al., 2011). The California, Oregon, and Washington stock of humpback whales calve and mate in coastal Central America and Mexico and migrate up the coast in the summer and fall to feed (Carretta et al., 2007). Photo-identification studies suggest that whales feeding in the northwest are part of a small sub-population that primarily feeds from central Washington to southern Vancouver Island (Calambokidis et al., 2004, 2008).

Although humpback whales were common in inland Washington waters prior to the whaling period, few sightings had been reported in this area before 2002 (Scheffer and Slipp, 1948; Calambokidis and Steiger, 1990; Pinnell and Sandilands, 2004). Most sightings occur in the Strait of Juan de Fuca and in the San Juan Island area. In Puget Sound, Calambokidis et al. (2002) recorded only six individuals between 1996 and 2001. However, from January 2003 through July 2012 there were over 60 sightings reported to Orca Network, some of which could be the same individuals. Therefore, humpback whales are considered to be regular but not frequent visitors to Puget Sound, especially south of Admiralty Inlet. Puget Sound opportunistic sightings primarily occur April through July, but sightings are reported in every month of the year. A review of reported sightings in Puget Sound indicates humpback whales usually occur as individuals or in pairs (Orca Network, 2020).

4.1.1.3 Site-Specific Occurrence

Sightings of humpback whales in Puget Sound vary by location, but historically were infrequent. A small number of humpback whales (based on concurrent sightings of one to four individuals, including a cow/calf pair) was present in Puget Sound from September through -mid-2019 (Orca Network, 2020). Most of the sightings reported to Orca Network since 2003 were in the main basin of Puget Sound with numerous sightings in the waters between Point No Point and Whidbey Island, Possession Sound and southern Puget Sound in the vicinity of Point Defiance (Orca Network, 2020). No humpback whales have been reported in Port Townsend Bay although they have been reported just north of Port Townsend and along Marrowstone Island as they move south into Puget Sound (Orca Network, 2020).

The number of humpback whales potentially present near NAVMAG Indian Island over the time period of the requested authorization is expected to be very low in any month.

4.1.1.4 Critical Habitat

Critical habitat for the Central American and Mexico DPSs was designated in 2021 (86 FR 21082). However, the designated critical habitat does not extend into Puget Sound; therefore, NAVMAG Indian Island is not included.

4.1.2 Killer Whale, Eastern North Pacific Southern resident

4.1.2.1 Status and Management

The Southern Resident killer whale (SRKW) stock contains three pods (J, K, and L pods), considered one stock under the MMPA and as a "distinct population segment" (therefore, "species") under the ESA. The SRKW stock is protected and designated as depleted under the MMPA and listed as endangered under the ESA.

4.1.2.2 Distribution

The Eastern North Pacific Southern Resident stock is a transboundary stock that occurs in inland waters of Washington and British Columbia. They regularly visit coastal sites off Washington state and Vancouver Island (Ford et al., 1994) and are known to travel as far south as central California (Black, 2011), but less is known of these offshore movements. Photo-identification of individual whales in the stock through the years has resulted in a substantial understanding of this stock's structure, behaviors, and movements in inland waters. SRKWs are most frequently observed in the inland waters of Washington State and British Columbia during the late spring, summer, and fall (Hanson & Emmons, 2011). In Washington inland waters Southern Residents are most often observed in Haro Strait, along the west side of San Juan Island, and in the Strait of Juan de Fuca (see review in Kriete, 2007; NMFS 2008a; Hanson & Emmons, 2011). Southern Residents occasionally occur in Puget Sound typically in the fall or winter months (NMFS, 2006) when in-water construction will occur.

4.1.2.3 Site-Specific Occurrence

SRKWs are expected to occur occasionally in the waters north NAVMAG Indian Island; however, it is unlikely any would occur close to the Ammunition Wharf (Orca Network, 2020). Pod sizes of Southern Resident killer whales range from approximately 20 (J pod) to 35 (L pod) individuals whales (Baird & Dill, 1996; Houghton et al., 2015). Group sizes encountered can be smaller or larger if pods temporarily separate or join together. Any of the three pods could enter Puget Sound although it is more likely for the smaller J and K pods to occur. Occurrence in the inland waters are low in the winter through early spring (Orca network, 2020). Therefore, some exposure to groups of up to 20 individuals or more could occur over the duration of the NAVMAG Indian Island Pile Replacement and Maintenance Program.

4.1.2.4 Critical Habitat

In 2006, NMFS designated approximately 6,630 kilometers square (km^2) of critical habitat in three specific marine areas (79 FR 69054):

- Summer Core Area in Haro Strait and waters around the San Juan Islands;
- Puget Sound; and
- Strait of Juan de Fuca.

However, critical habitat does not include the Port Townsend/Indian Island/Walan Point naval restricted area which extends out 500 m from the Ammunition Wharf (73 FR 78633). The physical and biological features identified as essential for conservation of the SRKW critical habitat are:

- Water quality to support growth and development;
- Prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth; and
- Passage conditions to allow for migration, resting, and foraging.

In 2021, NMFS revised the critical habitat designation for SRKWs (86 FR 41668); however, critical habitat was not revised within the inland waters of Washington, including Puget Sound.

4.2 Non ESA-Listed Marine Mammals

4.2.1 Gray Whale, Eastern North Pacific

4.2.1.1 Status and Management

Two North Pacific populations of gray whales are formally recognized: the Western Pacific subpopulation (also known as the Western North Pacific or the Korean-Okhotsk population) that is critically endangered and shows no apparent signs of recovery, and the Eastern Pacific population (also known as the Eastern North Pacific or the California-Chukchi population) that appears to have recovered from exploitation and was removed from listing under the ESA in 1994 (Carretta et al., 2016). All populations of the gray whale are protected under the MMPA; the Western Pacific subpopulation is listed as endangered under the ESA and is depleted under the MMPA, but there is no designated critical habitat for this species.

Tagging, photo-identification, and genetic studies have shown that small numbers of gray whales observed within the western North Pacific waters have also been observed in eastern North Pacific waters along the West Coast of North America (Lang 2010; Weller et al. 2013; Durban et al. 2017; Urbán *et al.* 2013; Mate *et al.* 2015). It is uncertain which stock these individuals belong to, and none of them have been observed in Puget Sound; therefore, it is unlikely that any members of the endangered western Pacific stock occur in the vicinity of NAVMAG Indian Island.

A group of a few hundred gray whales known as the Pacific Coast Feeding Group feeds along the Pacific coast between southeastern Alaska and southern California throughout the summer and fall (Calambokidis et al., 2002, 2015). This group of whales has generated uncertainty regarding the stock structure of the Eastern North Pacific population (Carretta et al., 2013). Photo-identification, telemetry, and genetic studies suggest that the Pacific Coast Feeding Group may be demographically distinct (Calambokidis et al., 2010, 2017; Mate et al., 2010; Frasier et al., 2011; Langerquist et al., 2019). However, the NMFS Task Force on gray whale stock structure (Weller et al., 2013) was not able to provide definitive advice as to whether the Pacific Coast Feeding Group is a separate population stock under MMPA guidelines, and the group has no formal status under the MMPA, International Union for Conservation (of Nature and Natural Resources), or ESA. Currently, the Pacific Coast Feeding Group is not treated as a distinct stock in the NMFS stock assessment reports, but this may change in the future based on new information (Carretta et al., 2020; Weller et al., 2013).

Gray whales received protection from commercial whaling in the 1930s. However, hunting of the western population continued for many more years. The International Whaling Commission (IWC) sets a quota allowing catch of gray whales annually from the eastern population for aboriginal subsistence. In 2012, the IWC approved a 6-year quota (2013–2018) of 744 gray whales, with an annual maximum of 140 whales for native people of Chukotka, Russia and Washington State (Makah Indian Tribe) (IWC, 2015).

4.2.1.2 Distribution

Eastern gray whales are known to migrate along the U.S. West Coast on both their northward and southward migrations. This species makes the longest annual migration of any mammal—between 15,000 and 20,000 km roundtrip (Jones & Swartz, 2009 Jefferson et al., 2015). The migration connects summer arctic feeding grounds with winter mating and calving regions in temperate and subtropical coastal waters. Winter grounds extend from central California south along Baja California, the Gulf of California, and the mainland coast of Mexico. The northward migration to the feeding grounds occurs in two phases. The first phase, in late January through March, consists of newly pregnant females, who go first to maximize feeding time, followed by adult females and males, then juveniles. The second phase, in April through May, consists primarily of mothers and calves that have remained in the breeding area longer allowing calves to strengthen and rapidly increase in size before the northward migration (Herzing & Mate, 1984; Jones & Swartz, 2009). Beginning in the fall, whales start the southward migration from the summer feeding to winter calving areas mainly following the coast to Mexico. The trip averages two months. During the southbound migration, peak sightings occur between early December and mid-February off the Oregon coast and in January off the Washington coast (Herzing & Mate, 1984, Rugh et al., 2001; Laake et al., 2012).

Most of the Eastern North Pacific stock summers in the shallow waters of the northern Bering Sea, Chukchi Sea, and western Beaufort Sea (Rice and Wolman, 1971), but a small proportion (approximately 200 individuals) spend the summer and fall feeding along the Pacific coast from southeastern Alaska to central California (Sumich, 1984; Calambokidis et al., 2002, 2010; Gosho et al., 2011; Carretta et al., 2012). These whales are collectively known as the "Pacific Coast Feeding Group" (Carretta et al., 2016).

The migration routes of the Western North Pacific (WNP) subpopulation of gray whales are poorly known (Weller et al., 2002). Previous sighting data suggested that the remaining population of western gray whales had a limited range extent between the Okhotsk Sea off the coast of Sakhalin Island and the South China Sea (Weller et al., 2002). However, recent long-term studies of radio-tracked whales indicate that the coastal waters of eastern Russia, the Korean Peninsula, and Japan are part of the migratory route (Weller et al., 2012). There is also photographic evidence of a match between a whale found off Sakhalin and the Pacific coast of Japan, more than 1,500 km south of the Sakhalin feeding area (Weller et al., 2008). Tagging, photo-identification, and genetic studies show that some whales identified in the WNP off Russia have been observed in the Eastern North Pacific (ENP), including the west coast of Vancouver Island, British Columbia, and Baja California, Mexico (Lang, 2010; Mate et al., 2011; Weller et al., 2012; Urbán et al., 2013; Mate et al., 2015). These studies have recorded a total of 27 gray whales observed in both the WNP and ENP (Carretta et al., 2016). Some whales that feed off Sakhalin Island in summer migrate east across the Pacific to the west coast of North America in winter, while others migrate south to waters off Japan and China (Carretta et al., 2016). Some presumed WNP whales may be ENP whales foraging in areas historically attributed to the WNP subpopulation (Mate et al., 2015). No photo-matches of "Sakhalin" whales have been reported in Puget Sound or other Washington inland waters. Given the small number of whales that have been detected in both the WNP and ENP, and the uncertainty over their assignment to a stock, it is unlikely that an individual of the endangered WNP subpopulation would occur in the vicinity of NAVMAG Indian Island.

4.2.1.3 Site-Specific Occurrence

As the majority of gray whales migrate past the Strait of Juan de Fuca in route to or from their feeding or breeding grounds, a few of them enter Washington inland waters to feed (Stout et al., 2001; Calambodkidis et al., 2015). Gray whales are observed in Washington inland waters, including Puget Sound in all months of the year (Calambokidis et al., 2010; Orca Network, 2020) with peak numbers from March through June (Calambokidis et al., 2010, 2015). Fewer than 20 gray whales are documented in the inland waters of Washington and British Columbia each year beginning in January (Orca Network, 2011, as cited by Washington Department of Fish and Wildlife [WDFW], 2012). Most whales sighted are part of a small regularly occurring group of 6 to 10 gray whales that use mudflats in the Whidbey Island and the Camano Island area as a springtime feeding area (Calambokidis et al., 2010). Gray whales feed on benthic invertebrates, including dense aggregations of ghost shrimp and tubeworms (Weitkamp et al., 1992, Richardson, 1997).

Gray whales that are not identified with the regularly occurring group in the Whidbey Island and Camano Island area are occasionally sighted in Puget Sound. These whales are not associated with feeding areas and are often emaciated (WDFW, 2012). There are typically from 2 to 10 stranded gray whales per year in Washington (Cascadia Research, 2012).

Gray whales are expected to occur in the waters surrounding NAVMAG Indian Island. Gray whales are expected to occur primarily from March through June when in-water construction work will not occur. Therefore, some exposure to individual gray whales could occur over the duration of the Proposed Action; however, project timing will help to minimize potential exposures.

4.2.2 Humpback Whale, Central North Pacific, Hawaii DPS

4.2.2.1 Status and Management

The humpback whale Hawaii DPS, part of the Central North Pacific stock, was delisted under the ESA, given that this population segment is believed to have fully recovered and now has an abundance greater than the pre-whaling estimate (Barlow et al., 2011; Bettridge et al., 2015; Muto et al., 2020; NMFS, 2016a; Wade et al., 2016). The stock is not considered depleted or strategic under the MMPA. The stock structure of humpback whales was defined by the NMFS based on feeding areas because of the species' fidelity to feeding grounds (Carretta et al., 2020). NMFS designated four stocks in the North Pacific, discussed above for the California/Oregon/Washington stock.

4.2.2.2 Distribution

Most humpback whale sightings occur in the Strait of Juan de Fuca and in the San Juan Island area. In Puget Sound, Calambokidis et al. (2004) recorded only six individuals between 1996 and 2001. However, from January 2003 through July 2012 there were over 60 sightings reported to Orca Network (2020), some of which could be the same individuals. Therefore, humpback whales are considered to be regular but not frequent visitors to Puget Sound, especially south of Admiralty Inlet. Puget Sound opportunistic sightings primarily occur April through July, but sightings are reported in every month of the year. A review of reported sightings in Puget Sound indicates humpback whales usually occur as individuals or in pairs (Orca Network, 2020).

4.2.2.3 Site Specific Occurrence

In addition to the Central America and Mexico DPSs occurring in Puget Sound, the non ESA-listed Hawaii DPS may also occur, although in small numbers. However, the different DPS are only distinguishable by DNA sampling or photo identification.

It is likely that the Hawaii DPS would follow the same patterns as the Central America and Mexico DPS within Puget Sound. No humpback whales have been reported in Port Townsend Bay although they have been reported just north of Port Townsend and along Marrowstone Island as they move south into Puget Sound (Orca Network, 2020).

The number of humpback whales, including the Hawaii DPS, potentially present near NAVMAG Indian Island over the time period of the requested authorization is expected to be very low in any month.

4.2.3 Minke Whale, California/Oregon/Washington

4.2.3.1 Status and Management

Minke whales are protected under the MMPA, but they are not designated as depleted, nor are they listed under the ESA. Within U.S. waters, the Northern Pacific subspecies is broken into three management stocks: the Alaskan stock; the California, Oregon, Washington stock; and the Hawaiian stock. Because minke whales from California to Washington appear behaviorally distinct from migratory whales further north and are considered “resident,” minke whales in coastal waters of California, Oregon, and Washington (including Washington inland waters) are considered a separate stock (Carretta et al., 2020).

4.2.3.2 Distribution

As noted above, minke whales appear to establish home ranges in the inland waters of Washington (Dorsey, 1983; Dorsey et al., 1990). Minke whales are reported in the inland waters year-round, although the majority of the records are from March through November (Calambokidis & Baird, 1994). Minke whales are sighted primarily in the San Juan Islands and Strait of Juan de Fuca but are relatively rare in Puget Sound south of Admiralty Inlet (Orca Network, 2020). In the Strait of Juan de Fuca, individuals move within and between specific feeding areas around submarine banks (Stern et al., 1990).

Dorsey et al. (1990) noted minke whales feeding in locations of strong tidal currents. Hoelzel et al. (1989) reported that 80 percent of feeding observations in the San Juan Islands were over submarine slopes of moderate incline at a depth of about 20 m to 100 m. Three feeding grounds have been identified in the Strait of Juan de Fuca and San Juan Islands area (Osborne et al., 1988; Hoelzel et al., 1989; Dorsey et al., 1990; Stern et al., 1990). There is year-to-year variation in the use of these feeding areas, and other feeding areas probably exist (Osborne et al., 1988; Dorsey et al., 1990). A review of Washington inland water sighting data from January 2005 through August 2012 indicates that Minke whales typically occur as lone individuals or in small groups of two or three (Orca Network, 2020).

4.2.3.3 Site-Specific Occurrence

No minke whales have been reported in Port Townsend Bay although they have been reported in the Strait de Juan de Fuca and north of Port Townsend and along the western side of Whidbey Island near Smith Island in October (Orca Network, 2020). It is would be rare for a minke whale to be exposed to pile driving sound during vibratory driving of steel piles which may only occur up to two days per year.

Based on the information presented, the number of minke whales potentially present near NAVMAG Indian Island is expected to be very low in October and unlikely from November through February (Orca Network, 2020).

4.2.4 Dall’s Porpoise, California/Oregon/Washington

4.2.4.1 Status and Management

Dall’s porpoises are protected under the MMPA and are not listed under the ESA. Dall’s porpoise is managed by NMFS within U.S. Pacific economic exclusion zone waters as two stocks: (1) an Alaska stock; and (2) a California/Oregon/Washington stock (Muto et al., 2020; Carretta et al., 2020). The California, Oregon, and Washington stock occurs in Washington inland waters (Carretta et al., 2020 as presented in Carretta et al., 2013).

4.2.4.2 Distribution

Dall's porpoise is one of the most common odontocete species in North Pacific waters (Jefferson, 1991; Ferrero & Walker, 1999; Calambokidis & Barlow, 2004; Williams & Thomas 2007). 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). However, the species is only common between 32 degrees N and 62 degrees N in the eastern North Pacific (Morejohn, 1979; Houck & Jefferson, 1999). Dall's porpoise are found in outer continental shelf, slope, and oceanic waters, typically in temperatures less than 17 degrees C (Houck & Jefferson, 1999; Reeves et al., 2002; Jefferson et., 2015).

Dall's porpoises may occur in Washington inland waters year-round, but appears to be very rare (Evenson et al., 2016). Extensive aerial surveys conducted in Puget Sound and Hood Canal in all seasons from 2013–2015 logged only one sighting of one individual (Jefferson et al., 2016). Only four Dall's porpoise were detected in aerial surveys of the northern inland waters of Washington (Strait of Juan de Fuca, San Juan Islands, Strait of Georgia) during spring 2015 (Smultea et al., 2015). Additional sightings have been reported in the Strait of Juan de Fuca and Haro Strait between San Juan Island and Vancouver Island (Nysewander et al., 2005; Orca Network, 2020). Tagging studies suggest Dall's porpoises seasonally move between the Haro Straight area and the Strait of Juan de Fuca or farther west (Hanson et al., 1998).

4.2.4.3 Site-Specific Occurrence

Dall's porpoise were detected in Puget Sound during aerial surveys in winter (1993–2008) and summer (1992–1999) (Nysewander et al., 2005; WDFW, 2008), with additional observations reported to Orca Network (2020). During the surveys, Dall's porpoise were sighted in Puget Sound as far south as Carr Inlet in southern Puget Sound and as far north as Saratoga Passage, north of NAVSTA Everett (Nysewander et al., 2005; WDFW, 2008). Recent extensive aerial surveys of Puget Sound and Hood Canal during 2013–2015 detected only one individual (Jefferson et al., 2016), but did not specify its location.

The number of Dall's porpoises potentially present near NAVMAG Indian Island is expected to be very low in any month. Dall's porpoises are more likely to occur during winter months than summer months.

4.2.5 Harbor Porpoise, Washington Inland Waters

4.2.5.1 Status and Management

Harbor porpoises are protected under the MMPA, but not listed under the ESA. NMFS conservatively recognizes two stocks in Washington waters: the Oregon/Washington Coast stock and the Washington Inland Waters stock (Carretta et al., 2020). Individuals from the Washington Inland Waters stock are expected to occur in Puget Sound.

