REQUEST FOR AN INCIDENTAL HARASSMENT AUTHORIZATION HAMPTON ROADS BRIDGE-TUNNEL EXPANSION PROJECT HAMPTON-NORFOLK, VIRGINIA

I 64 Hampton Roads Bridge Tunnel Expansion Project

Hampton Roads Connector Partners
240 Corporate Blvd. 4th floor
Norfolk, VA 23502

Hampton Norfolk, Virginia

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ABBREVIATIONS and ACRONYMS

μPa	microPascal(s)
BOEM	Bureau of Ocean Energy Management
CBBT	Chesapeake Bay Bridge Tunnel
CeTAP	Cetacean and Turtle Assessment Program
CFR	Code of Federal Regulations
D	depleted
dB	decibels
dBA	A-weighted decibels
dB peak	peak sound level
dB re 1 μPa	decibels referenced to a pressure of 1 microPascal
DoN	Department of the Navy
DPS	Distinct Population Segment
E	endangered
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
ESA	Endangered Species Act
FHWA	Federal Highway Administration
FR	Federal Register
GARFO	Greater Atlantic Regional Fisheries Office
HF	high-frequency
HOT	High Occupancy Toll
HRBT	Hampton Roads Bridge-Tunnel
Project	Hampton Roads Bridge-Tunnel Expansion Project
HRCP	Hampton Roads Connector Partners
HRCS	Hampton Roads Crossing Study
Hz	hertz
I	Interstate
ICE	International Construction Equipment
IHA	Incidental Harassment Authorization
IPAC	Information for Planning and Consultation
kHz	kilohertz
km^2	square kilometer(s)
$L_{E,24h}$	sound exposure level, cumulative 24 hours
LF	low-frequency
L_{eq}	averaged cumulative sound pressure level
L_{max}	maximum sound pressure level
$L_{pk,flat}$	peak sound pressure level (unweighted)
LOA	Letter of Authorization
M	mortality

m^2	square meter(s)
MF	mid-frequency
MLLW	Mean Lower Low Water
MMO	Marine Mammal Observer(s)
MMPA	Marine Mammal Protection Act
MOT	Maintenance of Traffic
N	no
NEFSC	Northeast Fisheries Science Center
NL	not-listed
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
OBIS SEAMAP	Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations
Pa	Pascal(s)
POC	Plan of Cooperation
PSO	Protected Species Observer(s)
PTS	permanent threshold shift
PW	pinnipeds in water
re	referenced to
rms	root-mean-square
SAV	submerged aquatic vegetation
SEFSC	Southeast Fisheries Science Center
SEL	sound exposure level(s)
SEL_{cum}	cumulative sound exposure level
SPL	sound pressure level(s)
SSL	sound source level(s)
SSV	sound source verification
TBM	Tunnel Boring Machine
TL	Transmission Loss
TTS	temporary threshold shift
UME	Unusual Mortality Event
U.S.	United States
USACE	United States Army Corps of Engineers
USC	United States Code
USFWS	United States Fish and Wildlife Service
VDOT	Virginia Department of Transportation
WSDOT	Washington State Department of Transportation
Y	yes

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

Hampton Roads Connector Partners (HRCP) is working with the Virginia Department of Transportation (VDOT) and federal and state agencies to advance the design, approvals, and multi-year construction of the Interstate-64 (I-64) Hampton Roads Bridge-Tunnel (HRBT) Expansion Project (Project). HRCP requests an Incidental Harassment Authorization (IHA) for the take of small numbers of marine mammals, by Level A and Level B harassment, incidental to construction associated with the Project that represent critical path work (i.e., activities that directly affect the overall Project schedule) and can begin Spring 2020.

The Project includes additional construction activities that were requested under a rulemaking and Letter of Authorization (LOA) under a separate application submitted November 2019 and are not included in this request for an IHA. The construction activities covered in the LOA are scheduled to begin in September 2020 and will continue over a 5-year period through August 2025. Under the LOA application, HRCP requested authorization for the take of small numbers of marine mammals, by Level A and Level B harassment, incidental to construction of the following Project components:

- Installation and removal of Jump Trestles at the North Trestle, South Trestle, and Willoughby Bay
- Installation of templates and permanent piles at the North Trestle, South Trestle, and Willoughby Bay
- Installation and removal of sheet piles at the North Trestle (North Shore Abutment), North Island Abutment, North Island Expansion, South Island Abutment, and South Island Expansion
- Installation of settlement reduction piles at the South Island
- Installation of deep foundation piles at the South Island
- Removal of the TBM Platform at the South Island
- Removal of the existing Hampton Creek Approach Channel Marker at North Island
- Installation of the new Hampton Creek Approach Channel Marker at North Island
- Removal of the Conveyor Trestle at the South Island
- Removal of temporary trestles for jet grouting at the South Island
- Removal of mooring piles at the North Trestle, South Trestle (located at the South Island), and North Island
- Removal of temporary trestles for bridge construction at the North Shore
- Installation and removal of temporary trestles for bridge construction at the North Trestle, South Trestle, and Willoughby Bay
- Installation and removal of temporary Maintenance of Traffic (MOT) Trestle at the South Trestle

- Installation and removal of temporary docks and finger piers at the Willoughby Spit Laydown Area
- Installation and removal of Demolition Trestles at the North Trestle and South Trestle
- Installation and removal of the mooring piles at Willoughby Bay (Safe Haven) and South Island

HRCP requests that the remaining components be authorized under this IHA application. Under this IHA application, HRCP requests authorization for the take of small numbers of marine mammals, by Level A and Level B harassment, incidental to construction of the following Project components:

- Tunnel Boring Machine (TBM) Platform at the South Island
- Conveyor Trestle at the South Island
- Temporary trestles for jet grouting at the South Island
- Temporary trestle for bridge construction at the North Shore
- Mooring piles at the South Trestle (located at the South Island), North Island, and Willoughby Bay
- Installation and removal of piles for test pile program

In-water construction associated with these Project components is scheduled to begin in April 2020 and be completed within one year. HRCP therefore requests an IHA that is valid for one year, from 01 April 2020 through 31 March 2021.

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) regulations governing the issuance of IHAs and LOAs permitting the incidental take of marine mammals under certain circumstances are codified in 50 Code of Federal Regulations (CFR) Part 216, Subpart I (Sections 216.101–216.108). The Marine Mammal Protection Act (MMPA) defines “take” to mean “to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal” (16 United States Code [USC] Chapter 31, Section 1362 (13)). Section 216.104 sets out 14 specific items that must be addressed in requests for rulemaking and renewal of regulations pursuant to Section 101(a)(5) of the MMPA.

The 14 items are addressed in Sections 1 through 14 of this application for an IHA, and include the following:

1. Description of Specified Activity
2. Dates, Duration, and Specified Geographic Region
3. Species and Numbers of Marine Mammals
4. Affected Species Status and Distribution
5. Type of Incidental Taking Authorization Requested
6. Take Estimates for Marine Mammals
7. Anticipated Impact of the Activity
8. Anticipated Impacts on Subsistence Uses
9. Anticipated Impacts on Habitat
10. Anticipated Effects of Habitat Impacts on Marine Mammals
11. Mitigation Measures to Protect Marine Mammals and Their Habitat

12. Mitigation Measures to Protect Subsistence Uses
13. Monitoring and Reporting
14. Suggested Means of Coordination

1.2 PROJECT PURPOSE AND NEED

HRBT is a major road transport infrastructure project along the existing I-64 highway in Virginia, consisting of roadway improvements, trestle bridges, and bored tunnels crossing Hampton Roads between Norfolk and Hampton. The Project will address severe traffic congestion at the existing HRBT crossing by increasing capacity and upgrading approximately 9.9 miles of I-64 between Settlers Landing Road (Exit 267, Mile Marker 267.26) in Hampton and the I-564 Interchange (Exit 276, Mile Marker 277.19) in Norfolk, Virginia. The Project will include widening I-64 to create an eight-lane facility with a consistent six-lanes between the I-64/I-664 and I-64/I-564 Interchange, which could expand to eight-lanes during peak travel periods with the use of drivable shoulder lanes within the Project limits. The additional lane and part-time shoulder lane in each direction will be operated as High Occupancy Toll (HOT) managed lanes. The new configuration will result in two general purpose lanes and one new permanent and one part-time HOT lane in each direction. The Project will include the construction of two new two-lane tunnels, expansion of the existing portal islands, and full replacement of the existing North and South bridge-trestles.

The Intermodal Surface Transportation Efficiency Act of 1991 provided funding for the Hampton Roads Crossing Study (HRCS), which considered potential improvement options to relieve congestion at the HRBT. In 2014, the Hampton Roads Transportation Accountability Commission included the HRCS in its list of priority projects, which led to the development of a Supplemental Environmental Impact Statement to evaluate options for this crossing. In December 2016, the Commonwealth Transportation Board approved “Alternative A” as the preferred alternative for this study, laying the groundwork to complete the Supplemental Environmental Impact Statement and obtain a Record of Decision in June 2017. An Environmental Assessment Re-evaluation was prepared in June 2018 to account for change to managed traffic lanes in the I-64 corridor, with a resulting Finding of No Significant Impact issued by the Federal Highway Administration (FHWA) on 23 October 2018.

1.3 PROJECT ACTIVITIES

1.3.1 PROJECT OVERVIEW

The Project will widen I-64 for approximately 9.9 miles along I-64 from Settlers Landing Road in Hampton, Virginia, to the I-64/I-564 interchange in Norfolk, Virginia. The Project will create an eight-lane facility with six consistent use lanes. The expanded facility will include four general purpose lanes, two new HOT lanes, and two new drivable (hard-running) shoulders to be used as HOT lanes during peak usage.

The Project will include full replacement of the North and South Trestle-Bridges, two new parallel tunnels constructed using a TBM, expansion of the existing portal islands, and widening of the Willoughby Bay Trestle-Bridges, Bay Avenue Bridges, and Oastes Creek Bridges. Also, upland portions of I-64 will be widened to accommodate the additional lanes, the Mallory Street Bridge will be replaced, and the I-64 overpass bridges will be improved.

The Project design is divided into five segments (Table 1-1, Figure 1-1) as follows:

- Segment 1a (Hampton) begins at the northern terminus of the Project in Hampton and ends at the north end of the north approach slabs for the north tunnel approach trestles. This segment has two interchanges and also includes improvements along Mallory Street to accommodate the bridge replacement over I-64. This segment covers approximately 1.2 miles along I-64.
- Segment 1b (North Trestle-Bridges) includes the new and replacement north tunnel approach trestles, including any approach slabs. This segment covers approximately 0.6 mile along I-64.
- Segment 2a (Tunnel) includes the new bored tunnels, the tunnel approach structures, buildings, the North Island improvements for tunnel facilities, and South Island improvements. This segment covers approximately 1.8 miles along I-64.
- Segment 3a (South Trestle-Bridge) includes the new South Trestle-Bridge and any bridge elements that interface with the South Island to the south end of the south abutments at Willoughby Spit. This segment covers approximately 1.2 miles along I-64.
- Segment 3b (Willoughby Spit) continues from the south end of the south approach slabs for the south trestle and ends at the north end of the north approach slabs for the Willoughby Bay trestles. This segment includes a modified interchange connection to Bayville Street, and has a truck inspection station for the westbound tunnels. This segment covers approximately 0.6 mile along I-64.
- Segment 3c (Willoughby Bay Trestle-Bridges) includes the entire structures over Willoughby Bay, from the north end of the north approach slabs on Willoughby Spit to the south end of south approach slabs near the 4th View Street interchange. This segment covers approximately 1.0 mile along I-64.
- Segment 3d (4th View Street Interchange) continues from the Willoughby Trestle-Bridges south, leading to the north end of the north approach slabs of I-64 bridges over Mason Creek Road along mainline I-64. This segment covers approximately 1.0 mile along I-64.
- Segment 4a (Norfolk-Navy) goes from the I-64 north end of the north approach slabs at Mason Creek Road to the north end of the north approach slabs at New Gate/Patrol Road. There are three interchange ramps in this segment: westbound I-64 exit ramp to Bay Avenue, eastbound I-64 entrance ramp from Ocean Avenue, and westbound I-64 entrance ramp from Granby Street. The ramps in this segment are all on structure. This segment covers approximately 1.5 miles along I-64.
- Segment 5a (I-564 Interchange) starts from the north end of the north approach slab of the New Gate/Patrol Road Bridge to the southern Project Limit. This segment runs along the Navy property and includes an entrance ramp from Patrol Road, access ramps to and from the existing I-64 Express Lanes, ramps to and from I-564, and an eastbound I-64 entrance ramp from Little Creek Road. This segment covers approximately 1.2 miles along I-64.

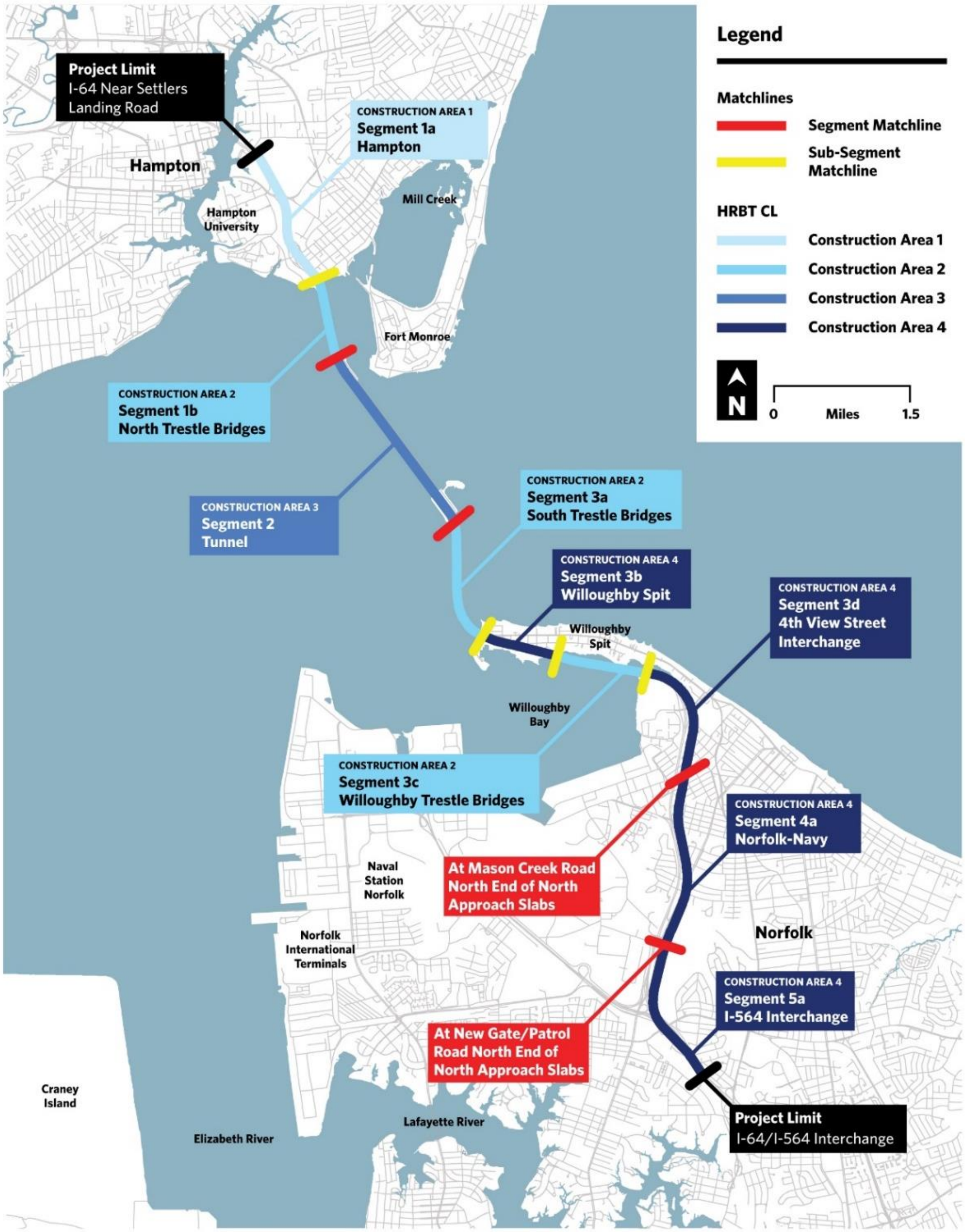
Table 1-1: HRBT Expansion Project Design Segments

Project Design Segment Number and Name	Construction Area
Segment 1a (Hampton)	Area 1
Segment 1b (North Trestle-Bridges)	Area 2
Segment 2a (Tunnel)	Area 3
Segment 3a (South Trestle-Bridge)	Area 2
Segment 3b (Willoughby Spit)	Area 4
Segment 3c (Willoughby Bay Trestle-Bridges)	Area 2
Segment 3d (4th View Street Interchange)	Area 4
Segment 4a (Norfolk-Navy)	Area 4
Segment 5a (I-564 Interchange)	Area 4

Proposed in-water marine construction activities that have potential to affect marine mammals will occur at the following locations in Construction Areas 2 and 3 (Figure 1-1):

- North Trestle-Bridges (Segment 1b)
- Tunnel - North Island and South Island (Segment 2a)
- South Trestle-Bridge (Segment 3a)
- Willoughby Bay Trestle-Bridges (Segment 3c)

Figure 1-1: Hampton Roads Bridge-Tunnel (HRBT) Expansion Project Design Segments and Key Map



Marine construction activities in these design segments include: tunneling, pile installation (driving), pile removal, fill placement associated with island expansion, dredging, demolition of existing in-water structures, and associated vessel (barge and tug) movements. Pile installation methods will include impact and vibratory driving, jetting, and drilling with a down-the-hole hammer. Pile removal techniques for temporary piles will include cutting 3 feet below the mud line. In-water pile installation using impact and vibratory driving, jetting, and drilling with a down-

the-hole hammer, have the potential to harass marine mammals as defined under the MMPA of 1972, as amended in 2007 (16 USC 31), and could result in incidental takes of individual marine mammals from exposure to Project-related noise. Other activities are not anticipated to result in noise levels that rise to the level of acoustic harassment under the MMPA.

As stated above, HRCP is requesting an IHA for those Project activities and components scheduled to begin April 2020, including pile installation for the following components:

- TBM Platform at the South Island
- Conveyor Trestle at the South Island
- Temporary trestles for jet grouting at the South Island
- Temporary trestle for bridge construction at the North Shore
- Mooring piles at the South Trestle (located at the South Island), North Island, and Willoughby Bay
- Installation and removal of piles for test pile program

All remaining Project components will be constructed beginning approximately September 2020 through 2025, which will be authorized under a rulemaking and LOA.

Activities considered in this IHA application include installation of steel pipe piles that are 24, 36, or 42 inches[1] in diameter to support temporary work trestles, platforms, and moorings. Test piles will consist of 24-inch concrete square, 30-inch concrete square, or 54-inch concrete cylinder piles. Only concrete load test piles will be removed under this IHA (cut 3 feet below the mudline), but this activity is not anticipated to result in noise levels that rise to the level of acoustic harassment under the MMPA.

Pile installation methods will include vibratory and impact installation, jetting, as well as drilling with a down-the-hole hammer, as described below in Section 1.3.3. More than one installation method can be used within a day and at each location. Pile installation will occur in waters ranging in depth from less than 3.3 feet near the shore to approximately 28 feet, depending on the structure and location. The majority of the piles will be in water depths of 12 to 15 feet. A description of pile driving activities considered in this IHA application is provided in Section 1.3.2 and Table 1-2. Pile driving locations for each Project component are provided in Attachment 1.

1.3.2 PROJECT COMPONENTS

It is important to note that the Project construction activities and components will change as the design is finalized, construction contracts are awarded, and construction details are further refined.

The pile installation schedule provided in this IHA application is currently the best estimate for the project based on design, means and methods, and construction information. The quantity of pile production could differ from a month to another to adjust schedule constraints (such as

[1] In this IHA application, the units of measure reported for pile installation are U.S. customary units, which are typically used in construction. Units of measure for scientific information, including acoustics, are metric. When appropriate, units are reported as both U.S. customary and metric.

change in the construction critical path, procurement and delivery of items, weather delays, and unforeseeable events).

1.3.2.1 TBM Platform at the South Island (Segment 2a)

HRCP is constructing the temporary TBM Platform or "quay" at the South Island to allow for the delivery, unloading, and assembly of the TBM components from barges to the South Island. The large TBM components will be delivered by barge and then transferred to the TBM Platform using a Self-Propelled Modular Transport, crawler crane, sheerleg crane and/or other suitable equipment. The TBM Platform will also allow barge delivery and storage of concrete tunnel segments as the boring operation progresses. The concrete tunnel segments will be offloaded and moved using a combination of crawler cranes and a gantry crane installed on the TBM Platform. The tunnel segments will be stored on the TBM Platform prior to delivery to the tunnel shaft for installation.

The TBM Platform is a steel structure founded on 216 36-inch diameter steel pipe piles[2], with an overall area of approximately 0.40 acre (approximately 166 feet x 9 feet). The piles will be installed using a combination of vibratory and impact hammers except along the shoreline where drilling with a down-the-hole hammer may be needed to install piles through the large armor stone (see Section 1.3.3). The piles are 154 feet long and will have an average embedded length of approximately 140 feet. Table 1-2 provides additional information on the pile driving operation including estimated pile installation times and number of strikes necessary to drive a pile to completion.

The superstructure of the TBM Platform is set on top of the piles and consists of transverse and longitudinal beams below a 13/16-inch-thick plate set on top of the beams. Rail beams will be installed on top of the plate and will support the gantry crane. A concrete slab may be placed on top of the steel plates or timber trusses.

Mooring dolphins will be installed along the shoreline of the South Island in the areas adjacent to the TBM Platform. Each dolphin will consist of 36-inch diameter steel piles and will be installed with a combination of vibratory and impact hammers.

At the conclusion of the Project, the TBM Platform and the mooring dolphins will be removed or cut to approximately 3 feet below the mudline. Work associated with TBM Platform and mooring dolphin removal will be performed under a rulemaking and LOA.

1.3.2.2 Conveyor Trestle at the South Island (Segment 2a)

Tunnel boring spoils and other related materials will be moved between the South Island and barges via a conveyor belt and other equipment throughout tunnel boring. The Conveyor Trestle will also be used for maintenance and mooring of barges and vessels carrying TBM materials and other Project-related materials.

The Conveyor Trestle is a steel structure founded on 84 36-inch diameter steel piles, with an overall area of approximately 0.42 acre (approximately 673 feet x 27 feet). The piles will be installed using a combination of vibratory and impact hammers except near shore where a down-the-hole hammer may be needed to install piles through the armor stone (see Section

[2] Unless otherwise noted, references to "steel pile(s)" refer to steel pipe piles.

1.3.3). The piles are approximately 140 feet long and will have an average embedded length of approximately 100 feet.

Additionally, mooring dolphins will be installed along the area of or adjacent to the Conveyor Trestle. Each dolphin will consist of 36-inch diameter steel piles and will be installed with a combination of vibratory and impact hammers.

At the conclusion of the Project, the Conveyor Trestle and mooring dolphins will be removed. Work associated with Conveyor Trestle and mooring dolphin removal will be performed under a rulemaking and LOA.

1.3.2.3 Temporary Trestle for Bridge Construction at the North Trestle (Segment 1b)

The temporary North Shore Work Trestle will support construction of the permanent eastbound North Trestle-Bridge in the shallow water (<4 to 6 feet Mean Low Water) closer to the North Shore, avoiding the need to dredge or deepen this area (which otherwise would have been required for barge access) and minimizing potential impacts to the adjacent submerged aquatic vegetation (SAV). The temporary North Shore Work Trestle is a steel structure founded on 194 36-inch diameter steel piles with 30-40 feet spans sized to accommodate a 300-ton crane. The piles will be installed using a combination of vibratory and impact hammers except along the shoreline where drilling with a down-the-hole hammer may be needed to install piles through the armor stone (see Section 1.3.3). The main portion of the North Shore Work Trestle will be approximately 1,130 feet long by 45 feet wide, with three approximately 80 feet x 30 feet fingers and an additional landing area approximately 150 feet x 45 feet, for a total overall approximate area of 1.49 acres.

Mooring dolphins will be installed at the southern end and along the outside edge of the North Shore Work Trestle. Each dolphin will consist of 24-inch diameter steel piles. Additional 42-inch diameter steel pipe piles will be installed along the outer edge of the North Shore Work Trestle to provide additional single mooring points for barges and vessels delivering material and accessing the trestle. The mooring dolphin piles and the single mooring point piles will be installed using a vibratory hammer.

Once that portion of the permanent eastbound North Island Bridge is complete, the temporary North Shore Work Trestle pile foundations will be removed via vibratory hammer and the work trestle reused for similar purposes at a different location on the Project (e.g., Willoughby Bay work trestles submitted under a separate rulemaking and LOA). Removal of the temporary North Shore Work Trestle and mooring dolphins will be performed under a rulemaking and LOA.

1.3.2.4 Moorings at the North Trestle (Segment 1b)

Temporary moorings will be installed at the North Trestle to support the construction of temporary work trestles and permanent trestle bridges. Mooring dolphins will be installed consisting of clusters of 24-inch diameter steel piles. An additional 36 42-inch diameter steel pipe piles will be installed along what will become the outer edge of the work trestle to provide additional single mooring points for barges and vessels delivering material and accessing the trestle. The mooring dolphin piles and the single mooring point piles will be installed using a vibratory hammer. A total of 66 steel pipe piles will be driven, 36 42-inch diameter steel piles and 30 24-inch diameter steel piles at the North Trestle.

At the conclusion of the Project, the moorings will be removed. Work associated with removal of the moorings will be performed under a rulemaking and LOA.

1.3.2.5 Moorings at the North Island Expansion (Segment 2a)

Temporary moorings will be installed along the perimeter of the North Island Expansion area to support the construction of the Island expansion. Eighty (80) 42-inch diameter steel pipe piles will be installed to provide mooring points for barges and vessels. The mooring point piles will be installed using a vibratory hammer.

At the conclusion of the Project, the moorings will be removed. Work associated with removal of the moorings will be performed under a rulemaking and LOA.

1.3.2.6 Temporary Trestles for Jet Grouting at the South Island (Segment 2a)

Unconsolidated soil conditions at the western edge of the South Island – along the centerline and depth of the planned tunnel alignment – require ground improvements to allow tunnel boring to proceed safely and efficiently. Ground improvements will be achieved using deep injection of a concrete-like material into subsurface environments or jet grouting to stabilize and consolidate the sediments along the planned tunnel alignment and tunnel depth. A single fluid system consisting only of air, water, and grout will be used for the jet.

Two temporary work trestles will be constructed along either side of the planned tunnel alignment to support jet grouting activity. Each trestle will be approximately 40 feet wide and extend approximately 1,000 feet west of the South Island shoreline, for a total overall approximate area of 1.84 acres. The two temporary Jet Grouting Trestles will be constructed, each will be founded on 102 36-inch diameter steel piles (a total of 204 steel piles) with 25 +/- feet spans sized to accommodate a 35-ton drill rig and support equipment. The piles will be installed using a combination of vibratory and impact hammers except along the shoreline where drilling with a down-the-hole hammer may be needed to install piles through the armor stone (see Section 1.3.3). To minimize hydroacoustic impacts caused by the impact hammer, a bubble curtain will be used when installing piles for the temporary trestles in water depths greater than 20 feet.

At the conclusion of the Project, the Jet Grouting Trestles will be removed by cutting the steel pipe piles 3 feet below the mudline. Work associated with removal of the Jet Grouting Trestles will be performed under a rulemaking and LOA.

1.3.2.7 Moorings at the South Trestle (Segment 3a)

Temporary moorings will be installed in the area of the South Trestle to support the construction of temporary work trestles and permanent trestle bridges. Six mooring dolphins will be installed and each will consist of three 24-inch diameter steel piles for a total of 18 24-inch diameter steel piles. An additional 41 42-inch diameter steel pipe piles will be installed along what will become the outer edge of the work trestle to provide additional single mooring points for barges and vessels delivering material and accessing the trestle. The mooring dolphin piles and the single mooring point piles will be installed using a vibratory hammer.

At the conclusion of the Project, the moorings will be removed. Work associated with removal of the moorings will be performed under a rulemaking and LOA.

1.3.2.8 Moorings at Willoughby Bay (Segment 3c)

Temporary moorings will be installed in Willoughby Bay to support the construction of temporary work trestles and permanent trestle bridges. Six mooring dolphins will be installed – each consisting of three 24-inch diameter steel piles. An additional 50 42-inch diameter steel pipe piles will be installed along what will become the outer edge of the work trestle to provide additional single mooring points for barges and vessels delivering material and accessing the trestle. The mooring dolphin piles and the single mooring point piles will be installed using a vibratory hammer. A total of 68 steel pipe piles will be driven, 50 42-inch diameter steel piles and 18 24-inch diameter steel piles.

An additional 50 42-inch diameter steel pipe piles will be installed in Willoughby Bay to create moorings for additional staging of barges and safe haven for vessels in the event of severe weather. The moorings will be configured as two 2,000-feet long lines with a 42-inch diameter steel mooring pile every 80-feet. The piles will be installed using a vibratory hammer.

At the conclusion of the Project, the moorings will be removed. Work associated with removal of the moorings will be performed under a rulemaking and LOA.

1.3.2.9 Piles for Testing Program (Segments 1b, 2a, 3a, and 3c)

HRCP will perform limited pile load testing to confirm permanent concrete pile design during April – June 2020, the remainder of the requisite pile load tests will be performed during construction of the permanent trestle bridges under a rulemaking and LOA.

Test piles will be installed at the North Trestle (1 test pile), South Trestle (2 test piles), and at Willoughby Bay (1 test pile) – test piles will be 24-inch concrete square, 30-inch concrete square, and/or 54-inch concrete cylinder piles. Requisite pile load tests will be performed during construction to confirm permanent concrete pile design for the permanent trestle bridges. Pre-drilling will be done in the open without the use of a caisson. The drill, drill steel, and auger would be in leads and either attached to the pile leads or used independently and indexed to the template to resist rotation. The auger is anticipated to be 54-inch in diameter and 10 feet or less in height.

Test piles will be set using temporary steel templates designed to support and position the test pile while being driven. The templates will be supported by four temporary 36-inch diameter steel pipe piles, generally one at each corner of the template. A two-tier template will be used to account for the possible batter of the permanent piles. A vibratory hammer will be used to install the temporary 36-inch diameter steel piles supporting the template and proofed using an impact hammer to confirm sufficient load capacity. Some areas near the shorelines may require the use of drilling with a down-the-hole hammer to install the templates. Test piles will be cut 3 feet below the mudline and removed.

Permanent concrete test piles will be driven using an impact hammer. Where geotechnical conditions require, the permanent piles may also be installed via jetting (See Section 1.3.3). Where jetting is required, an outer steel pipe pile caisson may be installed using a vibratory hammer before installation of the square concrete piles (Willoughby Bay).