4.2.5.2 Distribution

In Washington inland waters, harbor porpoise are known to occur in the Strait of Juan de Fuca and the San Juan Island area year-round (Calambokidis and Baird, 1994; Osmek et al., 1996; Carretta et al., 2012). Harbor porpoises were historically one of the most commonly observed marine mammals in Puget Sound (Scheffer and Slipp, 1948); however, there was a significant decline in sightings beginning in the 1940s (Everitt et al., 1979; Calambokidis et al., 1992). Only a few sightings were reported between the 1970s and 1980s (Calambokidis et al., 1992; Osmek et al., 1996; Raum-Suryan and Harvey, 1998), and no harbor porpoise sightings were recorded during multiple ship and aerial surveys conducted in Puget Sound (including Hood Canal) in 1991 and 1994 (Calambokidis et al., 1992; Osmek et al., 1996).

Incidental sightings of marine mammals during aerial bird surveys conducted as part of the Puget Sound Ambient Monitoring Program (PSAMP) detected few harbor porpoises in Puget Sound between 1992 and 1999 (Nysewander et al., 2005). However, these sightings may have been negatively biased due to the low elevation of the plane, which may have caused an avoidance behavior. Since 1999, PSAMP data, stranding data, and aerial surveys conducted from 2013 to 2016 documented increasing numbers of harbor porpoise in Puget Sound, indicating that the species is increasing in the area (Nysewander, 2008; WDFW, 2008; Jeffries, 2013; Smultea et al., 2017).

4.2.5.3 Site-Specific Occurrence

Raum-Suryan and Harvey (1998) reported a mean group size of 1.9 (range 1–8 individuals) in the San Juan Islands. Mean group size of harbor porpoises for each survey season in the 2013–2016 aerial surveys was 1.7 (Smultea et al., 2017). Little information is available on harbor porpoise occurrence outside of Hood Canal and no site-specific information is available for NAVMAG Indian Island.

No harbor porpoises have been reported in Port Townsend Bay although they have been reported just north of Port Townsend and along Marrowstone Island as they move south into Puget Sound (Orca Network, 2020).

Based on the information presented, the number of harbor porpoises present near NAVMAG Indian Island is expected to be very low in any month and even lower in winter months.

4.2.6 Killer Whale, West Coast Transient

4.2.6.1 Status and Management

Among the genetically distinct assemblages of killer whales in the northeastern Pacific, the West Coast Transient stock, which occurs from California to southeastern Alaska, is one of two stocks that may occur in the NAVMAG Indian Island area. Killer whales belonging to the West Coast Transient stock are protected under the MMPA, but not listed under the ESA.

4.2.6.2 Distribution

The geographical range of the West Coast Transient stock of killer whales includes waters from California through southeastern Alaska with a preference for coastal waters of southern Alaska and British Columbia (Krahn et al., 2002). Transient killer whales in the Pacific Northwest spend most of their time along the outer coast of British Columbia and Washington, but visit inland waters in search of harbor seals, sea lions, and other prey. Transients may occur in inland waters in any month (Orca Network, 2020). Morton (1990) found bimodal peaks in spring (March) and fall (September to November) for transients on the northeastern coast of British Columbia, and Baird and Dill (1995) found some transient groups frequenting the vicinity of harbor seal haul-outs around southern Vancouver Island during August and September, which is the peak period for pupping through post-weaning of harbor seal pups. However, not all transient groups were seasonal in these studies and their movements appeared to be unpredictable. During the period 2004–2010, transient killer whales occurred in Washington inland waters most frequently in August–September with a strong second peak in April–May (Houghton et al., 2015)

The number of West Coast Transient killer whales in Washington inland waters at any one time was considered likely to be fewer than 20 individuals (Wiles, 2004). Recent research suggests that the transient killer whales use of inland waters from 2004 through 2010 has increased and the trend is likely due to increasing prey abundance (Houghton et al., 2015). Many of the West Coast Transients in Washington inland waters have been catalogued by photo identification.

West Coast Transient killer whales most often travel in small pods of up to four individuals (Baird & Dill, 1996). Houghton et al. (2015) reported that the group size most often observed in the Salish Sea was four whales for 2004–2010, is larger than the size most often observed from 1987–1993, and that group size appeared to be increasing from 2004–2010. According to unpublished data (Houghton, 2012 personal communication), the most commonly observed group size in Puget Sound (Puget Sound is defined in Section 2 as waters east of Admiralty Inlet [including Hood Canal] through South Puget Sound and north to Skagit Bay) from 2004 to 2010 was six whales (mean = 6.88) (Houghton, 2012 personal communication).

4.2.6.3 Site-Specific Occurrence

West Coast Transient killer whales most often travel in small pods of up to four individuals (Baird & Dill, 1996). Houghton et al. (2015) reported that the group size most often observed in the Salish Sea was four whales for 2004–2010, is larger than the size most often observed from 1987–1993, and that group size appeared to be increasing from 2004–2010. Transient killer whales may occur during any month; however, the highest number of occurrences are in April to June and August to September (Houghton et al., 2015).

The number of transient killer whale potentially present near NAVMAG Indian Island during the October to January pile driving in-water work window is expected to be low.

4.2.7 California Sea Lion, United States

4.2.7.1 Status and Management

California sea lions are protected under the MMPA and are not listed under the ESA. NMFS has defined one stock for California sea lions (U.S. Stock), with five genetically distinct geographic populations: (1) Pacific Temperate, (2) Pacific Subtropical, (3) Southern Gulf of California, (4) Central Gulf of California, and (5) Northern Gulf of California. The Pacific Temperate population includes rookeries within U.S. waters and the Coronados Islands just south of the U.S./Mexico border. Animals from the Pacific Temperate population range north into Canadian waters, and movement of animals between U.S. waters and Baja California waters has been documented (Carretta et al., 2020).

4.2.7.2 Distribution

During the summer, California sea lions breed on islands from the Gulf of California to the Channel Islands and forage in the Southern California Bight. The primary rookeries are located on the California Channel Islands of San Miguel, San Nicolas, Santa Barbara, and San Clemente. In the nonbreeding season, adult and subadult males migrate northward along the coast to central and northern California, Oregon, Washington, and Vancouver Island, and return south in the spring (DeLong et al., 2017; Weise and Harvey, 2008). They are occasionally sighted hundreds of miles offshore (Lowry and Forney, 2005). Primarily male California sea lions migrate into northwest waters with most adult females with pups remaining in waters near their breeding rookeries off the coasts of California and Mexico (Melin et al., 2000; Lowry and Maravilla-Chavez, 2005; Kuhns and Costa., 2014; Lowry et al., 2017). California sea lions also enter bays, harbors, and river mouths and often haul out on artificial structures such as piers, jetties, offshore buoys, and oil platforms.

4.2.7.3 Site-Specific Occurrence

Jeffries et al. (2000) and Jeffries (2012 personal communication) identified dedicated, regular haul-outs used by adult and sub-adult California sea lions in Washington inland waters (Figure 4-1).

California sea lions are typically present most of the year except for mid-June through July in Washington inland waters, with peak abundance between October and May (NMFS, 1997; Jeffries et al., 2000). California sea lions would be expected to forage within the area, following local prey availability.

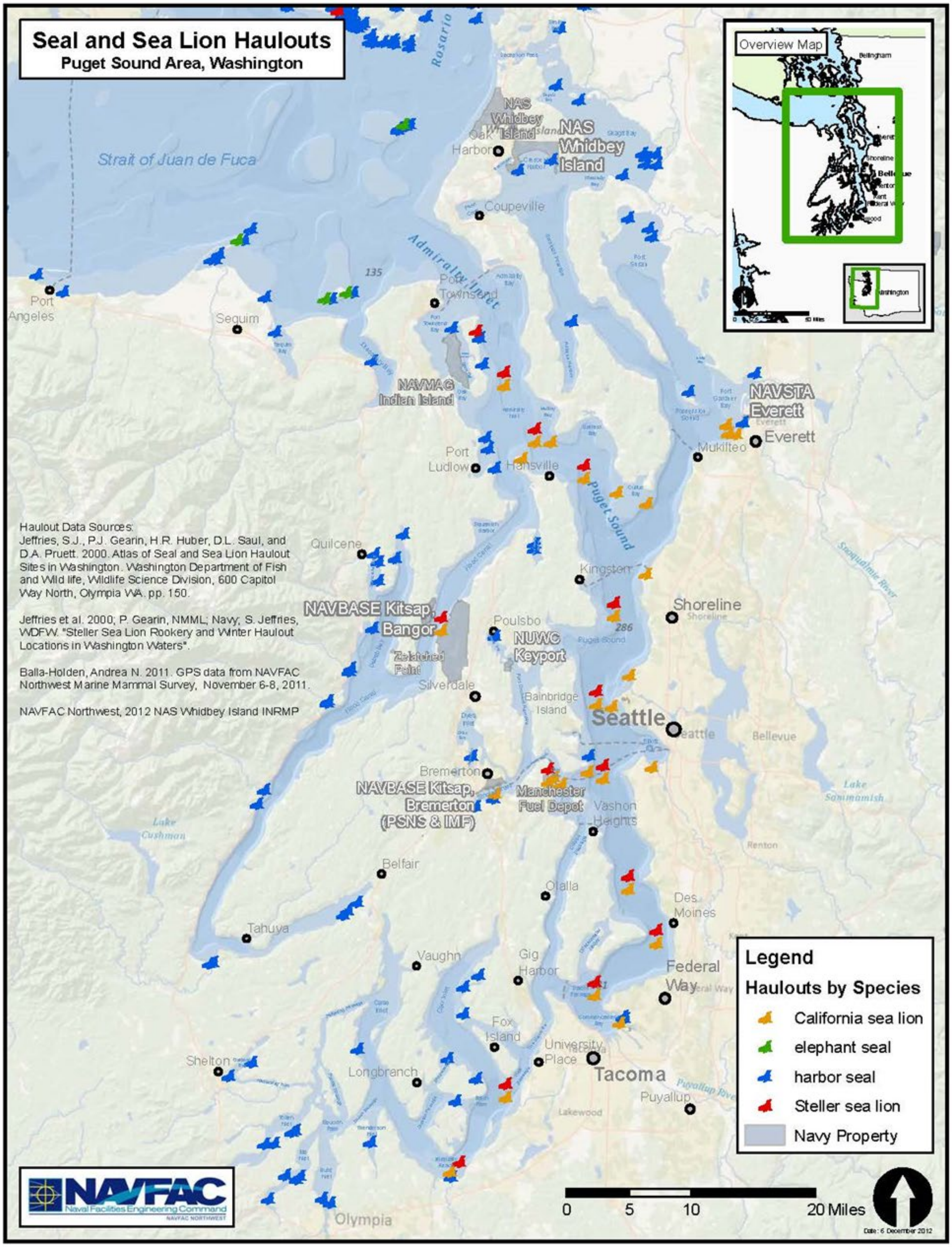

Figure 4-1. Pinniped Haul-outs and Locations of Navy Installations in Puget Sound

During shore-based monitoring for pile driving in 2015 and 2016, California sea lions were not documented on the Port Security Barriers at NAVMAG Indian Island (Navy, 2014, 2016, 2021) and one California sea lion was observed in 2020 (Navy, 2021).

4.2.8 Steller Sea Lion, Eastern United States

4.2.8.1 Status and Management

In the North Pacific, NMFS has designated two Steller sea lion stocks: (1) the western U.S. stock consisting of populations at and west of Cape Suckling, Alaska (144 degrees W longitude); and (2) the Eastern U.S. stock, consisting of populations east of Cape Suckling, Alaska. The western U.S. stock is listed as depleted under the MMPA and endangered under the ESA. Although there is evidence of mixing between the two stocks (Jemison et al., 2013), animals from the western U.S. stock are not present in Puget Sound. Individuals that occur in Puget Sound are part of the Eastern DPS (Muto et al., 2020). The Eastern DPS (stock) was removed from listing under the ESA in 2013 because it was stable or increasing throughout the northern portion of its range (Southeast Alaska and British Columbia) and stable or increasing slowly in the central portion of its range (Oregon through northern California) (NMFS 2012a; 78 FR 66140). Critical habitat has been designated for the Steller sea lion (58 FR 45269); however, there is no designated critical habitat for the species in Washington State.

4.2.8.2 Distribution

The eastern stock of Steller sea lions is found along the coasts of southeast Alaska to northern California where they occur at rookeries and numerous haul-out locations along the coastline (Jeffries et al., 2000; Scordino, 2006; NMFS, 2012b). Along the northern Washington coast, up to 25 pups are born annually (Jeffries, 2013). Male Steller sea lions often disperse widely outside of the breeding season from breeding rookeries in northern California (e.g., St. George Reef) and southern Oregon (e.g., Rogue Reef) (Scordino, 2006; Wright et al., 2010). Based on mark recapture sighting studies, males migrate back into these Oregon and California locations from winter feeding areas in Washington, British Columbia, and Alaska (Scordino, 2006).

In Washington, Steller sea lions use haul-out sites primarily along the outer coast from the Columbia River to Cape Flattery, as well as along the Vancouver Island side of the Strait of Juan de Fuca (Jeffries et al., 2000). A major winter haul-out is located in the Strait of Juan de Fuca at Race Rocks, British Columbia, Canada (Canadian side of the Strait of Juan de Fuca) (Edgell & Demarchi, 2012). Numbers vary seasonally in Washington with peak numbers present during the fall and winter months and a decline in the summer months that corresponds to the breeding season at coastal rookeries (approximately late May to early June) (Jeffries et al., 2000). In Puget Sound, Jeffries (2012 personal communication) identified five winter haul-out sites used by adult and subadult (immature or pre-breeding animals) Steller sea lions, ranging from immediately south of Port Townsend (near Admiralty Inlet) to Olympia in southern Puget Sound (see Figure 4-1). Numbers of animals observed at these sites ranged from a few to less than 100 (Jeffries, 2012 personal communication). In addition, Steller sea lions opportunistically haul out on various navigational buoys in Admiralty Inlet south through southern Puget Sound near Olympia (Jeffries, 2012 personal communication). One or two animals occur on these buoys.

4.2.8.1 Site-Specific Occurrence

No haul-outs are known in the immediate vicinity of NAVMAG Indian Island; therefore, no shore-based surveys have been conducted there and no opportunistic sightings have been reported. The nearest Steller sea lion haul-outs to NAVMAG Indian Island is located on the east side of Marrowstone Island, approximately 7 km away (Figure 4-1). Monitoring during pile driving in 2015 and 2016 did not observe any Steller sea lions hauled out on the Port Security Barrier or swimming through the area (Navy, 2014, 2016, 2021). Therefore, Steller sea lions are expected to be rare in the waters off NAVMAG Indian Island.

4.2.9 Northern Elephant Seal, California Breeding

4.2.9.1 Status and Management

Northern elephant seals are protected under the MMPA and are not listed under the ESA. NMFS has defined one stock for the northern elephant seal, the California Breeding stock, which is geographically distinct from a population in Baja California. Individuals that may occur in Puget Sound belong to the California Breeding stock.

4.2.9.1.1 Distribution

The northern elephant seal occurs almost exclusively in the eastern and central North Pacific. Rookeries are located from central Baja California, Mexico, to northern California (Stewart & Huber, 1993). Adult elephant seals engage in two long migrations per year, one following the breeding season, and another following the annual molt (Stewart and DeLong, 1995; Robinson et al., 2012). Between the two foraging periods they return to land to molt with females returning earlier than males (March through April versus July through August). After the molt, adults then return to their northern feeding areas until the next winter breeding season. Breeding occurs from December to March (Stewart & Huber, 1993). Juvenile elephant seals typically leave the rookeries in April or May and head north, traveling an average of 900 to 1,000 km. Most elephant seals return to their natal rookeries when they start breeding (Huber et al., 1991). Their foraging range extends thousands of miles offshore into the central North Pacific. Adults tend to stay offshore, but juveniles and subadults are often seen along the coasts of Oregon, Washington, and British Columbia (Condit & Le Boeuf, 1984; Stewart & Huber, 1993).

In Washington inland waters, there are regular haul-out sites in the Strait of Juan de Fuca at Smith and Minor Islands, Dungeness Spit, and Protection Island that are thought to be used year-round (Jeffries et al., 2000; Jeffries, 2012 personal communication) (Figure 4-1). Pupping has occurred at these sites, as well as Race Rocks on the British Columbia side of the Strait of Juan de Fuca (Jeffries, 2012 personal communication). Typically, these sites have small numbers of 2 to 10 individuals present.

4.2.9.2 Site-Specific Occurrence

No haul-outs occur in Puget Sound with the exception of individual elephant seals occasionally hauling out for two to four weeks to molt, usually during the spring and summer and typically on sandy beaches (Calambokidis & Baird, 1994). These animals are usually yearlings or subadults and their haul-out locations are unpredictable. Although regular haul-outs occur in the Strait of Juan de Fuca, the occurrence of elephant seals in Puget Sound is unpredictable and rare.

4.2.10 Pacific Harbor Seal, Washington Northern Inland Waters

4.2.10.1 Status and Management

Harbor seals are not listed as depleted under the MMPA, nor are they listed under the ESA.

Three stocks occur in Washington’s inland waters:

- Hood Canal stock;
- Northern Inland Waters stock; and
- Southern Puget Sound stock.

Based on radio telemetry results, interchange between inland and coastal stocks is unlikely (Jeffries et al., 2003).

4.2.10.2 Distribution

Harbor seals are a coastal species, rarely found more than 21 km from shore, and frequently occupy bays, estuaries, and inlets (Baird 2001). Individual seals have been observed several kilometers upstream in coastal rivers (Baird 2001). Ideal harbor seal habitat includes haul-out sites, shelter during the breeding periods, and sufficient food (Bjørge, 2002). Haul-out areas can include intertidal and subtidal rock outcrops, sandbars, sandy beaches, peat banks in salt marshes, and artificial structures such as log booms, docks, and recreational floats (Wilson, 1978; Prescott, 1982; Schneider & Payne, 1983, Gilbert & Guldager, 1998; Jeffries et al., 2000; Lambourn et al., 2010). Harbor seals do not make extensive pelagic migrations (i.e., less than 50 km; Baird 2001), though some long distance movement of tagged animals in Alaska (174 km) and along the U.S. West Coast (up to 550 km) have been recorded (Brown & Mate, 1983; Womble & Gende, 2013). Harbor seals have also displayed strong fidelity to haul-out sites.

Harbor seals are the most common, widely distributed marine mammal found in Washington marine waters and are frequently observed in the nearshore marine environment. They occur year-round and breed in Washington. Numerous harbor seal haul-outs occur in Washington inland waters (Jeffries et al., 2000). Haul-outs include intertidal and subtidal rock outcrops, beaches, reefs, sandbars, log booms, and floats. Numbers of individuals at haul-outs range from a few to between 100 and 500 individuals (Jeffries et al., 2000).

4.2.10.3 Site-Specific Occurrence

Harbor seals are expected to occur year-round, the nearest documented haul-out to NAVMAG Indian Island is Rat Island at the north end of Indian Island approximately 1.8-2.4 km from the Ammunition Wharf. The haul-out at Rat Island is estimated to have less than 100 individuals (Jeffries, 2012 personal communication) although recently as many as 325 seals in late October (October 26, 2021; Navy, 2022).

5 Type of Incidental Taking Authorization Requested

The type of incidental taking authorization that is being requested (i.e., takes by harassment only, takes by harassment, injury, and/or death), and the method of incidental taking.

5.1 Take Authorization Request

Under Section 101 (a)(5)(A) of the MMPA, the Navy requests an LOA for the incidental take of marine mammals incidental to noise generated during cutting and vibratory pile extraction, and vibratory, jetting, and impact pile driving during pile replacement activities described in this application. The Navy requests an LOA for a period of 5 years from October 1, 2023 through September 30, 2028.

Except with respect to certain activities not pertinent here, the MMPA defines ''harassment'' as: any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment] (50 CFR, Part 216, Subpart A, Section 216.3-Definitions).

5.2 Method of Incidental Taking

This authorization request considers noise from vibratory and impact pile extraction and installation as outlined in Section 1 that has the potential to disturb or displace marine mammals or produce a temporary shift in their hearing ability (temporary threshold shift) resulting in Level B harassment as defined above. Other pile repair activities included in the NAVMAG Indian Island Ammunition Wharf Maintenance and Pile Replacement Program are not included in this request. Impact driving of steel piles have the potential to produce a permanent shift in the ability of harbor seals to hear resulting in Level A harassment. Level A harassment is only requested for this small resident species because of its long duration diving ability (i.e., dives are between 3-15 min with a maximum of 35 minutes; Eguchi and Harvey, 1995) which may allow it to enter the Level A harassment zone unseen. If a harbor seal enters the Level A harassment zone, pile driving would be stopped immediately.

Level A harassment will be minimized to the extent practicable given the methods of installation and measures designed to minimize the possibility of injury to marine mammals. First, damaged piles will be removed by cutting. Second, the majority of piles installed will be concrete, which are not expected to cause injury to marine mammals due to the short duration (only proofing) and relatively low installation impact driving sound levels (174 dB RMS re 1 µPa at 10 m). Third, jetting will be the primary method of concrete pile installation. Jetting has very low sound levels (147.5 dB re 1 µPa at 10 m; NAVFAC SW, 2020). Vibratory pile drivers will be the primary method of steel pile installation. Vibratory pile drivers also have relatively low sound levels (166 dB re 1 µPa at 10 m) and are not expected to cause injury to marine mammals; however, they could cause a behavioral response (Level B non-injury). Fourth, impact driving of steel piles will not occur without a noise attenuation measure (i.e., bubble curtain) in place, and all pile driving will either not start or be halted if marine mammals approach the “shutdown zones.” The shutdown zones encompass the Level A injury zone for all species of marine mammals. Additionally, the Level B behavioral response zone for cetaceans will be monitored to the extent practicable and the Navy will implement a shutdown of pile driving if whales or porpoises are seen entering a Level B monitoring zone. This measure is intended to minimize exposure of cetaceans to harassment, although it will likely cause more pile driving shutdowns and delays. See Section 11 for more details on the impact reduction and mitigation measures proposed.

The Proposed Action is not anticipated to affect the prey base or significantly affect other habitat features of marine mammals that would meet the definition of take.

6 Take Estimates for Marine Mammals

By age, sex, and reproductive condition (if possible), the number of marine mammals (by species) that may be taken by each type of taking, and the number of times such takings by each type of taking are likely to occur.

6.1 Introduction

In-water pile driving will temporarily increase the local underwater and airborne noise environment in the vicinity of the NAVMAG Indian Island project. Research suggests that increased noise may impact marine mammals in several ways and depends on many factors. This is discussed in more detail in Section 7. Assessing whether a sound may disturb or injure a marine mammal involves understanding the characteristics of the acoustic source and the potential effects that sound may have on the physiology and behavior of that marine mammal. Although it is known that sound is important for marine mammal communication, navigation, and foraging (NRC, 2003, 2005), there are many unknowns in assessing impacts such as the potential interaction of different effects and the significance of responses by marine mammals to sound exposures (Nowacek et al., 2007; Southall et al., 2007, 2019). Furthermore, many other factors besides the received level of sound may affect an animal's reaction, such as the animal's physical condition, prior experience with the sound, and proximity to the source of the sound.

Vibratory pile driving described in Chapter 1 of this application is not expected to result in Level A exposure of marine mammals as defined under the MMPA. However, the noise related impacts discussed in this application may result in Level B harassment. Impact pile driving of both concrete and steel piles could result in Level A and Level B exposure of marine mammals as defined under the MMPA. The methods for estimating the number and types of exposure are summarized below.

Exposure of each species was determined by:

- Estimating the area of impact where noise levels exceed acoustic thresholds for marine mammals (Sections 6.2 and 6.3);
- Evaluating potential presence of each species based on historical occurrence, density, or by survey as outlined in Section 6.4; and
- Estimating potential harassment exposures by multiplying the density or site-specific abundance, as applicable, of each marine mammal species calculated in the area by their probable duration during construction (Section 6.5).

Each of the three items above is discussed in the sections following.

6.2 Description of Noise Sources

Ambient sound is a composite of sounds from multiple sources, including environmental events, biological sources, and anthropogenic activities. Physical noise sources include waves at the surface, precipitation, earthquakes, ice, and atmospheric noise, among other events. Biological sources include marine mammals, fish, and invertebrates. Anthropogenic sounds are produced by vessels (small and large), dredging, aircraft overflights, construction activities, geophysical explorations, commercial and military sonars, and other activities. Known noise levels and frequency ranges associated with anthropogenic sources similar to those that would be used for this project are summarized in Table 6-1. Details of each of the sources are described in the following text.

In-water construction activities associated with the proposed project include impact, jetting, and vibratory pile driving. The sounds produced by these activities fall into two sound types: impulsive and non-impulsive (defined below). Impact pile driving produces impulsive sounds, while jetting and vibratory pile driving produces non-impulsive 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 (Ward, 1997).

Impulsive sounds (e.g., explosions, seismic airgun pulses, and impact pile driving), which are referred to as pulsed sounds in Southall et al. (2007, 2019), are brief, broadband, atonal transients (Harris, 1998) and occur either as isolated events or repeated in some succession (Southall et al., 2007). Impulsive sounds are 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 (Southall et al., 2007). Impulsive sounds generally have a greater capacity to induce physical injury compared with sounds that lack these features (Southall et al., 2007, 2019).

Non-impulsive sounds (referred to as non-pulsed in Southall et al., 2007, 2019) can be tonal, broadband, or both. They lack the rapid rise time and can have longer durations than impulsive sounds. Non-impulsive sounds can be either intermittent or continuous. Examples of non-impulsive sounds include vessels, aircraft, and machinery operations such as drilling, dredging, jetting, cutting, and vibratory pile driving (Southall et al., 2007, 2019).

In some environments, the duration of both impulsive and non-impulsive sounds can be extended due to reverberations.

Table 6-1. Representative Levels of Underwater Anthropogenic Noise Sources

Noise Source	*Frequency Range (Hz)*	*Source Level*	*Reference*
Dredging	1–500	161–186 dB RMS re: 1 μPa at 1 m	Richardson et al., 1995; DEFRA, 2003; Reine et al., 2014
Small vessels	860–8,000	141–175 dB RMS re: 1 μPa at 1 m	Galli et al., 2003; Matzner & Jones, 2011; Sebastianutto et al., 2011
Large ship	20–1,000	176–186 dB re: 1 $\mu Pa^2 sec$ SEL at 1 m	McKenna, 2011
Tug docking gravel barge	200–1,000	149 dB re: 1 μPa at 100 m	Blackwell and Greene, 2002

Key: dB = decibel; Hz = Hertz; RMS = root mean square; SEL = sound exposure level; dB re 1 μPa @ 1 m = decibels (dB) referenced to (re) 1 micro (μ) Pascal (Pa) at 1 m

6.3 Vocalization and Hearing of Marine Mammals

Marine mammals can produce sounds and use sounds to forage, orient, detect, and respond to predators, and facilitate social interactions (Richardson et al., 1995; Southall et al., 2007, 2019). Measurements of marine mammal sound production and hearing capabilities provide some basis for assessing whether exposure to a particular sound source may affect a marine mammal behaviorally or physiologically. Marine mammal hearing abilities are quantified using live animals either via behavioral audiometry or electrophysiology (see Schusterman, 1981; Au, 1993; Wartzok & Ketten, 1999; Nachtigall et al., 2007). Behavioral audiograms, which are plots of animals' exhibited hearing threshold versus frequency, are obtained from captive, trained animals using standard testing procedures with appropriate controls and are considered to be a more accurate representation of a subject's hearing abilities. Behavioral audiograms of marine mammals are difficult to obtain because many species are too large, too rare, and too difficult to acquire and maintain for experiments in captivity. Consequently, our understanding of a species' hearing ability may be based on the behavioral audiogram of a single individual or small group of animals. In addition, captive animals may be exposed to local ambient sounds, other environmental factors, and aging effects that may impact their hearing abilities and may not accurately reflect the hearing abilities of free-swimming animals.

Electrophysiological audiometry measures small electrical voltages produced by neural activity when the auditory system is stimulated by sound. The technique is relatively fast, does not require a conscious response, and is routinely used to assess the hearing of newborn humans. It has recently been adapted for use on non-humans, including marine mammals (Thorson et al., 1998; Szymanski et al., 1999; Dolphin, 2000). For both methods of evaluating hearing ability, hearing response in relation to frequency is a generalized U-shaped curve or audiogram showing the frequency range of best sensitivity (lowest hearing threshold) and frequencies above and below with higher threshold values.

For animals not available in captive or stranded settings (including large whales and rare species), estimates of hearing capabilities are made based on anatomical and physiological structures, the frequency range of the species' vocalizations, and extrapolations from related species (Ketten, 1997, 1998; Cranford and Krysl, 2015).

NMFS reviewed studies of hearing sensitivity of marine mammals and developed thresholds for use as guidance when assessing the effects of anthropogenic sound on marine mammals based on measured or estimated hearing ranges (NMFS, 2016b, 2018). The guidance places marine mammals into the following functional hearing groups based on their generalized hearing sensitivities: high-frequency cetaceans, mid-frequency cetaceans, low-frequency cetaceans (mysticetes), phocid pinnipeds (true seals), and otariid pinnipeds (sea lions and fur seals). Table 6-2 provides a summary of sound production and hearing capabilities for marine mammal species assessed in this application.

Table 6-2. Hearing and Vocalization Ranges for Marine Mammal Functional Hearing Groups and Species Potentially Within the Project Areas

Functional Hearing Group	*Species*	*Functional Hearing Range*
Low-frequency cetaceans	Gray whale, humpback whale, , minke whale	7 Hz to 35 kHz
Mid-frequency cetaceans	Killer whales	150 Hz to 160 kHz
High-frequency cetaceans	Dall's porpoise and harbor porpoise,	275 Hz to 160 kHz
Phocidae	Harbor seal and elephant seal	In-water: 50 Hz to 86 kHz In-air: 75 Hz to 30 kHz
Otariidae	California sea lion and Steller sea lion	In-water: 60 Hz to 39 kHz In-air: 50 Hz to 75 kHz

Hz = Hertz; kHz = kilohertz
References: Schusterman, 1981; Hemila et al., 2006; Southall et al., 2007, 2019; NMFS, 2016b, 2018.

6.4 Sound Exposure Criteria and Thresholds

Under the MMPA, NMFS has defined levels of harassment for marine mammals. Level A harassment is defined as, "Any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild." Level B harassment is defined as, "Any act of pursuit, torment, or annoyance which 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."

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. Currently, NMFS uses underwater sound exposure thresholds to determine when an activity could result in impacts to a marine mammal defined as Level A (injury) or Level B (disturbance including behavioral and temporary threshold shift) harassment (NMFS, 2005). NMFS (2016, 2018) has recently developed acoustic threshold levels for determining the onset of permanent threshold shift (PTS) in marine mammals in response to underwater impulsive and non-impulsive sound sources. The criteria use cumulative SEL metrics (dB SEL_{CUM}) and peak pressure (dB PEAK) rather than the previously used dB RMS metric. NMFS equates the onset of PTS, which is a form of auditory injury, with Level A harassment under the MMPA and "harm" under the ESA. Level B harassment occurs when marine mammals are exposed to impulsive underwater sounds >160 dB RMS re 1 µPa (impact pile driving), and to non-impulsive underwater sounds >120 dB RMS re 1 µPa (vibratory pile driving) (NMFS, 2005; Table 6-3). The onset of temporary threshold shift (TTS) may be a form of Level B harassment under the MMPA and "harassment" under the ESA. All forms of harassment, either auditory or behavioral, constitute "incidental take" under these statutes.

NMFS uses generic sound exposure thresholds to determine when an activity in the ocean that produces airborne sound might result in impacts to a marine mammal (NMFS, 2005; 70 FR 1871). Construction-period airborne noise would have little impact to cetaceans because noise from airborne sources would not transmit as well underwater (Richardson et al., 1995); thus, noise would primarily be a problem for hauled-out pinnipeds. NMFS has identified behavioral harassment threshold criteria for airborne noise generated by pile driving for pinnipeds regulated under the MMPA. Level A injury threshold criteria for airborne noise have not been established. The Level B behavioral harassment threshold for harbor seals is 90 dB RMS re 20 µPa (unweighted) and for all other pinnipeds is 100 dB RMS re 20 µPa (unweighted).

6.5 Limitations of Existing Noise Criteria

The application of the 120 dB RMS re 1 µPa behavioral threshold can sometimes be problematic because this threshold level can be either at or below the ambient noise level of certain locations. The 120 dB RMS re 1 µPa threshold level for non-impulsive noise originated from research conducted by Malme et al. (1984, 1988) for California gray whale response to continuous industrial sounds such as drilling operations. The 120 dB re 1 µPa non-impulsive sound threshold should not be confused with the species-specific 120 dB pulsed sound criterion established for migrating bowhead whales in the Arctic as a result of research in the Beaufort Sea (Richardson et al., 1995; Miller et al., 1999).

To date, there is no research or data supporting a response by pinnipeds or odontocetes to non-impulsive sounds from vibratory pile driving as low as the 120 dB threshold. Southall et al. (2007, 2019) reviewed studies conducted to document behavioral responses of harbor seals and northern elephant seals to non-impulsive sounds under various conditions and concluded that those limited studies suggest that exposures between 90 dB and 140 dB RMS re 1 µPa generally do not appear to induce strong behavioral responses.

6.6 Auditory Masking

Natural and artificial sounds can disrupt behavior through auditory masking or interference with a marine mammal's ability to detect and interpret other relevant sounds, such as communication and echolocation signals (Wartzok et al., 2004). Masking occurs when both the signal and masking sound have similar frequencies and either overlap or occur very close to each other in time. A signal is very likely to be masked if the noise is within a certain "critical bandwidth" around the signal's frequency and its energy level is similar or higher (Holt, 2008). Noise within the critical band of a marine mammal signal will show increased interference with detection of the signal as the level of the noise increases (Wartzok et al., 2004). For example, in delphinid subjects relevant signals needed to be 17 to 20 dB louder than masking noise at frequencies below 1 kHz to be detected and 40 dB greater at approximately 100 kHz (Richardson et al., 1995). Noise at frequencies outside of a signal's critical bandwidth will have little to no effect on the detection of that signal (Wartzok et al., 2004).

Additional factors influencing masking are the temporal structure of the noise and the behavioral and environmental context in which the signal is produced. Continuous noise is more likely to mask signals than is intermittent noise of the same amplitude; quiet "gaps" in the intermittent noise allow detection of signals which would not be heard during continuous noise (Brumm & Slabbekoorn, 2005). The behavioral function of a vocalization (e.g., contact call, group cohesion vocalization, echolocation click, etc.) and the acoustic environment at the time of signaling may both influence call source level (Holt et al., 2011), which directly affects the chances that a signal will be masked (Nemeth & Brumm, 2010). Miksis-Olds & Tyack (2009) showed that during increased noise manatees modified vocalizations differently depending on whether or not a calf was present.

Masking noise from anthropogenic sources could cause behavioral changes if it disrupts communication, echolocation, or other hearing-dependent behaviors. As noted above, noise frequency and amplitude both contribute to the potential for vocalization masking; noise from pile driving typically covers a frequency range of 10 Hz to 1.5 kHz, which is likely to overlap the frequencies of vocalizations produced by species that may occur in the project area. Amplitude of noise from both impact and vibratory pile driving methods is variable and may exceed that of marine mammal vocalizations within an unknown range of each incident pile.

Depending on the animal's location and vocalization source level, this range may vary over time. Based on the frequency overlap between noise produced by both vibratory and impact pile driving (10 Hz to 1.5 kHz) , animals that remain in a project area during steel pile driving may be vulnerable to masking for the duration of pile driving (typically 2 hours or less intermittently over the course of a day depending on site and project). Energy levels of vibratory pile driving are less than half that of impact pile driving; therefore, the potential for masking noise would be limited to a small radius around a pile. The likelihood that vibratory pile driving would mask relevant acoustic signals for marine mammals is negligible. In addition, most marine mammal species that may be subject to masking are transitory within the project areas. The animals most likely to be at risk for vocalization masking are resident pinnipeds (harbor seals and sea lions around local haul-out areas). Possible behavioral reactions to vocalization masking include changes to vocal behavior (including cessation of calling), habitat abandonment (long- or short-term), and modifications to the acoustic structure of vocalizations (which may help signalers compensate for masking) (Brumm & Slabbekoorn, 2005; Brumm & Zollinger, 2011). Given the relatively high source levels for most marine mammal vocalizations, the Navy has estimated that masking events would occur concurrently within the zones of behavioral harassment estimated for

Table 6-3. Injury and Disturbance Threshold Criteria for Underwater and Airborne Noise

Marine Mammals	*Airborne Noise (impact and vibratory pile driving) (re 20 µPa)[1]* Disturbance Guideline (haul-out)[3]	*Underwater Vibratory Pile Driving Noise (non-impulsive sounds) (re 1 µPa)[2]* PTS Onset (Level A) Threshold	*Underwater Vibratory Pile Driving Noise* Level B Disturbance Threshold	*Underwater Impact Pile Driving Noise (impulsive sounds) (re 1 µPa)* PTS Onset (Level A) Threshold[4]	*Underwater Impact Pile Driving Noise* Level B Disturbance Threshold
Low-Frequency Cetaceans (Gray, humpback, and minke whales)	Not applicable	199 dB SEL_{CUM}[4]	120 dB RMS	219 dB Peak[5] 183 dB SEL_{CUM}[6]	160 dB RMS
Mid-Frequency Cetaceans (Southern Resident and transient killer whales)	Not applicable	198 dB SEL_{CUM}[4]	120 dB RMS	230 dB Peak[5] 185 dB SEL_{CUM}[4]	160 dB RMS
High-Frequency Cetaceans (Dalls and harbor porpoises)	Not applicable	173 dB SEL_{CUM}[4]	120 dB RMS	202 dB Peak[5] 155 dB SEL_{CUM}[6]	160 dB RMS
Otariidae (California and Steller sea lions)	100 dB RMS (unweighted)	219 dB SEL_{CUM}[4]	120 dB RMS	232 dB Peak[5] 203 dB SEL_{CUM}[6]	160 dB RMS
Phocidae (Pacific harbor and northern elephant seals)	90 dB RMS (unweighted)	201 dB SEL_{CUM}[4]	120 dB RMS	218 dB Peak[5] 185 dB SEL_{CUM}[6]	160 dB RMS

Key: dB = decibel; PTS = permanent threshold shift; RMS = root mean square; SEL = sound exposure level

[1]Airborne disturbance thresholds not specific to pile driver type.

[2]Underwater RMS (dB RMS) and Peak (dB Peak) sound pressure have a reference value of 1 µPa. Cumulative sound exposure level (dB SELCUM) has a reference value of 1µPa^2 second.

[3]Sound level at which pinniped haul-out disturbance has been documented. This is not considered an official threshold, but is used as a guideline.

[4]Dual metric acoustic thresholds for impulsive sounds: Whichever results in the largest isopleth for calculating PTS onset is used in the analysis.

[5]Flat weighted or unweighted peak sound pressure within the generalized hearing range

[6]Cumulative sound exposure level over 24 hours.

Given the relatively high source levels for most marine mammal vocalizations, the Navy has estimated that masking events would occur concurrently within the zones of behavioral harassment estimated for vibratory and impact pile driving (see Section 6.3.2, Underwater Noise from Pile Driving) and are therefore taken into account in the exposure analysis.

6.7 Modeling Potential Noise Impacts from Pile Driving

6.7.1 Underwater Sound Propagation

Pile driving will generate underwater noise that potentially could result in disturbance to marine mammals swimming by a project area. Transmission loss (TL) underwater is the decrease in acoustic intensity as an acoustic pressure wave propagates out from a source until the source becomes indistinguishable from ambient sound. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water depth, water chemistry, and bottom composition and topography. A standard sound propagation model was used to estimate the range from pile driving activity to various expected sound pressure levels at potential project structures. This model follows a geometric propagation loss based on the distance from the driven pile, resulting in a 4.5 dB reduction in level for each doubling of distance from the source. In this model, the sound pressure level at some distance away from the source (e.g., driven pile) is governed by a measured source level, minus the transmission loss of the energy as it dissipates with distance. The transmission loss equation is:

$$TL = 15\log_{10}\left(\frac{R_1}{R_2}\right)$$

Where

TL is the transmission loss in dB,

R_1 is the distance of the modeled sound pressure level (SPL) from the driven pile; and

R_2 is the distance from the driven pile of the initial measurement.