1.3.3 IN-WATER MARINE CONSTRUCTION ACTIVITIES

Four methods of pile installation are anticipated. These include use of vibratory hammer, impact hammer, jetting, and drilling with a down-the-hole hammer. More than one installation method could be used within a day and at each location. Most steel pipe piles will be installed using a combination of vibratory (ICE 416L or similar) and impact hammers (S35 or similar). Steel pipe piles at the North Shore Work Trestle, Jet Grouting Trestle, and TBM Platform will be installed using the vibratory hammer approximately 80% of the time and impact hammer approximately 20% of the time, while all mooring piles and steel pipe piles at the Conveyor Trestle will be installed using the vibratory hammer approximately 90% and the impact hammer approximately 10% of the time. Depending on the location, the pile will be advanced using vibratory methods and then impact driven to final tip elevation. Where bearing layer sediments are deep, driving will be conducted using an impact hammer so that the structural capacity of the pile embedment can be verified.

Permanent piles will be set using temporary steel templates. Templates will be positioned and held in place using spuds or steel pipe piles, up to 36-inch diameter, generally one at each corner of the template. Spuds will be installed under their own weight (i.e., set in place) and/or using a vibratory hammer, when necessary. As templates are temporary and largely do not bear significant vertical loads, installation (i.e., driving) and removal of template spuds requires de minimis driving time, approximately 30 to 60 seconds per spud and was not included in pile driving zone of influence estimates. Requisite pile load tests will be performed during construction to confirm permanent concrete pile design of the permanent trestle bridges. Permanent concrete piles will be installed using an impact hammer. Permanent concrete piles may also be installed via jetting. High-pressure water is sprayed out of the bottom of the pile to help penetrate dense sand layers and to allow pile driving with lower hammer impact energies (Caltrans 2015). During jetting pressurized fluid will be used to temporary loosen soils thus reducing the resistance of the pile to sinking into the ground. Jetting will not be conducted at the surface of the seabed but rather at depth once sufficient resistance to pile driving has been met. Jetting will not be used to remove or displace surface sediments. Where jetting is required, an outer steel pipe pile caisson may be installed before installation of the square concrete piles at Willoughby Bay. The caisson will be driven using a vibratory hammer and the sediment and sand removed from the caisson prior to driving the permanent concrete pile.

Pre-drilling will be performed on the 54-inch concrete cylinder permanent piles in the open without the use of a caisson. The drill, drill steel, and auger will be in leads and either attached to the pile leads or used independently and indexed to the template to resist rotation. The auger is anticipated to be 54-inch in diameter and 10 feet or less in height. The intent of pre-drilling is to loosen the soils directly underneath the pile to maximize pile advancement before the drive and shorten the length of driving time. The pre-drilling will not make a “hole” and the drilled soils will remain in the vertical drilled column. Pre-drilling may reduce driving times by as much as 50% and it is anticipated that the pre-drilling depth will be less than half the pile length. In case of dense sand or difficult driving soils pending the specifications, HRCP may drill to within 3-4 diameters above the final tip elevation. It is expected that the drill, drill turntable, drill steel, and drill bit would have almost no impact on noise levels. The equipment and nature of the act of pre-drilling in soils produce minimal noise and the pre-drilling will significantly reduce the driving time which in turn reduces the total noise levels. Once the drill auger reaches a certain depth, the soil moisture content is minimal. Water will be introduced into the soils through the drill steel out the bottom of the drill by a pressurized pump. This water and the act of drilling is what breaks up the consistency of the soils. Due to the specific gravity of the still dense soils versus

the surrounding water, the soils will remain in the drilled column and not be released into the surrounding water.

The pile installation methods used will depend on sediment depth and conditions at each pile location. Table 1-2 provides additional information on the pile driving operation including estimated pile driving times. The sum of the days of pile installation is greater than the anticipated number of days because more than one pile installation method will be used within a day and at each location. The overall number of anticipated days of pile installation is 312, based on a six-day work week for one year. Pile installation numbers might shift from a month to another depending on schedule constraints.

To minimize hydroacoustic impacts caused by the impact hammer, a bubble curtain will be used when installing piles for the temporary trestles in water depths greater than 20 feet. Bubble curtains will be used at the Jet Grouting Trestle to minimize noise for steel pipe piles located in deeper water (>20 feet).

Prior to installing steel pipe piles near shorelines protected with rock armor and/or rip rap (e.g., South Island shorelines; North Shore shoreline), it will be necessary to temporarily shift the rock armoring that protects the shoreline to an adjacent area to allow for the installation of the piles. The armor stone should only be encountered at the shoreline and at relatively shallow depths below the mudline. The armor stone and/or rip rap will be moved and reinstalled near its original location following the completion of pile installation. Alternatively, the piles may be installed without moving the armor stone, by first drilling through the stone with a “down-the-hole” hammer (e.g., Berminghammer BH 80 drill or equivalent) to allow for the installation of the piles. A down-the-hole hammer uses both rotary and percussion-type drill devices. This device consist of a drill bit that drills through stone using both rotary and pulse impact mechanisms. This breaks up the stone to allow removal of the fragments and insertion of the pile. The pile is usually advanced at the same time that drilling occurs. It is estimated that a down-the-hole hammer will be used for approximately 1 to 2 hours per pile, when necessary. It is anticipated that approximately 5% of the North Shore Work Trestle piles, 10% of the Jet Grouting Trestle piles, 10% of the Conveyor Trestle piles, and 50% of the TBM Platform piles may require use of a down-the-hole hammer Table 1-2

Table 1-2: Numbers and Types of Piles to be Installed for each Hampton Roads Bridge-Tunnel Expansion Project Component and Structure

Project Component	Pile Size) / Type and Material	Total Number of Piles	Embedment Length (feet)	Number of Piles Down-the-Hole	Average Down-the-Hole Duration Per Pile (minutes)	Number of Piles Vibrated / Hammered	Average Vibratory Duration Per Pile (minutes)	Approximate # of Impact Strikes Per Pile	Number of Piles Per Day Per Hammer	Estimated Total Number of Hours of Installation	Number of Days of Installation
North Trestle (Segment 1a)											
North Shore Work Trestle	36-inch Steel Pipe	194	100	10	120	184	50	40	3	162	65
Moorings	42-inch Steel Pipe	36	60	-	-	36	30	-	6	18	6
Moorings	24-inch Steel Pipe	30	60	-	-	30	30	-	6	15	5
Test Pile Program (Load Test Piles)	54-inch Concrete Cylinder Pipe	1	140	-	-	1		2,100	1	2	1
Test Pile Program (Production Piles)	54-inch Concrete Cylinder Pipe	10	140	-	-	10	-	2,100	1	20	10
North Island (Segment 2a)											
Moorings	42-inch Steel Pipe	80	60	-	-	80	30	-	6	40	13

Project Component	Pile Size) / Type and Material	Total Number of Piles	Embedment Length (feet)	Number of Piles Down-the-Hole	Average Down-the-Hole Duration Per Pile (minutes)	Number of Piles Vibrated / Hammered	Average Vibratory Duration Per Pile (minutes)	Approximate # of Impact Strikes Per Pile	Number of Piles Per Day Per Hammer	Estimated Total Number of Hours of Installation	Number of Days of Installation
Willoughby Bay (Segment 3c)											
Moorings	42-inch Steel Pipe	50	60	-	-	50	30	-	6	25	9
Moorings	24-inch Steel Pipe	18	60	-	-	18	30	-	6	9	3
Moorings (Safe Haven)	42-inch Steel Pipe	50	60	-	-	50	30	-	6	25	9
Test Pile Program (Load Test Piles)	24-inch or 30-inch Concrete Square Pipe	1	140	-	-	1		2,100	1	2	1
Test Pile Program (Production Piles)	24-inch or 30-inch Concrete Square Pipe	15	140	-	-	15	-	2,100	1	30	15
South Trestle (Segment 3a)											
Moorings	42-inch Steel Pipe	41	60	-	-	41	30	-	6	21	7
Moorings	24-inch Steel Pipe	18	60	-	-	18	30	-	6	9	3
Test Pile Program (Load Test Piles)	54-inch Concrete Cylinder Pipe	2	140	-	-	2		2,100	1	4	2

Project Component	Pile Size) / Type and Material	Total Number of Piles	Embedment Length (feet)	Number of Piles Down-the-Hole	Average Down-the-Hole Duration Per Pile (minutes)	Number of Piles Vibrated / Hammered	Average Vibratory Duration Per Pile (minutes)	Approximate # of Impact Strikes Per Pile	Number of Piles Per Day Per Hammer	Estimated Total Number of Hours of Installation	Number of Days of Installation
Test Pile Program (Production Piles)	54-inch, Concrete Cylinder Pipe	20	140	-	-	20	-	2,100	1	40	20
South Island (Segment 2a)											
TBM Platform	36-inch Steel Pipe	216	140	108	120	108	60	60	2	216	108
Jet Grouting Trestle	36-inch Steel Pipe	204	100	20	120	184	50	40	3	170	68
Conveyor Trestle	36-inch Steel Pipe	84	100	8	120	76	50	40	3	70	28
Total		**1,070**									

1.3.4 VESSELS

Vessels used for pile driving activities will consist of barges, floats, tugs, and crew boats. Vessels will be required to deliver equipment and construction materials to the work locations. Three barges ranging in size from 150 x 60 feet to 195 x 60 feet will be used at each pile driving location for pile driving and pile delivery Table 1-3. Three tug boats ranging in size from 60 x 24 feet to 100 x 34 feet will be used to move and position barges. Two to three crew boats will be used to transport construction workers to and from the Project components.

Table 1-3: Vessel Numbers and Types to be used during the Hampton Roads Bridge-Tunnel Expansion Project

Project Component	Number and Type of Vessel	Vessel Size (feet)	Draft (feet)
TBM Platform and Conveyor Trestle	2 barges for pile driving + 1 barge for delivery	150 x 60 to 195 x 60	4 to 10
Jet Grouting Trestles	2 barges for pile driving + 1 barge for delivery	150 x 60 to 195 x 60	4 to 10
North Shore Work Trestle	2 barges for pile driving + 1 barge for delivery	150 x 60 to 195 x 60	4 to 10
Test Piles	2 barges for pile driving + 1 barge for delivery	150 x 60 to 195 x 60	4 to 10
Mooring Piles	2 barges for pile driving + 1 barge for delivery	150 x 60 to 195 x 60	4 to 10
Total	**15**		

Increased vessel traffic potentially increases the chances for ship strikes of marine mammals. To minimize the potential for ship strikes, vessels greater than 65 feet in length working within and traveling to and from the Project area will travel at less than 10 knots when marine mammals are present and follow established vessel speed restrictions to be protective of marine mammals.

2 DATES, DURATION, AND SPECIFIED GEOGRAPHIC REGION

The date(s) and duration of such activity and the specific geographical region where it will occur.

2.1 DATES AND DURATIONS

In-water construction covered under this IHA application is scheduled to begin on or about April 2020 and continue through March 2021 (see Table 2-1). Most pile installation will be complete by September 2020. Some pile installation – at the Jet Grouting Trestles and North Shore Work Trestle – may extend beyond September. Mooring piles will be installed intermittently as work progresses and additional barges are used. Construction may occur at multiple locations simultaneously. Impact pile driving is projected to take place at 3 to 4 locations concurrently and there is a potential for a maximum of 5 concurrent pile driving locations. Pile installation will occur intermittently over the work period, for durations of minutes to hours at a time. Work schedule is dependent on weather, construction and mechanical delays, protected species shutdowns, and other potential delays and logistical constraints. Substantial shore-side (above-water) construction will also occur intermittently. Pile driving is scheduled to occur 6 days per week. The overall number of anticipated days of pile installation is 312, based on a six-day work week for one year.

Pile installation may extend into evening or nighttime hours as needed to accommodate pile installation requirements (e.g., once pile driving begins – a pile will be driven to design tip elevation).

Pile installation can occur at variable rates, from a few minutes one day to several hours the next. HRCP anticipate that 1 to 10 piles could be installed per day. In order to account for inefficiencies and delays, HRCP have estimated an average installation rate of 3.5 piles per day, with a probable range of 1 to 8 piles per day, for most components (Table 1-2). Pile installation numbers might shift from a month to another depending on schedule constraints.

Table 2-1: Anticipated Pile Installation Periods for each Hampton Roads Bridge-Tunnel Expansion Project Component

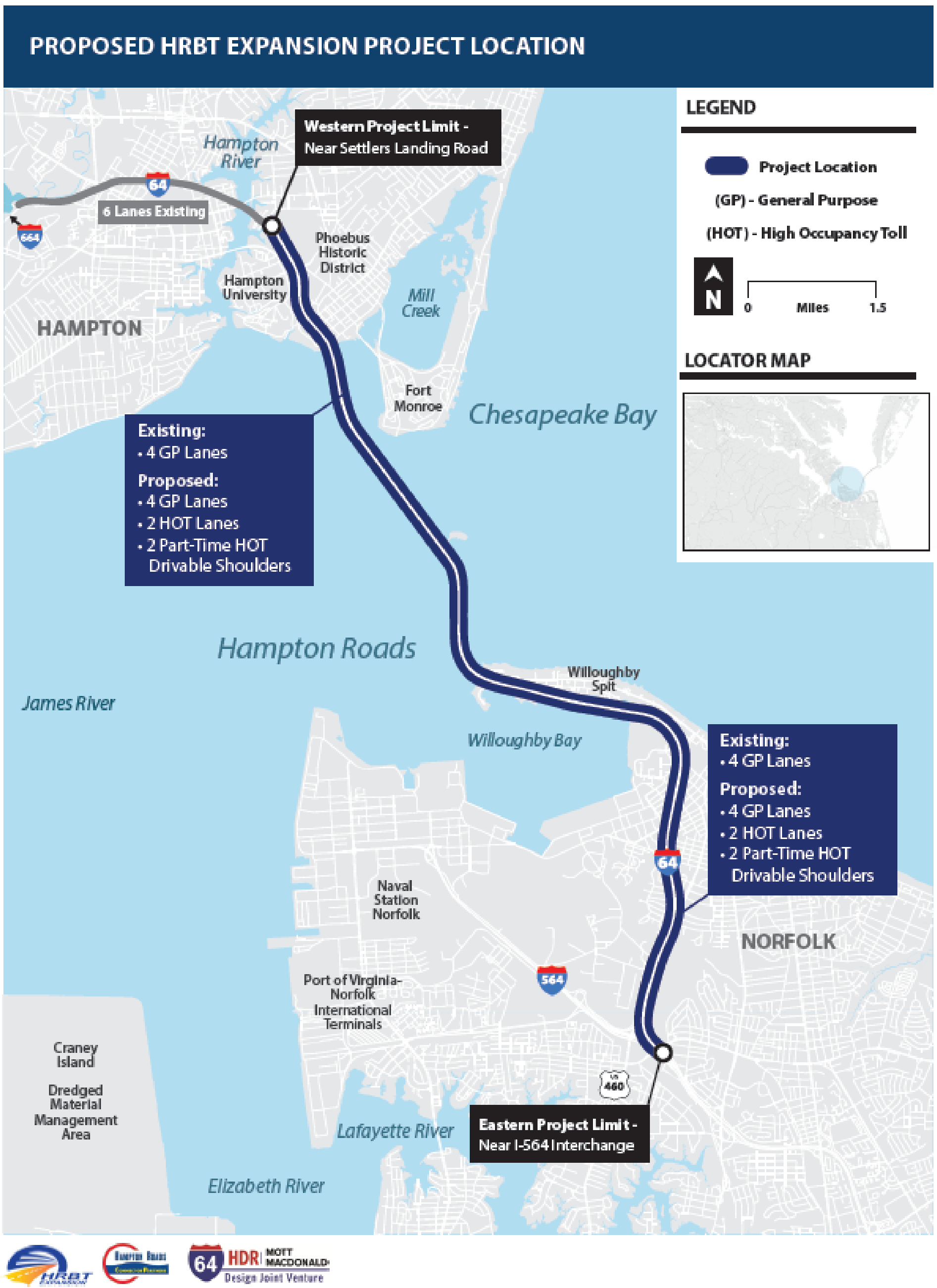
Project Component	Year	2020									2021		
	Month	A	M	J	J	A	S	O	N	D	J	F	M
TBM Platform		■	■	■	■	■	■						
Conveyor Trestle		■	■	■	■	■	■						
Jet Grouting Trestles		■	■	■	■	■	■	■	■				
North Shore Work Trestle		■	■	■	■	■	■	■	■	■			
Moorings		■	■	■	■	■	■	■	■	■	■	■	■
Test Pile Program		■	■	■	■								

TBM = Tunnel Boring Machine

2.2 GEOGRAPHICAL SETTING

The Project is located in the waterway of Hampton Roads adjacent to the existing bridge and island structures of the HRBT in Virginia (Figure 2-1). Hampton Roads is located at the confluence of the James River, the Elizabeth River, the Nansemond River, Willoughby Bay, and the Chesapeake Bay (Figure 2-1).

Figure 2-1: Hampton Roads Bridge Tunnel (HRBT) Expansion Project Location



2.3 PHYSICAL ENVIRONMENT

The Project will occur in Hampton Roads, Virginia (Figure 2-1). Hampton Roads, one of the world's largest natural harbors, incorporates the mouths of the Elizabeth River, Nansemond River, and James River with several smaller rivers and empties into the Chesapeake Bay near its mouth leading to the Atlantic Ocean. Hampton Roads is a wide marine channel that provides access to the Port of Virginia and several other deep water anchorages upstream of the Project area (VDOT and FHWA 2016). The Port of Virginia, located along the Elizabeth River, is a naturally deep harbor. Navigational channels are maintained by the U. S. Army Corps of Engineers (USACE) within Hampton Roads to provide transit to the many ports in the region. Maintained navigation channels near Project area consist of:

- Norfolk Harbor Entrance Reach (1,000 to 1,400 feet wide and is maintained at a depth of 50 feet Mean Lower Low Water (MLLW)).
- Hampton Creek Entrance Channel (200 feet wide and is maintained at a depth of 12 feet MLLW).
- Phoebus Channel (150 feet wide and is maintained at a depth of 12 feet MLLW).
- Willoughby Channel (200 feet wide and is maintained at a depth of 10 feet MLLW).

Sediments are mostly fine and medium sands with various amounts of coarse sand and gravel, and low organic carbon content. In the Fort Wool Cove (a cove of the decommissioned island fortification located approximately one mile south of Fort Monroe in the mouth of Hampton Roads, which sits near Willoughby Beach and Willoughby Spit, adjacent to the HRBT), sediments are fine and very fine sands with various amounts of silt and clay. There is no naturally occurring rocky or cobble bottom present at or adjacent to the Project area.

SAV occurs near the shores on the Hampton side and on the east side of the North Island (VDOT and FHWA 2016). Species of SAV most commonly found in the Chesapeake Bay and its tributaries, within the vicinity of the Project area, include eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*). Other species, less likely to occur due to their association with freshwater and lower salinity levels, include wild celery (*Vallisneria americana*), hydrilla (*Hydrilla verticillata*), redhead grass (*Potamogeton perfoliatus*), sago pondweed (*Stuckenia pectinata*), and Eurasian watermilfoil (*Myriophyllum spicatum*) (Orth et al. 2015; VDOT and FHWA 2016).

There are wetlands present within the Project area, primarily on the banks of the James River and tributaries (Oastes Creek and Mason Creek). The diversity of wetlands in this region spans a range of freshwater to saline, lunar-tidal estuaries; tidal and palustrine swamps; non-riverine, groundwater-saturated flats; seasonally flooded ponds and depressions; seepage slope wetlands; and various tidal and non-tidal aquatic habitats. There are mudflats adjacent to the Project area near the northern boundary at the Hampton River crossing and John's Creek.

The North Shore in Hampton contains estuarine intertidal sandy shore, estuarine intertidal reef, as well as SAV in shallow estuarine open water. Near the Hampton shore, the North Trestle crosses over a narrow strip of estuarine intertidal sandy shore. Seagrass beds occur on both sides of the North Trestle in this small area near the shore. The North Trestle is located in estuarine open water with depths less than 15 feet below MLLW.

The North Island is surrounded by estuarine intertidal sandy shore and rocky shore. There is a SAV bed to the east of the island outside of the construction area. Estuarine open water depths are primarily less than 15 feet below MLLW, but drop to approximately 25 feet below MLLW near the southwest corner of the island expansion closer to the Hampton Creek Entrance Channel.

The South Island is also surrounded by estuarine intertidal sandy shore and rocky shore, followed by estuarine open water. The proposed island expansion is mainly in deep water (15 to 30 feet below MLLW), with a pocket of deeper water approximately 35 feet below MLLW to the west.

The South Trestle is primarily located in estuarine open water with depths less than 15 feet below MLLW, with the exception of deep water (15 to 30 feet below MLLW) near the South Island approach. There is an estuarine intertidal sandy shore along the South Shore in Norfolk.

Willoughby Bay contains an estuarine intertidal sandy shore, with emergent and scrub/shrub wetlands along the shores. The bay between the shores is estuarine open water with depths to 15 feet below MLLW.

Temperature and salinity vary seasonally. Salinity is lower from March to May and increases in the summer and early fall. Temperature in the water column is well-mixed in spring and winter, due to larger turbulence mixing and weaker surface heating, and stratified in the summer to fall, primarily due to solar heating. Overturning occurs during fall as the surface water becomes progressively cooler and eventually colder than the bottom water (Lippson 1985).

Environmental aspects important to the analysis include pinniped haul outs and known feeding areas of marine mammals. Marine mammals occur within the waters of the Chesapeake Bay near the Project area. Seal presence has been documented at haul-out sites in the lower Chesapeake Bay which occur along the Chesapeake Bay Bridge Tunnel (CBBT) portal islands (Rees et al. 2016; Jones et al. 2018; Ampela et al. 2019) (Table 3-1). Seal presence in Virginia waters is seasonal, with individuals arriving in January to February (winter) and remaining into April to May (spring) (Costidis et al. 2017) (See Section 4.4 and Section 4.5).

Some humpback whales (*Megaptera novaeangliae*) of the West Indies distinct population segment (DPS) use the mid-Atlantic region to over-winter (Barco et al. 2002) and use the waters within and adjacent to the mouth of the Chesapeake Bay (Aschettino et al. 2017b, 2019) to feed. Humpback whales are known to transit in and through the Project area (Aschettino et al. 2017b, 2019; Movebank 2019) (Table 3-1) (See Section 4.1).

Figure 2-2 Seal Haul Outs Located Nearest to the Hampton Roads Bridge-Tunnel (HRBT) Expansion Project Area. The Chesapeake Bay Bridge Tunnel (CBBT) rock armor or island haul out locations are depicted by the green dots

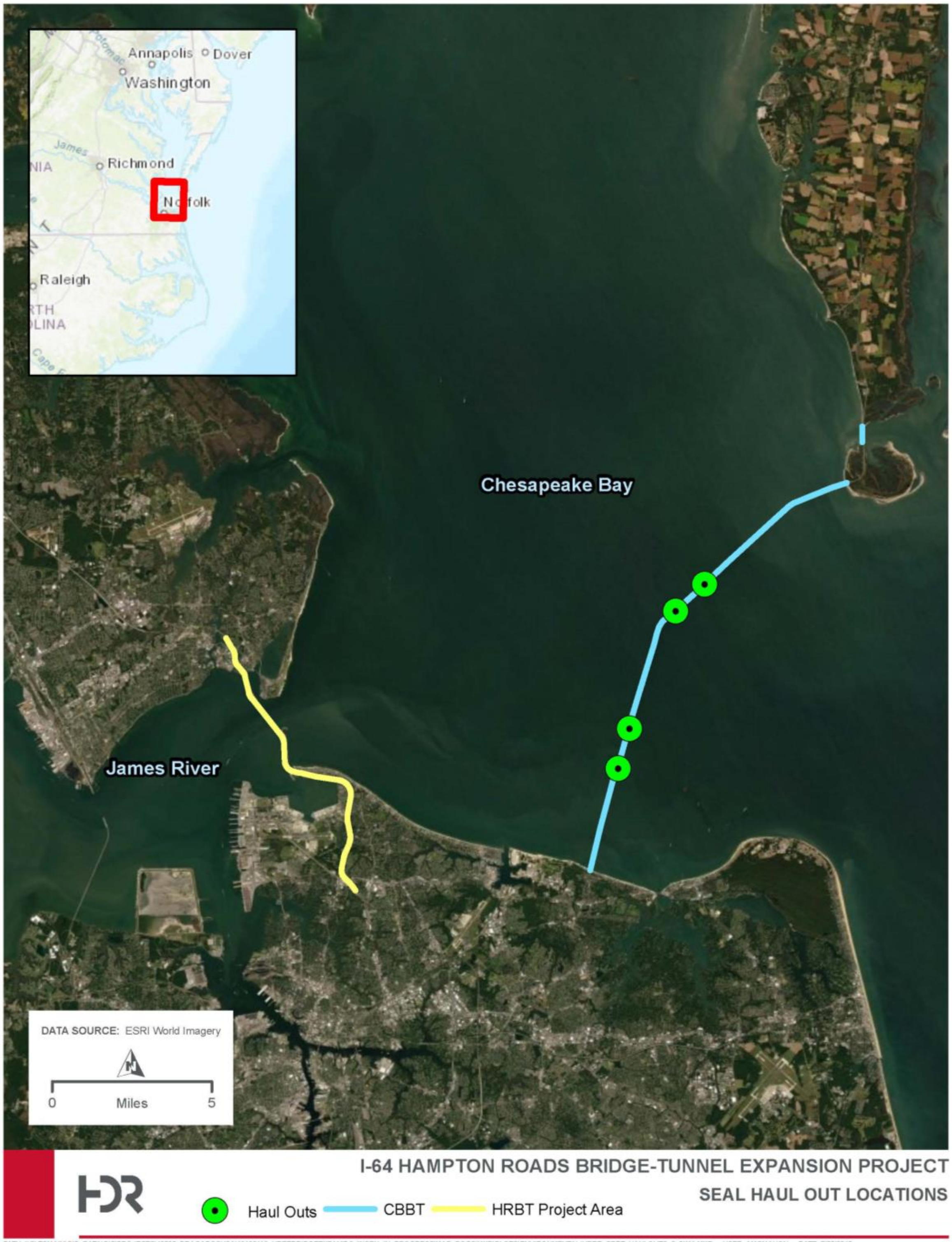
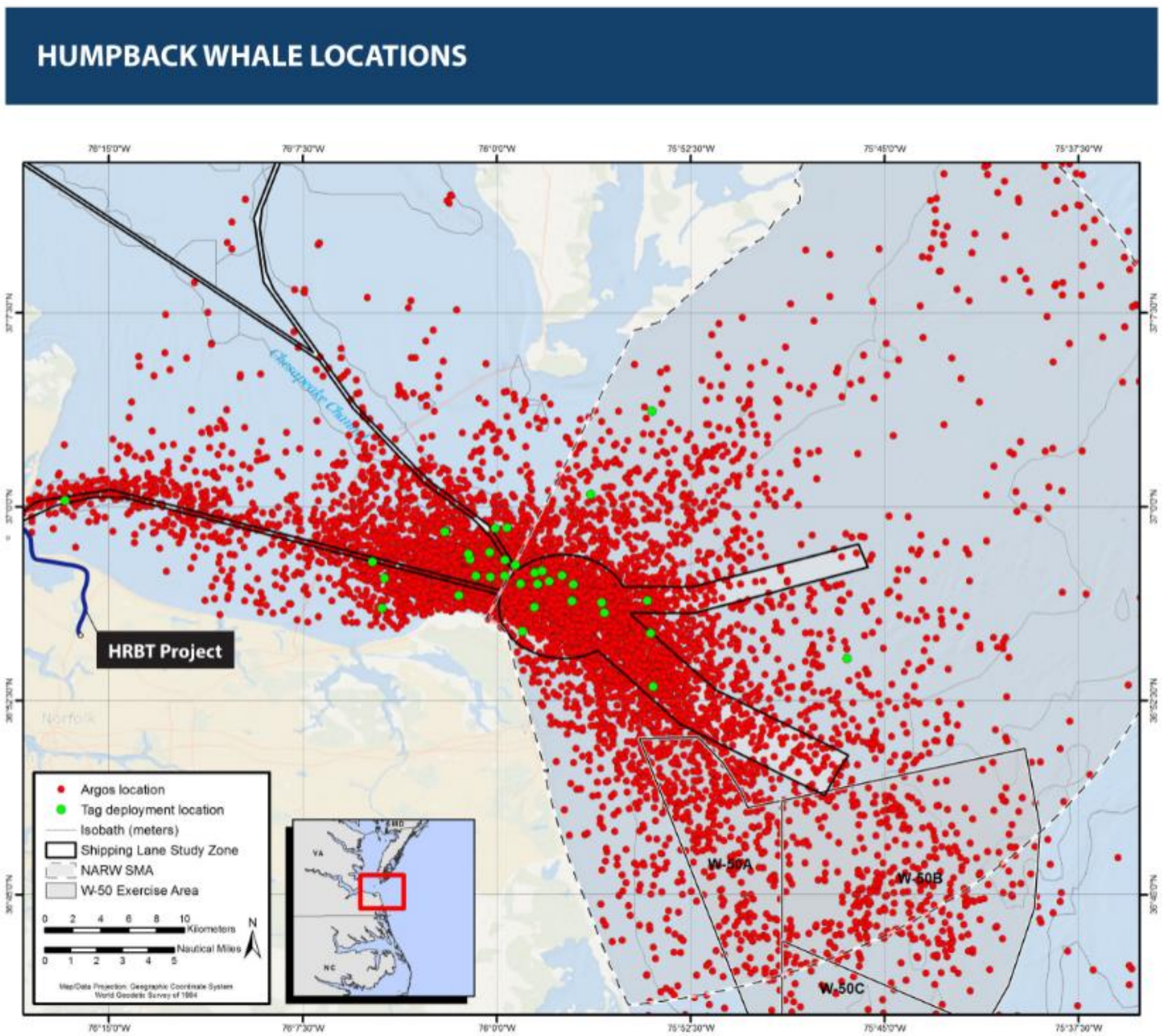


Figure 2-3: Tag Deployment Locations (green dots) and All Filtered Argos Locations (red dots) of Humpback Whales (Megaptera novaeangliae) during 2014/15 through 2017/18 Field Seasons of the U.S. Navy's Marine Species Monitoring Program. Source: Aschettino et al.



2.4 ACOUSTIC ENVIRONMENT

Sources of noise at the Project area include natural (wind, waves, fish, tidal currents, mammals) and anthropogenic (commercial and recreational ships/vessels, dredging, pile driving, etc.) sources. Naval Station Norfolk, the largest naval station in the world, uses Norfolk Harbor. In fiscal year 2015, 38 container ships (non-Navy) per week called at the Port of Virginia; 63% of the cargo was moved to and from the port by trucks and 33% was moved by train. Noise sources for vessels include cranes, whistles, and various motors for propulsion, while adjacent dockside noise sources include cranes, trucks, cars, and loading and unloading equipment. There are also three airports within 15 miles of the Project area (Norfolk International Airport, Chamber's Field, and Langley Air Force Base). Ship traffic, including ships transiting the Project area, can generate sounds ranging from 10 to 1,000 Hz (USACE 2017). However, average ambient noise in the Project area is assumed to be 120 decibels (dB) 1-second root-mean-

square (rm) sound pressure level (SPL) (see Section 6.2.1). Harassment of marine mammals could occur during exposure to underwater sound levels in excess of ambient. Sound levels likely vary seasonally, with elevated levels during summer when the tourism and fishing industries are at their peaks.