The degree to which underwater noise propagates away from a noise source is dependent on a variety of factors, most notably by bathymetry and presence or absence of reflective or absorptive conditions including the sea surface and sediment type. The TL model described above was used to calculate the expected noise propagation from both impact and vibratory pile driving, using representative source levels to estimate the Level B harassment zones or area exceeding the noise criteria.

6.7.2 Underwater Noise from Pile Driving

The intensity of pile driving sound is greatly influenced by factors such as the type of piles, type of driver, and the physical environment in which the activity takes place. To determine reasonable sound pressure levels from pile driving, studies with similar properties to the Proposed Action were evaluated. Data from prior pile driving projects at the NAVBASE Kitsap Bangor and Bremerton waterfronts were reviewed in the analysis. The representative sound pressure levels used in the analysis are presented in Table 6-4.

For the analyses that follow, the TL model described above was used to calculate the expected noise propagation from pile driving. For vibratory and impact behavioral zones and peak injury zones, a representative source level (Table 6-4) was use to estimate the area exceeding the noise criteria. For vibratory pile driving distances to the PTS thresholds, the TL model described above incorporated the auditory weighting functions for each hearing group using a single frequency as described in the NMFS Spreadsheet (NMFS, 2018). For impact pile driving distances to the PTS thresholds for 36-in steel pile and 24-in concrete pile, the TL model described above incorporated frequency weighting adjustments by applying the auditory weighting function over the entire one-second SEL spectral data sets from impact pile driving. If a source level for a particular pile size was not available, the next highest source level was used to produce a conservative estimate of areas above threshold values.

A bubble curtain will be used to minimize the noise generated by impact driving of steel pipe piles. The bubble curtain is expected to attenuate impact pile driving sound levels an average of 8 dB (Navy, 2015); therefore, 8 dB was subtracted from the peak and RMS values in Table 6-4 prior to modeling the behavioral and peak PTS thresholds for impact pile driving steel pipe piles. For the cumulative SEL PTS thresholds, auditory weighting functions were applied to the attenuated one-second SEL spectra for steel pipe piles. If a new method of sound attenuation is developed that has demonstrated an average of at least 8 dB of attenuation, then this method could be employed instead of a bubble curtain for driving steel pile.

Table 6-4. Underwater Noise Source Levels Modeled for Impact and Vibratory Pile Driving

Pile Driving Method	*Pile Type*	*Pile Diameter (inches)*	*RMS[1] (dB re 1 μPa)*	*Peak[1] (dB re 1 μPa)*	*SEL[2] (dB re 1 μPa[2] sec)*
Impact Installation	Concrete	24	174	189	167
	Steel Pipe[2]	36	192	211	184
Vibratory Removal	Steel Fender	14	150	N/A	N/A
Vibratory Installation	Steel Fender	14	150	N/A	N/A
	Composite Fender	18.75	150	N/A	N/A
	Steel pipe	36	167	N/A	N/A

Source: Navy, 2015; Navy, 2017, 2018, NAVFAC SW, 2020; WDOT, 2017.
Key: N/A = not applicable; RMS = root mean square; SEL = sound exposure level

[1]Sound pressure levels are presented for a distance of 10 m from the pile. RMS and Peak levels are relative to 1 μPa and cumulative SEL levels are relative to 1 μPa^2 sec; and

[2]Peak and RMS values modeled for impact driving 36-in steel piles will be reduced by 8 db for noise exposure modeling to account for attenuation from a bubble curtain.

Vibratory pile driving sound levels can be 20 to 30 or more dBs lower than impact driving sound levels and do not produce high peak amplitudes with fast rise times typical of steel impact pile driving. Therefore, bubble curtains are not used for vibratory pile driving.

Calculated distances to the underwater marine mammal thresholds during impact pile driving for the various hearing groups are provided in Table 6-5, Figure 6-1 (24 inch concrete piles, impact driving), and Figure 6-2 (36 inch steel piles, impact driving), and distances to the Peak PTS onset thresholds are provided in Table 6-6. Calculated distances to the underwater marine mammal thresholds during vibratory pile driving are provided in Table 6-7 and Figures 6-3 and 6-4. Adjusted maximum distances are provided where the extent of noise reaches land prior to reaching the calculated radial distance to the threshold. Areas encompassed within the threshold (Level B harassment zones) were calculated using the location of a representative pile that might be driven. Pile locations were chosen to model the greatest possible affected areas; typically these locations would be at the seaward end of a wharf that extends the farthest into the marine environment. Figures 6-1 through 6-4 illustrate the extent and area of each Level B harassment zones for a pile representing the worst-case extent of noise propagation (furthest from the shore) for Level B disturbance.

6.8 Airborne Sound Propagation

Pile driving can generate airborne noise that could potentially result in disturbance to marine mammals (pinnipeds) that are hauled out or at the water's surface. As a result, the Navy analyzed the potential for pinnipeds hauled out or swimming at the surface to be exposed to airborne sound pressure levels that could result in Level B behavioral harassment. The airborne noise threshold for behavioral harassment for all pinnipeds, except harbor seals, is 100 dB RMS re 20 µPa (unweighted) and for harbor seals is 90 dB RMS re 20 µPa (unweighted) (see Table 6-3). Construction noise behaves as point-source and, thus, propagates in a spherical manner with a 6 dB decrease in sound pressure level over water ("hard-site" condition) per doubling of distance (WDOT, 2015). A spherical spreading loss model, assuming average atmospheric conditions, was used to estimate the distance to the 100 dB and 90 dB RMS re 20 µPa (unweighted) airborne thresholds. The transmission loss equation is:

$$TL = 20\log_{10}\left(\frac{R_1}{R_2}\right)$$

where

TL is the transmission loss in dB,

R_1 is the distance of the modeled SPL from the driven pile; and

R_2 is the distance from the driven pile of the initial measurement.

Table 6-5. Calculated Radial Distance(s) to Underwater Marine Mammal Impact Pile Driving Noise Thresholds and Areas Encompassed Within Threshold Distance-SEL$_{CUM}$ Thresholds[1]

	Injury (PTS Onset) Level A Pinnipeds[2]		*Injury (PTS Onset) Level A Cetaceans[2]*			*Behavioral Disturbance Level B (160 dB RMS)[3]*	
Pile Size and Type	Harbor Seal	Sea Lion	Low Frequency	Mid Frequency	High Frequency	***Radial Distance to Threshold***	***Area Encompassed by Threshold[4]***
24-inch concrete[5]	29 m	2 m	54 m	2 m	64 m	86 m	0.02 km^2
36-inch steel[6]	182 m	13 m	243 m	8 m	256 m	398 m	0.5 km^2

Key: m = meter; km = kilometer; km^2 = kilometer squared; PTS = permanent threshold shift.

[1]Calculations based on SEL$_{CUM}$ threshold criteria shown in Table 6-3 and source levels shown in Table 6-4. Threshold distances and ensonified areas calculated for representative piles located at seaward ends of wharfs, intended to model a conservative scenario for pile driving at NAVMAG Indian Island.

[2]Representative spectra were used to calculate the distances to the injury (PTS onset) thresholds for each functional hearing group for 36-in steel pile, and 24-in concrete pile.

[3]Distances to behavioral disturbance thresholds calculated using practical spreading loss model.

[4]Areas were adjusted wherever land masses are encountered prior to reaching the full extent of the radius around the driven pile.

[5]Assumes 1,000 strikes/day for concrete (up to two piles). No bubble curtain proposed for concrete pile.

[6]Bubble curtain will be used only for 36-in steel piles. An 8 dB attenuation is estimated for steel piles using a bubble curtain. Assumes 500 strikes per day for proofing one steel pile per day.

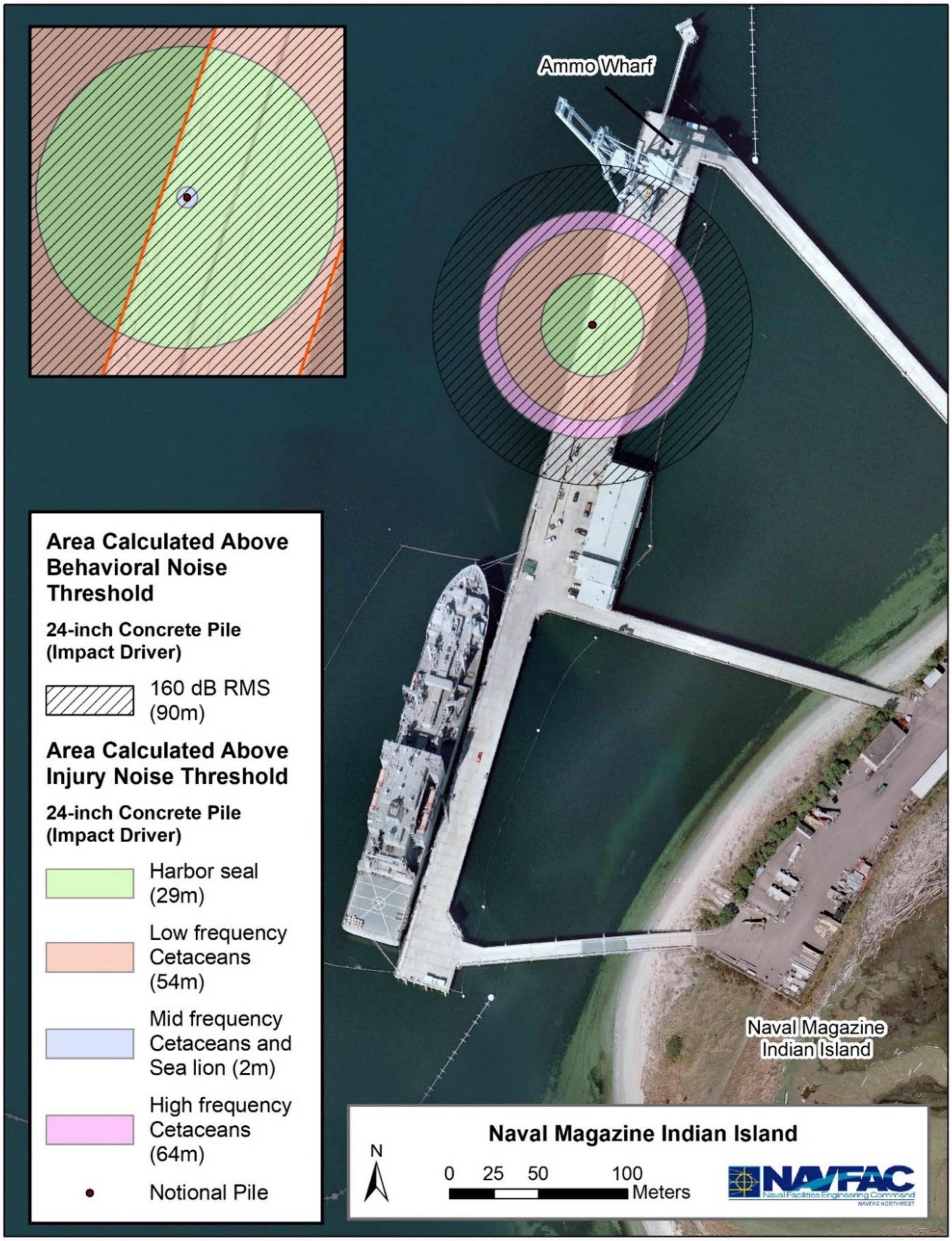

Figure 6-1. Marine Mammal Level A Injury Zones and Level B Behavioral Impact Zones for Impact Driving of 24 Inch Concrete Piles At NAVMAG Indian Island Ammunition Wharf (Sea lions Would Include California and Steller Sea Lions; Harbor Seal Zones Would Also Include Elephant Seals)

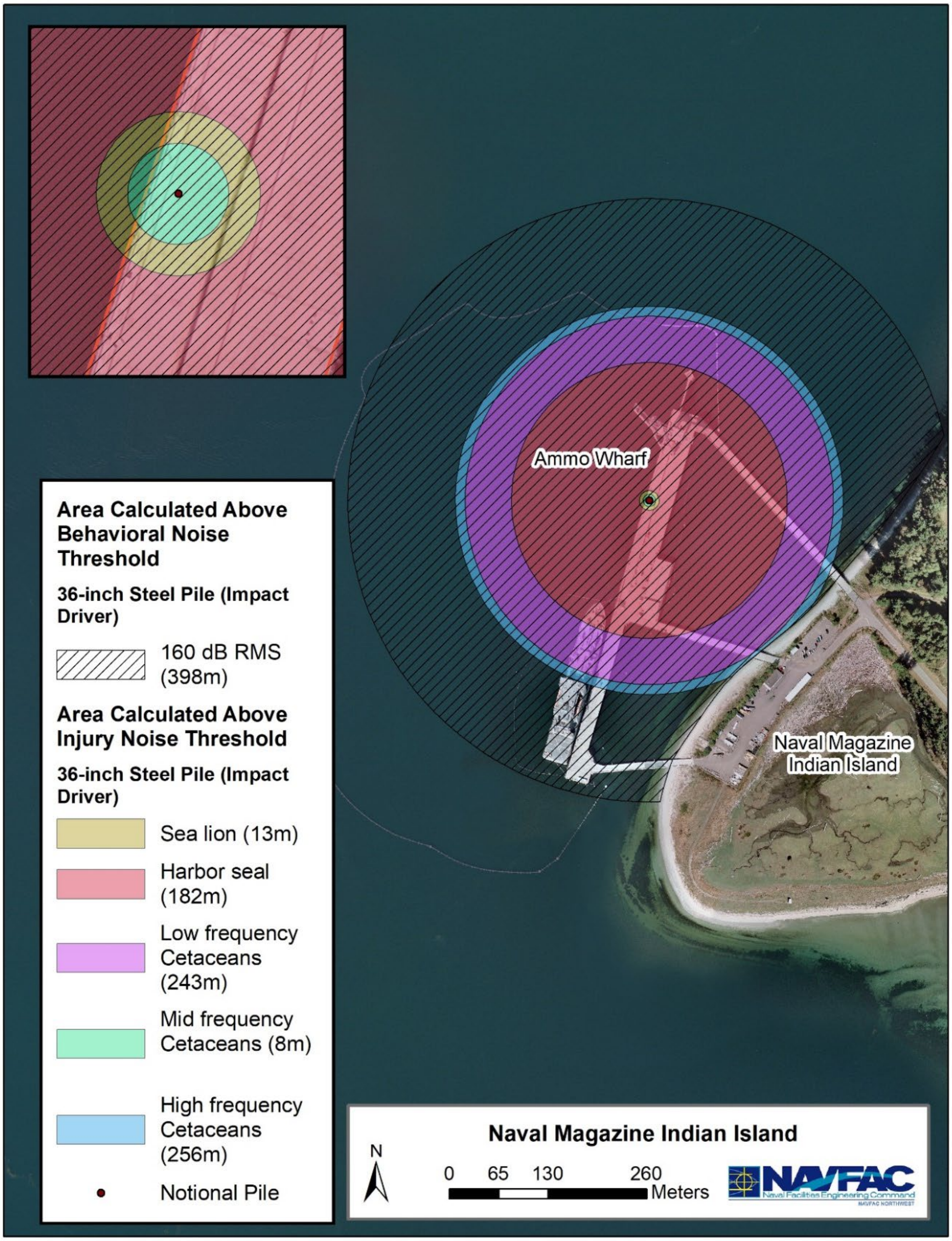

Figure 6-2. Marine Mammal Level A Injury Zones and Level B Behavioral Impact Zones for Impact Driving of 36 Inch Steel Piles At NAVMAG Indian Island Ammunition Wharf (Sea lions Would Include California and Steller Sea Lions; Harbor Seal Zones Would Also Include Elephant Seals)

Table 6-6. Calculated Radial Distance(s) to Underwater Marine Mammal Impact Pile Driving—Peak PTS Thresholds[1]

Pile Size and Type	*Injury (PTS Onset) Level A Pinnipeds (m)*		*Injury (PTS Onset) Level A Cetaceans (m)*		
	Phocids	*Otariids*	*Low Frequency*	*Mid Frequency*	*High Frequency*
24-in concrete	0	0	0	0	1
36-in steel[2]	1	0	1	0	12

Key: m = meter; PTS = permanent threshold shift.

[1]Calculations based on Peak threshold criteria shown in Table 6-3 and source levels in Table 6-4. Distances to peak PTS thresholds calculated using practical spreading loss model;

[2]Bubble curtain will be used for steel piles; therefore, 8 dB attenuation assumed.

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. To determine reasonable airborne source sound pressure levels, source levels were chosen based on a review of available pile driving in-situ recordings. Available data were limited to concrete and steel pile installation (Table 6-8). The level of airborne noise from impact or vibratory pile driving of other pile types is anticipated to be quieter than the levels presented in Table 6-8.

Table 6-7. Calculated Radial Distance(s) to Underwater Marine Mammal Vibratory Pile Driving Noise Thresholds and Areas Encompassed Within Threshold Distance[1]

Pile Size and Type	*Injury (PTS Onset) Level A Pinnipeds[2]*		*Injury (PTS Onset) Level A Cetaceans[2]*			*Behavioral Disturbance Level B (120 dB RMS)[3]*	
	Phocids	Otariids	Low Frequency	Mid Frequency	High Frequency	*Radial Distance to Threshold*	*Area Encompassed by Threshold[4]*
14-in steel H fender pile (vibratory)	<1 m	<1 m	<1 m	<1 m	<1 m	1,000 m	1.8 km^2
18.75-in composite fender pile (vibratory	<1 m	<1 m	<1 m	<1 m	<1 m	1,000 m	1.8 km^2
36-in steel (Vibratory)	4 m	<1 m	7 m	<1 m	11 m	13.6 km	54 km[5]

Key: HF = high frequency cetacean; km = kilometer; LF = low frequency cetacean; m = meter; MF = mid-frequency cetacean, OW= otariid (sea lion); PW = phocid (harbor seal); PTS = permanent threshold shift

Notes:

[1]Vibratory pile driving would only occur if it is necessary to install 36 inch steel piles, none are currently planned to be installed. If steel piles became necessary then only up to eight would be installed within the five years of the LOA.

[2]Distances to the injury (PTS onset) thresholds calculated using NMFS calculator with default Weighting Factor Adjustment of 2.5 (NMFS, 2016b). WFA = 2.5.

[3]Calculations based on threshold criteria shown in Table 6-3. Threshold distances and ensonified areas calculated for representative piles, intended to model a conservative scenario for pile driving at NAVMAG Indian Island.

[4]Distances to the behavioral disturbance thresholds calculated using practical spreading loss model.

[5]Areas encompassed by the threshold were adjusted wherever land masses are encountered prior to reaching the full extent of the radius around the driven pile.

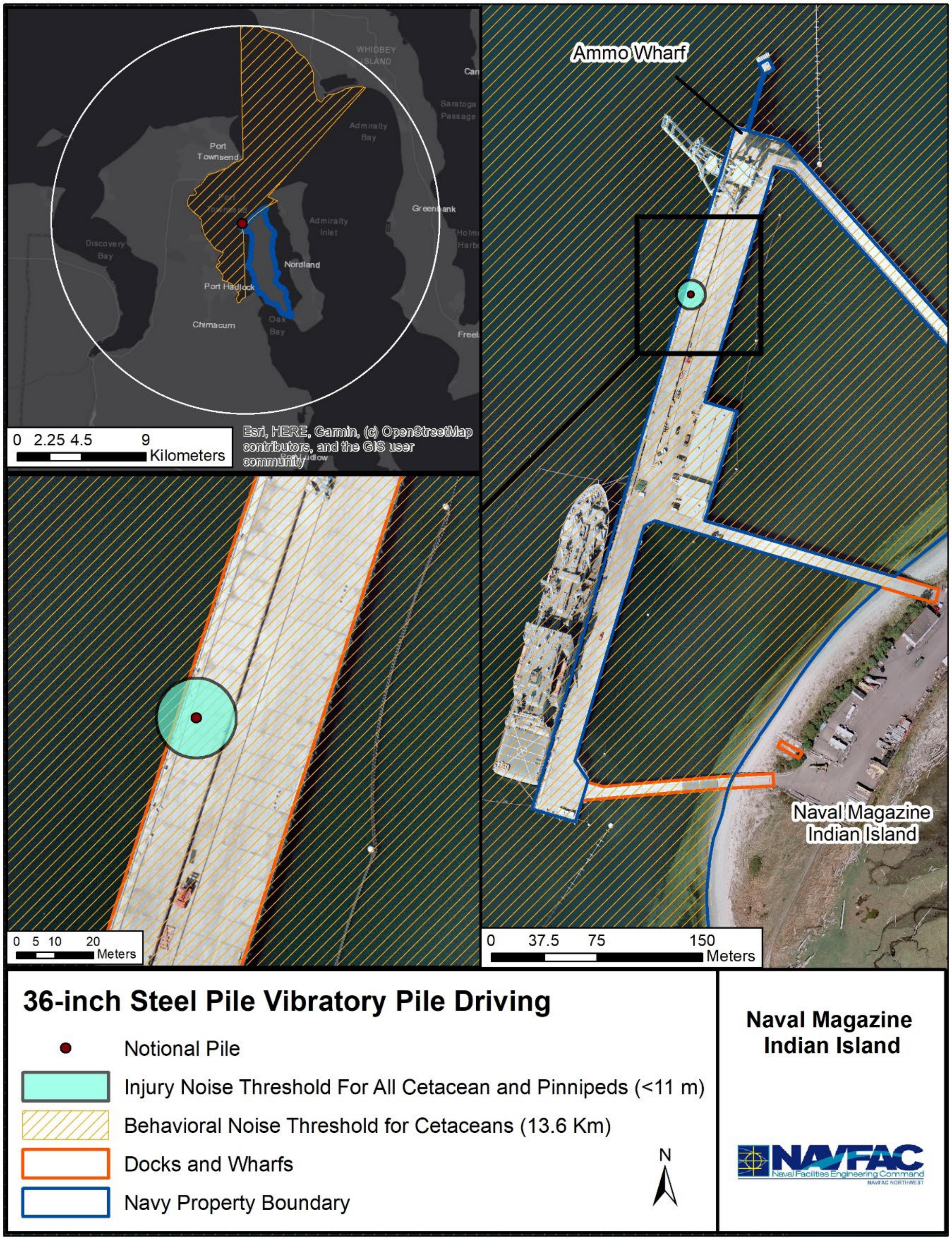

Figure 6-3. Marine Mammal Level A Injury Noise Threshold Zones and Level B Behavioral Noise Threshold Zones for Vibratory Driving of 36 Inch Steel Piles At NAVMAG Indian Island Ammunition Wharf

Figure 6-4. Marine Mammal Level A Injury Noise Threshold Zones and Level B Behavioral Noise Threshold Zones for Vibratory Driving Or Removal of 14-Inch Steel Fender Pile and 18.75- Inch Composite Fender Piles At NAVMAG Indian Island Ammunition Wharf

Table 6-8. Airborne Sound Levels from Impact and Vibratory Pile Driving (dB)

Pile Type	Size (diameter in inches)	Installation Method	
		Impact RMS L_{max} Impact	Vibratory RMS L_{eq} Vibratory
Concrete	24	109	N/A
Fender	14-18.75	NA	88
Steel Pipe	36	112	95

Source: Navy, 2015
Key: L_{eq} = equivalent sound level; L_{max} = maximum sound level; N/A = not available
Notes: All values relative to 20 µPa and at 15 m from pile. All values unweighted

The distances to the airborne harassment thresholds were calculated for steel pile impact and vibratory driving and concrete pile driving with the airborne transmission loss formula. The distances to the pinniped airborne noise thresholds produced by the loudest pile installation method (impact installation of 36-in steel pipe), are shown in Table 6-9. Because these areas are smaller than the underwater behavioral threshold zones, a separate analysis of Level B take was not conducted for the airborne zones. Harbor seals rarely haul out on the Port Security Barriers or other structures for the Ammunition Wharf compared to other installations (Harbor seals regularly haul out at Rat Island, approximately 1.8-2.4 km from the Ammunition Wharf). If animals did haul out in the airborne zones they would already have been exposed within a Level B underwater zone; therefore, no additional takes due to exposure to airborne noise are requested.

Table 6-9. Calculated and Measured Distances to Pinniped Behavioral Airborne Noise Thresholds

Installation Method	*Pile Size and Type*	*Harbor Seals and Elephant Seals Threshold = 90 dB RMS*	*California Sea Lions and Steller Sea lions Thresholds = 100 dB RMS*
Impact	24-in concrete[1]	134 m	42 m
	36-in steel	189 m	60 m
Vibratory	36-in steel	Measured mean[2] = 33 m (51 m max) Calculated[2] = 27 m	Measured mean[2] = 10 m (16 m max) Calculated[2] = 8 m
Vibratory	Steel 14-in and composite 18.75-in fender	Calculated[2] = <10 m	Calculated[2] = <10 m

Notes: Vibratory and impact pile driving of steel piles would only occur if it is necessary to install 36 inch steel piles, none are currently planned to be installed. If steel piles became necessary then only up to two would be installed per year within the five years of the LOA.
[1]Measured during EHW-2 construction, Illingworth & Rodkin, 2012;
[2]Calculated using spherical spreading model.

6.9 Estimated Duration of Pile Driving

The duration of daily pile driving duration will vary by the types of piles installed, and the need to move barges or equipment. Days of pile driving were based on the estimated work days using a slow production rate (e.g., providing the maximum number of potential exposures): The average for past concrete pile installation at NAVMAG Indian Island was two piles per day with a maximum of four piles (Navy, 2016). The rates are used solely to assess the number of days pile driving could occur if production was delayed due to equipment failure, safety, etc. In a real construction situation, pile driving production rates would be maximized when possible.

A conservative estimate of annual pile driving days over the duration of the 5-year LOA based on the assumption that pile driving rates would be relatively slow would be approximately 24 days per year with up to 22 concrete piles or fender piles, and up to two steel piles installed per year. The 36 inch steel piles are not currently planned to be installed but could be required depending on the results of future inspections. Conservatively, one concrete pile would installed per day using jetting followed by proofing with an impact hammer. There may be extra days for additional proofing or weather/equipment delays. Actual daily production rates may be higher (often two piles are installed in a day), resulting in fewer actual pile driving days.

To provide a general estimate of pile driving daily durations, information from past projects was reviewed. The estimated duration of impact and vibratory pile installation is summarized in Table 6-9. Navy geotechnical and engineering staff used data from a large wharf construction project in Hood Canal to estimate pile driving time and strikes needed to install steel piles using diesel hammers. Vibratory installation was estimated to take a median time of 10 minutes per pile with 45 minutes estimated as a maximum.[1] For steel piles that are "proofed" a median of 14 minutes per pile (approximately 600 strikes) was estimated.[2] Other piles may encounter difficult substrate and need to be advanced further with an impact driver. For piles that cannot be advanced with a vibratory driver, less than 30 minutes of impact driving (approximately 1,300 strikes) was conservatively estimated to complete installation.[3] No more than 4,000 strikes would occur on any one day per previous consultations between the Navy and NMFS (Navy, 2019; NMFS, 2019). This maximum number of strikes would account for approximately two steel piles installed with a median time of 14 minutes per pile (~30 min of drive time) or three concrete piles needing extended driving. Actual driving duration will vary due to substrate conditions and the type and energy of impact hammers. Additionally, some of the anticipated pile driving is contingent on emergent needs or emergencies that could potentially never occur. Therefore, estimates of marine mammal exposure based on the maximum strike numbers would be too conservative for this 5-year programmatic analysis. Therefore, Table 6-10 presents an estimated average strikes per day which is used in the exposure analysis.

Estimates of concrete pile impact driving durations are based on 2015 to 2016, and 2020 pile driving logs from the installation of 24-in octagonal piles data at NAVMAG Indian Island. Strikes per piles were calculated at an average of 544 based (Navy, 2016). Therefore, the numbers presented in Table 6-9 will likely overestimate strike numbers for this project. For purposes of analysis, impact pile driving of concrete piles is estimated to take a maximum of 1.5 hrs or an average of 30.7 min in a day.

Table 6-10. Pile Driving Duration Summary

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[1] Based on data from 809 piles installed with a vibratory driver at EHW-2, NAVBASE Kitsap Bangor. The 95th percentile installation time was 44 minutes/pile.

[2] Based on data from 501 piles installed at EHW-2, the median was 14 minutes/pile and the 95th percentile was 26 minutes/pile. Strike number estimates assumed an average estimated strike rate of 44 strikes per minute (or almost a strike every second and a half) rounded up from 3,960.

[3] Based on data from 501 piles installed at EHW-2, the median was 14 minutes/pile and the 95th percentile was 26 minutes/pile. Strike number estimates assumed an average estimated strike rate of 44 strikes per minute (or almost a strike every second and a half) rounded up from 3,960.

Installation Method, Pile Type, and Size	*Installation Rate for Replacement Piles*	*Estimated Duration*				
		Mean/ Pile[1]	*Maximum/ Pile*[1]	*Daily Time*[1]	*Estimated Mean Strikes/Day*	*Maximum Allowed Strikes/Day*
Impact Concrete 24-inch	2 piles/day	9.9 min	26.7 min	30 min	1,000 (448 strikes per pile)	4,000
Impact Steel 36-inch	1 pile/day	14 min	26 min	30 min	500	4,000
Fender pile	2 piles/day	3 min	5 min	10 min	N/A	N/A
Vibratory removal or installation of steel 14-in or composite 18.75-in fender piles	2 piles/day	2 min	5 min	10 min	N/A	N/A
Vibratory steel 36 inch	1 pile/day	10 min	45 min[2]	45 min	N/A	N/A

Key: N/A = not applicable;

Note: Vibratory and impact pile driving of steel piles would only occur if it is necessary to install 36 inch steel piles, none are currently planned to be installed. If steel piles became necessary then only up to two would be installed within the five years of the LOA.

[1] Mean and maximum duration based on data from 22 piles installed at NAVMAG Indian Island (Navy, 2016; Navy, 2018).

[2] Maximum duration assumes one pile advanced at rate of 45 minutes/pile, based on data from 809 piles installed with a vibratory driver at EHW-2, NAVBASE Kitsap Bangor.

For species with more frequent occurrence, but no site-specific surveys at NAVMAG Indian Island, density estimates in inland waters (Navy, 2019) were used for quantification of potential exposure. These species include harbor porpoise, Dall's porpoise, Steller sea lion, and California sea lion.

6.10 Estimating Potential Level B Harassment Exposures

Cetaceans spend their entire lives in the water and spend most of their time (greater than 90 percent for most species) entirely submerged below the surface. When at the surface, cetacean bodies are almost entirely below the water's surface, with only the blowhole exposed to allow breathing. This makes cetaceans difficult to locate visually and also exposes them to underwater noise, both natural and anthropogenic, essentially 100 percent of the time because their ears are nearly always below the water's surface.

Pinnipeds (seals and sea lions) spend significant amounts of time out of the water during breeding, molting, and resting hauling out periods. In the water, pinnipeds spend varying amounts of time underwater. California sea lions are known to rest at the surface in large groups for long amounts of time. When not actively diving, pinnipeds at the surface often orient their bodies vertically in the water column and hold their heads above the water surface. Consequently, pinnipeds may not be exposed to underwater sounds to the same extent as cetaceans.

For the purpose of assessing impacts from underwater sound, the Navy assumed that all cetaceans and pinnipeds in water spend 100 percent of their time underwater. This approach is conservative because pinnipeds spend a portion of their time at the surface to rest or swim, and, therefore, are expected to be exposed to less sound than is estimated by this approach.

To quantitatively assess exposure of marine mammals to noise levels from pile driving over the NMFS threshold guidance, two methods were used depending on the species spatial and temporal occurrence.

- For harbor seals, which are the primary species found within 1,000 m of the Ammunition Wharf during pile driving monitoring from 2014-2016, and 2020 (Navy, 2014, 2016, 2021), a daily rate of harbor seal occurrence was determined for vibratory installation of fender piles for the Level A and Level B harassment zones. Only harbor seals were observed during pile driving monitoring (Navy 2016, 2020) and weekly marine mammal surveys (2022) at NAVMAG Indian Island Ammunition Wharf with the exception of a single harbor porpoise and a single California sea lion. The mean daily average of harbor seals detected within each of the harassment monitoring zone (see Table 6-11) was calculated. To prevent overestimation of harbor seals, multiple sightings of the same seal were not used, only the sighting nearest Ammunition Wharf.
- For the other marine mammal species that do not occur near Indian Island but have the potential to occur, one animal for each species was added to be exposed each year. The two exceptions were Dall's and harbor porpoises and killer whales. Dall's and harbor porpoises often occur in a pods of 2-3 porpoises; therefore, three porpoises per year were added. Daily tracking of killer whales locations and movements (Using Orca Network and Pacific Whale Watch Association) allow the pile driving monitoring team to delay or shutdown pile driving depending on the position of killer whales. Therefore, Level A and Level B takes of killer whales would be prevented.
- For species that regularly occur in Puget Sound, but do not have site-specific abundances, marine mammal density estimates were used to determine the number of animals potentially exposed in a Level B harassment zone on any one day of pile driving or removal (Table 6-11). The density estimates used for this analysis come from the Pacific NMSDD, NAVFAC Pacific Technical Report (Navy, 2020) and Smultea et al. (2017) (for harbor porpoise). The seasonal density value for each species during the in-water work window at each site was used in the marine mammal take assessment calculation.

The equation for species likely to occur with only density estimates and no site-specific abundance was:

1) Exposure estimate = N × Level B harassment zone (km^2) × maximum days of pile driving

Where N = density estimate (animals per km^2) used for each species

Level B harassment zone = the area where noise exceeds the noise threshold value. The area of the harassment zone is truncated by land masses surrounding the area (i.e., Whidbey Island, Port Townsend mainland, and Indian Island).

For species with site-specific surveys available, exposures were estimated by:

The following assumptions were used to calculate potential exposures to impact and vibratory pile driving noise for each threshold:

- For formula (1) only harbor seals are expected to be present in the project area each day during impact pile driving;
- For formula (1) each species could be present in the project area each day during vibratory pile driving. The timeframe for takings would be one potential take (Level B harassment exposure) per individual, per 24 hours;

The largest Level B harassment zone will be produced by vibratory driving. The Level B harassment zone for a vibratory hammer will be encompassed by the larger Level B harassment zone from the impact driver. Impact pile driving was assumed to be one per day but actual daily production rates may be higher (two per day), resulting in fewer actual pile driving days. The pile driving days listed in Table 6-10 are used solely to assess the number of days during which pile driving could occur if production was delayed due to equipment failure, safety, etc. In a real construction situation, pile driving production rates would be maximized when possible.

All pilings installed will have an airborne noise disturbance distance equal to the pile that causes the greatest noise disturbance installed with the method that has the largest Level B harassment zone. However, the nearest pinniped haul-out is at Rat Island at the northern end of Indian Island, approximated 1.8 to 2.4 km from the Ammunition Wharf (depending on pile position on the Ammunition Wharf).

Table 6-11. Marine Mammal Species Densities Used in Exposure Calculations For Level A And Level B Harassment Zones

Species	***Region Location***	***Density (October–February)* Animals km^2***
Gray whale	North Puget Sound	Zero (within 1,000 m)[1] 0.00048 (Fall and Winter)[2]
Humpback whale	Puget Sound Puget Sound	Zero (within 1,000 m)[1] 0.00074 (Fall)[2] 0.00058 (Winter)[2]
Killer Whale Southern Resident	Port Townsend Port Townsend	Zero (within 1,000 m)[1] 0.0021 (Fall-Winter)[2]
Killer Whale Transient	North Puget Sound North Puget Sound	Zero (within 1,000 m)[1] 0.0024 (Fall)[2] 0.0016 (Winter)[2]
Minke Whale	Puget Sound	Zero (within 1,000 m)[1] 0.00045 (Annual)[2]
Harbor porpoise	North Puget Sound	1.16 (Annual)[2,3]
Dall's porpoise	Puget Sound	0.00045 (Annual)[2]
Steller sea lion	Puget Sound	Zero (within 1,000 m)[2] 0.0478 Fall and Winter)[1]
California sea lion	Puget Sound	Zero (within 1,000 m)[1] 0.2211 (Fall)[2] 0.1100 (Winter)[2]
Northern elephant seal	Puget Sound	Zero (within 1,000 m)[1] 0.0000 (Annual)[2]
Harbor seal	North Puget Sound	**14-18.75 inch Fender Pile Driving[1]** Within 10 m = 0.0 seals/day (Level A zone) Within 1,000 m = 15.54 seals per day (Level B zone) **24 inch Concrete Impact Pile Driving[1]** Within 29 m = 0.5 seals/day (Level A zone) Combine with the larger fender pile vibratory Level B zone **36 inch Steel Impact Pile Driving[1]** Within 182 m = 8 seals/day(Level A zone) Combine with the larger vibratory zone for Level B **36 inch Steel Vibratory Pile Driving** Within 10 m = 0.0 seals/day (Level A zone) Within 13.6 km (54 km^2) = 2.83 seals/km^2

*13.6 km with an area of 54 km^2 (a large part of the area was truncated by land masses) was used for 36 in steel pile vibratory installation

Sources: [1]Navy, 2014, 2016; 2021; [2]NMSDD (Navy, 2020), [3]Smultea et al. (2017).

Of significant note is that successful implementation of mitigation methods (i.e., visual monitoring and the use of shutdown zones) will result in no Level A exposure to all marine mammals except harbor seals because the injury zones will be monitored during pile driving. Harbor seal Level A exposure will be limited to the smallest extent practicable. The exposure assessment estimates the numbers of individuals potentially exposed to the effects of pile driving noise exceeding NMFS established thresholds. Results from acoustic impact exposure assessments should be regarded as conservative overestimates that are strongly influenced by limited marine mammal data, the assumption that marine mammals will be present during pile driving, and the assumptions that the maximum number of piles will be extracted or installed.

6.11 Exposure Estimates

Annual exposure estimates for each species for the 5-year period of this application are discussed in the following sections and presented in Table 6-12. Annual reporting requirements will provide details of how many actual and extrapolated animals of each species are exposed to noise levels considered potential Level A or Level B harassment at each location.

Exposure estimates generally do not differentiate age, sex, or reproductive condition. However, some inferences can be made based on what is known about the life stages of the animals that visit or inhabit Puget Sound. When possible and with the available data, this is discussed by species in the sections that follow.

The assumptions described above tend to produce highly conservative exposure estimates. At NAVBASE Kitsap Bremerton, for example, construction of Pier 6 provides a contrast between estimated exposures and actual reported exposure of several marine mammal species. The Navy requested takes of three species (harbor seal, California sea lion, Steller sea lion) but reported that only a fraction of the requested number of harbor seals and California sea lions were actually potentially exposed to elevated noise levels (all due to use of vibratory pile drivers).

In addition, the 2,154 of estimated exposures (39.6% of all exposures) are from 36 inch steel vibratory and impact pile driving which may not occur every year or at all. Steel pile installation will depend on the results of biennial inspections of the Ammunition Wharf piles and it there is a need for a steel pile. In the past 25 years there has only been one steel pile installed at the Ammunition Wharf (W. Kolina, personal communication, 2021); therefore, it is unlikely that the allotted two steel piles per year up to a total of eight steel piles would be installed.

6.11.1 Humpback Whale (Central North Pacific and California/Oregon/Washington Stocks)

Humpback whales (Central America, Hawaii, and Mexico DPSs) are considered rare in the project area. Based on the Navy's analysis of humpback whales' intermittent occurrence in Puget Sound, density estimates were not used to determine animals potentially exposed to impact pile driving noise; however, they were used to determine the potential impacts to steel pile vibratory driving. Humpback whales have been observed in the waters of Puget Sound in every month of the year, singly or in pairs. Because known feeding areas are not present at NAVMAG Indian Island, any exposure to elevated project noise levels is expected to be of short duration as the animal(s) moves through the area. Therefore, based on a low probability of occurrence within the vibratory monitoring zones, the Navy used formula (1) described in Section 6.11 to calculate potential Level B exposures. The Navy estimated zero takes for the duration of the LOA; however, due to the uncertainty of humpback whale movements and the large area of exposure during vibratory driving of 36 inch steel piles, the Navy requests takes for the exposure of five humpback whales for the duration of the 5-year NAVMAG Indian Island LOA. Animals of any age, sex, or reproductive status could be exposed (Table 6-12).