3 SPECIES AND NUMBERS OF MARINE MAMMALS

The species and numbers of marine mammals likely to be found within the activity area.

Although 40 species of marine mammals under NMFS jurisdiction have been documented to occur within the waters of the mid-Atlantic region of the western North Atlantic Ocean; only 8 of those species (six cetacean and two pinniped) have regular (species that occurs as a regular or normal part of the fauna of the area, regardless of how abundant or common it is) or rare (species that only occurs in the area sporadically, not common) occurrences in the Chesapeake Bay (Department of the Navy (DoN) 2008) (Table 3-1). Any occurrences of other marine mammal species would be considered extralimital (a species that does not normally occur in the area). The number of species occurring regularly near the Project area, in the Hampton Roads area of the Chesapeake Bay, is limited.

Marine mammal species that could occur in the Project area were identified using the Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS SEAMAP) database (Halpin et al. 2006; OBIS SEAMAP 2019); the U.S. Navy's Virginia Capes Marine Resource Assessments (DoN 2008, 2009); the U.S. Navy's Atlantic Fleet Training and Testing Final EIS/Overseas EIS (DoN 2013); Movebank Data Repository (database of animal tracking data) (Movebank 2019); Comprehensive Environmental Data and Reporting System database (VDOT 2019); the U.S. Navy's Marine Species Monitoring Program Website (DoN 2019); NMFS Endangered Species Act (ESA) Section 7 Mapper (NMFS Greater Atlantic Regional Fisheries Office (GARFO) 2019); Bureau of Ocean Energy Management (BOEM) Atlantic OCS Proposed Geological and Geophysical Activities, Mid-Atlantic and South Atlantic Planning Areas Final Programmatic EIS (BOEM 2014); and current United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) (USFWS 2019) Trust Resources Report. Eight marine mammal species may occur or are expected or likely to occur in or transit near the Project area based on an up-to-date literature review and the Project Final Supplemental Environmental Impact Statement and Environmental Assessment Re-Evaluation (VDOT and FHWA 2017, 2018) (Table 3-1)

- fin whale (*Balaenoptera physalus*),
- humpback whale (*Megaptera novaeangliae*),
- common minke whale (*Balaenoptera acutorostrata acutorostrata*),
- North Atlantic right whale (*Eubalaena glacialis*),
- common bottlenose dolphin (*Tursiops truncatus*),
- harbor porpoise (*Phocoena phocoena*),
- harbor seal (*Phoca vitulina*), and
- gray seal (*Halichoerus grypus atlantica*).

Five of the eight species addressed in this IHA application are considered regular inhabitants at least seasonally and have been documented within the Project area; the remaining three

species are considered rare (Table 3-1). The eight species represent two taxonomic orders: (1) the Cetacea (consisting of 4 whale, 1 dolphin, and 1 porpoise species), and (2) the Pinnipedia (consisting of 2 true seals: the harbor seal and gray seal). Two marine mammal species occurring in or near the Project area are listed as endangered under the ESA of 1973: the North Atlantic right whale and fin whale (35 Federal Register [FR] 12222; 73 FR 12024).

The estimated numbers of individuals of these eight species are further discussed in ensuing subsections and in Section 4 below.

3.1 SPECIES NOT EXPECTED TO BE INCIDENTALLY TAKEN

3.1.1 FIN WHALE

Fin whales in the North Atlantic belong to the Western North Atlantic stock (Hayes et al. 2019). The fin whale is listed as endangered under the ESA and is considered a strategic stock although no critical habitat is designated. The fin whale is MMPA depleted throughout its range. The most recent estimate of abundance is 1,618 individuals in the Western North Atlantic stock while the minimum population estimate is 1,234 (Hayes et al. 2019) (Table 3-1). NMFS initiated a 5-year review of the fin whale in January 2018 to determine whether a reclassification or delisting may be warranted (83 FR 4032; NMFS 2019). In February 2019, the review indicated that, based on the best available scientific and commercial information, the fin whale should be downlisted from endangered to threatened; however, this downlisting has not occurred and is recommended for future action (NMFS 2019).

Fin whales are typically found in waters of the Atlantic Exclusive Economic Zone (EEZ), from Cape Hatteras, North Carolina, northward to Maine (Hayes et al. 2019). New England waters tend to be the feeding grounds for the fin whale in the North Atlantic and it is believed that whales on these grounds exhibit patterns of seasonal occurrence and annual return (Hayes et al. 2019). Fin whales are in the mid-ocean near the Mid-Atlantic Ridge late fall through early winter (BOEM 2014).

The Chesapeake Bay region is considered to be a normal part of the range of the fin whale and it is noted that it was probably the most abundant large whale in Virginia's waters (Blaylock 1985; DoN 2009). Fin whales have been sighted off Virginia (Cetacean and Turtle Assessment Program (CeTAP) 1981, 1982; Swingle et al. 1993; DoN 2009; Hyrenbach et al. 2012; Barco 2013; Mallette et al. 2016a, b; Aschettino et al. 2018; Engelhaupt et al. 2017, 2018; Cotter 2019), and in the Chesapeake Bay (Bailey 1948; CeTAP 1981, 1982; Morgan et al. 2002; Barco 2013; Aschettino et al. 2018); however, they are not likely to occur in the Project area. Chances of fin whales being as far in the Chesapeake Bay as the HRBT are rare and are not likely to occur, sightings around the CBBT have occurred during the winter months (CeTAP 1981, 1982; Barco 2013; Aschettino et al. 2018).

Eleven fin whale strandings have occurred off Virginia from 1988 to 2016 mostly during the winter months of February and March, followed by a few in the spring and summer months (Costidis et al. 2017). Six of the strandings occurred in the Chesapeake Bay (three on eastern shore; three on western shore) with the remaining five occurring on the Atlantic coast (Costidis et al. 2017). Documented strandings near the Project area have occurred in: February 2012, a dead fin whale washed ashore on Oceanview Beach in Norfolk (Swingle et al. 2013); December 2017, a live fin whale stranded on a shoal in Newport News and died at the site (Swingle et al. 2018); February 2014, a dead fin whale stranded on a sand bar in Pocomoke Sound near Great

Fox Island, Accomack (Swingle et al. 2015); and, March 2007, a dead fin whale near Craney Island, in the Elizabeth River, in Norfolk (Barco 2013). There have not been any UMEs documented for fin whales in the last three decades. However, only stranded fin whales have been documented in the Project area; no free-swimming fin whales have been observed. Therefore, this species is not likely to occur in the Project area and is not discussed further.

3.1.2 COMMON MINKE WHALE

In the North Atlantic Ocean, there are four recognized populations of common minke whales (from herein referred to as minke whales): Canadian East Coast, west Greenland, central North Atlantic, and northeastern North Atlantic (Hayes et al. 2019). The stock that inhabits waters near the Project area off the U.S. eastern coast is the Canadian East Coast stock, distributed from the Davis Strait (45°W) to the Gulf of Mexico (BOEM 2014; Hayes et al. 2019). The minke whale ranges widely within the U.S. Atlantic EEZ typically in continental shelf waters (CeTAP 1982; Hayes et al. 2019). The Canadian East Coast stock is thought to winter in the West Indies, and in the mid-ocean south and east of Bermuda (Hayes et al. 2019). During summer months, the stock migrates north to New England and Canadian waters (Hayes et al. 2019). The minke whale is not listed as endangered under the ESA and no critical habitat is designated. The most recent estimate of abundance is 2,591 individuals in the Canadian East Coast stock while the minimum population estimate is 1,425 (Hayes et al. 2019) (Table 3-1).

Minke whales have been sighted off Virginia (CeTAP 1981, 1982; Hyrenbach et al. 2012; Barco 2013; Mallette et al. 2016a, b; McLellan 2017; Engelhaupt et al. 2017, 2018; Cotter 2019), near the CBBT (Aschettino et al. 2018) and in the Project area although the sightings in the Project area are known from strandings (Jensen and Silber 2004; Barco 2013; DoN 2009). In August 1994, a ship strike incident involved a minke whale in Hampton Roads (Jensen and Silber 2004; Barco 2013). It was reported that the animal was struck offshore and was carried inshore on the bow of a ship (DoN 2009). Twelve strandings of minke whales have occurred in Virginia waters from 1988 to 2016 (Costidis et al. 2017). One minke whale stranded in both 2017 and 2018 (Swingle et al. 2018; Costidis et al. 2019). These deaths declared the 2017–2019 Minke Whale Unusual Mortality Event (UME) along the Atlantic Coast (NOAA Fisheries 2019d). From 2017 through September 2019, four minke whales have stranded in Virginia waters (NOAA Fisheries 2019d). Since all minke whale occurrences in the Project area are due to strandings, minke whales are not expected in the Project area and are not discussed further.

3.1.3 NORTH ATLANTIC RIGHT WHALE

North Atlantic right whales are listed as endangered under the ESA (Table 3-1), and are considered one of the most critically endangered large whale species in the world (Clapham et al. 1999; Weinrich et al. 2000; Hayes et al. 2019; 71 FR 77704; 73 FR 12024). Since the 1890s, commercial whalers had hunted North Atlantic right whales to the brink of extinction. Although whaling is no longer a threat to the species, the leading causes of known mortality for North Atlantic right whales are entanglement in fishing gear and vessel strikes (Hayes et al. 2019). North Atlantic right whales inhabit the Atlantic Ocean and belong to the Western stock (formerly the Western North Atlantic stock) (Hayes et al. 2019). The most recent estimate of abundance is 451 individuals in the Western stock while the minimum population estimate is 445 (Hayes et al. 2019). Based off the North Atlantic Right Whale Consortium 2018 Annual Report Card, the best estimate for the end of 2017 is 411 North Atlantic right whales (Pettis et al. 2018). In 2017, 17 North Atlantic right whales were confirmed dead stranded (12 in Canada; 5 in the U.S.) and in 2018, three whales stranded in the U.S including one offshore of Virginia Beach, Virginia (0 in Canada); these deaths declared an Unusual Mortality Event (UME) (NOAA Fisheries 2019).

Currently, in 2019, nine whales have stranded in Canada, and one in the U.S., leaving the current total mortalities for the UME at 30 dead stranded whales (21 in Canada; 9 in the U.S) since 2017 (NOAA Fisheries 2019b). Despite recovery efforts, North Atlantic right whales face a high risk of extinction into the foreseeable future (NMFS 2012).

Three critical habitat areas were designated for this species in 1994: (1) the Cape Cod Bay/Stellwagen Bank, (2) the Great South Channel, and (3) waters adjacent to the coasts of Georgia and the east coast of Florida (59 FR 28805). In 2016, NMFS issued a final rule to replace the critical habitat for right whales in the North Atlantic with two new areas. The areas being designated as critical habitat contain approximately 29,763 square nautical miles of marine habitat in the Gulf of Maine and Georges Bank region (Unit 1) and off the Southeast U.S. coast (Unit 2) (81 FR 4837). No critical habitat occurs in the Project area.

The Western stock primarily inhabits coastal waters from Florida to New England north to the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence (Hayes et al. 2019). Research suggests that there are seven major habitats or congregation areas for this stock (Hayes et al. 2019): (1) the coastal waters of the southeastern U.S. (winter calving grounds [Florida and Georgia]); (2) the Great South Channel (spring calving grounds); (3) Jordan Basin; (4) Georges Bank/Gulf of Maine (fall feeding grounds); (5) Cape Cod and Massachusetts Bays (late winter/spring feeding grounds and nursery grounds; (6) the Bay of Fundy (summer/fall feeding grounds); and (7) the Scotian Shelf (summer/fall feeding grounds) (Weinrich et al. 2000; Mellinger et al. 2011; Hayes et al. 2019). In addition, Jeffreys Ledge, off the coasts of Massachusetts, New Hampshire, and Maine, is considered an important fall feeding area and summer nursery area for these whales (Weinrich et al. 2000).

The mid-Atlantic region has been identified as a primary migratory corridor for North Atlantic right whales (Knowlton et al. 2002; Firestone et al. 2008). Seasonal north-south migration of the Western stock occurs between feeding and calving areas, but North Atlantic right whales could be seen anywhere off the Atlantic U.S. throughout the year (Hayes et al. 2019). Seasonal occurrence of right whales in mid-Atlantic waters is normally during November through April, with peaks in December and April (Winn et al. 1986; Firestone et al. 2008) when whales are migrating to and from breeding/feeding grounds.

Based on sighting data and passive acoustic studies, the North Atlantic right whale could occur off Virginia year-round (DoN 2009; Salisbury et al. 2016). They have also been reported seasonally off Virginia during migrations in the spring, fall, and winter (CeTAP 1981, 1982; Niemeyer et al. 2008; Kahn et al. 2009; McLellan 2011b, 2013; Mallette et al. 2016a, b, 2017, 2018a; Palka et al. 2017; Cotter 2019). North Atlantic right whales are known to frequent the coastal waters of the mouth of the Chesapeake Bay (Knowlton et al. 2002) and the area is a seasonal management area (1 November – 30 April) mandating reduced ship speeds out to approximately 20 nautical miles for the species; however, the Project area is further inshore.

North Atlantic right whales have stranded in Virginia, one each in 2001, 2002, 2004, 2005: three during winter (February and March) and one in summer (September) (Costidis et al. 2017, 2019). All North Atlantic right whale strandings in Virginia waters have occurred on ocean-facing beaches along Virginia Beach and the barrier islands seaward of the lower Delmarva Peninsula (Costidis et al. 2017). Although there are no documented strandings near the Project area, in January 2018, a dead, entangled North Atlantic right whale was observed floating over 60 miles offshore of Virginia Beach (Costidis et al. 2019). This stranding was included as part of the 2017-2019 North Atlantic Right Whale Unusual Mortality Event (NOAA Fisheries 2019).

Therefore, this species is not likely to occur in the Project area and would not be exposed to any effects of bridge construction and is not discussed further.

Table 3-1: Marine Mammals Known to Occur in or near the Hampton Roads Bridge-Tunnel (HRBT) Expansion Project Area

Species/Stock	ESA/ MMPA Status; Strategic (Y or N)[1]	Estimated Stock Abundance[2]	Stock Status Factors (UMEs[3], spills, etc.)	Seasonal Occurrence in Project Area	Occurrence in the Project Area[4]
***Fin Whale* (*Balaenoptera physalus*) Western North Atlantic**	E/D; Y	1,618		Fall–Winter	Rare
Humpback Whale (*Megaptera novaeangliae*) Gulf of Maine	NL; N	896	UME	Year-Round	Regular
***Common Minke Whale* (*Balaenoptera acutorostrata acutorostrata*) Canadian East Coast**	NL; N	2,591	UME	Spring–Fall	Rare
***North Atlantic Right Whale* (*Eubalaena glacialis*) Western North Atlantic**	E/D; Y	451	UME	Winter–Spring	Rare
Bottlenose Dolphin (*Tursiops truncatus*) Western North Atlantic Offshore	NL; N	77,532		Spring–Fall	Rare
Bottlenose Dolphin (*Tursiops truncatus*) Western North Atlantic Northern Migratory Coastal	NL/D; Y	6,639		Spring–Fall	Regular
Bottlenose Dolphin (*Tursiops truncatus*) Western North Atlantic Southern Migratory Coastal	NL/D; Y	3,751		Spring–Fall	Regular

Species/Stock	ESA/ MMPA Status; Strategic (Y or N)[1]	Estimated Stock Abundance[2]	Stock Status Factors (UMEs[3], spills, etc.)	Seasonal Occurrence in Project Area	Occurrence in the Project Area[4]
Bottlenose Dolphin (*Tursiops truncatus*) Northern North Carolina Estuarine System	NL/D; N	823		Summer–Fall	Regular
Harbor Porpoise (*Phocoena phocoena*) Gulf of Maine-Bay of Fundy	NL; N	79,833		Winter–Spring	Regular
Harbor Seal (*Phoca vitulina*) Western North Atlantic	NL; N	75,834	UME	Winter–Spring	Regular
Gray Seal (*Halichoerus grypus atlantica*) Western North Atlantic	NL; N	27,131	UME	Winter–Spring	Regular

[1]Endangered Species Act (ESA) status: Endangered (E), /MMPA status: Depleted (D). NL = not-listed, indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds Potential Biological Removal or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.

[2]Stocks and stock sizes were taken from the latest stock assessment report (Hayes et al. 2019) from NOAA Fisheries at https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments

[3]UME = Unusual Mortality Event: https://www.fisheries.noaa.gov/national/marine-life-distress/active-and-closed-unusual-mortality-events

[4]Regular = A species that occurs as a regular or normal part of the fauna of the area, regardless of how abundant or common it is; Rare = A species that only occurs in the area sporadically (DoN 2009).

4 AFFECTED SPECIES STATUS AND DISTRIBUTION

A description of the status and distribution, including seasonal distribution (when applicable), of the affected species or stocks of marine mammals likely to be affected by such activities.

Although eight species of marine mammals have the potential to occur in or near the Project area, only five of those species may occur regularly and be incidentally taken during pile installation humpback whale, bottlenose dolphin, harbor porpoise, harbor seal, and gray seal. Their status, estimated stock abundance, and general and seasonal distribution and occurrence in the Project area are discussed in ensuing subsections.

The U.S. Navy, the Virginia Aquarium and Marine Science Center, and the University of Maryland's Center for Environmental Science have conducted recent studies and/or monitoring surveys in the Chesapeake Bay mid-Atlantic waters, addressing marine mammals within or near the Project area and are described below. Additional studies addressing particular species, focusing on recent data and reports, are referenced under each species section.

The U.S. Navy's Marine Species Monitoring Program, in support of Atlantic Fleet Training and Testing Marine Mammal Protection Act requirements (50 CFR Part 218), has been conducting marine mammal monitoring in the U.S. Navy Ranges, specifically in the Atlantic Ocean, since 2009. The U.S. Navy routinely conducts training and testing activities in the Virginia Capes Operating Area off the mid-Atlantic which lies east of the mouth of the Chesapeake Bay. The U.S. Navy has conducted the following marine mammal monitoring studies in the Chesapeake Bay area:

- Occurrence, Distribution, and Density of Marine Mammals Near Naval Station Norfolk and Virginia Beach – 2012 through 2015 (Engelhaupt et al. 2014, 2015, 2016)
- NAS Patuxent River Marine Species Surveys – 2015 through 2017 (Richlen et al. 2016, 2017, 2018)
- Haul-Out Counts and Photo-Identification of Pinnipeds in Virginia – 2014 through 2019 (Rees et al. 2016; Jones et al. 2018)
- Mid-Atlantic Humpback Whale Monitoring – 2015 through 2020 (Aschettino et al. 2015, 2016, 2017a, 2018, 2019)
- Pinniped Tagging and Tracking in Southeast Virginia – 2017 through 2019 (Ampela et al. 2019)
- Behavioral Response of Humpback Whales to Vessel Traffic – 2019 through 2020

The Virginia Aquarium and Marine Science Center has been conducting research on marine mammals off of Virginia since 1987 and holds permits from state and federal authorities for all activities related to marine mammal stranding response and research. The Virginia Aquarium and Marine Science Center has conducted the following marine mammal monitoring studies in the Chesapeake Bay area:

- Aerial Survey Baseline Monitoring in the Continental Shelf Region of the VACAPES OPAREA – 2012 through 2016 (Mallette et al. 2014, 2016b, 2017). Project covered the areas of the Chesapeake Bay mouth.
- Since 1991, the Stranding Response Team has been responsible for rendering aid to over 8,000 marine mammals and sea turtles that come ashore in Virginia (Swingle et al. 2007, 2010, 2011, 2012, 2013, 2014, 2015, 2018; Barco 2013; Barco and Swingle 2014; Costidis et al. 2017, 2019).

The University of Maryland's Center for Environmental Science, Chesapeake Biological Laboratory documents movements of bottlenose dolphin in the Chesapeake Bay. In its third year, the dolphin tracker, the Chesapeake DolphinWatch (DolphinWatch 2019), marks the location of dolphin sightings on a map of the Chesapeake and its tributaries. Since 2017, over 2,000 sightings in the Chesapeake Bay have been recorded.

4.1 HUMPBACK WHALE

Humpback whales that occur off the western North Atlantic belong to the Gulf of Maine stock from the West Indies DPS and consist of four separate discrete subpopulations that use four discrete feeding areas: the Gulf of Maine, Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland (Katona and Beard 1990; Bettridge et al. 2015; Hayes et al. 2019). Humpback whales that belong to the West Indies DPS are not listed as endangered under the ESA and no critical habitat is designated. The most recent estimate of abundance is 896 individuals in the Gulf of Maine stock while the minimum population estimate is 896 (Hayes et al. 2019) (Table 3-1). Analyses indicate that the Gulf of Maine humpback whale stock is characterized by a positive trend in abundance and is considered not depleted (Hayes et al. 2019).

The Gulf of Maine stock of humpback whales has a wide range in the western Northern Atlantic, typically in continental shelf and oceanic island waters (Hayes et al. 2019). The majority of humpback whales migrate to the West Indies during the winter to mate and calve where spatial and genetic mixing among feeding groups occurs (Stevick et al. 1998; Robbins et al. 2001; MacKay et al. 2016; Hayes et al. 2019). Some individuals are found year-round in the Gulf of Maine (Robbins 2007; Hayes et al. 2019), while others use the mid-Atlantic region to over-winter (Barco et al. 2002; Aschettino et al. 2018). During the spring and summer months, the stock migrates north to New England and Canadian waters to feed (Hayes et al. 2019). Feeding is the principal activity of humpback whales in New England waters, and their distribution in this region has been largely correlated to abundance of prey species: herring (*Clupea harengus*), sand lance (*Ammodytes* spp.), and other small fishes; and in the Northern Gulf of Maine: euphausiids (Hayes et al. 2019).

The Project area is not within normal humpback whale feeding or migration areas; however, they could occur in the Project area in relatively small numbers seasonally during migrations (Aschettino et al. 2017b). Sightings have been reported off Virginia during the fall and winter (CeTAP 1981, 1982; Swingle et al. 1993; Barco et al. 2002; McLellan 2011a; Engelhaupt et al. 2014, 2015, 2016, 2017, 2018; Aschettino et al. 2015, 2016, 2017a, 2018, 2019; Mallette et al. 2016a, b, 2017, 2018a, b; McAlarney et al. 2017, 2018; Northeast Fisheries Science Center and Southeast Fisheries Science Center (NEFSC and SEFSC) 2019) and most recently, the spring (Aschettino et al. 2019; Cotter 2019). Humpback whales are known to frequent the coastal waters of the mouth of the Chesapeake Bay during the winter months (Aschettino et al. 2015, 2016, 2017a, b, 2018; Movebank 2019), and on the rare occasion, inshore of the CBBT (Perkins and Beamish 1979; Aschettino et al. 2017b, 2018; Movebank 2019) (Table 3-1). Humpback whales could use the Chesapeake Bay area year-round based off sighting and stranding data (DoN 2009; Aschettino et al. 2015, 2016, 2017a, 2018, 2019). Baseline occurrence and behavior data for humpback whales in the Hampton Roads mid-Atlantic region was collected via satellite tags; these data show site fidelity to the Chesapeake Bay area (Table 3-1) (Aschettino et al. 2018, 2019) and movement in and around the Project area (Movebank 2019).

Vessel collisions and entanglements can cause serious injuries to humpback whales. Thirty-seven humpback whale strandings have occurred in Virginia from 1988 to 2016 (Costidis et al. 2017). Humpback whale strandings or entanglements have been recorded in every month of the year with April having the highest number of strandings (Costidis et al. 2017). Twenty-seven of the 37 strandings

occurred on ocean-facing beaches; however, some have occurred within the lower Chesapeake Bay (Barco 2013; Costidis et al. 2017). In Virginia, during 2017, eight humpback whales stranded and in 2018, five humpback whales stranded (Swingle et al. 2018; Costidis et al. 2019). A documented stranding occurred near the Project area in February 2017, where a dead humpback whale stranded in Hampton, just east of the HRBT (Swingle et al. 2018). In 2017, due to elevated humpback whale mortalities that have occurred along the Atlantic coast since 2016, from Maine to Florida, an UME was declared for humpback whales in the North Atlantic (NOAA Fisheries 2019a). From 2016 to October 2019, 105 humpback whale mortalities have occurred and Virginia had the second highest number (n = 19) of strandings along the western Atlantic coast from Maine to Florida (NOAA Fisheries 2019a). Therefore, humpback whales could occur near the Project area and incidental take could result from exposure to underwater sounds during pile driving.

4.2 COMMON BOTTLENOSE DOLPHIN

Common bottlenose dolphins (from herein referred to as bottlenose dolphin) are common in U.S. Atlantic waters year-round. Some stocks occupy the same range all year, while some coastal migratory stocks move seasonally along the coast (Hayes et al. 2019). These different stocks can overlap spatially with other distinct groups of bottlenose dolphins (Torres et al. 2003; Hayes et al. 2019). Bottlenose dolphins occupy a variety of habitats and can be found on the outer continental shelf and slope, as well as close to shore and in inshore waters, including bays, sounds and estuaries; however, highest densities tend to occur within inner shelf areas (Wells and Scott 1999; Hamazaki 2002; Hayes et al. 2019).

The population structure of bottlenose dolphins off Virginia is complex with an offshore stock (Western North Atlantic Offshore stock) located near the continental shelf edge and multiple migratory (Western North Atlantic Northern Migratory Coastal stock and Western North Atlantic Southern Migratory Coastal stock) and resident coastal stocks close to shore and in estuarine waters (Northern North Carolina Estuarine System stock) (Hayes et al. 2019). Bottlenose dolphins that inhabit the waters surrounding the Project area, in the Chesapeake Bay and off Virginia, could belong to these offshore, migratory, and resident stocks. Bottlenose dolphins are not listed under the ESA, but the Northern Coastal Migratory, Western North Atlantic Southern Migratory Coastal, and Northern North Carolina Estuarine System stocks are listed as depleted under the MMPA (Hayes et al. 2019). The most recent abundance estimate for the Western North Atlantic Northern Migratory Coastal stock is 6,639, with a minimum population estimate of 4,759 individuals and the most recent population estimate for the Southern Migratory Coastal stock is 3,751, with a minimum population estimate of 2,353 (Hayes et al. 2019) (Table 3-1). The most recent abundance estimate for the Northern North Carolina Estuarine System stock is 823, the minimum abundance estimate is 782, and the most recent population estimate for the Western North Atlantic Offshore stock is 77,532 with a minimum estimate of 56,053 (Hayes et al. 2019). The latest estimates declined due to possible effects from the 2013–2015 UME (see below).

Bottlenose dolphins are consistently seen in Virginia waters from May through October (Barco et al. 1999; Costidis et al. 2017; Cotter 2019) and are regularly sighted from early spring through late fall with sightings and stranding events in Virginia waters all months of the year (Swingle et al. 2010, 2011, 2012, 2013, 2014; DolphinWatch 2019). Sightings have been reported off Virginia and near the Project area during the summer, fall, and winter (CeTAP 1981, 1982; Hohn 1997; Torres et al. 2005; NEFSC and SEFSC 2012, 2013, 2016; Barco 2013, 2014; Garrison 2013; DiMatteo 2014; Roberts et al. 2016; Engelhaupt et al. 2014, 2015, 2016, 2017, 2018; Palka et al. 2017; Mallette et al. 2016a, b, 2017, 2018a, b; McAlarney et al. 2017, 2018; DolphinWatch 2019). Strandings of bottlenose dolphins are quite high in Virginia; from 2006 to 2016, an average of 66 individuals stranded each year (Costidis et

al. 2017). In 2013, a historic total of 427 strandings occurred which marked the start of a mid-Atlantic Bottlenose Dolphin UME (Costidis et al. 2017; Swingle et al. 2018) that ended in March of 2015. In 2017, 67 bottlenose dolphin strandings occurred in Virginia and in 2018, 76 bottlenose dolphin strandings were recorded (Swingle et al. 2018; Costidis et al. 2019). There are many documented strandings in and around the Project area (Barco 2013; Swingle et al. 2018; Costidis et al. 2019). Therefore, bottlenose dolphins are expected to occur in the Project area and incidental take could result from exposure to underwater sounds produced during pile driving.

4.3 HARBOR PORPOISE

The Gulf of Maine-Bay of Fundy stock of harbor porpoise inhabits waters off the U.S. eastern coast (Hayes et al. 2019). These small coastal harbor porpoises generally inhabit shallow, coastal waters of the continental shelf but are occasionally seen in deeper waters (Gaskin 1984; Westgate et al. 1998; Hayes et al. 2019). During fall and spring, harbor porpoises are widely dispersed from New Jersey north to Maine and during winter, range from New Brunswick, Canada, to North Carolina (DoN 2009; Roberts et al. 2016; Hayes et al. 2019). Harbor porpoises are not listed as an endangered or threatened species, but are protected under the MMPA. No critical habitat has been designated. The most recent estimate of abundance is 79,833 individuals in the Gulf of Maine-Bay of Fundy stock while the minimum population estimate is 61,415 (Hayes et al. 2019) (Table 3-1). A trend analysis has not been possible for this stock due to the relatively imprecise abundance estimates and long survey interval (Hayes et al. 2019).

The inland waters of Virginia are considered to be part of the normal habitat of the harbor porpoise (Polacheck et al. 1995; DoN 2009). Sightings have been reported off Virginia (DoN 2009; Hyrenbach et al. 2012) and they regularly occur in the Chesapeake Bay (Prescott and Fiorelli 1980; Polacheck et al. 1995; DoN 2009). A few sightings have occurred near the HRBT (pers. comm. Mark Cotter, HDR Inc., May 2019). There are documented sightings near the Project area during the spring and winter, although, most of these sightings are known from stranding data (Polacheck et al. 1995; Cox et al. 1998; Morgan et al. 2002; Swingle et al. 2007; Barco 2013). From 1988 to 2016, harbor porpoise were the second most marine mammal species to strand in Virginia, with 327 strandings and an average of 11 strandings per year (Costidis et al. 2017). There were five harbor porpoise strandings in Virginia in 2017 and one in 2018 (Costidis et al. 2019). There are documented strandings near the Project area that have occurred during the months of February, March, April, May, and July (Barco 2013). Although not typically expected as far inshore as the HRBT, harbor porpoise could occur in the Project area and incidental take could result from exposure to underwater sounds produced during pile driving.