To protect this species from noise impacts, the Navy will implement a shutdown if humpback whales are seen by protected species observers in an injury or behavioral harassment zone (see mitigation measures in Chapter 11). A monitor will be stationed at locations from which the injury zone for impact pile driving is visible and will implement shutdown if a whale enters either zone. With the implementation of monitoring, even if a whale enters an injury zone, shutdown would occur before cumulative exposure to noise levels that would result in PTS could occur. Because pile driving will be shutdown if whales are in the injury zone, no Level A take is requested. Any exposure of humpback whales to pile driving noise will be minimized to short-term Level B behavioral harassment in areas beyond the portion of the Level B harassment zone that can be visually monitored during vibratory pile driving.

In summary, the Navy requests Level B takes for the exposure of one whale per year for the duration of the 5-year NAVMAG Indian Island LOA (Table 6-12). Animals of any age, sex, or reproductive status could be exposed to underwater pile driving sounds.

6.11.2 Killer Whale, Eastern North Pacific Southern Resident Stock

Eastern North Pacific Southern Resident killer whales occur seasonally in Puget Sound, although they have not been reported in Port Townsend. Animals, when present, are most frequently seen in waters north of NAVMAG Indian Island in late spring, summer, and fall. They are occasionally observed in Puget Sound in winter months but less frequently than in summer and fall. There is a low probability of occurrence at any project site during the in-water work window and the daily information provided by the Orca Network on the location of killer whales.

To protect Southern Resident killer whales from noise impacts, the Navy will implement a shutdown if killer whales are seen by marine mammal monitors in any of the behavioral harassment zones (see mitigation measures in Chapter 11). The movements and locations of SRKWs are tracked daily by the Center for Whale Research, Orca network, and NMFS; therefore, exposures to vibratory pile driving can be avoided if SRKWs are known to be near the monitoring zones.

In summary, the Navy does not requests Level A or B takes for Southern Resident killer whales for the duration of the 5-year NAVMAG Indian Island LOA (Table 6-12).

6.11.3 Gray Whale

Most gray whales in Puget Sound utilize the feeding areas in northern Puget Sound around Whidbey Island and in Port Susan in March through June with a few individual sightings occurring year-round that are not always associated with feeding areas. Therefore, grays whales are included in this application. Any exposure to elevated project noise levels are expected to be of short duration as the animal(s) moves through an area. Moreover, the majority of in- water work will occur during the fall and winter when gray whales are less likely to be present in Puget Sound. Therefore, based on a low probability of occurrence within the vibratory monitoring zones, the Navy used formula (1) described in Section 6.11 to calculate potential Level B exposures. The formula estimated zero takes for the duration of the LOA; however, due to the uncertainty of gray whale movements and the large area of exposure during vibratory driving of 36 inch steel piles, the Navy requests takes for the exposure of one gray whale per year for the duration of the 5-year NAVMAG Indian Island LOA.

To protect gray whales from noise impacts, the Navy will implement a shutdown if gray whales are seen by marine mammal monitors in an injury or behavioral harassment zone (see mitigation measures in Chapter 11). A monitor will be stationed at locations from which the injury zone for impact pile driving is

Table 6-12. Underwater Exposure Estimates By Species For Five Years (Annual Exposures In Parenthesis). Includes Cutting, Jetting, Vibratory, and Impact Driving Of 24 Inch Concrete and Fender Piles, Impact and Vibratory Driving of 36 Inch Steel Piles.

Species	*Total Exposure Estimates For Five Years (Exposures per year)*						
	24 Inch Concrete Piles and/or 14-in/18.75-in Fender Piles (Up to 22 piles/Year)		*36 Inch Steel Piles (Up to 2 pile/Year)*		*Total Level B*	*Total Level A*	*Percent of Stock/DPS All Five Years*
	Level B	*Level A*	*Level B*	*Level A*			
	Impact or Vibratory	*Impact*	*Vibratory and Impact*	*Impact*			
ESA-Listed Species							
Humpback Whale California-Oregon-Washington and Central North Pacific	0	0	5 (1)	0	5 (1)	0	0.03
Southern Resident Killer[‡]	0	0	0	0	0	0	0
Non ESA-Listed Species							
Gray Whale	0	0	5 (1)	0	5 (1)	0	0.02
Minke Whale	0	0	5 (1)	0	5 (1)	0	0.55
Dall's Porpoise	15 (3)	0	15 (3)	0	30 (6)	0	0.02
Harbor Porpoise[ǂ]	15 (3)	0	625 (125)	0	640 (128)	0	3.39
Killer Whale Transient[‡]	0	0	0	0	0	0	0
California Sea Lion	5 (1)	0	100 (20)	0	105 (21)	0	0.04
Steller Sea Lion	5 (1)	0	25 (5)	0	30 (6)	0	0.06
Northern Elephant Seal	5 (1)	0	5 (1)	0	10 (2)	0	0.01
Pacific Harbor Seal	1,710 (342)	55 (11)	1,530 (306)	70 (14)	3,240 (648)	125 (25)	30.5
Total For All Species	**1,755 (351)**	**55 (11)**	**2,315 (463)**	**70 (14)**	**4,070 (814)**	**125 (25)**	

ǂ Dall's porpoise and harbor porpoise group size may be 1-3 animals; therefore, the estimates are for single Dall's porpoise or harbor porpoise that may have 1-2 conspecifics.

‡ Pile driving would be delayed or shut down if killer whales are approaching or near the NAVMAG Indian Island Level B zones. NMFS, Center for Whale Research, and Orca Network track killer whales daily and would know if killer whales if they are within the Salish Sea (including Puget Sound, Strait de Juan de Fuca, and the San Juan Islands) and near NAVMAG Indian Island Ammunition Wharf. Therefore, killer whale takes are not likely to occur.

Notes: Although no Steller sea lions or northern elephant seals were observed during previous monitoring (Navy, 2015, 2016, 2021), these species are increasingly using Puget Sound; therefore, a small number (one per year) was added to compensate for an animal that could occur near NAVMAG Indian Island or within the large vibratory Level B zone.

visible and will implement shutdown if a whale enters either zone. With the implementation of monitoring, even if a whale enters an injury zone, shutdown would occur before cumulative exposure to noise levels that would result in PTS could occur. Because pile driving will be shutdown if whales are in the injury zone, no Level A take is requested. Any exposure of gray whales to pile driving noise will be minimized to short-term Level B behavioral harassment in areas beyond the portion of the Level B harassment zone that can be visually monitored during vibratory pile driving.

In summary, the Navy requests Level B takes for exposure of five gray whales for the duration of the 5-year NAVMAG Indian Island LOA (Table 6-12). Animals of any age, sex, or reproductive status could be exposed to underwater pile driving sounds.

6.11.4 Minke Whale

Minke whales in Washington inland waters typically feed in the areas around the San Juan Islands and along banks in the Strait of Juan de Fuca. Minke whales are infrequent visitors to Puget Sound, especially east of Admiralty Inlet (see Figure 1-1). When present, minke whales are usually seen singly or in pairs. Therefore, based on a low probability of occurrence within the vibratory monitoring zones, the Navy used formula (1) described in Section 6.11 to calculate potential Level B exposures. The formula estimated zero takes for the duration of the LOA; however, due to the uncertainty of minke whale movements and the large area of exposure during vibratory driving of 36 inch steel piles, the Navy requests takes for the exposure of one minke whale per year for the duration of the 5-year NAVMAG Indian Island LOA.

To protect minke whales from noise impacts, the Navy will implement a shutdown if minke whales are seen by marine mammal monitors in an injury or behavioral harassment zone (see mitigation measures in Chapter 11). A monitor will be stationed at locations from which the injury zone for impact pile driving is visible and will implement shutdown if a whale enters either zone. With the implementation of monitoring, even if a whale enters an injury zone, shutdown would occur before cumulative exposure to noise levels that would result in PTS could occur. Because pile driving will be shutdown if whales are in the injury zone, no Level A take is requested. Any exposure of minke whales to pile driving noise will be minimized to short-term Level B behavioral harassment in areas beyond the portion of the Level B harassment zone that can be visually monitored during vibratory pile driving.

In summary, although minke whales would be rare in the Action Area, the Navy requests Level B takes for exposure of up to five minke whales for the duration of the 5-year NAVMAG Indian Island LOA (Table 6-12). Animals of any age, sex, or reproductive status could be exposed to underwater pile driving sounds.

6.11.5 Dall's Porpoise

In Washington inland waters, Dall's porpoises are most abundant in the Strait of Juan de Fuca and Haro Strait in the San Juan Island area, but may be present in Puget Sound year-round. Group size is usually one to three, but up to 25 individuals have been reported. In Puget Sound, the Navy has estimated that Dall's porpoise density is 0.045 animals/ km^2 (Table 6-10), although they have not been reported near the NAVMAG Indian Island in recent years and their occurrence in Puget Sound appears to be declining (Smultea et al., 2015; Evenson et al., 2016; Jefferson et al., 2016). Therefore, based on a low probability of occurrence within the vibratory monitoring zones, the Navy used formula (1) described in Section 6.11 to calculate potential Level B exposures. The formula estimated zero takes for the duration of the LOA; however, due to the uncertainty of Dall's porpoise movements and the large area of exposure area during vibratory driving of 14-18.75 fender piles and 36 inch steel piles, the Navy requests takes for the exposure of 30 Dall's porpoise for the duration of the 5-year NAVMAG Indian Island LOA. Animals of any age, sex, or reproductive status could be exposed.

To protect Dall's porpoises from noise impacts, the Navy will implement a shutdown if porpoises are seen by marine mammal monitors in an injury or behavioral harassment zone (see mitigation measures in Chapter 11). A monitor will be stationed at locations from which the injury zones for impact pile driving are visible and will implement shutdown if a porpoise enters either zone. With the implementation of monitoring, even if a harbor porpoise enters an injury zone, shutdown would occur before cumulative exposure to noise levels that would result in PTS could occur. Because pile driving will be shutdown if porpoises are in the injury zone, no Level A take is requested. Any exposure of Dall's porpoises to pile driving noise will be minimized to short-term behavioral harassment in the area beyond the portion of the Level B harassment zone that can be visually monitored during vibratory pile driving.

In summary, although Dall's porpoises would be rare in the Action Area, the Navy requests Level B takes for exposure of 30 Dall's porpoises (15 for concrete/fender piles and 15 for steel piles) for the duration of the 5-year NAVMAG Indian Island LOA (Table 6-12). Animals of any age, sex, or reproductive status could be exposed to underwater sounds.

6.11.6 Harbor Porpoise

Harbor porpoises may be present in all major regions of Puget Sound throughout the year. Group sizes ranging from 1 to 150 individuals were reported in aerial surveys conducted from summer 2013 to spring 2016 but mean group size was 1.7 animals (Smultea et al., 2017). The estimated harbor porpoise density in inland waters is provided in Table 6-10. Level B exposure estimates utilized the formula of Level B harassment zone x density x days of vibratory pile driving as described in Section 6.11 with these densities and the anticipated number of pile driving days. Harbor porpoises were not observed during pile driving monitoring at NAVMAG Indian Island ammunition wharf from 2014 to 2016 (Navy, 2014, Navy 2016) but one was observed in 2020 within 200 m of the Wharf (Navy, 2021).

To protect harbor porpoises from noise impacts, the Navy will implement a shutdown if porpoises are seen by marine mammal monitors in an injury or behavioral harassment zone (see mitigation measures in Chapter 11). A monitor will be stationed at locations from which the injury zones for impact pile driving are visible and will implement shutdown if a porpoise enters either zone. With the implementation of monitoring, even if a harbor porpoise enters an injury zone, shutdown would occur before cumulative exposure to noise levels that would result in PTS could occur. Because pile driving will be shutdown if porpoises are approaching the injury zone, no Level A take is requested. Any exposure of harbor porpoises to pile driving noise will be minimized to short-term behavioral harassment in the area beyond the portion of the Level B harassment zone that can be visually monitored during vibratory pile driving.

In summary, the Navy requests Level B takes of up to 640 harbor porpoises (15 for concrete/fender piles and 625 for steel piles) for the duration of the 5-year NAVMAG Indian Island LOA (Table 6-12). Animals of any age, sex, or reproductive status could be exposed to underwater pile driving sounds.

6.11.7 Killer Whale, West Coast Transient Stock

Transient killer whales occasionally occur throughout Puget Sound with sightings within Port Townsend (Orca Network, 2020). Animals, when present, are most frequently seen in waters north of NAVMAG

Indian Island in late spring, summer, and fall. They are occasionally observed in Puget Sound in winter months but less frequently than in summer and fall. There is a low probability of occurrence at any project site during the in-water work window and the daily information provided by the Orca Network on the location of killer whales.

Prior to pile driving, the monitoring team will check with the local whale monitoring group (Center for Whale Research) and NMFS to determine if killer whales are near Indian Island. If killer whales are near Indian Island then pile driving can be reduced or delayed to avoid takes. To protect transient killer whales from noise impacts, the Navy will implement a shutdown if killer whales are seen by marine mammal monitors in an injury or behavioral harassment zone (see mitigation measures in Chapter 11).

In summary, the Navy requests no Level A or Level B takes for West Coast transient killer whales for the duration of the 5-year NAVMAG Indian Island LOA (Table 6-12).

6.11.8 California Sea Lion

California sea lions occur in Puget Sound from August to June. This species occasionally hauls out on the port security barriers at NAVMAG Indian Island. These haul-outs are adjacent to, in, or near the Level B harassment zones, so exposure may occur if animals move through Level B harassment zones during impact or vibratory pile driving activities. Since primarily only male California sea lions migrate into the Study Area (Jeffries et al., 2000), all exposures are expected to be sub-adult or adult males. Animals could be exposed when traveling, resting, and foraging. California sea lions were not observed during previous pile driving monitoring at NAVMAG Indian Island ammunition wharf in 2014 to 2016 (Navy, 2014, Navy 2016) but one was observed during 2020 (Navy, 2021). Although their occurrence is unlikely, Level B exposures for the concrete and fender pile driving were estimated as one sea lion per year. Level B exposures estimates for steel piles utilized the formula of Level B harassment zones x density x days of vibratory pile driving as described in Section 6.11 with these densities and the anticipated number of pile driving days. Because a Level A injury zone can be effectively monitored and a shutdown zone will be implemented, no exposure to Level A noise levels is anticipated. Any exposure of California sea lions to pile driving noise will be minimized to short-term behavioral Level B harassment.

In summary, the Navy requests Level B takes for exposure of 105 California sea lions (Five for concrete/fender piles and 100 for steel piles) for the duration of the 5-year NAVMAG Indian Island LOA (Table 6-12). Animals of any age, sex, or reproductive status could be exposed to underwater pile driving sounds, although primarily adult and sub-adult males.

6.11.9 Steller Sea Lion

Steller sea lions occur seasonally in Puget Sound primarily from September through May. Exposure may occur if these animals move through Level B harassment zones during impact or vibratory pile driving. Although theie occurrence is unlikely, Level B exposures for the concrete and fender pile driving were estimated as one sea lion per year. Level B exposure estimates for steel piles utilized the formula of Level B harassment zone x density x days of pile driving as described in Section 6.11 with these densities and the anticipated number of pile driving days. Exposures are expected to be limited to sub-adult or adult males. Animals could be exposed when traveling, resting, and foraging. Steller sea lions were not observed during previous monitoring at NAVMAG Indian Island ammunition wharf in 2014 to 2016 (Navy, 2014, 2016, 2021). Because a Level A injury zone can be effectively monitored, a shutdown zone will be implemented, and no exposure to Level A noise levels is anticipated at any location. Any exposure of Steller sea lions to pile driving noise will be minimized to short-term behavioral Level B harassment.

In summary, the Navy requests Level B takes for exposure of up to 25 Steller sea lions (Five for concrete/fender piles and 20 for steel piles) for the duration of the 5-year NAVMAG Indian Island LOA (Table 6-12). Animals of any age, sex, or reproductive status could be exposed to underwater pile driving sounds, although primarily adult and sub-adult males.

6.11.10 Northern Elephant Seal

Northern elephant seals are considered rare visitors to Puget Sound. However, solidary juvenile elephant seals have been known to sporadically haul out to molt in Puget Sound during spring and summer months.

No regular elephant seal haul outs occur in Puget Sound although individual elephant seals have been detected hauling out for 2 to 4 weeks to molt, usually during the spring and summer. Haul out locations are unpredictable, but only one record is known for a Navy installation (Section 4.10). Because there are occasional sightings in Puget Sound, the Navy reasons that over the 5-year span of this requested authorization, exposure of up to 10 northern elephant seals could occur incidental to pile driving. Any exposure or northern elephant seals to pile driving noise will be minimized to short-term behavioral harassment. Because elephant seals are rare in the project area and monitoring and shutdown measures will be implemented, no Level A exposure is anticipated.

In summary, the Navy requests Level B takes for exposure of up to 10 northern elephant seals (Five for concrete/fender piles and five for steel piles) for the duration of the 5-year NAVMAG Indian Island LOA (Table 6-12). Animals of any age, sex, or reproductive status could be exposed to underwater sounds.

6.11.11 Pacific Harbor Seal

Pacific harbor seals are expected to occur year-round at NAVMAG Indian Island. This species hauls out regularly at Rat Island adjacent to the northeastern end of Indian Island year-round with a dip in numbers in winter months. Harbor seals are most likely to be exposed to Level A noise when they swim through the area near the Ammunition Wharf during impact pile driving (182 m for steel impact driving and 29 m for concrete impact driving). Pile driving will shutdown whenever a seal is detected by monitors nearing or within the injury zone, but harbor seals can dive for up to 15 minutes and may not be detected until they surface in the injury zone. For most pile driving activities, exposure of harbor seals to pile driving noise will be minimized to short-term behavioral harassment (Level B). Level B exposure estimates 1,710 harbor seals during concrete impact driving, or vibratory installation of fender piles, and 1,530 harbor seals during steel impact or vibratory pile driving (Navy, 2014, 2016, 2021). Level B exposure estimates for vibratory driving, the formula of Level B harassment zone x density x days of vibratory pile driving.

In summary, the Navy requests Level B takes of up to 3,240 Pacific harbor seals for the duration of the LOA. In addition, up to 125 harbor seal Level A takes for the duration of the 5-year NAVMAG Indian Island LOA (Table 6-12). Animals of any age, sex, or reproductive status could be exposed to underwater sounds. The 36 inch steel piles are not currently planned but may be installed if warranted by the biennial pile inspections.

7 Anticipated Impact of the Activity

The anticipated impact of the activity upon the species or stock of marine mammals

7.1 Potential Effects of Pile Driving on Marine Mammals

7.1.1 Potential Effects Resulting from Underwater Noise

The effects of pile driving noise on marine mammals are dependent on several factors, including the species, size of the animal, and proximity to the source; the depth, intensity, and duration of the pile driving sound; the depth of the water column; the substrate of the habitat; the 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. In general, sound exposure should be less intense farther away from the source. 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 (i.e., sand) will absorb or attenuate the sound more readily than hard substrates (rock) which may reflect the acoustic wave. Soft porous substrates will also likely require less time to drive the pile, and possibly less forceful equipment, which would ultimately decrease the intensity of the acoustic source.

Potential impacts to marine species can be caused by physiological responses to both the type and strength of the acoustic signature (Viada et al., 2008). Behavioral impacts may also occur, though the type and severity of these effects 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 from Level B effects such as brief behavioral disturbance, tactile perception, and physical discomfort, to Level A impacts, which may include slight injury of the internal organs and the auditory system, and possible death of the animal (Yelverton et al., 1973; O'Keefe & Young, 1984; Ketten, 1995; Navy, 2001).