4.4 HARBOR SEAL

Harbor seals (true seal or Phocid pinniped) that inhabit the U.S. eastern coast belong to Western North Atlantic stock. The stock ranges from New Jersey to Labrador, with scattered sightings and strandings reported as far south as Florida (Hayes et al. 2019). Distribution along the U.S. Atlantic coast has shifted in recent years (Johnston et al. 2015; DiGiovianni et al. 2018; Jones et al. 2018), with an increased number of harbor seals reported in southern New England and the mid-Atlantic region (Hayes et al. 2019). Harbor seals migrate to northern areas for mating and pupping in the spring and summer, and return to more southerly areas in the fall and winter (Ampela et al. 2019). Pupping occurs at high-use haul-out sites off Manomet, Massachusetts and the Isles of Shoals, Maine (Hayes et al. 2019). Harbor seals are not listed as an endangered or threatened species but are protected under the MMPA. No critical habitat has been designated. The most recent harbor seal estimate of abundance is 75,834 individuals in the Western North Atlantic stock while the minimum population estimate is 66,884

(Hayes et al. 2019) (Table 3-1). A trend analysis has not been possible for this stock due to the relatively imprecise abundance estimates and long survey interval; however, there is a decline in the apparent abundance of harbor seals (Hayes et al. 2019).

Sightings of harbor seals in Virginia were once considered very uncommon (Potter 1991; DoN 2009), but now occur regularly in the Chesapeake Bay (DoN 2009). The 2015 stock assessment report noted that a small group of harbor seals (<50) hauls out in the Chesapeake Bay, Virginia (Waring et al. 2016). Harbor seal presence in Virginia waters is seasonal, with individuals arriving in January and February (winter) and extending into April and May (spring) (Costidis et al. 2017). Observations from the CBBT staff and local anglers indicate harbor seals have been using the CBBT islands (Table 3-1) to haul out on for many years, but that the number of animals appears to be increasing (Jones et al. 2018). Smaller numbers of harbor seals have been known to occasionally haul out on the rocks near the HRBT (pers. comm., Danielle Jones, Naval Facilities Engineering Command Atlantic, April 2019) and at Hopewell up the James River (Blaylock 1985; DoN 2009). Sightings have been reported off Virginia and near the Project area during the winter and spring (Barco 2013; Rees et al. 2016; Jones et al. 2018; Ampela et al. 2019).

Entanglement in fishing gear, vessel strikes, and pollution are the primary threats to harbor seals. Since 1991, harbor seals make up only 3% of the stranded marine mammals in Virginia (Costidis et al. 2017). In Virginia, four harbor seals stranded in 2017 and two in 2018 (Swingle et al. 2018; Costidis et al. 2019). A few documented strandings have occurred in or near the Project area: one in March 1991 near Wills Island, in the Elizabeth River, and the other in February 1998 off Hampton, in the James River (Barco 2013). Since July 2018, increased numbers of harbor seal and gray seal mortalities have occurred across Maine, New Hampshire, and Massachusetts (NOAA Fisheries 2019c). This event has been declared a 2018-2019 Pinniped UME along the Northeast Coast which encompasses all seal strandings from Maine to Virginia (NOAA Fisheries 2019c). From July 2018 to September 2019, ten seal strandings have occurred in Virginia waters (NOAA Fisheries 2019c). Harbor seals could occur in the Project area and incidental take could result from exposure to underwater sounds produced during pile driving.

4.5 GRAY SEAL

Gray seals (true seal or Phocid pinniped) that inhabit the U.S. eastern coast belong to Western North Atlantic stock. The stock ranges from New Jersey to Labrador, with scattered sightings and strandings reported as far south as North Carolina (Hayes et al. 2019). Distribution along the U.S. Atlantic coast has shifted in recent years (Johnston et al. 2015; DiGiovianni et al. 2018; Jones et al. 2018), with an increased number of gray seals reported in southern New England and the mid-Atlantic region (Hayes et al. 2019). There are three breeding aggregations in eastern Canada: Sable Island, Gulf of St. Lawrence, and at sites along the coast of Nova Scotia; however, they are considered a single population based on genetic similarity (Hayes et al. 2019). Pupping occurs at four established colonies: Muskeget and Monomoy Islands in Massachusetts, and Green and Seal Islands in Maine (Hayes et al. 2019). Gray seals are not listed as an endangered or threatened species but are protected under the MMPA. No critical habitat has been designated. Gray seal estimate of abundance is 27,131 individuals in the Western North Atlantic stock while the minimum population estimate is 23,158 (Hayes et al. 2019) (Table 3-1). Numbers indicate that the Western North Atlantic stock of gray seals are likely increasing in the U.S. Atlantic EEZ, but the rate of increase is unknown (Hayes et al. 2019).

Gray seals, rarely found resting on the rocks around the portal islands of the CBBT from December through April alongside harbor seals, are uncommon in Virginia and the Chesapeake Bay (Barco and

Swingle 2014). Sightings of gray seal in Virginia waters is sporadic, occurring in winter and early spring; however, observations appear to be increasing (DoN 2009; Costidis et al. 2017). Surveys conducted by the U.S. Navy at the CBBT portal islands recorded one gray seal in the 2014/2015, two gray seals in 2015/2016, and two gray seals in 2016/2017 seasons (Rees et al. 2016; 83 FR 36522) (Table 3-1). Sightings have been reported off Virginia and near the Project area during the winter and spring (Barco 2013; Rees et al. 2016; Jones et al. 2018; Ampela et al. 2019).

Entanglement in fishing gear, vessel strikes, and pollution are the primary threats to gray seals. There are only 15 gray seal strandings documented in Virginia from 1988–2013 (Barco and Swingle 2014). In Virginia, four gray seals stranded in 2018 (Costidis et al. 2019). There is one documented gray seal stranding which occurred in June 2007 on the Chesapeake Bay side of Willoughby Spit (Barco 2013). See Section 4.4 above regarding the 2018-2019 Pinniped UME along the northeast coast. Gray seals could occur in the Project area and incidental take could result from exposure to underwater sounds produced during pile driving.

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 INCIDENTAL HARASSMENT AUTHORIZATION

Under Section 101(a)(5)(D) of the MMPA, HRCP is requesting an IHA for the non-lethal take by harassment of small numbers of marine mammals, incidental to in-water pile installation associated with the Project. HRCP is requesting an IHA for the incidental Level B harassment of five marine mammal species: harbor seal, gray seal, bottlenose dolphin, harbor porpoise, and humpback whale; and Level A harassment of three species: bottlenose dolphin, harbor seal, and harbor porpoise. Level A and Level B harassment may result due to noise from in-water pile installation using impact and vibratory driving, jetting, and drilling with a down-the-hole hammer. By the implementation of the monitoring and mitigation procedures described in this IHA request, Level A take will be minimized and any potential disturbances to marine mammals are expected to be temporary, with no long-term impacts to individuals or populations. No lethal takes are expected.

HRCP is requesting that the IHA issued be effective from April 2020 to March 2021, for the one calendar year from the start of pile installation.

5.2 TAKE AUTHORIZATION REQUEST

HRCP is requesting the issuance of LOA for Level B take (behavioral harassment) of humpback whales, bottlenose dolphin, harbor porpoises, harbor seals, and gray seals that may occur in the Project area. In addition, HRCP requests Level A take of bottlenose dolphins, harbor porpoises, and harbor seals that may occur incidentally in the Project area. The request for a small number of takes for each species that is rarely or occasionally observed in the Project area reduces the risk of the Project being shut down if one of these species enters the Level B harassment zone during pile installation. The methodology described in Section 6 estimates potential noise exposures of marine mammals resulting from pile installation in the marine environment by vibratory and impact hammers, jetting, and drilling with a down-the-hole hammer. Modeling of potential exposures estimates tends to overestimate

exposures because all animals are assumed to be available to exposure while piles are being installed, it is assumed that animals remain in the area despite the sound levels, and the formulas used to estimate transmission loss (TL) and distance to sound-level thresholds use idealized parameters. Additionally, this approach assumes that no individuals avoid the area and that all exposed individuals are “taken,” contributing to an overestimation of “take.” The type of incidental take most likely to occur is that associated with Level B harassment as the result of noise from pile installation. No serious injury or lethal takes are expected as a result of the proposed pile installation. Pile removal, as outlined in Section 1, is not anticipated to result in underwater noise because a vibratory hammer will not be used; piles will be cut 3 feet below the mudline.

An estimated 6,811 potential marine mammal exposures to Level B harassment may occur during HRBT pile installation (see Section 6.5 for estimates of exposures by species). In addition, an estimated 120 potential marine mammal Level A exposures could occur. As described in Section 6.6, estimated takes may result from repeated exposures of a small number of individuals. HRCP does not expect that all potential exposures to Level A and Level B harassment will result from Project-related activities. However, to allow for uncertainty regarding the exact mechanisms of the physical and behavioral effects, and as a conservative approach, HRCP is requesting authorization for incidental harassment of 6,931 marine mammals (Table 6-20).

The HRCPs mitigation measures for the Project (Section 11) include monitoring of Level A and Level B harassment zones prior to the initiation of pile installation and “soft starts” or ramp-up procedures designed to allow marine mammals to leave the Project area before noise levels reach the threshold for harassment and the use of bubble curtains for steel pipe piles located in deeper waters (>20 feet) driven with impact hammers (see Section 11.1). These mitigation measures decrease the likelihood that marine mammals will be exposed to SPLs that could cause harassment.

5.3 INCIDENTAL TAKE METHODOLOGY

Pile installation activities as outlined in Section 1 have the potential to disturb or displace small numbers of marine mammals. Specifically, the proposed activities may result in “take” in the form of Level B harassment from underwater sounds generated by vibratory and impact pile installation, jetting, and drilling with a down-the-hole hammer. In addition, bottlenose dolphins, harbor seals and harbor porpoises may be incidentally exposed to Project-related underwater noise levels and durations that exceed species-specific thresholds for Level A harassment. Section 11 provides details on the impact minimization and reduction measures proposed.

Detectable effects of the Project on marine mammal habitat would be minor (Section 9). Indirect effects to prey would be insignificant and discountable due to recolonization and the temporary nature of the activity, and are expected to be undetectable. Barges and other vessels will be required to deliver the necessary equipment and materials to the Project and be used to construct the Project. All vessels larger than 65 feet will be required to travel at speeds less than 10 knots. Vessels traveling at 10 knots or less will minimize the risk of vessel collisions with marine mammals; therefore, no incidental take of marine mammals due to ship strikes is expected (see Section 7.2).

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 identified in Section 5, and the number of times such takings by each type of taking are likely to occur.

The NMFS application for IHAs requires applicants to determine the number and species of marine mammals that are expected to be incidentally harassed by an action and the nature of the harassment (Level A or Level B). Pile installation as outlined earlier has the potential to “take” marine mammals incidental to pile installation. Other activities are not expected to result in “take” as defined under the MMPA. In-water pile installation will temporarily increase the local underwater and in-air noise environment in the Project area. Research suggests that increased noise may impact marine mammals in several ways and that the likelihood of impacts depends on many factors (Section 7).

6.1 IN-AIR AND UNDERWATER SOUND DESCRIPTORS

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water. Sound is generally characterized by several variables, including frequency and intensity. Frequency describes the sound’s pitch and is measured in Hertz (Hz), while intensity describes the sound’s loudness and is measured in dB. Decibels are measured using a logarithmic scale.

The method commonly used to quantify in-air sounds consists of evaluating all frequencies of a sound according to a weighting system, reflecting that human hearing is less sensitive at low frequencies and extremely high frequencies than at the mid-range frequencies. This is called A-weighting, and the decibel level measured is called the A-weighted decibels (dBA) sound level. A filtering method to reflect the hearing of marine mammals such as hauled-put pinnipeds has not been developed for regulatory purposes.

Underwater sounds are described by a number of terms that are commonly used and specific to this field of study (Table 6-1). Two common descriptors are the root-mean-square SPL (dB rms) during the pulse or over a defined averaging period, and sound exposure level (SEL). The rms level is the square root of the energy divided by a defined time period and referenced to a pressure of 1 microPascal (dB re 1 µPa). Unless otherwise indicated, in-water sound levels throughout this report are presented in dB re 1 µPa.

Table 6-1: Definitions of Common Acoustical Terms

Term	Definition
Decibel (dB)	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for water is 1 microPascal (μPa) and for air is 20 μPa (approximate threshold of human audibility).
Sound Pressure Level (SPL)	Sound pressure is the force per unit area, usually expressed in microPascals (or 20 microNewtons per square meter [m^2]), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 m^2. The SPL is expressed in decibels as 20 times the logarithm to the base 10 of the ratio of the pressure exerted by the sound to a reference sound pressure. SPL is the quantity that is directly measured by a sound level meter.
Frequency Hertz (Hz)	Frequency is expressed in terms of oscillations, or cycles, per second. Cycles per second are commonly referred to as Hz. Typical human hearing ranges from 20 Hz to 20,000 Hz.
Sound Exposure Level (SEL)	The time integral of frequency-weighted squared instantaneous sound pressures. Proportionally equivalent to the time integral of the pressure squared. Sound energy associated with a pile driving pulse, or series of pulses, is characterized by the SEL. SEL is the constant sound level in one second, which has the same amount of acoustic energy as the original time-varying sound (i.e., the total energy of an event). SEL is calculated by summing the cumulative pressure squared over the time of the event (1μPa2-sec).
Peak Sound Pressure (unweighted), dB re 1 μPa	Peak SPL is based on the largest absolute value of the instantaneous sound pressure over the frequency range from 20 Hz to 20,000 Hz. This pressure is expressed in this report as dB re 1 μPa.
Root-Mean-Square (rms), dB re 1 μPa	The rms level is the square root of the energy divided by a defined time period. For pulses, the rms has been defined as the average of the squared pressures over the time that comprises that portion of waveform containing 90 percent of the sound energy for one impact pile installation impulse.
Ambient Noise Level	The ambient noise level is the background sound level, which is a composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Transmission Loss (TL)	TL underwater is the accumulated decrease in acoustic intensity as an acoustic pressure wave propagates out from a source. TL parameters vary with frequency, temperature, sea conditions, current, source and receiver depth, water chemistry, water depth, bottom composition and topography, and underwater objects in the area.

Spreading loss in marine waters is generally between 10 dB (cylindrical spreading) and 20 dB (spherical spreading), typically referred to as 10 log and 20 log, respectively. Cylindrical spreading occurs when sound energy spreads outward in a cylindrical fashion bounded by the bottom sediment and water surface, such as shallow water, resulting in a 3-dB reduction in noise level per doubling of distance. Spherical spreading occurs when the source encounters little to no refraction or reflection from boundaries (e.g., bottom, surface), such as in deep water, resulting in a 6-dB reduction in noise level per doubling of distance. NMFS generally prefers a TL of 15 log.

NMFS has published updated Technical Guidance (NMFS 2018a) that is currently being used to assess potential effects of exposure to underwater anthropogenic sound on the hearing of marine mammals.

The Technical Guidance identifies the received levels, or thresholds, above which individual marine mammals are predicted to experience permanent changes (e.g., a permanent threshold shift [PTS]) in their hearing sensitivity from incidental exposure to underwater anthropogenic sound sources (NMFS 2018a). NMFS considers the Technical Guidance to represent the best available scientific information and, on this basis, suggests that these thresholds and weighting functions be used to assess the potential for PTS in marine mammals, which equates to Level A harassment under the MMPA. The models used to derive the acoustic thresholds for onset of PTS incorporate marine mammal auditory weighting functions in recognition of the variability found among marine mammal species in their hearing sensitivity. The auditory weighting functions are defined for four functional hearing groups that are present in the Project area: low-frequency (LF), mid-frequency (MF), and high-frequency (HF) cetaceans, and phocid in water (PW) pinnipeds (Table 6-2). Additionally, the models used to derive the PTS onset acoustic thresholds incorporate a time component in the form of a cumulative sound exposure level (SEL_{cum}) for both impulsive and non-impulsive sound, and a SPL component by using peak sound level (L_{pk}) for impulsive sounds (NMFS 2018a).

Table 6-2: Marine Mammal Functional Hearing Groups and Representatives of Each Group that are Found Near the Hampton Roads Bridge-Tunnel

	Functional Hearing Group	Species	Generalized Hearing Range
Cetaceans	LF cetaceans	Humpback whales	7 Hz to 35 kHz
	MF cetaceans	Bottlenose dolphins	150 Hz to 160 kHz
	HF cetaceans	Harbor porpoises	275 Hz to 160 kHz
Pinnipeds	PW pinnipeds underwater	Harbor seals, Gray seals	50 Hz to 86 kHz

Source: NMFS 2018a

Notes: LF = low-frequency; MF = mid-frequency; HF = high-frequency; PW = phocid in water; Hz = Hertz; kHz = kilohertz.

NMFS continues to use its interim criteria to assess Level B harassment levels. Under the interim guidance, Level B harassment by impulsive sounds, such as impact pile installation and drilling with a down-the-hole hammer, occurs with exposure to an SPL of 160 dB rms for all marine mammals. Level

B harassment by non-impulsive sounds, such as vibratory pile installation and removal, occurs with exposure to an SPL of 120 dB rms for all marine mammals unless empirical data exist to justify a higher threshold (see Section 6.3.2).

This application uses the Technical Guidance acoustic thresholds to calculate Level A harassment isopleths and the NMFS interim criteria to calculate Level B harassment isopleths. The NMFS Companion User Spreadsheet (Version 2.0, 2018), provided by NMFS for use with the Technical Guidance (NMFS 2018a), was used as a basis to predict zones where the onset of a PTS in marine mammal hearing could occur. Since the onset of PTS based on SEL_{cum} is computed as farther from the pile than it would be using peak sound pressure computations, the onset of PTS is based on SEL computations; therefore, the onset of PTS based on peak sound levels is not provided in this assessment.

6.2 DESCRIPTION OF NOISE SOURCES

The Project will temporarily increase existing in-air and underwater acoustic levels in the Project vicinity, which is part of a high-use industrial area with frequent marine vessel traffic and associated activities. The soundscape in the vicinity of the Project will include existing ambient sound, plus pile installation noise from the Project. The Project may affect marine mammals by generating noise associated with installation of piles using vibratory hammers, impact hammers, jetting, and drilling with a down-the-hole hammer. Refer to Section 1.3.3 for a description of the in-water marine construction activities. Other activities associated with the Project (e.g., upland and above-water construction, vessel movements, and placement of fill) do not produce in-air or underwater noise levels expected to exceed Level A or Level B harassment levels for any marine mammal hearing group.

6.2.1 AMBIENT SOUND

Ambient (or background) sound is composed of sound from many sources and from multiple locations (Richardson et al. 1995). In general, ambient sound levels in the marine environment are variable over time due to a number of biological, physical, and anthropogenic (e.g., manmade) sources. Ambient noise can vary with location, time of day, tide, weather, season, and frequency on scales ranging from a second to a year. Underwater sound types in the Project area include physical noise, biological noise, and anthropogenic noise. Physical noise includes noise from waves at the water surface, rain, and currents; moving rocks, sediment, and silt; and atmospheric noise. Biological sound includes vocalizations and other sounds produced by marine mammals, fishes, seabirds, and invertebrates. Anthropogenic noise includes noise from vessels (small and large), shore-based manufacturing plants, marine fueling facilities, ferry and barge cargo loading/unloading operations, maintenance dredging, aircraft overflights, construction noise, and other sources, which produce varying noise levels and frequency ranges (Table 6-3).

Table 6-3: Representative Noise Levels of Anthropogenic Sources of Noise Commonly Encountered in Marine Environments

Noise Source	Frequency Range (Hz)	Underwater Noise Level (dB rms re 1 μPa)	Reference*
Small Vessels	250–1,000	151 dB at 1 meter	Richardson et al. 1995
Tug Docking Gravel Barge	200–1,000	149 dB at 100 meters	Blackwell and Greene 2002
Container/Cruise Ship	100–500	180 dB at 1 meter	Richardson et al. 1995
Dredging Operations	50–3,000	120–140 dB at 500 meters; 156.9 dB at 30 meters	URS 2007; SFS 2009

Note: dB = decibels; rms re 1 μPa = root mean square referenced to 1 microPascal; HZ = Hertz.

**SFS = Scientific Fishery Systems, Inc.; URS = URS Corporation*

Ongoing vessel activities, land-based industrial and commercial activities, military usage (training, testing, and in-water construction activities), and regular aircraft operations result in elevated in-air and underwater sound conditions in the Project area that increase with proximity to the component sites. Sound levels likely vary seasonally, with elevated levels during summer, when the tourism and fishing industries are at their peaks.

The underwater ambient sound levels along the mid-Atlantic Corridor were recorded: at the 10-meter (33-feet) measurement site ambient levels were dominated by sounds below 30 Hz and above 1,000 Hz, while at the 200-meter (650-feet) measurement site, the ambient levels were dominated by sounds above 500 Hz (Illingworth and Rodkin, Inc. 2017). Illingworth and Rodkin, Inc. (2017) provides a snapshot of background noise measured prior to impact driving of 61-centimeter (24-inch) square concrete square piles and vibratory driving of timber piles approximately 8-inches at the tip in October 2014 at Naval Station Norfolk. Water depth at the pile locations was approximately 12 meters (40 feet). Average ambient noise was 123 and 122 dB 1-second rms SPL (range = 116 to 140 dB), respectively and 124 and 123 dB 10-second rms SPL (range = 119 to 132 dB), respectively.

However, NMFS prefers that a larger data set be used to establish a different ambient noise value, so the NMFS default value, 120 dB, will be used to represent the ambient noise level in the Project area.

6.2.2 UNDERWATER NOISE LEVELS

6.2.2.1 Pile Installation Noise Levels

The Project includes vibratory hammer and impact hammer pile installation of steel pipe piles, drilling with a down-the-hole hammer installation, and removal of concrete load test pipe piles. Sound source levels (SSLs) for each method of installation were estimated using empirical measurements from similar projects in Norfolk and Little Creek (Craney Island), elsewhere in Virginia, or outside of Virginia (California, Florida, Washington, Alaska) (Table 6-4).

Table 6-4: Estimates of Underwater Sound Source Levels Generated during Vibratory and Impact Pile Installation, and Drilling with a Down-the-Hole Hammer Installation

Method and Pile Type	Sound Source Level at 10 meters			Literature Source
Vibratory Hammer	**dB rms**			
42-inch steel pile	168			City and Borough of Sitka Department of Public Works 2017
36-inch steel pile	167			DoN 2015
24-inch steel pile	161			DoN 2015
Down-the-hole Hammer	**dB rms**	**dB SEL**	**dB peak**	
All pile sizes	180	164	190	Denes et al. 2019
Impact Hammer	**dB rms**	**dB SEL**	**dB peak**	
36-inch steel pile	193	183	210	Chesapeake Tunnel Joint Venture 2018
36-inch steel pile, attenuated*	186	176	203	DoN 2015; Chesapeake Tunnel Joint Venture 2018
54-inch concrete cylinder pile**	176	174	192	MacGillivray et al. 2007
30-inch concrete square pile**	176	174	192	MacGillivray et al. 2007
24-inch concrete square	176	166	188	Caltrans 2015

SEL = sound exposure level; dB peak = peak sound level; rms = root mean square; DoN = Department of the Navy.

**SSLs are a 7 dB reduction from Chesapeake Tunnel Joint Venture values due to usage of a bubble curtain.*

***SSLs taken from 36-inch concrete square piles, no project specific information provided.*

6.2.2.2 Multiple Vibratory Hammer Noise Levels

Simultaneous use of hammers could result in increased SPLs and harassment zone sizes given the proximity of the component sites and the rules of decibel addition. NMFS (2018b) handles overlapping sound fields created by the use of more than one hammer differently for impulsive (impact hammer and drilling with a down-the-hole hammer) and continuous sound sources (vibratory hammer) (Table 6-5). Previously, drilling with a down-the-hole hammer was classified as a continuous noise source by NMFS but NMFS now considers this an impulsive noise source (84 FR 64847). For this analysis, drilling with a down-the-hole hammer will be treated the same as an impact hammer. Based on the NMFS (2018b) guidance for use of two impact hammers simultaneously, it is unlikely that the two hammers would strike at the same exact instant, and therefore, the SPLs will not be adjusted regardless of the distance between the hammers. In this case, each impact hammer and drilling with a down-the-hole hammer will be considered to have its own independent harassment zones (Section 6.4).

When two continuous noise sources, such as vibratory hammers, have overlapping sound fields, there is potential for higher sound levels than for non-overlapping sources. This method was used by

Washington State Department of Transportation (WSDOT) for the construction of the Seattle Multimodal Construction Project (82 FR 15497), as well as by NMFS for the Parallel Thimble Shoal Tunnel Project (84 FR 64847) and Ferry Berth Improvements in Tongass Narrows, Alaska (85 FR 673).

When two or more vibratory hammers are used simultaneously, and the isopleth of one sound source encompasses the sound source of another isopleth, the sources are considered additive and combined using the following rules (Table 6-5): for addition of two simultaneous vibratory hammers, the difference between the two SSLs is calculated, and if that difference is between 0 and 1 dB, 3 dB are added to the higher SSL; if difference is between 2 or 3 dB, 2 dB are added to the highest SSL; if the difference is between 4 to 9 dB, 1 dB is added to the highest SSL; and with differences of 10 or more decibels, there is no addition.

Table 6-5: Rules for Combining Sound Levels Generated during Pile Installation

Hammer Types	Difference in SSL	Level A Zones	Level B Zones
Vibratory, Impact	Any	Use impact zones	Use vibratory zone
Impact, Impact	Any	Use zones for each pile size and number of strikes	Use zone for each pile size
Vibratory, Vibratory	0 or 1 dB	Add 3 dB to the higher source level	Add 3 dB to the higher source level
	2 or 3 dB	Add 2 dB to the higher source level	Add 2 dB to the higher source level
	4 to 9 dB	Add 1 dB to the higher source level	Add 1 dB to the higher source level
	10 dB or more	Add 0 dB to the higher source level	Add 0 dB to the higher source level

Source: Modified from USDOT 1995, WSDOT 2018, and NMFS 2018b

Note: dB = decibels; SSL = sound source level.

For simultaneous usage of three or more continuous sound sources, such as vibratory hammers, the three overlapping sources with the highest SSLs are identified. Of the three highest SSLs, the lower two are combined using the above rules, then the combination of the lower two is combined with the highest of the three. For example, with overlapping isopleths from 24-, 36-, and 42-inch diameter steel pipe piles with SSLs of 161, 167, and 168 dB rms respectively, the 24- and 36-inch would be added together; given that 167 – 161 = 6 dB, then 1 dB is added to the highest of the two SSLs (167 dB), for a combined noise level of 168 dB. Next, the newly calculated 168 dB is added to the 42-inch steel pile with SSL of 168 dB. Since 168 – 168 = 0 dB, 3 dB is added to the highest value, or 171 dB in total for the combination of 24-, 36-, and 42-inch steel pipe piles (NMFS 2018b; WSDOT 2018).

During installation activities covered under this IHA application, there may be times when multiple construction sites are active concurrently and vibratory hammers are used simultaneously. The likelihood of such an occurrence is anticipated to be infrequent and would be for short durations on that day. In-water pile installation is an intermittent activity, and it is common for installation to start and stop multiple times as each pile is adjusted and its progress is measured and documented. Following an approach modified from WSDOT in their Biological Assessment manual and described above (Table 6-

5), decibel addition calculations were carried out for all possible combinations of vibratory installation of 24-, 36- and 42-inch steel pipe piles throughout the Project area (Table 6-6). Implementation of harassment zones during use of multiple hammers is discussed in Section 11.2.1.

Table 6-6: Possible Vibratory Pile Combinations for the Project

Method			Vibratory								
	Pile Diameter (Inches)		24	24+24	36	42	36+24	42+24	36+36	42+36	42+42
		SSL (dB)	161	164	167	168	168	169	170	171	171
Vibratory	24	161	**164**	**166**	**168**	**169**	**-**	**-**	**-**	**-**	**-**
	36	167	**168**	**169**	**170**	**171**	**171**	**-**	**172**	**-**	**-**
	42	168	**169**	**169**	**171**	**171**	**171**	**172**	**172**	**173**	**173**

SSL = Sound Source Level; dB = decibels.
"-" combination not valid, must compare lowest 2 values first, then highest value.

6.2.3 IN-AIR NOISE LEVELS

The largest pile size for the Project is 54-inch concrete cylinder piles, but measurements of in-air noise associated with installation of this and other smaller concrete pile sizes are limited. In-air noise levels during impact installation of 24-inch concrete square piles at Naval Station Norfolk and Joint Expeditionary Base-Little Creek and Craney Island averaged 88 dBA as measured at 50 feet (15 meters) (Illingworth and Rodkin, Inc. 2017). During impact driving of the 24-inch concrete square piles, the average L_{max} was 101 dBA and the average L_{eq} was 93 dBA. However, installation of similarly-sized steel pipe piles generally produces higher SPLs than concrete, and installation of 36-inch steel pipe piles is anticipated to be among the highest SPLs resulting from Project activities. In-air noise levels from impact installation of 36-inch steel pipe piles were measured during the Naval Base Kitsap at Bangor EHW-2 Project (DoN 2015). In-air noise levels during impact installation were 109 dB (unweighted) re 20 µPa as measured at 15 meters (50 feet).

6.3 APPLICABLE NOISE CRITERIA

NMFS published updated Technical Guidance in April 2018 that identifies the received levels, or thresholds, above which individual marine mammals are predicted to experience changes in their hearing sensitivity (either temporary or permanent) for acute, incidental exposure to underwater anthropogenic noise sources (i.e., Level A harassment; NMFS 2018a). The 2018 Technical Guidance does not address Level B harassment thresholds. To assess Level B harassment levels, NMFS continues to use its interim criteria.

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, but which *does not* have the potential to injure a marine mammal or marine mammal stock in the wild.”

6.3.1 LEVEL A HARASSMENT

For underwater noise exposure, this IHA application uses the 2018 Technical Guidance for assessing Level A harassment (NMFS 2018a). Received levels, or thresholds, above which individual marine

mammals are predicted to experience permanent changes in their hearing sensitivity (or a PTS) due to underwater anthropogenic sound sources have also been weighted by functional hearing groups as defined in the Technical Guidance (Table 6-7; NMFS 2018a). Under the 2018 Technical Guidance, these levels are considered thresholds for Level A (injury) harassment. Calculation of Level A harassment isopleth distances based on PTS onset acoustic thresholds requires information on characteristics of the sound and the local environment.

Table 6-7: Summary of Permanent Threshold Shift Onset Acoustic Thresholds for Assessing Level A Harassment of Marine Mammals from Exposure to Noise from Continuous and Impulsive Underwater Sound Sources

Functional Hearing Group Frequency Range Species Groups	Impulsive (Impact Hammer and Drilling with a Down-The-Hole Hammer)	Non-Impulsive (Vibratory Hammer)
Low-Frequency (LF) Cetaceans ***7 Hz to 35 kHz*** **Humpback whale**	$L_{pk,flat}$: 219 dB $L_{E,\ LF,\ 24h}$: 183 dB	$L_{E,\ LF,\ 24h}$: 199 dB
Mid-Frequency (MF) Cetaceans ***150 Hz to 160 kHz*** **Bottlenose dolphin**	$L_{pk,flat}$: 230 dB $L_{E,\ MF,\ 24h}$: 185 dB	$L_{E,\ MF,\ 24h}$: 198 dB
High-Frequency (HF) Cetaceans ***275 Hz to 160 kHz*** **Harbor porpoise**	$L_{pk,flat}$: 202 dB $L_{E,\ HF,\ 24h}$: 155 dB	$L_{E,\ HF,\ 24h}$: 173 dB
Phocid Pinnipeds (PW) Underwater ***50 Hz to 86 kHz*** **Harbor seal, gray seal**	$L_{pk,flat}$: 218 dB $L_{E,\ PW,\ 24h}$: 185 dB	$L_{E,\ PW,\ 24h}$: 201 dB

$L_{pk,flat}$ = Peak sound pressure level (unweighted); $L_{E,24h}$ = Sound exposure level, cumulative 24 hours; Hz = Hertz; kHz = kilohertz; dB = Decibels.

Source: NMFS 2018a.

6.3.2 LEVEL B HARASSMENT

For impulse sounds (e.g., impact pile installation and drilling with a down-the-hole hammer), the Level B harassment threshold is set at an SPL value of 160 dB re 1 μPa rms (Table 6-8). For non-pulsed and continuous sounds (e.g., vibratory pile installation), the Level B harassment threshold is set at an SPL of 120 dB re 1 μPa rms (Table 6-8). Underwater sound levels were assumed to be 120.0 dB rms for this evaluation as discussed in Section 6.2.1 and Table 6-8.

For in-air noise exposure of hauled-out pinnipeds, NMFS uses criteria for Level B harassment of 90 dB re 20 μPa for harbor seals and 100 dB re 20 μPa for all other pinnipeds. These criteria do not differentiate among sound types.

Table 6-8: Summary of Level B Harassment Thresholds of Marine Mammals from Exposure to Noise from Continuous and Impulsive Underwater Sound Sources

Functional Hearing Group Frequency Range Species Groups	Impulsive Sound (Impact Hammer and Drilling with a Down-The-Hole Hammer) dB rms re 1 μPa	Threshold Non-Impulsive Sound (Vibratory Hammer) dB rms re 1 μPa
Low-Frequency (LF) Cetaceans ***7 Hz to 35 kHz*** **Humpback whale**	160 dB	120 dB
Mid-Frequency (MF) Cetaceans ***150 Hz to 160 kHz*** **Bottlenose dolphin**	160 dB	120 dB
High-Frequency (HF) Cetaceans ***275 Hz to 160 kHz*** **Harbor porpoise**	160 dB	120 dB
Phocid Pinnipeds (PW) Underwater ***50 Hz to 86 kHz*** **Harbor seal, gray seal**	160 dB	120 dB

rms SPL = Sound Pressure Level Root Mean Squared; dB re 1 μPa = decibel reference level 1 microPascal; dB = decibels.

6.4 DISTANCES TO SOUND THRESHOLDS

6.4.1 UNDERWATER NOISE

Vibratory and impact pile installation and drilling with a down-the-hole hammer will generate underwater noise that could potentially disturb marine mammals in the Project area. Ambient underwater sound levels were assumed to be 120 dB rms for this evaluation (Section 6.2.1). The SSLs for pile installation were estimated using the results of measurements from the best available and most relevant sound source verification (SSV) studies (Table 6-4). NMFS typically recommends a default practical spreading loss coefficient of 15 as described by Davidson (2004) and Thomsen et al. (2006) when site-specific empirical data are unavailable. Using a TL coefficient of 15 produces conservative estimates of harassment thresholds for the Project, and was used for impact and vibratory hammering and drilling with a down-the-hole hammer.

6.4.1.1 Level A Harassment

Sound propagation and the distances to the sound isopleths defined by NMFS for Level A harassment of marine mammals under the 2018 Technical Guidance were estimated (Table 6-9 and Table 6-10) using the User Spreadsheet developed by NMFS for this purpose (NMFS 2018a) (Attachment 3). Table 6-9 harassment isopleths represent the number of piles that will typically be installed by a single vibratory hammer within a day; see Section 6.4.1.3 for a discussion of isopleths for larger numbers of piles resulting from use of multiple vibratory hammers. The method uses estimates of SPL and duration of the activity to calculate the threshold distances at which a marine mammal exposed to those values would experience a PTS. Differences in hearing abilities among marine mammals are accounted for by use of weighting factor adjustments for the four functional hearing groups that are present in the Project area (LF, MF, HF, and PW) (NMFS 2018a). All necessary parameters were available for the SEL_{cum} method for calculating isopleths, and therefore, this method was selected to calculate Level A isopleth

distances for impact installation and drilling with a down-the-hole hammer, and SPL rms was used for vibratory installation. The SEL_{cum} method resulted in isopleths that were larger than those calculated using the peak SPL method, and therefore, the SEL_{cum} isopleths were selected for the entire Project.

The permanent piles could either be 24-inch concrete square piles, 30-inch concrete square piles, or 54-inch concrete cylinder piles. The largest pile size for the Project is 54-inch concrete piles; however, it was selected for worse-case scenario.

Level A harassment zones of the Project are shown in Attachment 2, Figure 6-1 through Figure 6-18. A 10-meter minimum shutdown zone will be implemented for all species and pile installation methods to prevent direct injury of marine mammals. To avoid unauthorized Level A take, if Level A take numbers are approaching authorized levels, shutdown will be implemented before individuals reach the Level A zones.

Table 6-9: Calculated Distances to Level A Harassment Isopleths during Vibratory Pile Installation with no Attenuation, For All Locations

Project Component	Pile Size and Type	Number of Piles Per Day	Minutes Per Pile	Level A Harassment Isopleth Distance (meters)				Level A Harassment Isopleth Areas (km^2)			
				Cetaceans			Pinnipeds	Cetaceans			Pinnipeds
				LF	MF	HF	PW	LF	MF	HF	PW
All Locations*	42-inch Pipe, Steel	6	30	42	4	62	26	<0.10			
All Locations*	36-inch Pipe, Steel	3	50	32	3	47	20	<0.01			
All Locations*	24-inch Pipe, Steel	6	30	15	2	21	9	<0.01			
TBM Platform	36-inch Pipe, Steel	2	60	28	3	41	17	<0.01			

Note: a 10-meter shutdown zone will be implemented for all species and activity types to prevent direct injury of marine mammals.
** All locations exclude the TBM platform as the TBM Platform piles have a different duration for installation, and therefore the zone sizes are different.*
LF = Low-frequency; MF = Mid-frequency; HF = High-frequency; PW = Phocids in water; km^2 = square kilometers, TBM = Tunnel Boring Machine.

Table 6-10: Calculated Distances to Level A Harassment Isopleths during Impact Pile Installation with and without Attenuation, For the Jet Grouting Trestle

Jet Grouting Trestle, Impact	Pile Size and Type	Approximate Number of Strikes Per Pile	Number of Piles Per Day	Level A Harassment Isopleth Distance (meters)				Level A Harassment Isopleth Areas (km^2)			
				Cetaceans			Pinnipeds	Cetaceans			Pinnipeds
				LF	MF	HF	PW	LF	MF	HF	PW
Without Bubble Curtain	36-inch Pipe, Steel	40	3	243	9	290	130	0.11	<0.01	0.16	<0.10
With Bubble Curtain	36-inch Pipe, Steel	40	3	83	3	99	45	0.014	<0.001	0.20	<0.01

Note: a 10-meter shutdown zone will be implemented for all species and activity types to prevent direct injury of marine mammals.
LF = Low-frequency; MF = Mid-frequency; HF = High-frequency; PW = Phocids in water; km^2 = square kilometers.

Table 6-11: Calculated Distances to Level A Harassment Isopleths during Impact Pile Installation with No Attenuation

Project Component	Pile Size and Type	Approximate Number of Strikes Per Pile	Number of Piles Per Day	Level A Harassment Isopleth Distance (meters)				Level A Harassment Isopleth Areas (km^2)			
				Cetaceans			Pinnipeds	Cetaceans			Pinnipeds
				LF	MF	HF	PW	LF	MF	HF	PW
North Trestle											
North Shore Work Trestle	36-inch Pipe, Steel	40	3	243	9	290	130	0.19	<0.001	0.26	0.05
North Trestle, Willoughby Bay, and South Trestle											
Test Pile Program	54-inch Concrete Cylinder	2,100	1	412	15	490	221	0.53	<0.001	0.75	0.15
Test Pile Program	30-inch Concrete Square	2,100	1	412	15	490	221	0.53	<0.001	0.75	0.15
Test Pile Program	24-inch Concrete Square	2,100	1	121	5	144	65	0.05	<0.001	0.07	0.01
South Island											
TBM Platform	36-inch Pipe, Steel	60	2	243	9	290	130	0.11	<0.001	0.16	<0.10
Conveyor Trestle	36-inch Pipe, Steel	40	3	243	9	290	130	0.11	<0.001	0.16	<0.10
Down-the-Hole											
TBM Platform	36-inch Pipe, Steel	50,400	2	1,171	42	1,395	627	2.437	<0.01	3.446	0.704

Project Component	Pile Size and Type	Approximate Number of Strikes Per Pile	Number of Piles Per Day	Level A Harassment Isopleth Distance (meters)				Level A Harassment Isopleth Areas (km^2)			
				Cetaceans			Pinnipeds	Cetaceans			Pinnipeds
				LF	MF	HF	PW	LF	MF	HF	PW
North Shore Work Trestle	36-inch Pipe, Steel	50,400	3	1,534	55	1,827	821	3.615	<0.01	4.790	1.548
Jet Grouting Trestle	36-inch Pipe, Steel	50,400	3	1,534	55	1,827	821	3.615	<0.01	5.908	1.548
Conveyor Trestle	36-inch Pipe, Steel	50,400	3	1,534	55	1,827	821	3.615	<0.01	5.908	1.548

Note: a 10-meter shutdown zone will be implemented for all species and activity types to prevent direct injury of marine mammals. The permanent piles could either be 24-inch concrete square piles, 30-inch concrete square piles, or 54-inch concrete cylinder piles. The largest pile size for the Project is 54-inch concrete piles; however, it was selected for worse-case scenario. LF = Low-frequency; MF = Mid-frequency; HF = High-frequency; PW = Phocids in water; km^2 = square kilometers; TBM = Tunnel Boring Machine.

6.4.1.2 Level B Harassment

Sound propagation and distances to the sound isopleths defined by NMFS for Level B harassment of marine mammals when a single or independent vibratory hammer is used were estimated using the practical spreading loss model. The source levels for pile installation were estimated using the results of measurements from the best available and most relevant SSV studies (Table 6-4).

The attenuation of underwater noise (TL) is estimated using the practical spreading loss model. The formula for TL is:

$$TL = X \log10^{(R/D)}$$

where R is the distance from the source, D is the distance of the known or measured noise level, and X is the TL coefficient. NMFS typically recommends a TL coefficient of 15 dB per tenfold increase in distance when site-specific empirical data are unavailable (i.e., 15 log10 in this case). This model, based on the default practical spreading loss assumption and NMFS preferred TL coefficient, can be rearranged to estimate the distances to the Level B harassment thresholds as follows:

$$R = D * 10^{(TL/15)}$$

where TL is the difference between the SSL and the Level B harassment threshold (120 dB or 160 dB). Distances to the Level B harassment isopleths vary by pile size and installation method (Table 6-12).

The Level B harassment zones for when a single or independent vibratory hammer is used are shown in Attachment 2, Figures 6-19 through 6-30.

Table 6-12: Distances to Level B Harassment Isopleths for Different Pile Sizes and Types and Methods of Installation

Location and Component	Method and Pile Type	Distance to Level B Isopleth (meters), Unattenuated	Level B Area Unattenuated (km^2)
Vibratory Hammer (Level B Isopleth = 120 dB)			
North Trestle			
Moorings	42-inch steel piles	15,849	96.781
North Shore Work Trestle	36-inch steel piles	13,594	85.525
Moorings	24-inch steel piles	5,412	25.335
North Island			
Moorings	42-inch steel piles	15,849	100.937
South Island			
TBM Platform	36-inch steel piles	13,594	81.799
Conveyor Trestle	36-inch steel piles	13,594	81.799
Jet Grouting Trestle	36-inch steel piles	13,594	81.799
South Trestle			

Location and Component	Method and Pile Type	Distance to Level B Isopleth (meters), Unattenuated	Level B Area Unattenuated (km^2)
Moorings	42-inch steel piles	15,849	305.343
Moorings	24-inch steel piles	5,412	55.874
Willoughby Bay			
Moorings	42-inch steel piles	15,849	5.517
Moorings	24-inch steel piles	5,412	5.517
Down-the-Hole Hammer (Level B Isopleth = 160 dB)			
North Shore Work Trestle	36-inch steel piles	215	0.145
TBM Platform	36-inch steel piles	215	0.087
Jet Grouting Trestle	36-inch steel piles	215	0.087
Conveyor Trestle	36-inch steel piles	215	0.087
Impact Hammer (Level B Isopleth = 160 dB)			
North Trestle			
North Shore Work Trestle	36-inch steel piles	1,585	3.806
South Island			
TBM Platform	36-inch steel piles	1,585	0.087
Conveyor Trestle	36-inch steel piles	1,585	0.087
Jet Grouting Trestle with Bubble Curtain	36-inch steel piles	541*	0.012*
North Trestle, South Trestle, Willoughby Bay			
Test Pile Program	54-inch concrete cylinder piles	117	0.04
Test Pile Program	30-inch concrete square piles	117	0.04
Test Pile Program	24-inch concrete square piles	117	0.04

dB = decibels; km^2 = square kilometers; TBM = Tunnel Boring Machine.

**Values smaller than other 36-Inch steel piles due to usage of a bubble curtain, resulting in a 7 dB reduction in dB rms, dB peak, and dB SEL. Reference Table 6-4 for more information.*

6.4.1.3 Level A and Level B Harassment Zones for Multiple Hammers

The extent to which use of more than one vibratory hammer could occur within a day or simultaneously is unknown and difficult to quantify. To simplify implementation of Level A zones for use of more than one vibratory hammer within a day and/or during simultaneous use of multiple vibratory hammers with overlapping isopleths, Level A zone sizes were calculated for the longest anticipated duration of the largest pile sizes that could be installed within a day. For example, if 18 42-inch steel pipe piles were installed with a vibratory hammer on a single day, the Level A zone for each of three functional hearing groups would remain smaller than 100 meters; the Level A zone for harbor porpoises would be 128 meters. However, it is highly unlikely that a harbor porpoise could accumulate enough sound from the installation of multiple piles in multiple locations for the duration required to meet this Level A threshold. Additionally, this scenario, installation of 18 42-inch steel pipe piles within a day, represents a level of efficiency (production rate) that is unlikely to be matched or exceeded in the field. Other combinations of pile sizes and

numbers would result in Level A zones smaller than 100 meters. To be precautionary, a shutdown zone of 100 meters for all species will be implemented for each vibratory hammer on days when it is anticipated that multiple vibratory hammers will be used, whether at a single or multiple sites (see Section 11.1). This mitigation measure, although conservative, would also minimize the need for on-site coordination among Project sites and components.

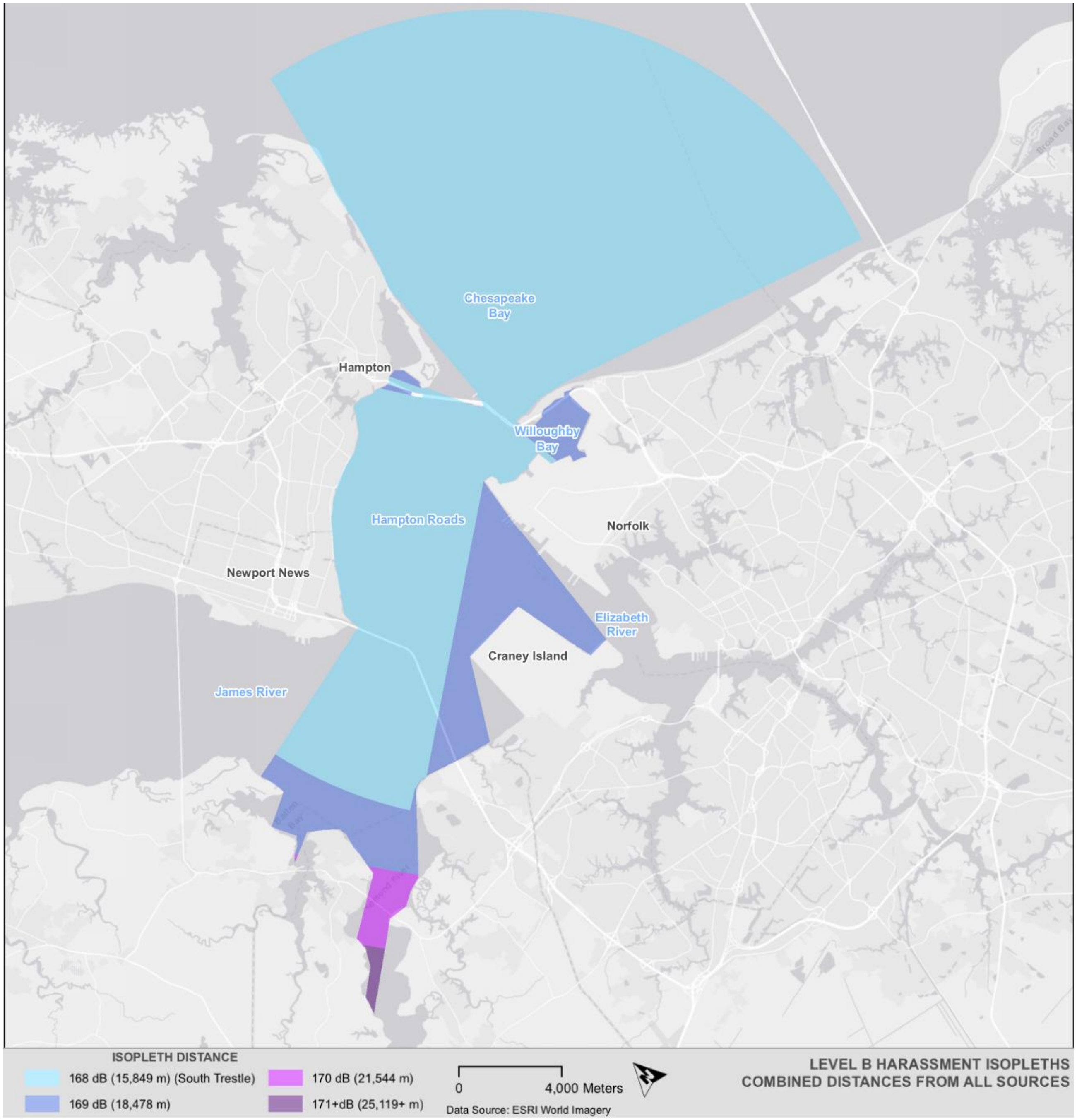
When multiple vibratory hammers are used simultaneously, the Level B harassment zone will be larger than reported above depending on the combination of sound sources due to decibel addition of multiple vibratory hammers as discussed in Section 6.2.2.2. Table 6-13 lists the distances to Level B isopleths for decibel levels resulting from the simultaneously installation of piles with multiple vibratory hammers. Figure 6-1 shows the Level B harassment zone for various decibel levels as a result of decibel addition. Note that in this figure, South Trestle is the only sound source that ensonifies an area extending into Chesapeake Bay, and thus only the largest single-source isopleth has been mapped from South Trestle into the Chesapeake Bay.

Table 6-13: Distances to Level B Harassment Isopleths for Multiple Hammer Additions

Combined SSL (dB)	Distance to Level B Isopleth (meters)
163	7,356
164	8,577
165	10,000
166	11,659
167	13,594
168	15,849
169	18,478
170	21,544
171	25,119
172	29,286
173	34,145

Note: dB = decibels; SSL = sound source level.

Figure 6-1: Level B Harassment Zones for Multiple Hammer Scenarios. Note: Level B harassment area from South Trestle into the Chesapeake Bay is the 168 dB isopleth resulting from vibratory installation of a single 42-inch pile. Due to physical barriers, no sounds



6.4.1.4 In-Air Noise

Pinnipeds (harbor seals and gray seals) can be affected by in-air noise when they are hauled out. Loud noises can cause hauled-out pinnipeds to panic back into the water, leading to disturbance and possible injury. For in-air sound exposure of hauled-out pinnipeds, NMFS uses criteria for Level B harassment of 90 dB re 20 μPa rms for harbor seals and 100 dB re 20 μPa rms for all other pinnipeds.

The spherical spreading model was used to estimate noise threshold distances from the maximum anticipated in-air noise source level. The equation uses ambient sound level with NMFS defined noise thresholds as follows:

$$D = D_o * 10^{((\text{Construction Noise} - \text{Noise Threshold})/\alpha)}$$

In the model,

D = the distance from the noise source

D_o = the reference measurement distance (15 meters in this case)

α = 20 for hard ground or water, which assumes a 6 dBA reduction per doubling distance

Given the source level of 109 dBA for in-air noise during impact pile installation of 36-inch steel piles (Section 6.2.3), the calculated isopleths for in-air noise can be used for all pile sizes and types associated with the Project. Installation of smaller piles is generally assumed to produce lower sound levels than installation of larger piles. Based on this model, in-air noise from impact installation of 36-inch steel piles could extend up to 136 meters (446.2 feet) from the noise source over open water until it attenuates to a level below the NMFS threshold for harassment of phocid pinnipeds such as harbor and gray seals (Table 6-14).

Table 6-14: Distance (meters) from Impact Installation to the Isopleth where In-air Sound will Attenuate to NMFS Thresholds for Harassment

Method, Pile Type	Harbor Seals and Gray Seals (90 decibels (dB))
Impact Hammer	
All Project Piles	136 meters

The estimates for distances that in-air noise could travel and exceed the harassment threshold for in-air disturbance fall far short of the distance to the nearest known pinniped haul outs on the CBBT Islands (17.2 kilometers (9.3 nautical miles)) (Figure 2-2). However, there are anecdotal reports of seals hauling out on the rocks near the HRBT (see Section 4.4) and other human-made and natural coastal features in the general Project area. Exact numbers of seals that may use the Project area are not available. HRCP estimates that up to 1 harbor seal per day could be hauled out close enough to active construction sites to be incidentally exposed to in-air noise from pile installation.

6.5 ESTIMATED TAKES

Estimated exposure and take of marine mammals associated with the Project is based on presence/absence, distribution, and abundance information presented in Section 4. Marine

mammal take is requested for the following five species and is distinguished in the following subsections.

6.5.1 HUMPBACK WHALE

Humpback whales are relatively rare in the Project area and density data for this species within the Project vicinity do not exist or were not calculated because sample sizes were too small to produce reliable estimates of density. Humpback whale sighting data collected by the U.S. Navy near Naval Station Norfolk and Virginia Beach from 2012 to 2015 (Engelhaupt et al. 2014, 2015, 2016) and in the mid-Atlantic (including the Chesapeake Bay) from 2015 to 2018 (Aschettino et al. 2015, 2016, 2017a, 2018) did not produce high enough sample sizes to calculate densities, or survey data were not collected during systematic line-transect surveys. However, humpback whale densities have been calculated for populations off the coast of New Jersey, resulting in a density estimate of 0.000130 animals per square kilometer or one humpback whale within the area (off the coast of New Jersey) on any given day of the year (Whitt et al. 2015). In the Project area, a similar density may be expected, although the Project area is much smaller. Aschettino et al. (2018) observed and tracked two individual humpback whales in the Hampton Roads area of the Project area (Movebank 2019), and based on these data, the HRCP is requesting two Level B exposure every two months for the duration of in-water pile installation. Pile installation is expected to occur over a 12-month period; therefore, a total of 12 Level B exposures of humpback whales (1 humpback whale x 12 months) is requested. No Level A exposures are requested for humpback whales. Humpback whales are not anticipated to enter the Level A harassment zones during pile installation.

6.5.2 BOTTLENOSE DOLPHIN

The expected number of bottlenose dolphins in the Project area was estimated using daily sighting rates of marine mammals from vessel line-transect surveys near Naval Station Norfolk and adjacent areas near Virginia Beach, Virginia, from August 2012 through August 2015 (Engelhaupt et al. 2016). Many of the data from the Engelhaupt et al. (2016) study were collected from the coastal region outside Chesapeake Bay, where bottlenose dolphin numbers are higher than within the Project area. For this analysis, only bottlenose dolphin sightings located west of 76°10' (76.16667°) were used, which includes the largest area that could be ensonified by Project-related noise.

Sighting rates (number of dolphins per day) were determined for each of the four seasons (Table 6-15). The number of sightings per season ranged from 5 in spring to 24 in fall; no bottlenose dolphins were sighted in the winter months. Bottlenose dolphin abundance was highest in the fall, with 24 sightings representing 245 individuals, followed by the spring (n = 156), and summer (n = 115). It is anticipated that more pile installation will occur in the spring, summer, and fall seasons. Therefore, the average daily sighting rates of bottlenose dolphins across spring, summer, and fall were averaged to estimate that 20.33 bottlenose dolphins per day potentially could be exposed to Project-related noise (Table 6-15).

Table 6-15: Average Daily Sighting Rates of Bottlenose Dolphins Within the Project Area

Season	Number of Sightings Per Season	Average Number of Dolphins Sighted Per Day
Spring, March – May	5	17.33
Summer, June – August	14	16.43
Fall, September – November	24	27.22
Winter, December – February	0	0.00
Average: Spring, Summer, and Fall		**20.33**

Source: Engelhaupt et al. 2016

The number of days of pile installation is estimated to be 312 (see Section 2.1). The number of bottlenose dolphins that potentially could be exposed during the Project is therefore estimated as 6,343 individuals (20.33 bottlenose dolphins per day x 312 days).

Level A zones and areas (Table 6-9 through Table 6-11) are small for bottlenose dolphins, which are categorized in the MF cetacean functional hearing group. Maximum Level A isopleths are 55 meters for drilling with a down-the-hole hammer installation of 36-inch steel pipe piles. The largest Level A harassment area from 36-inch steel pipe piles that would affect bottlenose dolphins is less than 0.01 km^2 (Table 6-11). Given the daily sighting rates presented in Table 6-15, and the small Level A zones, HRCP do not anticipate that bottlenose dolphins will be exposed to Level A noise. Further, the largest Level A zone is within the proposed 10-meter shutdown zone. However, given the extensive nature of this Project, and the potential for bottlenose dolphins to be present within the Project area in higher numbers during summer and fall seasons, HRCP request 63 Level A exposures for bottlenose dolphins, which is about 1% of the total potential exposures. A total of 6,280 Level B exposures of bottlenose dolphins is requested (6,343 total exposures – 63 Level A takes = 6,280 Level B takes).

The total number of bottlenose dolphin exposures will be split between the three bottlenose dolphin stocks: Western North Atlantic Southern Migratory Coastal; Western North Atlantic Northern Migratory Coastal; and North Carolina Estuarine (see Table 6-20 in Section 6.6).

6.5.3 HARBOR PORPOISE

Harbor porpoises are known to occur in the coastal waters near Virginia Beach (Hayes et al. 2019), and although they have been reported on rare occasions in the Chesapeake Bay closer to Norfolk, they are rarely seen in the Project area. Density data for this species within the Project vicinity do not exist or were not calculated because sample sizes were too small to produce reliable estimates of density. Harbor porpoise sighting data collected by the U.S. Navy near Naval Station Norfolk and Virginia Beach from 2012 to 2015 (Engelhaupt et al. 2014, 2015, 2016) did not produce high enough sample sizes to calculate densities. One group of two harbor porpoises was seen during spring 2015 (Engelhaupt et al. 2016).

It is estimated that one group of two harbor porpoises could be exposed to Project-related underwater noise each month during the spring (March–May) for a total of 6 harbor porpoises (i.e., 1 group of 2 individuals per month x 3 months = 6 harbor porpoises).

The largest Level A harassment zone for harbor porpoises extends 1,828 meters from the noise source during drilling with a down-the-hole hammer installation of 36-inch steel pipe piles for a harassment area of 5.9 km^2, which is larger than the area of the Level B zone (0.015 km^2). (Table 6-11). Because harbor porpoises move quickly and elusively, it is possible that harbor porpoises may enter the Level A harassment zone without detection. As such, HRCP requests small numbers of Level A exposure for harbor porpoises during the Project. On approximately 21% of the days, the Level A zone size exceeds the size of the Level B zone. Therefore, 21% of the total takes will be Level A. It is anticipated that 2 individuals may enter the Level A harassment zone during pile installation during spring, for a total of 2 potential Level A exposures. It is anticipated that 4 individuals may enter the Level B harassment zone during pile installation, for a total of 4 potential Level B exposures per year (6 total exposures – 2 Level A take = 4 Level B take).

6.5.4 HARBOR SEAL

The expected number of harbor seals in the Project area was estimated using systematic, land- and vessel-based survey data for in-water and hauled-out seals collected by the U.S. Navy at the CBBT rock armor and portal islands from November 2014 through May 2018 (Rees et al. 2016; Jones et al. 2018). The number of harbor seals sighted by month from 2014 through 2018, in the Chesapeake Bay waters, in the vicinity of the Project, ranged from 0 to 170 individuals (Table 6-15). Harbor seals are not expected to be present in the Chesapeake Bay during the months of June through October (Table 6-16 and Table 6-17).

Table 6-16: Summary of Historical Harbor Seal Sightings by Month from 2014 to 2018

Number of Individual Harbor Seals						
Month	**2014**	**2015**	**2016**	**2017**	**2018**	**Monthly Average**
January	-	-	33	120	170	**107.7**
February	-	39	80	106	159	**96**
March	-	55	61	41	0	**39.3**
April	-	10	1	3	3	**4.3**
May	-	3	0	0	0	**0.8**
June	Seals not expected to be present.					**0**
July	Seals not expected to be present.					**0**
August	Seals not expected to be present.					**0**
September	Seals not expected to be present.					**0**
October	Seals not expected to be present.					**0**
November	1	0	1	0	-	**0.5**
December	4	9	24	8	-	**11.3**

Source: Rees et al. 2016; Jones et al. 2018.

Note: Seal counts began in November 2014 and were collected for four field seasons (2014/2015, 2015/2016, 2016/2017, and 2017/2018) ending in May 2018. In January 2015, no surveys were conducted.

Table 6-17: Average Number of Individual Harbor Seal Sightings Summarized by Season

Season	Average Number of Individuals Per Season
Spring (March – May)	45
Summer (June – August)	0
Fall (September – November)	1
Winter (December – February)	215
Total Harbor Seals Per Year	**261**

(Data from Table 6-16)

The total number of harbor seals potentially exposed to in-water noise is 261. The largest Level A isopleth associated with drilling with a down-the-hole hammer of 36-inch steel pipe piles for harbor seals is 821 meters (Table 6-11). The area of this Level A zone is 1.55 km^2, which is larger than the area of the Level B zone (0.015 km^2). HRCP do not anticipate that harbor seals will approach the Project area within 821 meters of pile installation in order to be exposed to Level A noise. On approximately 21% of the days, the Level A zone size exceeds the size of the Level B zone. Therefore, 21% of the total takes will be Level A. HRCP request 55 Level A exposures of harbor seals and 206 Level B exposures of harbor seals (261 total exposures – 55 Level A take = 206 Level B take).