7.1.1.1 Physiological Responses

Direct tissue responses to impact/impulsive sound stimulation may range from mechanical vibration or compression with no resulting injury to tissue trauma (injury). Because the ears are the most sensitive organ to pressure, they are the organs most sensitive to injury (Ketten, 2000). Sound-related trauma can be lethal or sub-lethal. Lethal impacts are those that result in immediate death or serious debilitation in or near an intense source (Ketten, 1995). Sub-lethal damage to the ear from a pressure wave can rupture the tympanum, fracture the ossicles, and damage the cochlea; cause hemorrhaging, and leakage of cerebrospinal fluid into the middle ear (Ketten, 2004). Sub-lethal impacts also include hearing loss, which is caused by exposure to perceptible sounds. Permanent hearing loss (also called permanent threshold shift) can occur when the hair cells of the ear are damaged by a very loud event, as well as by prolonged exposure to noise. Instances of temporary threshold shifts and/or auditory fatigue are well documented in marine mammal literature as being one of the primary avenues of acoustic impact. Temporary loss of hearing sensitivity has been documented in controlled settings using captive marine mammals exposed to strong sound exposure levels at various frequencies (Ridgway et al., 1997; Kastak and Schusterman, 1998; Kastak et al., 1999; Finneran et al., 2005). While injuries to other sensitive organs are possible, they are less likely since pile driving impacts are almost entirely acoustically mediated, versus explosive sounds which also include a shock wave that can result in damage. Based on the mitigation measures outlined in Chapter 11 and the conservative modeling assumptions discussed in Chapter 6, Level A harassment is not expected to any individuals, except potentially harbor seals during impact pile driving. However, based on the continued presence of harbor seals near NAVMAG Indian Island through multiple years of construction, no effect to the harbor seal population at NAVMAG Indian Island is expected. Therefore, auditory effects could be experienced by individual harbor seals, but will not cause population-level impacts or affect the continued survival of the species.

7.1.1.2 Behavioral Responses

Behavioral responses to sound can be highly variable. 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 occurs when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok et al., 2004). Animals are most likely to habituate to sounds that are predictable and unvarying. The opposite process is sensitization—when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. Behavioral state or differences in individual tolerance levels may affect the type of response as well. For example, animals that are resting may show greater behavioral change in response to disturbing noise levels than animals that are highly motivated to remain in an area for feeding (Richardson et al., 1995; NRC, 2003; Wartzok et al., 2004). Indicators of disturbance may include sudden changes in the animal's behavior or avoidance of the affected area. A marine mammal may show signs that it is startled by the noise and/or it may swim away from the sound source and avoid the area. Increased swimming speed, increased surfacing time, and cessation of foraging in the affected area would indicate disturbance or discomfort. Pinnipeds may increase their haul out time, possibly to avoid in-water disturbance.

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 and including pile driving) have been varied, but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds 2002; also see reviews in Gordon et al., 2004; Wartzok et al., 2004; and Nowacek et al., 2007). Some studies of acoustic harassment and acoustic deterrence devices have found habituation in resident populations of seals and harbor porpoises (see review in Southall et al., 2007, 2019). Blackwell et al. (2004) found that ringed seals exposed to underwater pile driving sounds in the 153–160 dB RMS range tolerated this noise level and did not seem unwilling to dive. One ringed seal individual was as close as 63 m from the pile driving. Responses of two pinniped species to impact pile driving at the San Francisco-Oakland Bay Bridge East Span Seismic Safety Project were mixed (California Department of Transportation, 2001; Thorson & Reyff, 2006; Thorson, 2010). Harbor seals were observed in the water at distances of approximately 400–500 m from the pile driving activity and exhibited no alarm responses, although several showed alert reactions, and none of the seals appeared to remain in the area. One of these harbor seals was even seen to swim to within 150 m of the pile driving barge during pile driving. However, at the onset of pile driving, several sea lions were observed at distances of 500–1,000 m swimming rapidly and porpoising away from pile driving activities. Sea lions swimming through the area after pile driving had begun did not show the same startle reaction as during the initiation of pile driving. Observations at other construction sites (for example, the Navy's Point Loma fuel pier project) indicated that sea lions typically did not respond behaviorally to pile driving (Navy, 2017). The reasons for these differences are not known, and probably reflect the context of construction activities and the previous experiences of the animals.

Observations of marine mammals on NAVBASE Kitsap Bangor during the Test Pile Program concluded that pinniped (harbor seal and California sea lion) foraging behaviors decreased slightly during construction periods involving impact and vibratory pile driving, and both pinnipeds and harbor porpoise were more likely to change direction while traveling during construction (HDR, 2012). Pinnipeds were more likely to dive and sink when closer to pile driving activity, and a greater variety of other behaviors were observed with increasing distance from pile driving. Relatively few observations of cetacean behaviors were obtained during pile driving, and all were outside the Waterfront Restricted Area (WRA). Most harbor porpoises were observed swimming or traveling through the project area and no obvious behavioral changes were associated with pile driving.

During the 3 years of EHW-2 construction monitoring, only California sea lions and harbor seals were detected within the shutdown and behavioral Level B harassment zones (Primary Surveys) and outside the WRA (Outside Boat Surveys). The sample size for California sea lions was too small during pile driving to identify any trends in responses to construction (Hart Crowser, 2013, 2014, 2015). Harbor seals engaged in a variety of behaviors during pile driving, including swimming, diving, sinking, and looking. They were equally likely to swim, dive, or sink as their ultimate behavior if they were inside the 464-m behavioral Level B harassment zone and most likely to dive if they were outside the WRA. However, observation effort within the WRA was more intense than effort outside WRA. Harbor porpoises were only observed outside the WRA, where the predominant behavior during construction (vibratory pile driving) was swimming or traveling through the project area. During pre-construction monitoring, protected species observers also reported harbor porpoise foraging. Protected species observers did not detect adverse reactions to Test Pile Program or EHW-2 construction activities consistent with distress, injury, or high speed withdrawal from the area, no obvious changes in less acute behaviors.

Marine mammal monitoring at the Port of Anchorage marine terminal redevelopment project found no response by marine mammals swimming within the threshold distances to noise impacts from construction activities including pile driving (both impact hammer and vibratory driving) (Integrated Concepts and Research Corporation, 2009). Most marine mammals observed during the two lengthy construction seasons were beluga whales while harbor seals, harbor porpoises, and Steller sea lions were observed in smaller numbers. Background noise levels at this port are typically at 125 dB.

A comprehensive review of acoustic and behavioral responses to noise exposure by Nowacek et al. (2007) concluded that one of the most common behavioral responses is displacement. To assess the significance of displacements, it is necessary to know the areas to which the animals relocate, the quality of that habitat, and the duration of the displacement in the event that they return to the pre-disturbance area. Short-term displacement may not be of great concern unless the disturbance happens repeatedly. Similarly, long-term displacement may not be of concern if adequate replacement habitat is available.

Marine mammals encountering pile driving operations over a project's construction timeframe would likely avoid affected areas in which they experience noise-related discomfort, limiting their ability to forage or rest there. As described in the section above, individual responses to pile driving noise are expected to be variable. Some individuals may occupy a project area during pile driving without apparent discomfort (this has occur recently during the 2020 Service Pier Extension project), but others may be displaced with undetermined effects. Avoidance of the affected area during pile driving operations would reduce the likelihood of injury impacts, but would also reduce access to foraging areas. Noise-related disturbance may also inhibit some marine mammals from transiting the area. However, previous pile driving activities were short duration and only occurred during the 4.5 month in-water work window and did not appear to driving seals away from the area (Navy, 2014, 2016, 2021). Since pile driving will only occur during daylight hours, marine mammals transiting a project area or foraging or resting in a project area at night will not be affected. Effects of pile driving activities will be experienced by individual marine mammals, but will not cause population-level impacts or affect the continued survival of the species.

7.1.2 Potential Effects Resulting from Airborne Noise

Airborne noise resulting from pile driving has the potential to cause behavioral harassment, depending on their distance from pile driving activities. Airborne pile driving noises are expected to have very little impact to cetaceans because noise from atmospheric sources does not transmit well through the air-water interface (Richardson et al., 1995), consequently, cetaceans are not expected to be exposed to airborne sounds that will result in harassment as defined under the MMPA. Airborne noise will primarily be an issue for pinnipeds that are swimming or hauled out within the range of impact as defined by the acoustic criteria discussed in Chapter 6. Most likely, airborne sound will 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 usual or preferred locations and move farther from the noise source. Pinnipeds swimming in the vicinity of pile driving may avoid or withdraw from the area, or may show increased alertness or alarm (e.g., heading out of the water, and looking around). However, studies of ringed seals 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 peak dBs and 96 dB RMS, which suggests that habituation occurred.

California sea lions and harbor seals were present during impact installation and vibratory extraction of piles at NAVBASE Kitsap Bremerton in February 2014 and November 2014 to February 2015 (Northwest Environmental Consulting, 2014, 2015). In February 2014, California sea lions were observed basking on the PSB within the underwater behavioral Level B harassment zone (117 m from the driven pile) and no behavioral harassment takes were documented because they did not enter the water. California sea lions and harbor seals were observed in the water during vibratory hammer activity. Protected species observers detected 160 individuals during vibratory pile extraction within the 1,600-m vibratory Level B harassment zone, resulting in exposure to noise levels above the Level B threshold. Protected species observers detected 125 individuals during impact pile driving within the 117-m impact Level B harassment zone, resulting in exposure to noise levels above the Level B threshold. There were no shutdowns of pile driving activity because pinnipeds never entered the injury zones. No visible behaviors indicating a reaction to noise disturbance were observed. Behaviors observed included hauling-out (resting), foraging, milling, and traveling.

Based on these observations, marine mammals in the impact zones may exhibit temporary behavioral reactions to airborne pile driving noise. These exposures may have a temporary effect on individual or groups of animals, but this level of exposure is very unlikely to result in population-level impacts.

7.2 Conclusions Regarding Impacts to Species or Stocks

Individual marine mammals may be exposed to sound pressure levels during pile driving operations, which may result in Level B behavioral harassment and, for harbor seals, some Level A harassment. Any marine mammals that are exposed (harassed) may temporarily change their normal behavior patterns (i.e., swimming speed, foraging habits, etc.) or be temporarily displaced from the area of construction. Any exposures to Level B harassment will likely have only a minor effect on individuals and no effect on the population. For harbor seals, exposure to Level A harassment during steel impact driving could result in a change in hearing thresholds permanently. To avoid permanent impacts to harbor seal hearing, a shutdown zone will be implemented that will encompass as much of the Level A zone as practicable. The sound generated from vibratory pile driving will not result in injury to marine mammals because the areas where injury could potentially occur are small, will be fully monitored, and pile driving will be shutdown if marine mammals are approaching these zones. Mitigation is expected to avoid most potential adverse underwater impacts to marine mammals from impact pile driving. Nevertheless, some exposure is unavoidable. The expected level of unavoidable exposure (defined as acoustic harassment) is presented in Chapter 6. This level of effect is not anticipated to have any adverse impact to population recruitment, survival, or recovery.

8 Anticipated Impacts on Subsistence Uses

The anticipated impact of the activity on the availability of the species or stock of marine mammals for subsistence uses.

8.1 Subsistence Harvests by Northwest Treaty Indian Tribes

Not applicable. The proposed action will take place in Puget Sound, and no activities will take place in or near a traditional Alaska subsistence hunting area.

9 Anticipated Impacts on Habitat

The anticipated impact of the activity upon the habitat of the marine mammal populations, and the likelihood of restoration of the affected habitat.

Impacts to habitat will be temporary and include increased human activity and noise levels, localized, minor impacts to water quality, and changes in prey availability near the individual project site. Impacts from pile driving will not result in permanent impacts to habitats used directly by marine mammals.

9.1 Effects from Human Activity and Noise

Existing human activity and underwater noise levels, primarily due to industrial activity and vessel traffic, could increase above baseline temporarily during pile repair and replacement activities.

Marine mammals in the proposed project and surrounding areas encounter vessel traffic associated with both Navy and non-navy activities. Vessels are used in day-to-day activities including security along the waterfront. Several studies have linked vessels with behavioral changes in killer whales in Pacific Northwest inland waters (Kruse, 1991; Kriete, 2002; Bain et al., 2006; Williams et al., 2006, 2009), although it is not well understood whether the presence and activity of the vessels, the vessel noise produced, or a combination of these factors produces the changes. The probability and significance of vessel and marine mammal interactions is dependent upon several factors including numbers, types, and speeds of vessels; the regularity, duration, and spatial extent of activities; and the presence/absence and density of marine mammals.

Behavioral changes in response to vessel presence include avoidance reactions, alarm/startle responses, temporary abandonment of haul-outs by pinnipeds, and other behavioral and stress-related changes (such as altered swimming speed, direction of travel, resting behavior, vocalizations, diving activity, and respiration rate) (Watkins, 1986; Würsig et al., 1998; Terhune & Verboom, 1999; Ng & Leung, 2003; Foote et al., 2004; Mocklin, 2005; Bejder et al., 2006; Nowacek et al., 2007). Some dolphin species approach vessels and are observed bow riding or jumping in the wake of vessels (Norris & Prescott, 1961; Shane et al 1986; Würsig et al., 1998; Ritter, 2002). In other cases, neutral behavior (i.e., no obvious avoidance or attraction) has been reported (review in Nowacek et al., 2007). Little is known about the biological importance of changes in marine mammal behavior under prolonged or repeated exposure to high levels of vessel traffic, such as increased energetic expenditure or chronic stress, which can produce adverse hormonal or nervous system effects (Reeder & Kramer, 2005).

During NAVMAG Indian Island construction activities, additional vessels may operate in project areas, but will operate at low speeds within the relatively limited construction zone and access routes during the in-water construction period. The presence of vessels will be temporary and occur at current Navy facilities that have some level of existing vessel traffic. Therefore, effects are expected to be limited to short-term behavioral changes and are not expected to rise to the level of take or harassment as defined under the MMPA.

Additional noise could be generated by barge-mounted equipment, such as cranes and generators, but this noise will typically not exceed existing underwater noise levels resulting from existing routine waterfront operations. While the increase may change the quality of the habitat, is not expected to exceed the Level A or B harassment thresholds and impacts to marine mammals from these noise sources is expected to be negligible.

9.2 Impacts on Water Quality

Temporary and localized reduction in water quality will occur as a result of in-water construction activities. Most of this effect will occur during the installation and removal of piles when bottom sediments are disturbed. Effects to turbidity and sedimentation are expected to be short-term, minor, and localized. Turbidity will return to normal levels within minutes to hours after pile extraction or installation. Turbidity and sedimentation levels are not anticipated to result in increases that are significant for marine mammals or their forage base. During pile repair and replacement activities, suspension of anoxic sediment compounds could result in temporary, minor, localized reduced dissolved oxygen in the water column. However, if decreases occur, they would be minimal and localized and are not anticipated to result in levels that are significant for marine mammals or their forage base.

9.3 Impacts on Prey Base (Fish)

Pile repair and replacement will impact marine habitats used by fish. Marine habitats used by fish species that occur in the NAVMAG Indian Island Program area include nearshore intertidal and subtidal habitats, including piles used for structure and cover. The greatest impact to prey species during pile repair and replacement will result from behavioral disturbance due to pile driving noise. Secondary impacts include benthic habitat displacement, re-suspension of sediments, and injury from underwater noise. The prey base for the most common marine mammal species (harbor seal and California sea lion) in the project area includes a wide variety of fish such as Pacific hake, Pacific herring, and salmonids. However, observations of marine mammals near NAVMAG Indian Island showed that harbor seals and California sea lions are primarily transiting through the NAVMAG Indian Island Action Area and are not foraging in the area (Navy, 2014, 2016, 2021; DeLong et al., 2017). Steller sea lions in the vicinity of the project area probably consume pelagic and bottom fish. Dall's porpoise and harbor porpoise likely feed on schooling forage fish, such as Pacific herring, smelts, and squid. Transient killer whales in the Puget Sound prey on pinnipeds. Southern Resident killer whales occur in Puget Sound and consume fish; primarily salmon; although pods of killer whales are rarely seen in Port Townsend Bay (Orca Network, 2020).

9.3.1 Underwater Noise Impacts on Fish

The greatest impact to marine fish during construction will occur during impact pile driving because pile driving will exceed the established underwater noise behavior guidance and injury thresholds for fish. However, most piles will be installed with a vibratory driver or they will be concrete, which have lower amplitude sound levels and are not typically associated with fish kills.

During pile driving, the associated underwater noise levels will have the potential to cause injury and could result in behavioral responses, including project area avoidance. To reduce potential effects to salmonids, including juvenile ESA-listed salmonids, the project will adhere to the in-water work window for pile extraction and installation. A bubble curtain will be deployed to reduce the underwater noise levels and associated impacts to underwater organisms during impact pile driving of steel piles. To further minimize the underwater noise impacts during steel pile driving, vibratory pile drivers will be used to the maximum extent practicable to drive piles. An impact hammer will be primarily used to verify load-bearing capacity or where piles cannot be advanced further with a vibratory driver due to hard substrate conditions. However, most or all of the piles installed will be 24 inch concrete piles. The installation of concrete piles by jetting and impact driving produces less noise than the installation of steel piles.

Fish within the areas where noise exceeds the behavioral guidance (150 dB RMS re 1 µPa) may display a startle response during initial stages of pile driving and will potentially avoid the immediate project vicinity during pile driving and other construction activities. However, field observation investigations of juvenile salmonid behavior near pile driving projects (Feist, 1991; Feist et al., 1992), found little evidence that normally nearshore out-migrating salmonids move farther offshore to avoid the general project area. In fact, some studies indicate that construction site behavioral responses, including site avoidance, may be as strongly tied to visual stimuli as to underwater sound (Feist, 1991; Feist et al., 1992; Ruggerone et al., 2008). Therefore, it is possible that salmonids, and likely other species, may alter their normal behaviors including startle response and avoidance of the immediate project site.

Thus, prey availability for marine mammal predators within an undetermined portion of the areas near the Action Area could be reduced temporarily in localized areas during pile driving. However, with the minimization measures that will be implemented, the effect to the overall marine mammal fish forage base will be minimized. Therefore, adverse effects to the marine mammal prey base will be insignificant and will not rise to the level of MMPA take.

9.3.2 Impacts on Fish Habitats/Abundance

Pile repair and replacement activities will adversely affect some habitat conditions for marine fish, including forage fish, in the project area. Positioning and anchoring the construction barges and removing/driving piles will locally increase turbidity, disturb benthic habitats, and disturb forage fish in the immediate project vicinities. Additionally, removal of marine vegetation attached to piles will occur. Construction could bury benthic organisms with limited mobility under sediment. Increased turbidity could make it difficult for predators to locate prey. All of these actions will be temporary with sediments settling back soon after the cessation of activities, and will be localized to the immediate project area around piles. Foraging and refuge habitat quality for prey species will be temporarily degraded over localized areas. The effect is expected to be insignificant to the forage base for marine mammals. Impacts to benthic habitats reflect the number of piles being driven at each project site over the course of the NAVMAG Indian Island pile driving activities. All affected areas are expected to recover quickly and no new overwater structures are being built that will permanently degrade or alter habitat.

Impacts to salmonid and forage fish populations, including ESA-listed species, will be minimized by adhering to the in-water work window designated at NAVMAG Indian Island (October 1 to January 15). These in-water work windows are designated for the period out-migrating juvenile salmonids are least likely to occur (Tidal Reference Area 10, Port Townsend; USACE, 2015). Some habitat degradation is expected during construction, but the impacts to fish species and their habitats will be temporary and localized. The presence, shading potential, and associated artificial lighting of the NAVMAG Indian Island Ammunition Wharf would not be increased and is not anticipated to alter the behavior of juvenile salmonids using the nearshore migratory pathway. Adult salmonids would not experience a substantial barrier effect, and there would be little or no overall delay in their movements. In addition, the numbers of marine mammals affected by impacts to prey populations will be small; therefore, the impact will be insignificant in the context of marine mammal populations.

No indirect effects are expected to the Southern Resident killer whale's prey base. The diet of Southern Resident killer whales consists primarily of adult Chinook (Ford et al., 1998, 2010; Hanson et al., 2010) along with several other salmonid species. Minimization efforts, including adhering to in-water work windows and the use of a noise attenuating device for impact driving steel pile, are likely to minimize this potential adverse effect (refer to Chapter 11 for specific mitigation efforts). Therefore, the project's effect on the Southern Resident killer whale prey base will be insignificant and is not likely to adversely affect the population.