HRCP estimates that up to 1 harbor seal per day could be hauled out close enough to active construction sites to be incidentally exposed to in-air noise from pile installation but given that the known haul out is 9.3 nautical miles from the Project and the in-air Level B harassment zone extends 136 meters from the noise source (see Section 6.4.1.4), it is not expected that a harbor seal will be exposed every day (see Section 4.4 and Section 6.2.3). Therefore, HRCP requests that 1 harbor seal per day x 312 days = 312 in-air Level B harbor seal exposures.

6.5.5 GRAY SEAL

The expected number of gray seals in the Project area was estimated using systematic, land- and vessel-based survey data for in-water and hauled-out seals collected by the U.S. Navy at the CBBT rock armor and portal islands from 2014 through 2018 (Rees et al. 2016; Jones et al. 2018). Seasonal numbers of gray seals in the Chesapeake Bay waters in the vicinity of the Project area in previous years have been low (Table 6-18). Gray seals are not expected to be present in the Chesapeake Bay during the months of June through October (Table 6-18 and Table 6-18).

Table 6-18: Summary of Historical Gray Seal Sightings by Month from 2014 to 2018

	Number of Individual Gray Seals					
Month	2014	2015	2016	2017	2018	Monthly Average
January	-	0	0	0	0	**0**
February	-	1	1	0	1	**0.8**
March	-	0	0	0	0	**0**
April	-	0	0	0	0	**0**
May	-	0	0	0	0	**0**

June	Seals not expected to be present.					**0**
July	Seals not expected to be present.					**0**
August	Seals not expected to be present.					**0**
September	Seals not expected to be present.					**0**
October	Seals not expected to be present.					**0**
November	0	0	0	0	-	**0**
December	0	0	0	0	-	**0**

Source: Rees et al. 2016; Jones et al. 2018

Table 6-19: Average Number of Individual Gray Seal Sightings Summarized by Season

Season	Average Number of Individuals per Season
Spring (March – May)	0
Summer (June – August)	0
Fall (September – November)	0
Winter (December – February)	1

(Data from Table 6-18)

Gray seals are expected to be very uncommon in the Project area. The historical data indicate that approximately one gray seal has been seen per year. It is estimated that there could be 3 gray seals exposed to Level B harassment during each of the winter months (December through February). Therefore, HRCP estimate that 9 gray seals could be exposed to Level B harassment (3 gray seals per month x 3 months = 9 gray seals).

No Level A exposures are requested for gray seals.

The in-air Level B harassment zone extends 136 meters from the noise source. No gray seals are known to haul out within 136 meters of any of the Project component locations; therefore, exposure of hauled out gray seals to in-air noise is not anticipated.

6.6 MARINE MAMMAL TAKES REQUESTED

These analyses provide estimates of the numbers of animals by species that could be exposed to received noise levels causing Level A and Level B harassment (Table 6-20) incidentally to the proposed Project.

Due to the variable spatial distribution and limited abundance of some of the marine mammal species identified, and the implementation of the mitigation measures as described in Section 11, there is a negligible chance that pile installation could result in serious injury or death of marine mammals. The exposure estimates do not account for the potential for marine mammals to avoid the Project area due to increased noise levels, and therefore are likely overestimates of the numbers of potential exposures to Level A and B harassment. In addition, the exposure estimates are based on a conservative area of ensonification and a conservative estimation of marine mammal abundance, and therefore, are likely a significant overestimate of the actual potential for take by acoustic harassment. It is also assumed that an animal will be taken once over a 24-hour period; however, the same individual may be taken multiple times over the duration of the Project.

Therefore, both the number of takes and the affected population percentages represent the maximum potential take numbers.

Table 6-20: Summary of the Estimated Numbers of Marine Mammals Potentially Exposed to Level A and Level B Harassment Sound Levels

Species	Stock	Population Estimate	Estimated Number of Exposures Level A Harassment	Estimated Number of Exposures Level B Harassment	Total Number of Exposures	Percent of Population Potentially Exposed
Humpback Whale	Gulf of Maine	896	0	12	12	1.34
Bottlenose Dolphin	Western North Atlantic Southern Migratory Coastal	88,745	44	5,654	5,698	6.42
	Western North Atlantic Northern Migratory Coastal	6,639	3	426	429	6.46
	North Carolina Estuarine	823	16	200	216	26.2
Harbor Porpoise	Gulf of Maine-Bay of Fundy	79,833	2	4	6	<0.01
Harbor Seal	Western North Atlantic	75,834	55	518	573	0.76
Gray Seal	Western North Atlantic	27,131	0	9	9	0.03
Total Requested Exposures			**120**	**6,811**	**6,931**	

7 ANTICIPATED IMPACT OF THE ACTIVITY

The anticipated impact of the activity to the species or stock of marine mammal.

The following sections assess the anticipated impact of the proposed Project on the species and stocks of marine mammals occurring within the Project area. This assessment is based on a review of available data and studies focused on marine mammal responses to noise. This

includes a summary on what is known about behavioral and physiological impacts to marine mammals from noise exposure. Extensive reviews on the subject of marine mammals and noise can be found in numerous documents (e.g., Richardson et al. 1995; National Research Council (NRC) 2003; Southall et al. 2007, 2019).

The ability to hear and transmit sound (echolocation/vocalization) is vital for marine mammals to perform several life functions. Marine mammals use sound to gather and understand information about their current environment, including detecting prey and predators. They also use sound to communicate with one another. The distance a sound travels through the water depends highly on existing environmental conditions (sea floor topography and ambient noise levels) and characteristics of the sound (source levels and frequency; Richardson et al. 1995). Impacts to marine mammals can vary among species based on their sensitivity to sound and their ability to hear different frequencies. The Project may impact marine mammals behaviorally and physiologically from temporary increases in underwater and in-air noises during pile installation. The level of impact on marine mammals from pile installation will vary depending on the species of marine mammal, the distance between the marine mammal and the pile installation, the intensity and duration of the pile installation, and the environmental conditions.

Whales, dolphins, porpoises, and seals are mobile species and are capable of avoiding the disturbance and pile installation associated with Project. Given the preference of whales in deeper waters than what is found in the Project area, and the Project area not within normal whale feeding or migration areas, their presence in the Project area is unlikely. Dolphins, porpoises, and seals may be found in the Project area and could potentially be displaced within the Level A and Level B harassment zones.

7.1 ASSESSMENT OF POTENTIAL ACOUSTIC IMPACTS

Behavioral and physiological impacts from noise exposure differ among species. Differences in response have also been documented between age and sex classes. Younger animals are often more sensitive to noise disturbance, and noise can therefore have a greater effect on them (NRC 2003).

Behavioral and physiological changes that may result from increased noise levels include changes in tolerance levels; masking of natural sounds; behavioral disturbances; and temporary or permanent hearing impairment, or non-auditory physical effects (Richardson et al. 1995). Richardson et al. (1995) has suggested four zones (described below) to assess the potential effects of noise on marine mammals.

7.1.1 ZONE OF HEARING LOSS, DISCOMFORT, OR INJURY

When the received sound level is high enough, it may cause discomfort or tissue damage to auditory or other systems. Additionally, temporary or permanent reduction in hearing sensitivity may result from high received sound levels. An animal may experience temporary threshold shift (TTS) when hearing loss is temporary, or PTS when partial or full hearing loss is permanent. The level of hearing loss depends on the frequency, intensity, and duration of sound to which the animal is exposed (Finneran 2016). Marine mammals exposed to high received sound levels may also experience non-auditory physiological effects such as increased stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage. PTS and TTS may reduce an animal’s ability to avoid predators, communicate with others, or forage effectively. TTS is not considered injurious and will constitute a Level B take. PTS is considered injurious and

will constitute a Level A take. No serious or lethal injuries are anticipated. See Section 6.3 for Level A and Level B take definitions.

Kastak and Schusterman (1995) tested in-air auditory thresholds by exposing a harbor seal inadvertently to broadband construction noise for 6 days, with intermittent exposure averaging 6 to 7 hours per day. When the harbor seal was tested immediately upon cessation of the noise, a TTS of 8 dB at 100 Hz was evident. Following 1 week of recovery, the harbor seal's hearing threshold was within 2 dB of its original level. Pure-tone sound detection thresholds were obtained in-water for harbor seals before and immediately following exposure to octave-band noise (Kastak et al. 1999). Test frequencies ranged from 100 Hz to 2 kilohertz (kHz), and octave-band SELs were approximately 60 to 75 dB SEL. Each harbor seal was trained to dive into a noise field and remain stationed underwater during a noise-exposure period that lasted a total of 20 to 22 minutes. The average threshold shift relative to baseline thresholds for the harbor seals following noise exposure was 4.8 dB, and the average shift following the recovery period was 20.8 dB (Kastak et al. 1999).

Some species of odontocetes may have the ability to dampen hearing sensitivity in expectation of loud noise. Dampening has been observed in captive bottlenose dolphins (Nachtigall et al. 2016a), false killer whales (*Pseudorca crassidens*) (Nachtigall and Supin 2013), and, to a lesser degree, harbor porpoises (Nachtigall et al. 2016b). When animals were given a series of warning pips in advance of a louder noise, hearing threshold shifted. For false killer whales and bottlenose dolphins, the magnitudes, durations, and timing of both threshold shift and recovery in relation to the warning and loud sounds indicated a conditioned dampening response rather than noise-induced threshold shift (Nachtigall and Supin 2013; Nachtigall et al. 2016a).

PTS and TTS as a result of the Project are not expected to occur in any marine mammal species, because no animal is anticipated to remain within the Level A zone for the amount of time it would take to accumulate the injury, and implementation of mitigation measures, such as ramp-up procedures and monitoring the harassment zones (Section 11), will help avoid potential close approach of animals to pile installation that could result in Level A takes, Level B takes, or serious injury/mortality.

7.1.2 ZONE OF MASKING

The area within which noise is strong enough to interfere with the detection of other sounds, including communication calls, prey or predator sounds, and other environmental sounds, is known as the zone of masking. Within this zone, animals are likely to experience some decrease in ability to successfully forage, locate mates or conspecifics, avoid predators, identify and navigate to ideal habitats, or avoid hazards (e.g., vessels, shallows, ice). Masking is considered Level B harassment and 160 dB for impact sound sources and 120 dB for continuous noise are used to estimate the zone of masking.

Marine mammal signals may be masked by increased noise levels or overlapping frequencies. Research has indicated that the majority of vibratory activity falls within 400 and 2,500 Hz (Blackwell 2005; URS 2007). Baleen whales produce sounds to communicate and possibly navigate in the frequency range from 10 Hz to 10 kHz, whereas toothed whales produce sounds for echolocation and to communicate in the frequency range from 1 to 150 kHz (Richardson et al. 1995; Madsen et al. 2006). Harbor seals produce social calls at 500 to 3,500 Hz and clicks from 8 to 150 kHz (reviewed in Richardson et al. 1995). Harbor porpoises produce acoustic signals in a very broad frequency range, <100 Hz to 160 kHz (Verboom and Kastelein 2004). To combat the

effects of masking, animals may alter the frequency or loudness of their vocalizations or echolocation clicks. North Atlantic right whales (Parks et al. 2018) and killer whales (*Orcinus orca*) (Holt et al. 2009) have been observed to increase call amplitude when ambient sound levels are increased. Bottlenose dolphin recordings from the Florida Gulf coast showed an increase in call frequencies as a response to increased ambient noise levels (van Ginkel et al. 2017).

The Project is within an area heavily used by regular vessel activity, including recreational craft, local ferries, military vessels, tourist cruises, and commercial fishing vessels. It is likely that marine mammals in the Project area have become habituated to increased noise levels. Implementation of the proposed mitigation measures, such as ramp-up procedures and monitoring the harassment zones (Section 11) will reduce impacts on marine mammals, with any minor masking occurring near the sound source, if at all.

7.1.3 ZONE OF RESPONSIVENESS

The zone of responsiveness is the area within which marine mammals react behaviorally or physiologically from exposure to increased noise levels. The level of effect is dependent on the acoustical characteristics of the noise, current physical and behavioral state of the animals, ambient noise levels and environmental conditions, and context of the sound (e.g., if it sounds similar to a predator; Richardson et al. 1995; Southall et al. 2007). Behavioral effects that are temporary may indicate that the animal has simply heard a sound, and the effect may not be long-term (Southall et al. 2007). Behavioral and physiological effects described here will be considered Level B harassment.

Responses from marine mammals in the presence of pile installation might include a reduction of acoustic activity, a reduction in the number of individuals in the area, and avoidance of the area. Of these, temporary avoidance of the noise-impacted area is the most common response (e.g., Dähne et al. 2013; Graham et al. 2017). Avoidance responses may be initially strong if the marine mammals move rapidly away from the source or weak if movement is only slightly deflected away from the source. Noise from pile installation could potentially displace marine mammals from the immediate area of the activity; however, they would likely return after pile installation is completed, as demonstrated by a variety of studies on temporary displacement of marine mammals by industrial activity (reviewed in Richardson et al. 1995). Any masking event that could possibly rise to Level B harassment under the MMPA would occur concurrently within the zones of behavioral harassment already estimated for vibratory, impact, and down-the-hole pile installation, and have already been taken into account in the exposure analysis.

7.1.4 ZONE OF AUDIBILITY

The most extensive of the four zones, the zone of audibility, is the area within which the animal might hear the noise. Marine mammals as a group have functional hearing ranges of 10 Hz to 180 kHz, with thresholds of best hearing near 40 dB (Ketten 1998; Southall et al. 2007, 2019). Marine mammals can typically be divided into five groups that have consistent patterns of hearing sensitivity (see section 6.3). Difficulties in human ability to determine the audibility of a particular noise for other species has so far precluded development of applicable criteria for the zone of audibility. This zone does not fall in the sound range of a “take” as defined by NMFS.

Repeated or sustained disruption of important behaviors (such as feeding, resting, traveling, and socializing) is more likely to have a demonstrable impact than a single exposure (Southall et al. 2007). However, it is likely that marine mammals exposed to repetitious construction sounds will

become habituated, desensitized, and tolerant after initial exposure to these sounds (Southall et al. 2007).

Marine mammals residing in and transiting through this area are routinely exposed to sounds louder than 120 dB, and continue to use this area; therefore, it appears they have become habituated and are not harassed by these sounds.

7.2 POTENTIAL EFFECTS OF VESSEL INTERACTIONS ON MARINE MAMMALS

The Project will lead to a minor temporary increase in the number of vessels operating in the Project area. The humpback whale, in particular, is vulnerable to ship strikes, though its presence in the Project area is rare. Harbor seals and gray seals that haul out on the portal islands of the CBBT from November through May, as well as bottlenose dolphins and harbor porpoises may be susceptible to ship strikes.

To minimize the potential for ship strikes associated with vessel traffic in the Project area, vessels within the Project area and travelling to and from the Project area will travel at less than 10 knots. Barges and other vessels will be required to deliver the necessary equipment and materials to the Project and be used to construct the Project. Vessels traveling at 10 knots or less will minimize the risk of vessel collisions with marine mammals; therefore, no ship strikes are expected.

Given the significant baseline level of vessel traffic in the Project area, the addition of a limited number of Project vessels related to construction will increase the risk of vessel strike by an amount that is too small to be meaningfully measured or detected. Therefore the operation of vessels in the Project area will result in an insignificant increased risk of vessel strike.

7.3 CONCLUSIONS REGARDING IMPACTS TO SPECIES OR STOCKS

Consideration of negligible impact is required for NMFS to authorize the incidental take of marine mammals. In 50 CFR § 216.103, NMFS defines negligible impact to be “an impact resulting from a specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stocks [of marine mammals] through effects on annual rates of recruitment or survival,” Based upon best available data regarding the marine mammal species (including density, status, and distribution) likely to occur in the Project area, incidental take is expected to result in only short-term changes in behavior, such as avoidance of the Project area, changes in swimming speed or direction, and changes in foraging behavior. Such impacts are unlikely to have any effect on recruitment or survival and; therefore, would have a negligible impact on the affected stocks of humpback whales, bottlenose dolphins, harbor porpoises, harbor seals, and gray seals. Implementation of mitigation measures proposed in Section 11 is likely to minimize most potential adverse underwater impacts to individual marine mammals or stocks and their habitat from pile installation. Impacts to individual humpback whales bottlenose dolphin, harbor porpoises, harbor seals, and gray seals are expected to be small and of short duration. Nevertheless, some level of disturbance impact is unavoidable. The expected level of unavoidable impact (defined as an acoustic or harassment “take”) is defined in Section 6.

Requested Level B take of marine mammals would likely include multiple (estimated as daily) takes of the same individual(s), mainly dolphins, resulting in estimates of take (as percentage of the stock) that are high compared to actual take. Exposure to Level A noise is unlikely, since

isopleths are relatively small, though small numbers of Level A take were requested. No lethal takes or serious injuries are anticipated.

8 ANTICIPATED IMPACTS ON SUBSISTENCE USES

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

Potential impacts resulting from the Project will be limited to individuals of marine mammal species located in the Chesapeake Bay that have no subsistence requirements. There is no known subsistence hunting near the proposed Project area, so the proposed activities will not have any impact on the availability of the species or stocks for subsistence users. Therefore, no impacts on the availability of species or stocks for subsistence use are considered.

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.

9.1 EFFECTS OF PROJECT ACTIVITIES ON MARINE MAMMAL HABITAT

A relatively small area of new habitat loss will result from the Project. Furthermore, the nearshore and intertidal habitat where the Project will occur is an area of relatively high marine vessel and aircraft traffic. Most marine mammals do not generally use the area within the footprints of the Project components. Temporary, intermittent, and short-term habitat alteration may result from increased noise levels within the Level B harassment zones. Effects on marine mammals, as described above, would be limited to temporary displacement from pile installation noise and effects on prey species (Section 9.2).

No critical habitat is designated under the ESA for any marine mammal species in the Project area; therefore, no marine mammal critical habitat is expected to be impacted during the Project.

9.2 EFFECTS OF PROJECT ACTIVITIES ON MARINE MAMMAL PREY HABITAT

Essential Fish Habitat (EFH) has been designated within the Project area for some species of fish (i.e., Black Sea Bass (*Centropristus striata*), Atlantic Herring, (*Clupea harengus*), King Mackerel (*Scomberomorus cavalla*), and Spanish mackerel (*Scomberomorus maculatus*); NMFS GARFO 2019), which are common prey of marine mammals. Adverse effects on EFH are not expected. Fish populations in the Project area that serve as marine mammal prey could be temporarily affected by noise from in-water pile installation. The frequency range in which fish generally perceive underwater sounds is 50 to 2,000 Hz, with peak sensitivities below 800 Hz (Popper and Hastings 2009). Fish behavior or distribution may change, especially with strong and/or intermittent sounds that could potentially harm fish. High underwater SPLs have been documented to alter behavior, cause hearing loss, and injure or kill individual fish by causing serious internal injury (Hastings and Popper 2005).

Pile installation and removal may result in a small increase in sedimentation within a few feet of the piles. A small amount of sediment and drill tailings may be deposited in proximity to each pile. Minor and temporary increases in turbidity may result from this process, but the effects on fish and marine mammal prey would be negligible. Indirect effects to prey would be insignificant and discountable due to the temporary nature of the activity, and are expected to be undetectable to marine mammals. The physical disturbance of sediments and entrainment of associated benthic resources could reduce the availability of marine mammal prey, but the impacted benthic habitat represents an insignificant amount of the available habitat in the region, and recolonization of the opportunistic benthic species would occur quickly, making impacts to habitat and prey negligible (VDOT and FHWA 2016).

In general, impacts on marine mammal prey species are expected to be minor and temporary. Indirect effects to prey would be insignificant and discountable due to recolonization and the temporary nature of the activity, and are expected to be undetectable.

The Project is relatively small compared to the available habitat throughout other parts of the Chesapeake Bay. The most likely impact to fish from the Project would be temporary behavioral avoidance of the immediate area, although any behavioral avoidance of the disturbed area would still leave significantly large areas of fish and marine mammal foraging habitat. Therefore, the impact on marine mammal prey during the Project is expected to be negligible.

10 ANTICIPATED EFFECTS OF HABITAT IMPACTS ON MARINE MAMMALS

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

The potential impacts of the Project on marine mammal habitat and their prey are discussed in Section 9. The effects of the Project on marine mammal habitat and their prey are expected to be short-term and minor and will not result in any permanent impacts on habitats used by marine mammals or their prey sources.

Permanent loss of habitat during pile driving is limited to the footprint of the piles and areas of fill placement. The anticipated impacts to marine mammal populations associated with temporary modification of marine habitat associated with elevated sound levels from the Project were discussed in detail earlier in Section 6 and Section 7. Such effects are expected to be limited to short-term localized impacts such as movement away, displacement, or behavioral changes. Displacement of marine mammals by noise would not be permanent and would not have long-term effects. The Project is not expected to have any habitat-related effects that could cause significant or long-term consequences for individual marine mammals or their populations, because pile installation/removal and other noise sources will be temporary and intermittent.

The effects on food resources are expected to be negligible and insignificant at the population level for both marine mammal prey and marine mammals, as described in Section 9. Marine mammal food sources will not be permanently affected and the Project-related impacts will not have long-term effects on marine mammal habitat or prey habitat in the Project area; the effects of the Project on marine mammal habitat and their prey are expected to be short-term and minor.

Marine mammal habitat will not be negatively affected permanently and there will be no impacts to rookeries, mating grounds, or feeding grounds for any of the marine mammals in the Project area. Impacts from the Project will not affect the fitness of marine mammal species or stocks. The Project will not inhibit mating or rearing, remove predator refuge, or increase energetic demands via movement barriers. Therefore, Project-related impacts are expected to be negligible and insignificant at the population level for both marine mammal prey and marine mammals.

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 their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

The exposures outlined in Section 6 represent the maximum potential number of marine mammals, including multiple takes of the same resident individuals, which could be exposed to acoustic sources reaching Level A and Level B harassment levels. HRCP proposes to employ a number of mitigation measures to minimize the number of marine mammals affected. Mitigation measures will include those that address all phases of pile installation in general, those that are specific to physical pile installation/removal, those that pertain to Level A and Level B harassment zones, and those that involve observation of marine mammals in the Project area. Marine mammal monitoring and mitigation methods are described in more detail in a Marine Mammal Monitoring Plan which will be submitted prior to issuance of the IHA.

11.1 PILE INSTALLATION AND ASSOCIATED ACTIVITIES

Pile installation mitigation measures include:

Marine Mammal Observers (MMOs)

- MMOs (also known as [Protected Species Observers [PSOs]) will be employed as described in Section 13.

Vessel Speed Reductions

- If a marine mammal approaches within 10 meters of a Project vessel (e.g., barge, tugboat; Section 1.3.4), operations shall cease and the vessel shall reduce speed to the minimum level (less than 10 knots) required to maintain steerage and safe working conditions until the marine mammal is at least 10 meters away from the vessel.

Soft-Start

- Before impact installation or proofing (load testing; Section 1.3.2.8) occurs, the Contractor will employ a ramp-up procedure to minimize impacts. The following guidelines will be employed by the Contractor:
    - HRCP shall use soft start techniques when impact pile driving. Soft start requires contractors to provide an initial set of strikes at reduced energy, followed by a thirty-second waiting period, then two subsequent reduced energy strike sets.

- Soft start shall be implemented at the start of each day's impact pile driving and at any time following cessation of impact pile driving for a period of 30 minutes or longer.
- If a marine mammal is present within the Level A harassment zone, ramping up will be delayed until the animal(s) leaves the Level A harassment zone. Activity will begin only after the MMO has determined, through sighting, that the animal(s) has moved outside the Level A harassment zone.
- If a marine mammal is present in the Level B harassment zone, ramping up may begin and a Level B take will be recorded. Ramping up may occur when these species are in the Level B harassment zone, whether they enter the Level B zone from the Level A zone or from outside the Project area.
- If a marine mammal is present in the Level B harassment zone, the Contractor may elect to delay ramping up to avoid a Level B take. To avoid a Level B take, ramping up will begin only after the MMO has determined, through sighting, that the animal(s) has moved outside the Level B harassment zone.
- No vibratory soft-start is required.

Avoiding Unauthorized Take

- To avoid unauthorized Level A take, if Level A take numbers are approaching authorized levels, shutdown will be implemented before individuals reach the Level A zones.
- To avoid unauthorized Level B take, a shutdown will be implemented if a species for which Level B take is not authorized approaches the Level B zone.
- If Level B take numbers of authorized species are approaching authorized levels, shutdown will be implemented to avoid additional Level B take.

Shutdown Zones

- A minimum 10-meter shutdown zone will be implemented for all species and activity types to prevent direct injury of marine mammals.
- Shutdown zones have been rounded up relative to the calculated Level A harassment zones to assist MMOs in effectively shutting down before individuals could cross into their respective Level A zones. Although every effort will be made to shut down at these expanded zone distances, especially for low-frequency cetaceans (humpback whales), potential Level A exposure will not be documented unless the individual crosses into its Level A zone as calculated in Table 6-9 through Table 6-11. Duration within the Level A zone will also be documented.
- A shutdown zone of 100 meters will be implemented for each vibratory hammer on days when it is anticipated that multiple vibratory hammers will be used, whether at a single or multiple sites.

Bubble Curtains

- To minimize hydroacoustic impacts caused by impact hammers, bubble curtains will be used for steel pipe piles, in water deeper than 20 feet, driven with impact hammers. This includes the structural steel piles for the temporary Jet Grouting Trestles.

11.2 HARASSMENT ZONES

Modeling results for Level A and Level B harassment zones discussed in Section 6 were used to develop mitigation measures for pile installation and removal. During pile installation, the

shutdown zone shall include all areas where the modeled underwater SPLs are anticipated to equal or exceed the Level A harassment criteria regardless of duration of exposure (see Table 6-7). A 10-meter shutdown zone will be implemented for all species and all activity types to prevent direct contact and injury of marine mammals with construction equipment.

For those marine mammals for which Level B take has not been requested, in-water pile installation will shut down immediately when the animals are sighted approaching the zone (Table 11-1). If a marine mammal authorized for Level B take is present in the Level B harassment zone, installation may continue, and a Level B take will be recorded. Pile installation may occur when these species are in the Level B harassment zone, whether they entered the Level B zone from the Level A zone (if relevant), or from outside the Project area. If Level B take reaches the authorized limit, then pile installation will be stopped as these species approach, to avoid additional take of these species.

Table 11-1: Summary of Marine Mammals and Action during the Hampton Roads Bridge-Tunnel Expansion Project Activity

Common Name	Scientific Name	Status	Level B Take Requested	Level A Take Requested	Action During Project Activity
Humpback Whale	*Megaptera novaeangliae*	Not-listed	Yes	No	Record take for Level B; Shut down if observed approaching or within Level A zones.
Bottlenose Dolphin	*Tursiops truncatus*	Not-listed	Yes	Yes	Record take for Level B; if Level A take numbers are approaching authorized levels, shutdown will be implemented before individuals reach the Level A zones.
Harbor Porpoise	*Phocoena phocoena*	Not-listed	Yes	Yes	
Harbor Seal	*Phoca vitulina*	Not-listed	Yes	Yes	
Gray Seal	*Halichoerus grypus atlantica*	Not-listed	Yes	No	Record take for Level B; Shut down if observed approaching or within Level A zones.

Implementation of the above mitigation measures will be completed by MMOs as described in Section 13.

Calculated Level A harassment zones for each activity and pile size and type from Table 6-9 through Table 6-11 are depicted in Table 11-2 below.

Table 11-2: Level A Shutdown Zones for All Species

Method	Pile Size and Type	Number of Piles Installed Per Day	Minutes (min) Per Pile or Strikes Per Pile	Level A Harassment Isopleth Distance (meters)			
				Cetaceans			Pinnipeds
				LF	MF	HF	PW
Vibratory Installation	42-inch Pipe, Steel	6	30 min	42	4	62	26
	36-inch Pipe, Steel	3	50 min	32	3	47	20
		2	60 min	28	3	41	17
	24-inch Pipe, Steel	6	30 min	15	2	21	9
Down-the-Hole Installation	36-inch Pipe, Steel	2	50,400 strikes	1,171	42	1,395	627
		3	50,400 strikes	1,534	55	1,827	821
Impact Installation	36-inch Pipe, Steel	3	40 strikes	243	9	290	130
		2	60 strikes	243	9	290	130
	30-inch Pipe, Concrete Square or 54-inch Pipe, Concrete Cylinder	1	2,100 strikes	412	15	490	221
	24-inch Pipe, Concrete Square	1	2,100 strikes	121	5	144	65
Impact Installation / Bubble Curtain	36-inch Pipe, Steel	3	40 strikes	83	3	99	45

11.2.1 IMPLEMENTATION OF MULTIPLE HAMMER HARASSMENT ZONES

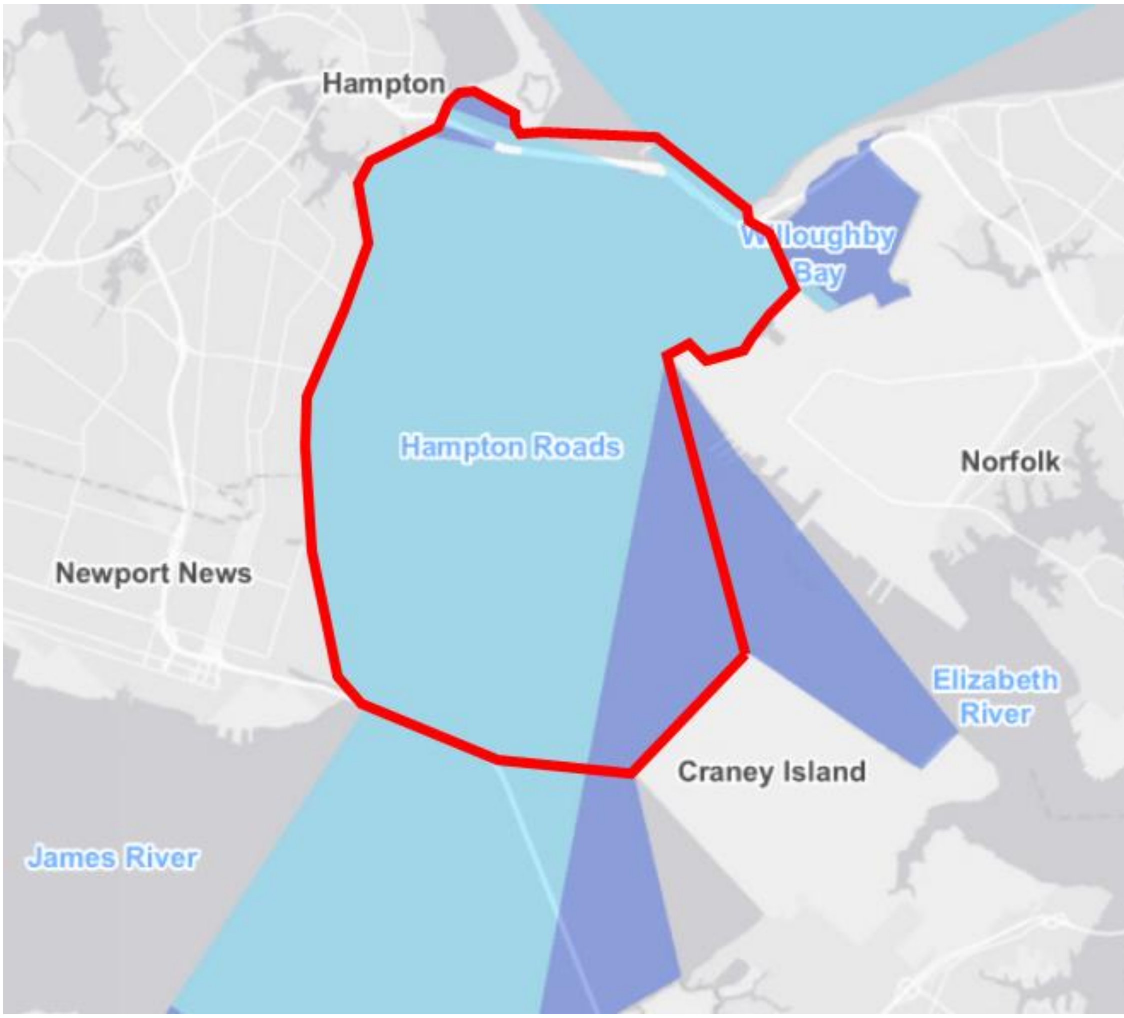
Due to the likelihood of multiple active construction sites across the Project, it is possible that multiple vibratory hammers with overlapping sound fields may be in operation simultaneously during certain times throughout the duration of the Project. As described in Section 6.4.1.2, the decibel addition of continuous noise sources results in much larger zone sizes than a single vibratory hammer.

Decibel addition is not a consideration when sound fields do not overlap. Willoughby Bay is largely surrounded by land, and sound will be prevented from propagating to other Project construction sites (Figure 1-1 and Figure 6-1). Therefore, Willoughby Bay will be treated as an independent site with its own sound isopleths and observer requirements when construction is taking place within the bay. Willoughby Bay is relatively small and will be monitored from the construction site by a single observer.

Additionally, the South Trestle is the only site where the sound will propagate into Chesapeake Bay (Figure 6-1). Sound from other construction sites will not overlap with South Trestle and will not propagate into Chesapeake Bay. Therefore, the South Trestle also will be treated as an independent site with its own sound isopleths and observer requirements when construction is taking place. When the South Trestle site is active, an observer will be positioned on land to view as much of the Level B zone as possible. If the entire Level B zone is not visible, take may be estimated based on the proportion of the zone that is visible.

If two or more vibratory hammers at the other 3 Project sites (North Trestle, North Shore, South Island) are installing piles, there is potential for the sound fields to overlap when installation occurs simultaneously. If two piles that are 36-inch or larger in diameter are simultaneously installed with vibratory hammers, the Level B harassment area can extend up to a 25 km radius to the southwest (Figure 6-1, 171 dB isopleth). However, the Level B zones resulting from simultaneous use of multiple vibratory hammers are truncated in nearly all directions by the mainland and islands, which prevent propagation of sound beyond the confines of a core area (Figure 11-1 area outlined in red). The largest ensonified radii extend to the south into the James and Nansemond rivers, areas where marine mammal abundance is anticipated to be low and approaching zero.

Figure 11-1: Core Monitoring Area (area outlined in red with potential monitoring locations) for the Level B Zone for the Project.



HRCP will monitor this core area, called the Core Monitoring Area, during times when two or more vibratory hammers are simultaneously active at the other 3 Project construction sites. The Core Monitoring Area would encompass the area between the two bridge/tunnels, with observers positioned at key areas to monitor the geographic area between the bridges (Figure 11-1; area outlined in red). Depending on placement, the observers will be able to view west/southwest towards Batten Bay and the mouth of the Nansemond River. Marine mammals transiting the area will be located and identified as they move in and out of the Chesapeake Bay.

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, you must submit either a plan of cooperation (POC) 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.

The POC is not applicable. The proposed activity is located in the Chesapeake Bay where no relevant subsistence uses of marine mammals will be impacted by this action. No activities will take place in or near a traditional Arctic subsistence hunting area. Based on the discussions in Section 8, there are no impacts on the availability of species or stocks for subsistence use.

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 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 would 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.

Monitoring measures will be implemented along with mitigation measures (Section 11) to avoid and minimize impacts on marine mammals during the Project, as discussed in detail in the Marine Mammal Monitoring Plan, which will be submitted prior to issuance of the IHA. The monitoring plan will focus on visual observations.

Trained MMOs will collect sighting data and behavioral responses to construction for all marine mammals observed within the harassment zones during construction. In-water pile installation/removal will be shut down if marine mammals for which no take has been authorized are observed approaching the Level B harassment zone. In-water work will remain shut down until marine mammals for which no take has been authorized have left the harassment zone. For marine mammals for which take authorization has been received, pile installation may continue if the marine mammal enters the Level B harassment zone and take is documented.

Trained or experienced observers will be present during all pile installation and removal using impact and vibratory methods and drilling with a down-the-hole hammer. Observers must be able to positively identify the marine mammals in the area and have prior training or expertise in monitoring and surveying marine mammals, with credentials available for review. Observers must maintain verbal contact with Project personnel to immediately call for a halt of pile installation operations to avoid exposures to noise, as described in Section 11.2.

13.1 MARINE MAMMAL OBSERVER QUALIFICATIONS

Marine mammal monitoring will be conducted by MMOs who meet or exceed the minimum qualifications identified by NMFS in the final IHA. These will include the following:

- MMOs will be independent observers (i.e., not construction personnel).
- At least one MMO must have prior experience working as an observer.
- Other observers may substitute education (undergraduate degree in biological science or related field) or training for experience.
- Two or more MMOs will be responsible for monitoring each Project component. One MMO will be designated as the lead MMO or monitoring coordinator. The lead MMO must have prior experience working as an observer.
- MMOs must have:
    - The ability to conduct field observations and collect data according to assigned protocols.
    - Experience or training in the field identification of marine mammals, including the identification of behaviors.
    - Sufficient training, orientation, or experience with construction operations to provide for personal safety during observations.
    - Writing skills sufficient to prepare a report of observations, including, but not limited to:
        - The number, species, and behavior of marine mammals observed.
        - Dates and times when in-water pile installation was conducted
        - Dates and times when in-water pile installation was suspended to avoid potential harassment of marine mammals observed within the harassment zone
    - The ability to communicate orally, by radio, or in person with Project personnel to provide real-time information on marine mammals observed in the Project area.

13.2 OBSERVATIONS

MMOs will be positioned at the best practical vantage point(s). The position(s) may vary based on construction activity and location of piles or equipment. At least one of the monitoring locations will have the following characteristics:

- An unobstructed view of the pile being driven, and
- An unobstructed view of the Level A harassment zones.

This central position will generally be staffed by the lead MMO, who will monitor the shutdown zones and communicate with construction personnel about shutdowns and take management.

The MMO at this location will be able to see at least a radius around the construction site that exceeds the largest Level A zone. Walking or otherwise moving around the construction site may be helpful for monitoring the shutdown zones in their entirety. MMOs will watch for marine mammals entering and leaving the James River and will alert the lead MMO of the number and species sighted, so that no unexpected marine mammals will approach the construction site. This will avoid and minimize Level A take of all species.

The MMOs will begin observations 30 minutes prior to the start of pile installation/removal. Pile driving may commence at the end of the 30-minute pre-activity monitoring period, provided observers have determined that the shutdown zone is clear of marine mammals, which includes delaying start of pile driving installation if a marine mammal is sighted in the zone. If a marine mammal approaches or enters the shutdown zone during installation or pre-activity monitoring, all pile driving installation at that location shall be halted or delayed, respectively. If pile driving is halted or delayed due to the presence of a marine mammal, the activity may not resume or commence until either the animal has voluntarily left and been visually confirmed beyond the shutdown zone and 15 minutes have passed without re-detection of the animal.

MMOs will have no other construction-related tasks or responsibilities while monitoring for marine mammals. MMOs will understand their roles and responsibilities before beginning observations. Each MMO will be trained and provided with reference materials to ensure standardized and accurate observations and data collection. A clear authorization and communication system will be in place to ensure that MMOs and construction crew members understand their respective roles and responsibilities.

Specific aspects and protocols of observations will also include:

- If waters exceed a sea-state that restricts the MMO’s ability to make observations within the Level A harassment zone of pile driving (e.g., excessive wind or fog), pile installation and removal will cease. Pile driving will not be initiated until the entire Level A harassment zone is visible.
- If any marine mammal species not authorized for take is encountered during pile installation or removal and is likely to be exposed to Level B harassment, then in-water pile installation or removal will cease and the observations will be reported to NMFS' Office of Protected Resources.
- When a marine mammal is observed, its location will be determined using a rangefinder to verify distance and a GPS or compass to verify heading.
- The MMOs will record any authorized cetacean or pinniped present during monitoring and the harassment zone within which it is located, if applicable. The harassment zones are shown in Table 6-9 through Table 6-12 and Attachment 2, Figure 6-1 through Figure 6-30.
- Ongoing in-water pile installation may be continued during periods when conditions such as low light, high sea state, fog, ice, rain, glare, or other conditions prevent effective marine mammal monitoring of the entire Level B harassment zone. MMOs will continue to monitor the visible portion of the Level B harassment zone throughout the duration of pile installation.

13.3 DATA COLLECTION

NMFS requires that the MMOs use NMFS-approved sighting forms that contain the following information:

- Date and time that pile installation begins or ends;
- Pile installation occurring during each observation period;
- Weather (wind, precipitation, fog);

- Tide state and water currents;
- Visibility;
- Species, numbers, and, if possible, sex and age class of marine mammals;
- Marine mammal behavior patterns observed, including bearing and direction of travel, and, if possible, the correlation to SPLs;
- Distance from pile installation site to marine mammals, if pile installation is occurring during marine mammal observations; and
- Other human activity in the Project area.

13.4 REPORTING

A draft report will be submitted to NMFS within 90 calendar days of the completion of marine mammal monitoring. A final report will be prepared and submitted to NMFS within 30 days following receipt of comments on the draft report from NMFS. To the extent practicable, the MMOs will record behavioral observations that may make it possible to determine if the same or different individuals are being "taken" as a result of Project activities over the course of a day. In general, reporting will include:

- Descriptions of any observable marine mammal behavior in the Level A and Level B harassment zones
- Descriptions of in-water and in-air pile installation occurring at the time of the observable behavior
- Actions performed to minimize impacts to marine mammals (e.g., shutdowns)
- Times when work was stopped and resumed due to the presence of marine mammals
- Results, which include the detections of marine mammals, species and numbers observed, sighting rates and distances, and behavioral reactions within the Level A and Level B harassment zones
- A refined take estimate based on the number of marine mammals observed during the course of construction

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.

To minimize the likelihood that impacts will occur to the species and stocks of marine mammals, all Project activities will be conducted in accordance with all federal, state, and local regulations. To further minimize potential impacts from the planned Project, HRCP will continue to cooperate with NMFS and other appropriate federal agencies (e.g., USFWS, USACE) and the State of Virginia.

HRCP will cooperate with other marine mammal monitoring and research programs taking place in the Chesapeake Bay area. HRCP will also assess mitigation measures that can be implemented to eliminate or minimize any impacts from these Project activities. HRCP will make available its field data and behavioral observations on marine mammals that occur in the Project

area. Results of monitoring efforts will be provided to NMFS in a draft summary report within 90 calendar days of the conclusion of the monitoring. This information will be made available to regional, state, and federal resource agencies, universities, and other interested private parties upon written request to NMFS.

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ATTACHMENT 1.
PILE DRIVING LOCATIONS AND COMPONENTS

Attachment 1 Figure 1: Pile Driving Locations and Components

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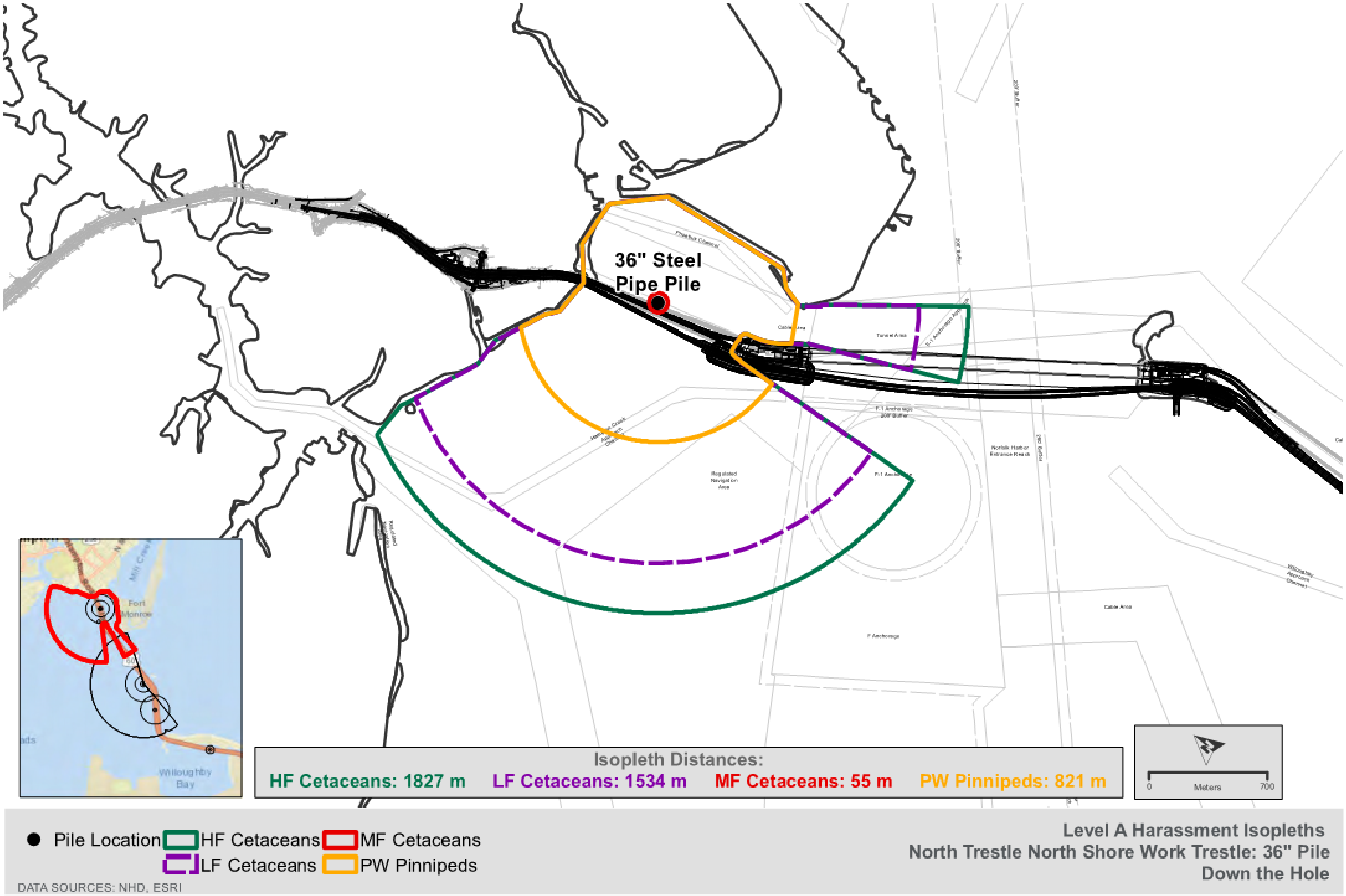
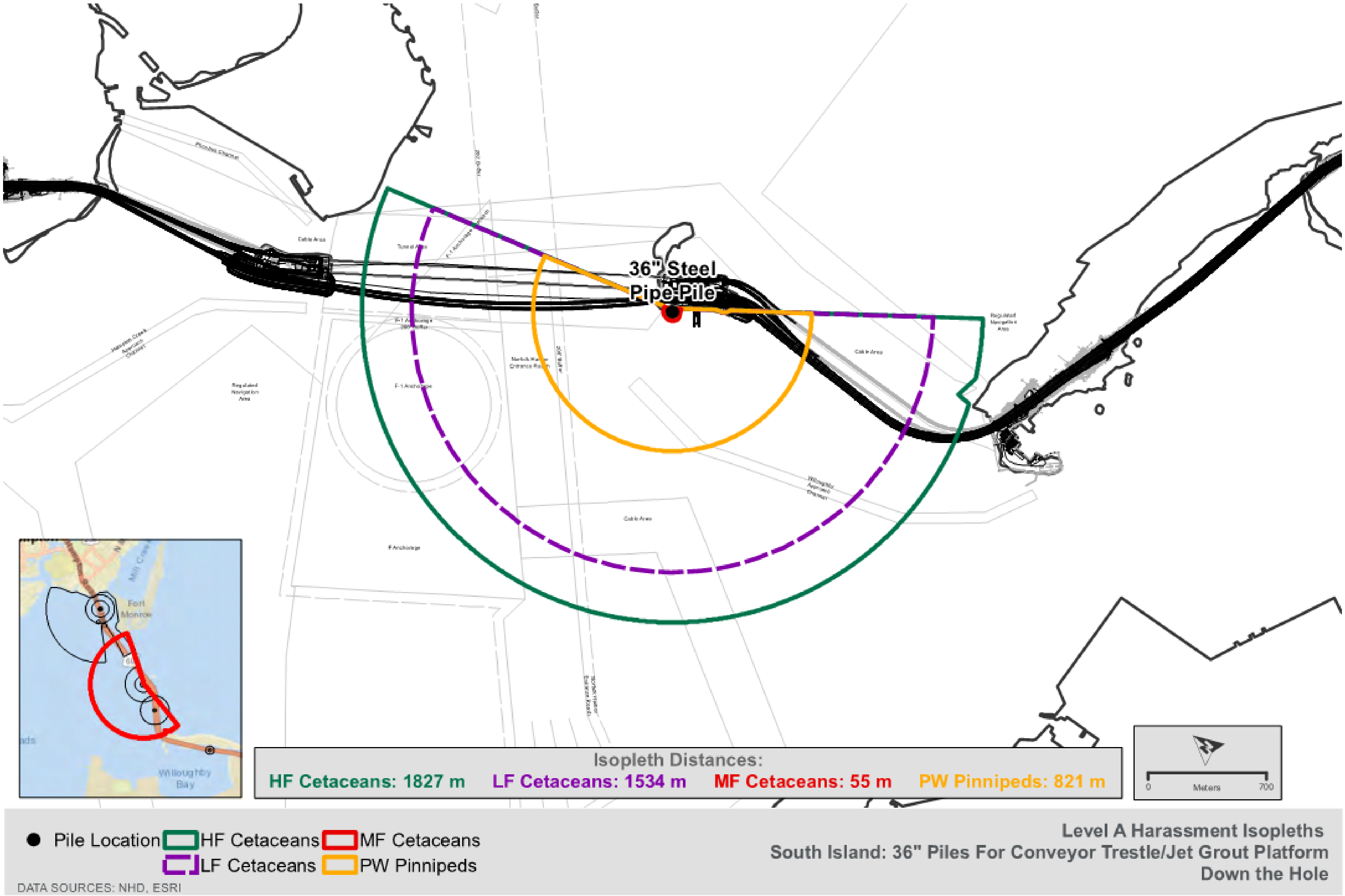
ATTACHMENT 2.
LEVEL A AND LEVEL B HARASSMENT ZONE FIGURES FROM SECTION 6

LEVEL A

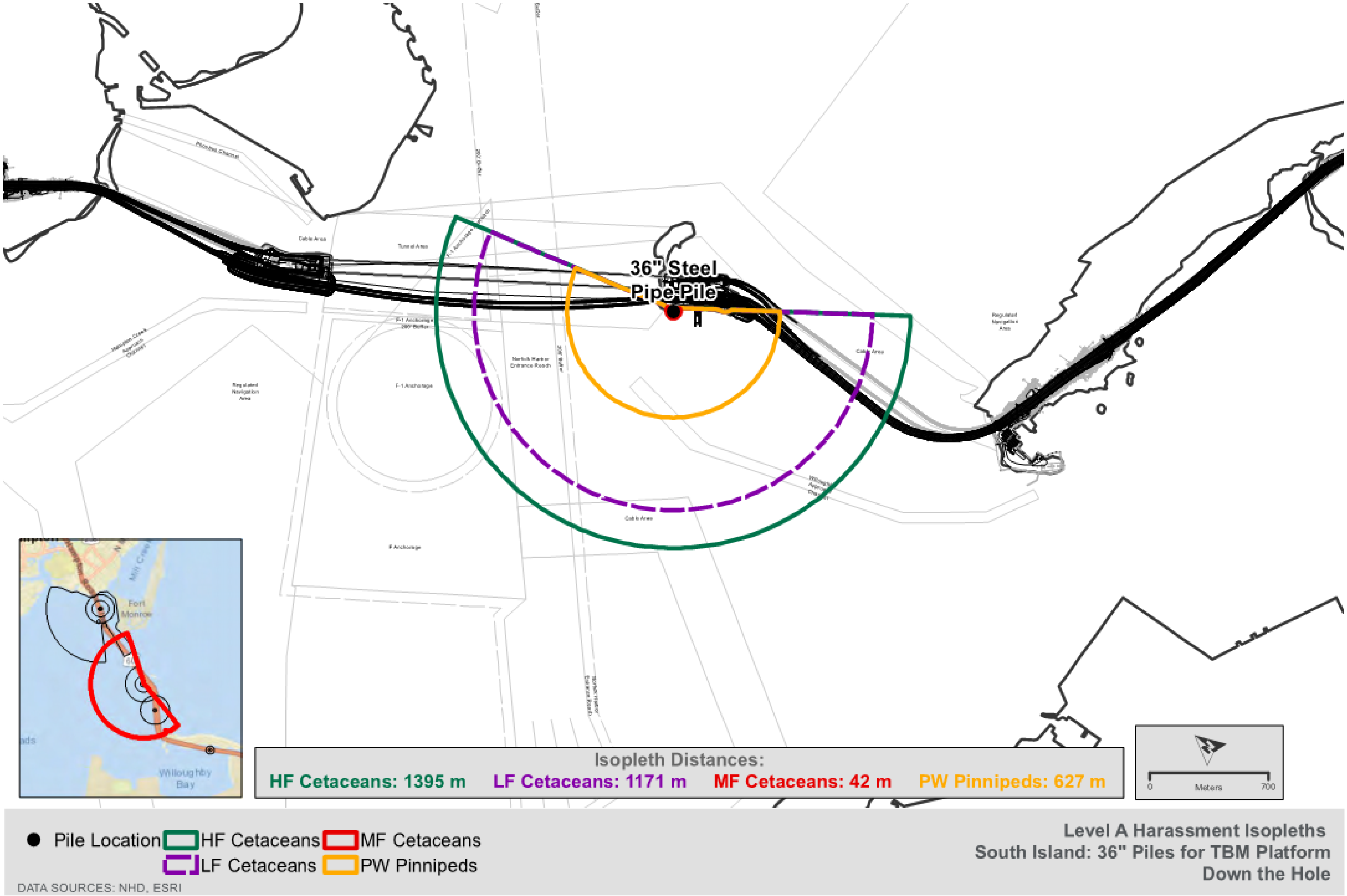
Attachment 2 Figure 1: Level A Harassment Isopleths North Trestle North Shore Work Trestle: 36-inch Pile Down-the-Hole Hammer



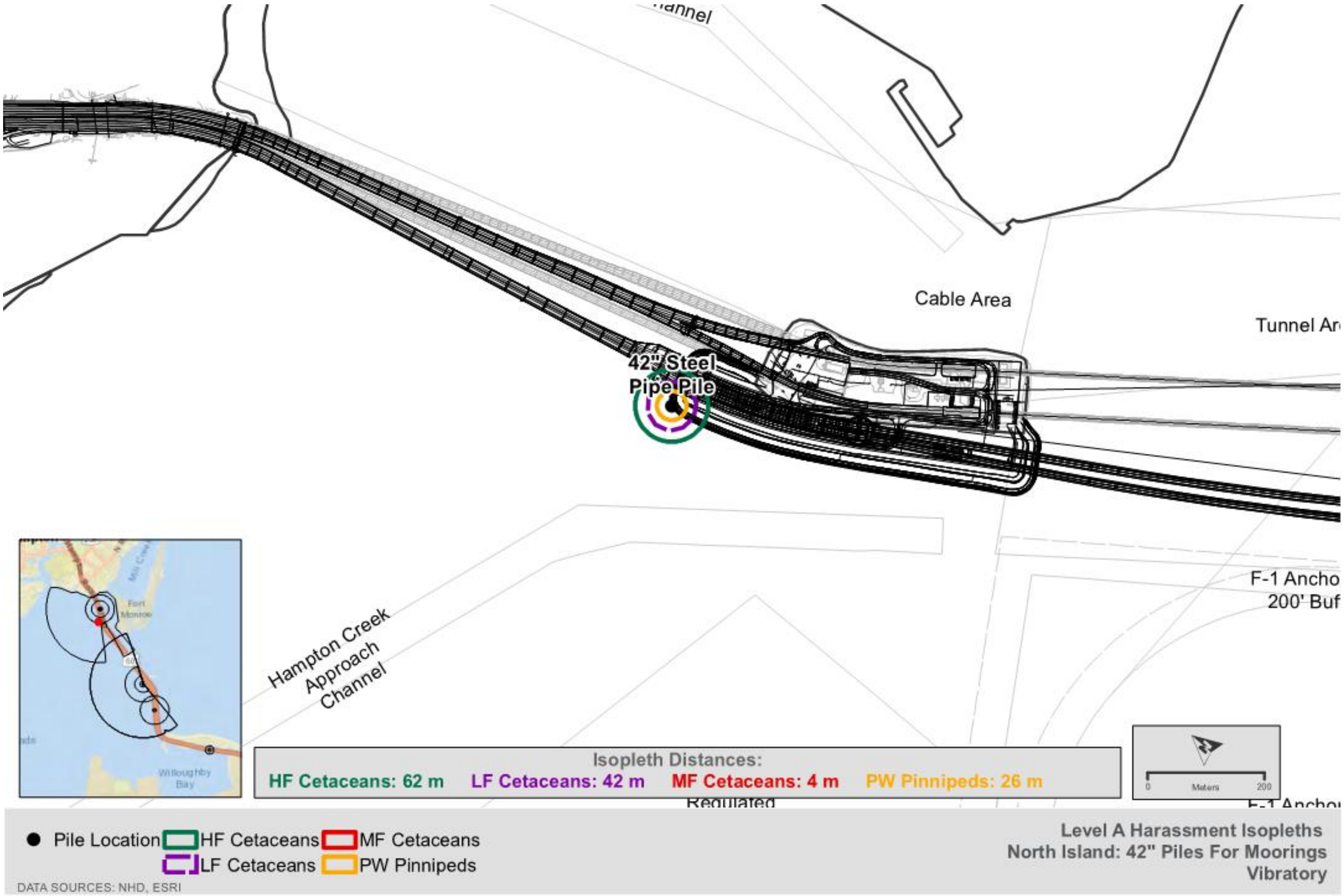
Attachment 2 Figure 2: Level A Harassment Isopleths South Island Conveyor and Jet Grout Trestles: 36-inch Pile Down-the-Hole Hammer



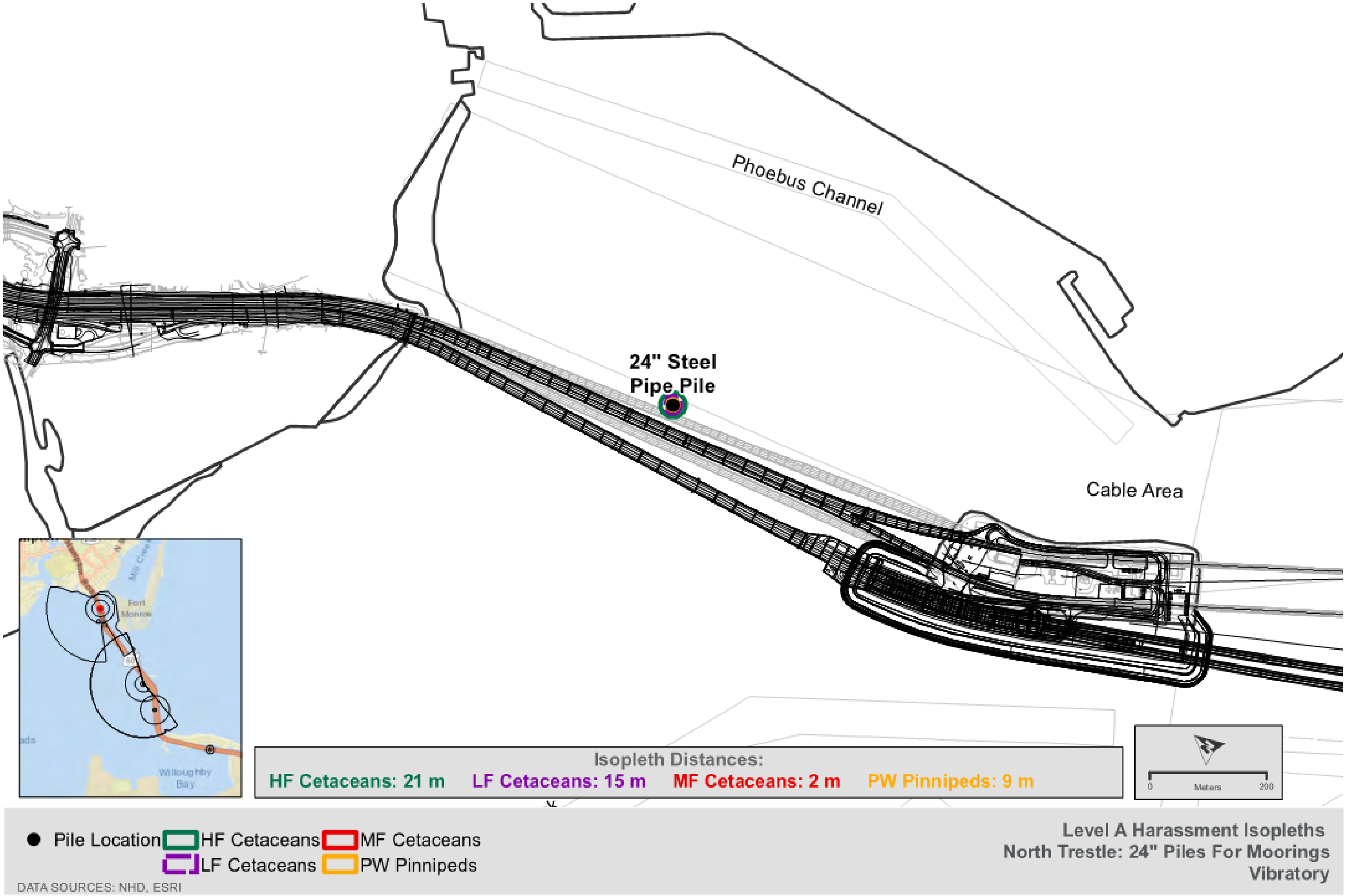
Attachment 2 Figure 3: Level A Harassment Isopleths South Island TBM Platform: 36-inch Pile Down-the-Hole Hammer