9.4 Effect on Haul-out Sites

Observations recorded the NAVMAG Indian Island Ammunition Wharf during previous project construction monitoring and weekly surveys, showed that pinnipeds did not haul out on any of the artificial structure or the adjacent beaches, and only transited through the area offshore of the port security barriers (Navy, 2016, 2020, 2022). The nearest haul out site is at Rat Island, which is only used by harbor seals; however, it is too far (approximately 1.8-2.4 km to the northeast of the Ammunition Wharf) for harbor seals hauled out at this location to be impacted by pile driving activities.

9.5 Likelihood of Habitat Restoration

All impacts to marine mammal habitat are expected to be limited to the duration of pile extraction and installation during the in-water work window each year. In-water activities associated with the Proposed Action are not likely to have a permanent, adverse effect on any marine habitat or population of fish species.

10 Anticipated Effects of Habitat Impacts on Marine Mammals

The anticipated impact of the loss or modification of the habitat on the marine mammal population involved.

The proposed activities are not expected to have any habitat-related effects that could cause significant or long-term consequences for populations of marine mammals because all activities will be temporary and all piles removed or replaced are within the existing footprint of the current Ammunition Wharf structure. Pile repair and replacement will affect marine mammal habitats indirectly through temporary, localized impacts on prey abundance and availability. The most important impacts on marine fish species consumed by marine mammals will result from potential injury and behavioral disturbance to fish species during pile driving. Information provided in Chapter 9 indicates there may be temporary impacts, but those impacts will be minimized through avoidance and mitigation measures, and limited to the immediate area surrounding the structures being repaired. Impacts will cease upon the completion of pile repair and replacement activities.

11 Mitigation Measures to Protect Marine Mammals and Their Habitat

The availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance

The Navy will employ the Best Management Practices (BMPs) and minimization measures listed in this section to avoid and minimize impacts to marine mammals, their habitats, and forage species. Best management practices, mitigation and minimization measures are included in construction contract plan and must be agreed upon by the contractor prior to any construction activities.

11.1 General Construction Best Management Practices

- All work will adhere to performance requirements of the Clean Water Act, Section 404 permit and Section 401 Water Quality Certification. No in-water work will begin until after issuance of regulatory authorizations.
- The construction contractor will be responsible for preparation of an environmental protection plan. The plan will be submitted and implemented prior to the commencement of any construction activities and is a binding component of the overall contract. The plan shall identify construction elements and recognize spill sources at the site. The plan shall outline BMP, responsive actions in the event of a spill or release, and notification and reporting procedures. The plan shall also outline contractor management elements such as personnel responsibilities, project site security, site inspections, and training.
- No petroleum products, fresh cement, lime, fresh concrete, chemicals, or other toxic or harmful materials shall be allowed to enter surface waters.
- Washwater resulting from washdown of equipment or work areas shall be contained for proper disposal and shall not be discharged unless authorized.
- Equipment that enters surface waters shall be maintained to prevent any visible sheen from petroleum products.
- No oil, fuels, or chemicals shall be discharged to surface waters, or onto land where there is a potential for re-entry into surface waters to occur. Fuel hoses, oil drums, oil or fuel transfer valves, fittings, etc. shall be checked regularly for leaks. Materials will be maintained and stored properly to prevent spills.
- No cleaning solvents or chemicals used for tools or equipment cleaning shall be discharged to ground or surface waters.
- Construction materials will not be stored where high tides, wave action, or upland runoff could cause materials to enter surface waters.
- Barge operations will be restricted to tidal elevations adequate to prevent grounding of a barge.
- Where eelgrass is present in the work area, the Navy shall provide the contractor with plan sheets showing eelgrass boundaries. The following restrictions shall apply to areas designated as having eelgrass:
    - No derrick spudding or anchoring will occur.
    - No scouring of sediments or significant sediment contamination will occur within eelgrass beds.

- Any floating debris generated during installation will be retrieved. Any debris in a containment boom will be removed by the end of the work day or when the boom is removed, whichever occurs first. Retrieved debris will be disposed of at an upland disposal site.

11.2 Pile Repair, Removal, and Installation Best Management Practices

11.2.1 Pile Inspection

Pile cleaning is necessary to be able to inspect the wharf for any structural concerns. Cleaning of piles in all of the action areas shall be conducted with the following restrictions:

- Work must be conducted during maximum daily tidal flows during spring, summer, and fall operations. Maximum tidal flows occur 1 hour after high or low slack tide to 1 hour prior to the next high or low slack tide.
- Monitor for turbidity. Cease operations if turbidity exceeds 5 nephelometric turbidity units (NTU) above background for background levels 50 NTU or less. If background is greater than 50 NTU, then cease operations if there is a 10 percent increase in turbidity.
- Removed marine growth must be collected and disposed in accordance with installation waste instructions.

11.2.2 General

- Removed piles and associated sediments (if any) shall be contained on a barge. If a barge is not utilized, piles and sediments may be stored in a containment area near the construction site.
- Pilings that break or are already broken below the waterline may be removed by wrapping the piles with a cable or chain and pulling them directly from the sediment with a crane. If this is not possible, pilings will be removed with a clamshell bucket. To minimize disturbance to bottom sediments and splintering of piling, the contractor will use the minimum size bucket required to pull out piling based on pile depth and substrate. The clamshell bucket will be emptied of piling and debris on a contained barge before it is lowered into the water. If the bucket contains only sediment, the bucket will remain closed and be lowered to the mudline and opened to redeposit the sediment. In some cases (depending on access, location, etc.), piles may be cut below the mudline and the resulting hole backfilled with clean sediment.
- Any floating debris generated during installation will be retrieved. Any debris in a containment boom will be removed by the end of the work day or when the boom is removed, whichever occurs first. Retrieved debris will be disposed of at an upland disposal site.
- If steel piles are filled with concrete, the tube used to fill steel piles with concrete will be placed toward the bottom of the pile to prevent splashing and overflow.
- If excavation around piles to be repaired or replaced is necessary, hand tools or a siphon dredge will be used to excavate around piles to be replaced.

11.3 Timing Restrictions

To minimize the number of fish exposed to underwater noise and other construction disturbance, in-water work will occur during the in-water work window of October 1 to January 15 when ESA-listed salmonids are least likely to be present (USACE, 2015).

All in-water construction activities will occur during daylight hours (sunrise to sunset) to protect foraging marbled murrelets, and allow visual detections and observations of marine mammals. Sunrise and sunset are to be determined based on the NOAA data, which can be found at http://www.esrl.noaa.gov/gmd/grad/solcalc. Non in-water construction activities could occur between 7:00 AM and 10:00 PM during any time of the year.

11.4 Minimization Measures for Marine Mammals

The following mitigation measures will be implemented during pile driving to avoid marine mammal exposure to Level A injurious noise levels generated from impact pile driving and to reduce to the lowest extent practicable exposure to Level B disturbance noise levels.

11.4.1 Coordination

The Navy shall conduct briefings between construction supervisors and crews, the marine mammal monitoring team, and Navy staff prior to the start of all pile driving activity and when new personnel join the work, to explain responsibilities, communication procedures, marine mammal monitoring protocol, and operational procedures.

11.4.2 Acoustic Minimization Measures

- Vibratory installation will be used to the extent possible to drive steel piles to minimize high sound pressure levels associated with impact pile driving;
- Jetting will be used to the extent possible to install concrete piles in order to minimize higher sound pressure levels associated with impact pile driving;
- A bubble curtain or other noise attenuation device that achieves an average of at least 8 dB of noise attenuation will be employed during impact installation or proofing of steel piles where water depths are greater than 0.67 m. A noise attenuation device is not required during vibratory pile driving for steel or impact installation of concrete piles;
- If a bubble curtain or similar measure is used, it will distribute air bubbles around 100 percent of the piling perimeter for the full depth of the water column. Any other attenuation measure must provide 100 percent coverage in the water column for the full depth of the pile. The lowest bubble ring shall be in contact with the mudline for the full circumference of the ring. The weights attached to the bottom ring shall ensure 100 percent mudline contact. No parts of the ring or other objects shall prevent full mudline contact;

11.4.3 Soft Start

The objective of a soft-start is to provide a warning and/or give animals in close proximity to pile driving a chance to leave the area prior to a vibratory or impact driver operating at full capacity thereby, exposing fewer animals to loud underwater and airborne sounds.

- A soft-start procedure will be used for impact pile driving at the beginning of each day's in-water pile driving or any time pile driving has ceased for more than 1 hour; and
- The following soft-start procedures will be conducted:
    - If a bubble curtain is used for impact pile driving, the contractor will start the bubble curtain prior to the initiation of impact pile driving to flush fish from the zone near the pile where SPL are highest; and
    - The contractor will provide an initial set of strikes from the impact hammer at reduced energy, followed by a 30-second waiting period, then two subsequent sets, regardless of whether other activities such as vibratory driving have occurred during the interim. (The reduced energy of an individual hammer cannot be quantified because they vary by

individual drivers. Also, the number of strikes will vary at reduced energy because raising the hammer at less than full power and then releasing it results in the hammer "bouncing" as it strikes the pile resulting in multiple "strikes").

11.4.4 Visual Monitoring and Shutdown Procedures

A marine mammal monitoring plan will be provided to NMFS prior to commencement of project activities. At a minimum the plan will include the following:

- For all impact and vibratory pile driving, a shutdown and Level B harassment zone will be monitored;
- All disturbance Level B harassment zone and shutdown zones will initially be based on the distances from the source predicted for each threshold level. Although different functional hearing groups of cetaceans (i.e., mid-frequency) and pinnipeds (i.e., otariid) were evaluated, the threshold levels used to develop the monitoring zones were selected to be conservative for cetaceans (and therefore at the lowest levels); as such, the monitoring zones for cetaceans were based on the high frequency threshold (harbor porpoise). In addition, based on the dual criteria, the cumulative SEL was selected over peak level to calculate monitoring zones because it was more conservative;
- Visual monitoring will be conducted by qualified, trained protected species observers (PSO[4]). An observer for the NAVMAG Indian Island project will be a biologist with prior training and experience conducting marine mammal monitoring or surveys, and who has the ability to identify marine mammal species and describe relevant behaviors that may occur in proximity to in-water construction activities;
- A trained observer will be placed at the best vantage point(s) practicable (e.g., from a small boat, construction barges, on shore, or any other suitable location) to monitor for marine mammals and implement shutdown/delay procedures when applicable by calling for the shutdown to the pile driver operator;
- If the shutdown zone is obscured by fog or poor lighting conditions, pile driving will not be initiated until the entire shutdown zone is visible;
- Monitoring will take place from 30 minutes prior to initiation through 30 minutes post-completion of pile driving. Prior to the start of pile driving, the shutdown zone will be monitored for 30 minutes to ensure that the shutdown zone is clear of marine mammals. Pile driving will only commence once observers have declared the shutdown zone clear of marine mammals;
- The shutdown zone will include all areas where the underwater sound pressure levels are anticipated to equal or exceed the Level A (injury) criteria for marine mammals. The shutdown zone will always be a minimum of 10 m to prevent injury from physical interaction of marine mammals with construction equipment. Shutdown will be implemented in accordance with procedures stated in final approved monitoring plans;
- The Level B harassment zone will include all areas where the underwater or airborne sound pressure levels are anticipated to equal or exceed the Level B (disturbance) criteria for marine mammals

[4] NMFS's requirements for PSO qualifications (as of April 2016) are as follows: (1) Independent observers (i.e., not construction personnel) are required; (2) At least one observer must have prior experience working as an observer; (3) Other observers may substitute education (undergraduate degree in biological science or related field) or training for experience; (4) Where a team of three or more observers are required, one observer should be designated as lead observer or monitoring coordinator. The lead observer must have prior experience working as an observer.

during impact pile driving. However, due to the large area of this zone and limited visibility due to structures such as PSB's within the zone, this zone may be reduced to a practicable monitoring area in final approved monitoring plans.;

- In accordance with the Plans, pile driving will cease if cetaceans are seen approaching or entering the shutdown (injury) zone. Work will be halted and delayed until either the animal has voluntarily left and been visually confirmed beyond the injury zone or visual portion of the Level B harassment zone or 15 minutes have passed without re-detection of the animal;
- If a pinniped approaches or enters a shutdown zone during pile impact or vibratory driving, work will be halted and delayed until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone or 15 minutes have passed without re-detection of the animal; and
- If a pinniped is observed in the Level B harassment zone, but not approaching or entering the shutdown zone, a "take" will be recorded and the work will be allowed to proceed without cessation of pile driving. Marine mammal behavior will be monitored and documented.

11.4.5 Data Collection

NMFS requires that at a minimum, the following information be collected on the sighting forms:

- Name of the PSOs;
- Date and time that pile removal or installation begins and ends;
- Construction activities occurring during each observation period;
- Weather parameters identified in the acoustic monitoring (e.g., percent cover, visibility);
- Water conditions (e.g., sea state, tidal state [incoming, outgoing, slack, low, and high]);
- Species, numbers, and, if possible, sex and age class of marine mammals;
- Time of sighting;
- Marine mammal behavior patterns observed, including bearing and direction of travel, and, if possible, the correlation to sound pressure levels;
- Distance from pile removal or installation activities to marine mammals and distance from the marine mammal to the observation point;
- Locations of all PSOs; and
- Other human activity in the area.

The Navy will note in behavioral observations, to the extent practicable, if an animal has remained in the area during construction activities. Therefore, it may be possible to identify if the same animal or a different individuals are being taken. Harbor seals may be identified by spot patterns or scars and sea lions identified by scars, brands, or fore flipper tags.

11.4.6 Mitigation Effectiveness

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. The observers will be positioned in locations, which provide the best vantage point(s) for monitoring. This will probably be an elevated position to provide a better range of viewing angles. In addition, the small radius of the shutdown zone makes the likelihood of detecting a marine mammal in this zone extremely high.

12 Mitigation Measures to Protect Subsistence Uses

Where the proposed activity would take place in or near a traditional Arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence uses, the applicant must submit either a plan of cooperation or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence uses. A plan must include the following:

(i) A statement that the applicant has notified and provided the affected subsistence community with a draft plan of cooperation

(ii) A schedule for meeting with the affected subsistence communities to discuss proposed activities and to resolve potential conflicts regarding any aspects of either the operation or the plan of cooperation

(iii) A description of what measures the applicant has taken and/or will take to ensure that proposed activities will not interfere with subsistence whaling or sealing

(iv) What plans the applicant has to continue to meet with the affected communities, both prior to and while conducting activity, to resolve conflicts and to notify the communities of any changes in the operation

Not applicable. The proposed action will take place in Puget Sound, and no activities will take place in or near a traditional Arctic subsistence hunting area. Therefore, there are no relevant subsistence uses of marine mammals implicated by this action.

13 Monitoring and Reporting

The suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species, the level of taking, or impacts on populations of marine mammals that are expected to be present while conducting activities and the suggested means of minimizing burdens by coordinating such reporting requirements with other schemes already applicable to persons conducting such activity. Monitoring plans should include a description of the survey techniques that will be used to determine the movement and activity of marine mammals near the activity site(s) including migration and other habitat uses, such as feeding.

13.1 Coordination

During the in-water work period covered by the LOA, the Navy will update NMFS on the progress of activities at NAVMAG Indian Island Ammunition Wharf (bimonthly: November 15 and January 15).

13.2 Monitoring Plans

To reduce impacts to marine mammals to the lowest extent practicable, a marine mammal monitoring plan will be approved by NMFS prior to the start of construction. The draft monitoring plan will be submitted in the spring prior to the start of the in-water work period (October). The final monitoring plan will be prepared and submitted to NMFS within 30 days following receipt of comments on the draft plan from NMFS.

Components of the monitoring plan are described in Section 11.4.

13.3 Reporting

The monitoring report will be submitted to NMFS within 90 work days of the completion of the in-water work period monitoring. The report will detail the monitoring protocol, summarize the data recorded during monitoring, and estimate the number of marine mammals that may have been harassed. The final report will be prepared and submitted to the NMFS within 30 days following receipt of comments on the draft report from the NMFS. This will also act as the annual report for the LOA.
The Marine Mammal Monitoring Plan will contain detailed reporting measures.

14 Suggested Means of Coordination

Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects.

The U.S. Navy is one of the world's leading organizations in assessing the effects of human activities in the marine environment including marine mammals. Over the last two decades, the Navy has funded over $240M specifically for marine mammal research. Navy scientists work cooperatively with other government researchers and scientists, universities, industry, and non-governmental conservation organizations in collecting, evaluating, and modeling information on marine resources. They also develop approaches to ensure that these resources are minimally impacted by existing and future Navy operations. It is imperative that the Navy's research and development (R&D) efforts related to marine mammals are conducted in an open, transparent manner with validated study needs and requirements. The goal of the Navy's R&D program is to enable collection and publication of scientifically valid research as well as development of techniques and tools for Navy, academic, and commercial use. Historically, R&D programs are funded and developed by the Navy's Chief of Naval Operations Energy and Environmental Readiness and Office of Naval Research, Code 322 Marine Mammals and Biological Oceanography Program. Primary focus of these programs since the 1990s is on understanding the effects of sound on marine mammals, including physiological, behavioral and ecological effects.

The Office of Naval Research's current Marine Mammals and Biology Program thrusts include, but are not limited to: (1) monitoring and detection research; (2) integrated ecosystem research including sensor and tag development; (3) effects of sound on marine life (such as hearing, behavioral response studies, physiology [diving and stress], and PCAD); and (4) models and databases for environmental compliance.

To manage some of the Navy's marine mammal research programmatic elements, the Navy developed the Living Marine Resources (LMR) Research and Development Program (http://www.lmr.navy.mil/) in 2011. The goal of the LMR Research and Development Program is to identify and fill knowledge gaps and to demonstrate, validate, and integrate new processes and technologies to minimize potential effects to marine mammals and other marine resources. Key elements of the LMR program include:

- Providing science-based information to support Navy environmental effects assessments for research, development, acquisition, testing, and evaluation as well as Fleet at-sea training, exercises, maintenance, and support activities;
- Improving knowledge of the status and trends of marine species of concern and the ecosystems of which they are a part;
- Developing the scientific basis for the criteria and thresholds to measure the effects of Navy-generated sound;
- Improving understanding of underwater sound and sound field characterization unique to assessing the biological consequences resulting from underwater sound (as opposed to tactical applications of underwater sound or propagation loss modeling for military communications or tactical applications); and
- Developing technologies and methods to monitor and, where possible, mitigate biologically significant consequences to LMR resulting from naval activities, emphasizing those consequences that are most likely to be biologically significant.

The following Puget Sound marine mammal monitoring activities and contracted studies are being conducted by the Navy outside of and in addition to the Navy's commitments to the NMFS under existing permits. To better understand marine mammal presence and habitat use in the Puget Sound Region, the Navy has funded and coordinated four major efforts:

- **Puget Sound Pinniped Haulout Surveys at Specific Naval Installations:** Biologists conduct counts of seals and sea lions at NAVBASE Kitsap Bremerton, Bangor, Manchester, and NAVSTA Everett. Counts are conducted weekly. All animals are identified to species where possible (Navy, 2020). This information aids in determination of seasonal use of each site and trends in the number of animals.
- **Marine Mammal Vessel Surveys in Hood Canal and Dabob Bay:** The Navy conducted a marine mammal density survey in Hood Canal and Dabob Bay during September and October 2011 and again in October 2012 (HDR Inc., 2012).
- **Aerial Pinniped Haulout Surveys:** The Navy funded and contracted WDFW to conduct aerial surveys of pinniped haul-outs in all of Puget Sound and the Strait of Juan de Fuca out to Cape Flattery. NMFS NWR funded the San Juan Islands Region. Collectively this information will be used to revise and update the 2000 Atlas of Seal and Seal Lion Haulouts in Washington State. The surveys began in 2013 and continued until spring 2014. The survey area did not cover the outer coast of Washington, only the inland waters.
- **Aerial Cetacean Surveys in Puget Sound (Admiralty Inlet and south):** The Navy has contracted aerial surveys of cetaceans in Puget Sound to better understand seasonality and distribution with the goal of improved density values. These surveys began in late 2013, and reports have been published (Smultea et al., 2015; Jefferson et al., 2016).

Overall, the Navy will continue to research and contribute to university/external research to improve the state of the science regarding marine species biology and acoustic effects. These efforts include monitoring programs, data sharing with NMFS from research and development efforts, and current research as previously described.

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