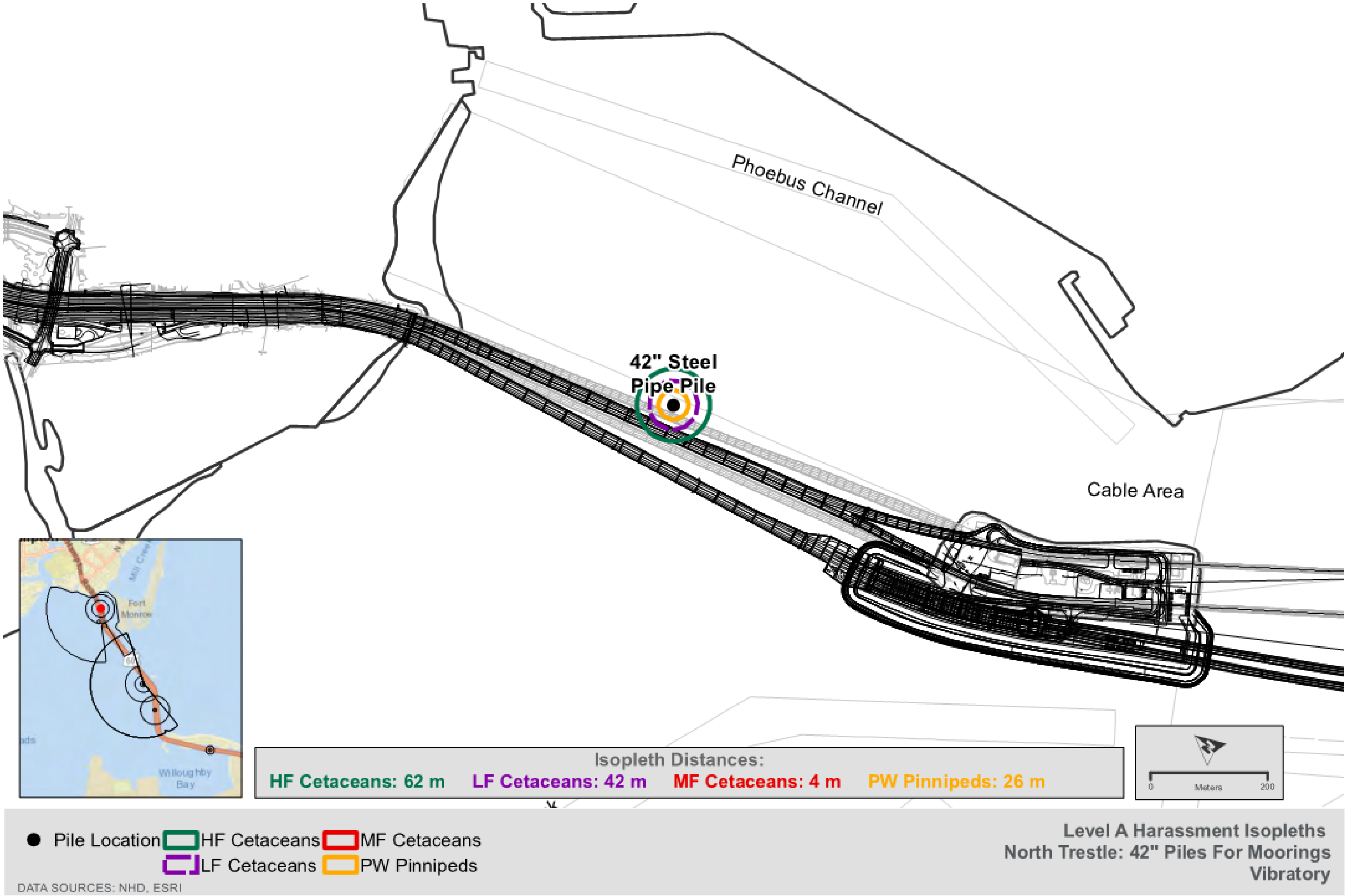
Attachment 2 Figure 4: Level A Harassment Isopleths North Island Moorings: Vibratory 42-inch Pile



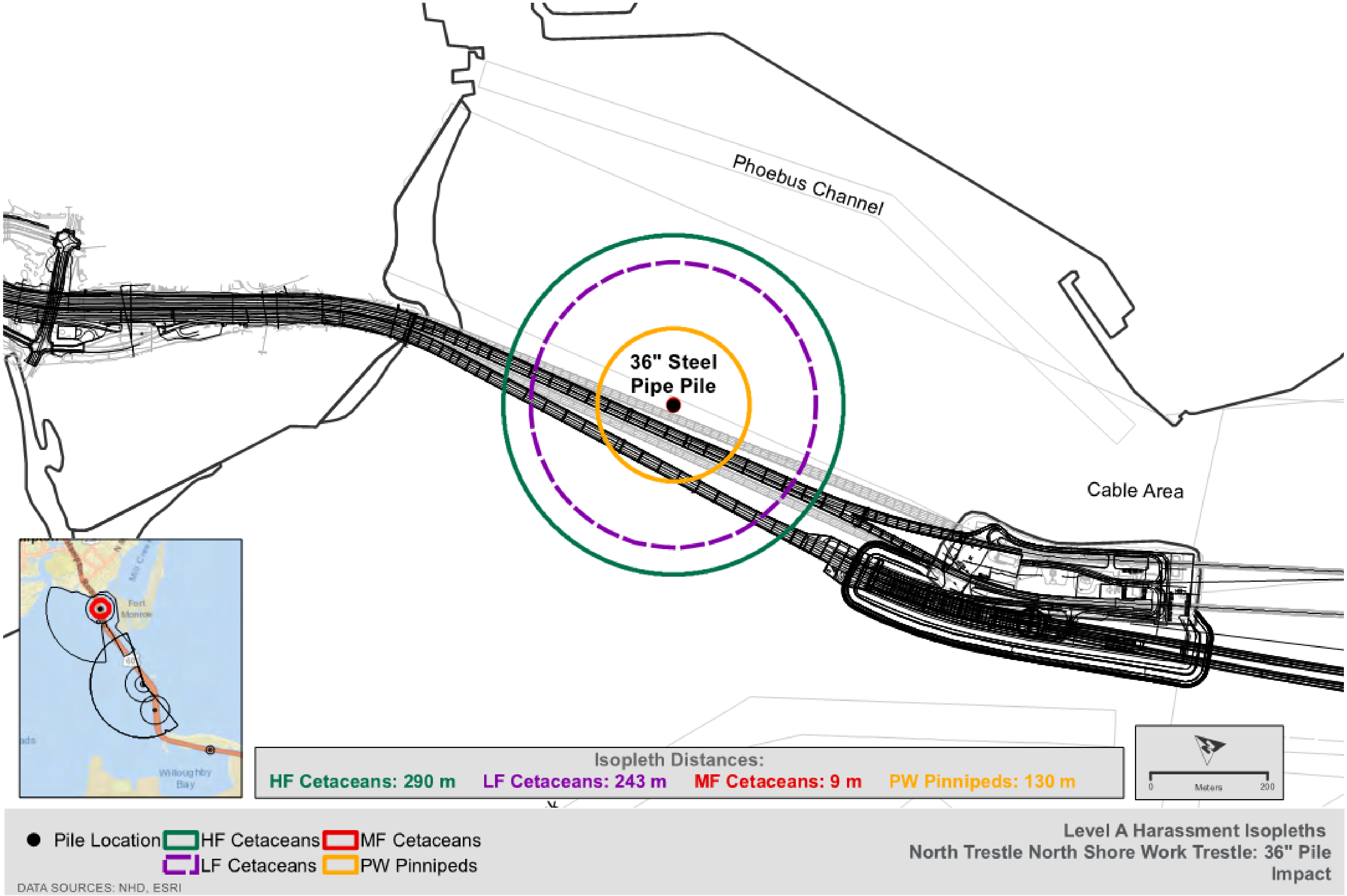
Attachment 2 Figure 5: Level A Harassment Isopleths North Trestle Moorings: Vibratory 24-inch Pile



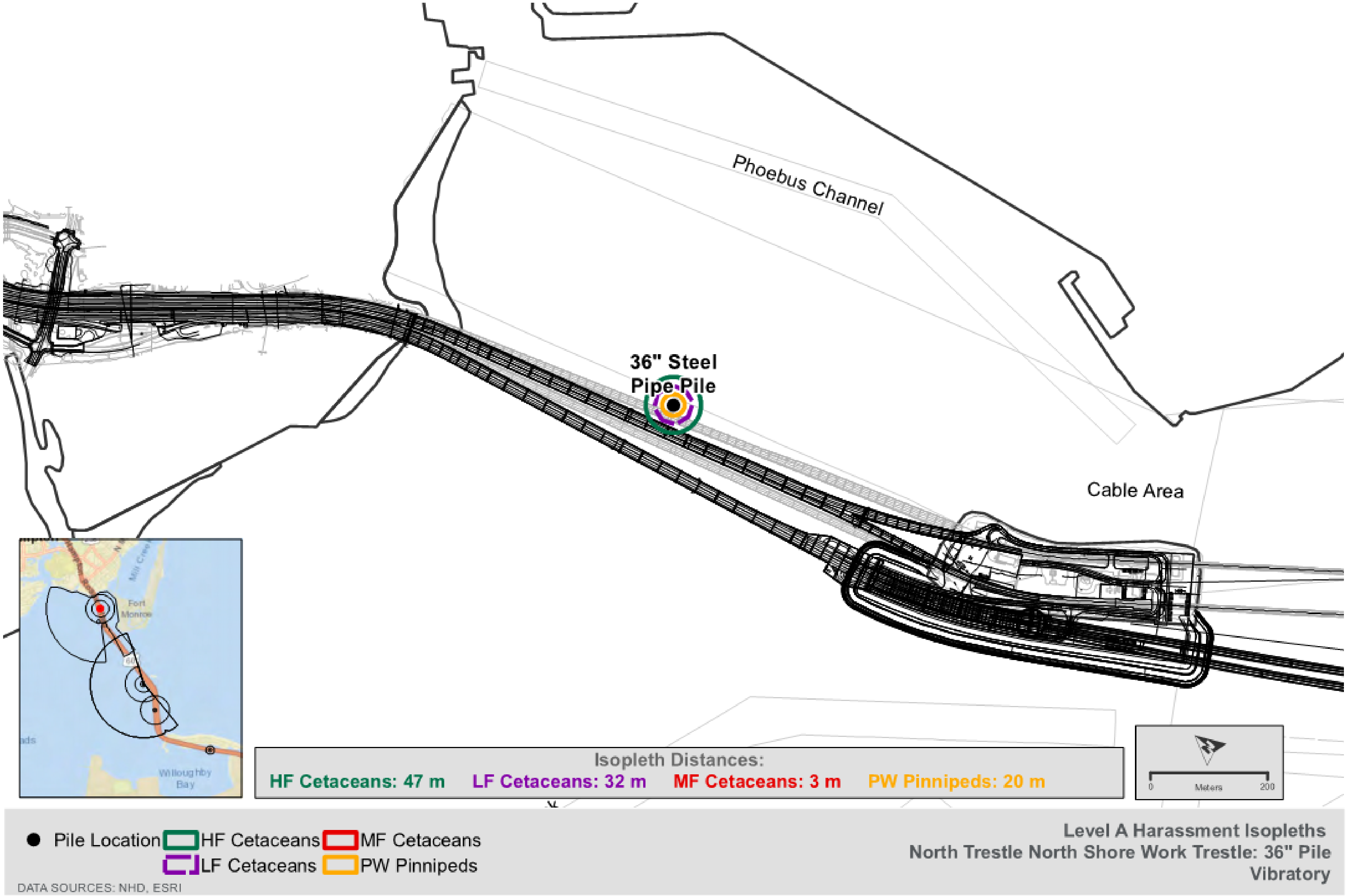
Attachment 2 Figure 6: Level A Harassment Isopleths North Trestle Moorings: Vibratory 42-inch Pile



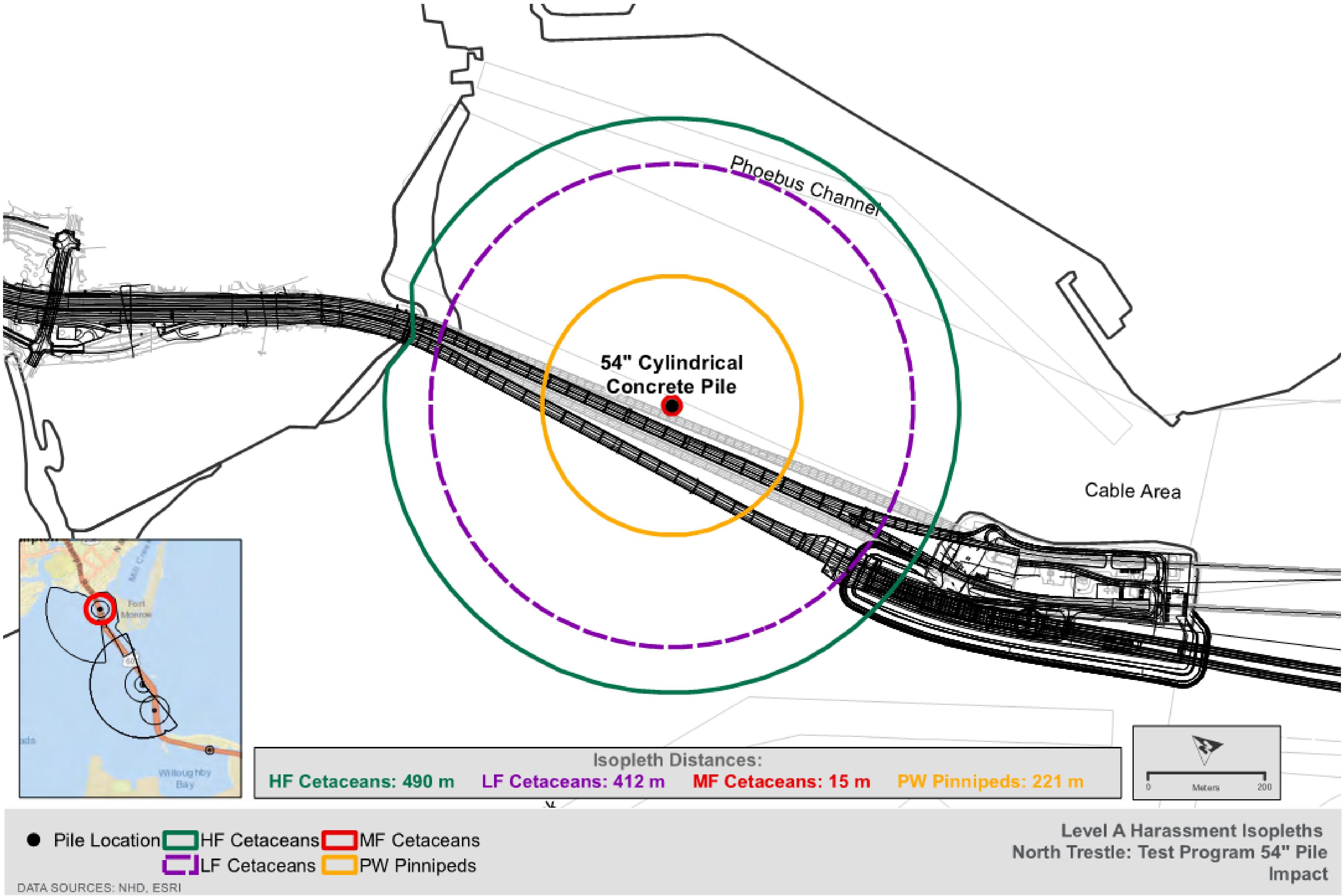
Attachment 2 Figure 7: Level A Harassment Isopleths North Trestle North Shore Work Trestle: Impact 36-inch Pile



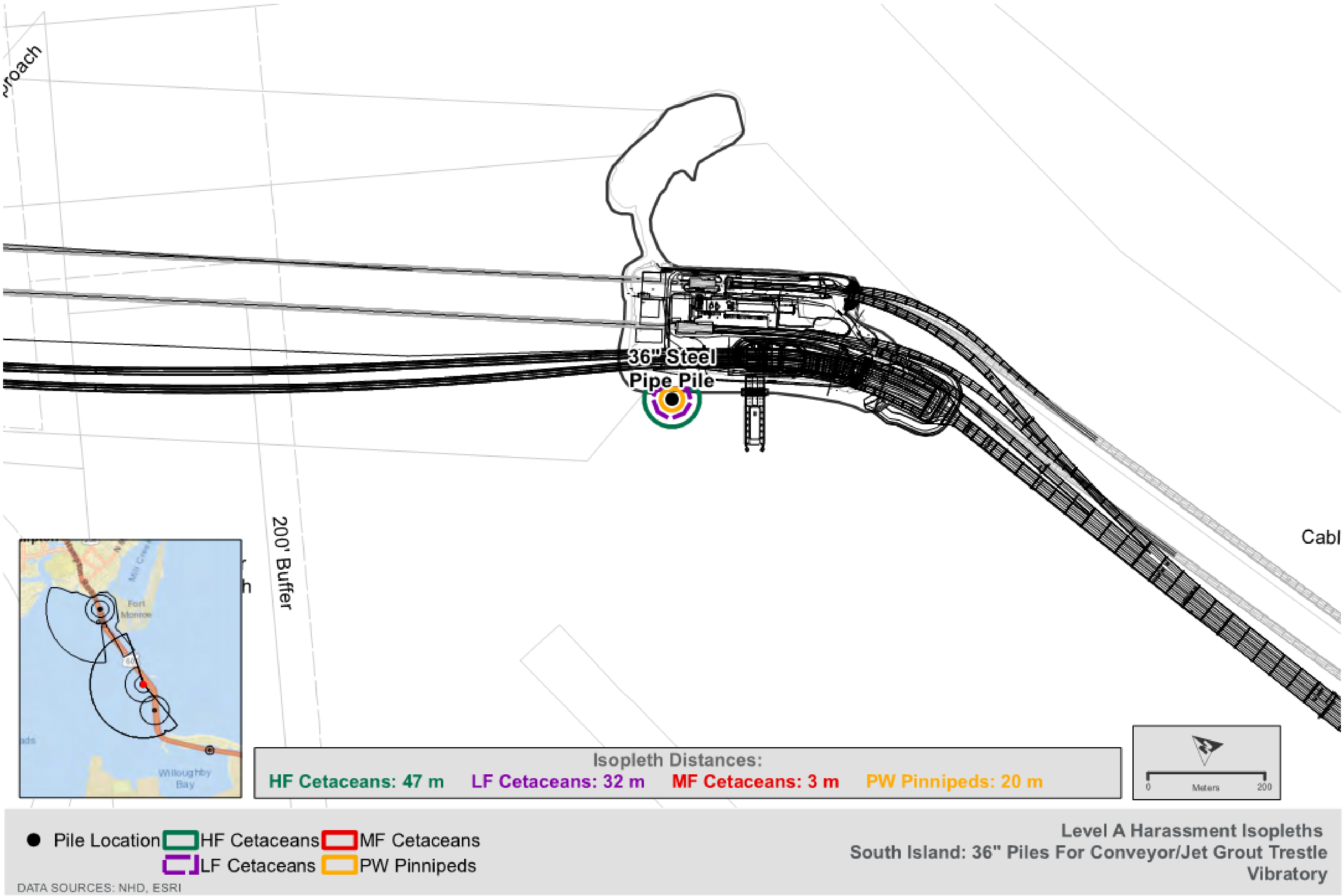
Attachment 2 Figure 8: Level A Harassment Isopleths North Trestle North Shore Work Trestle: Vibratory 36-inch Pile



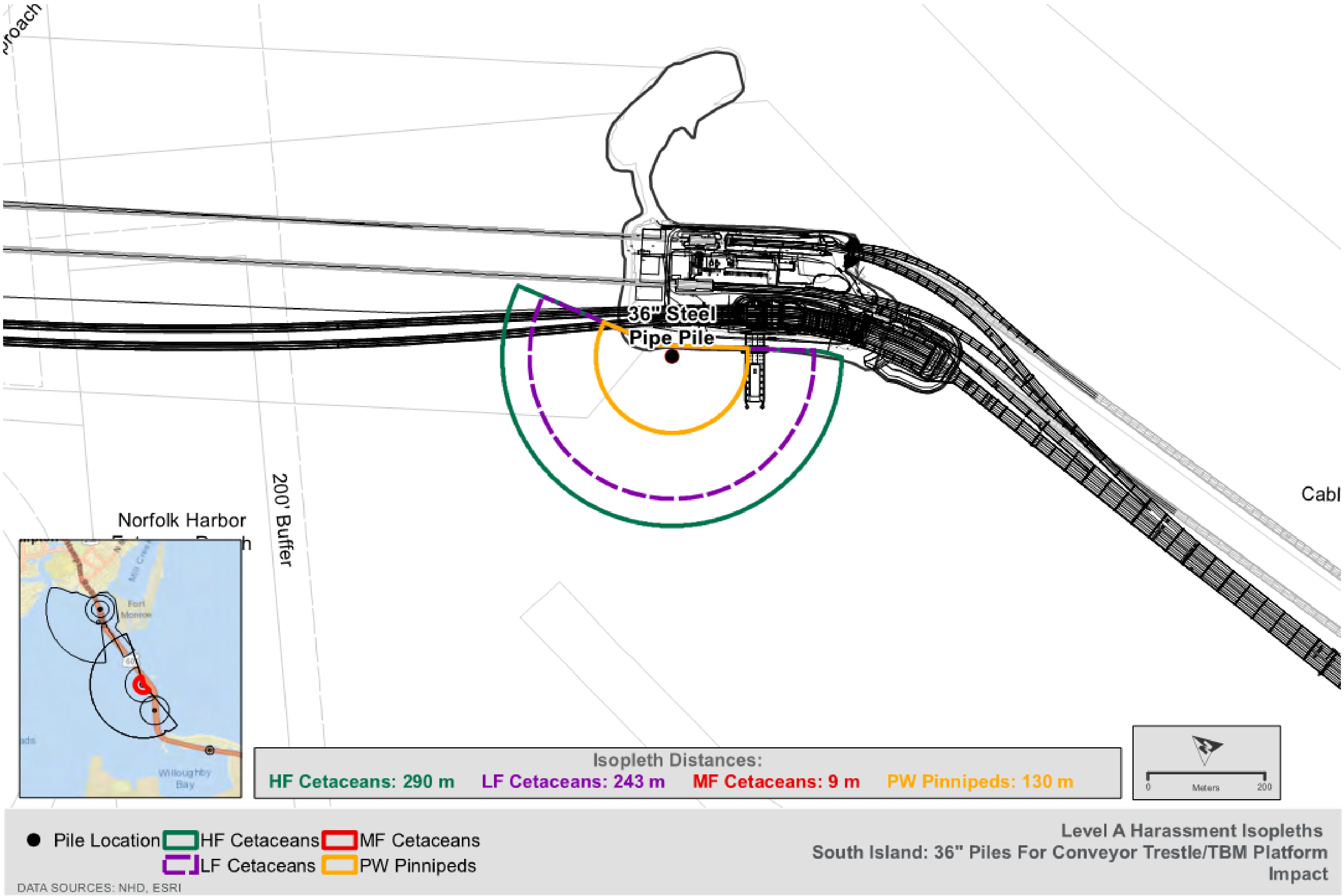
Attachment 2 Figure 9: Level A Harassment Isopleths North Trestle: Test Program 54-inch Concrete Impact Pile



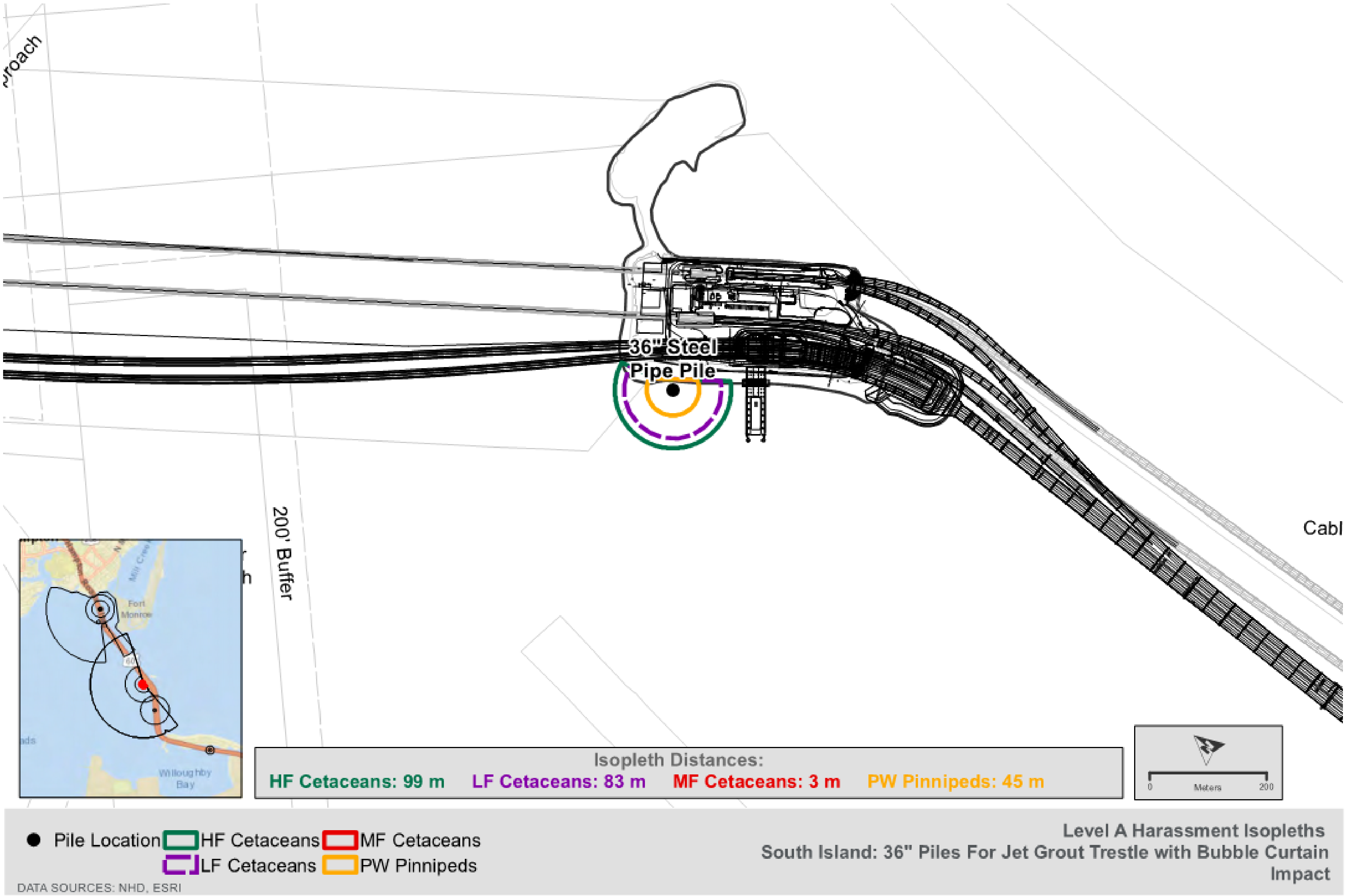
Attachment 2 Figure 10: Level A Harassment Isopleths South Island Conveyor Trestle and Jet Grout Trestle: Vibratory 36-inch Pile



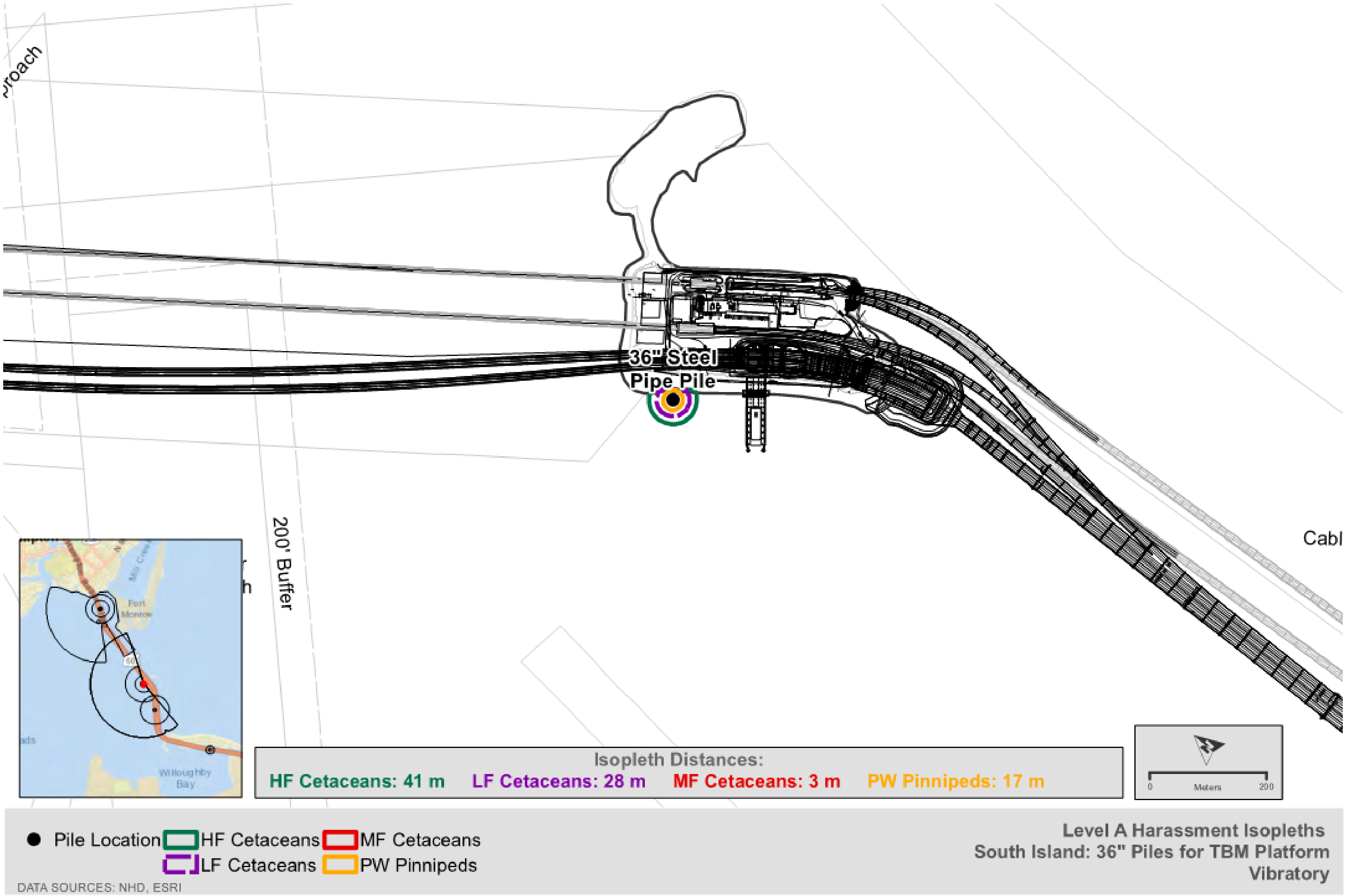
Attachment 2 Figure 11: Level A Harassment Isopleths South Island Conveyor Trestle, TBM Platform: 36-inch Impact Pile



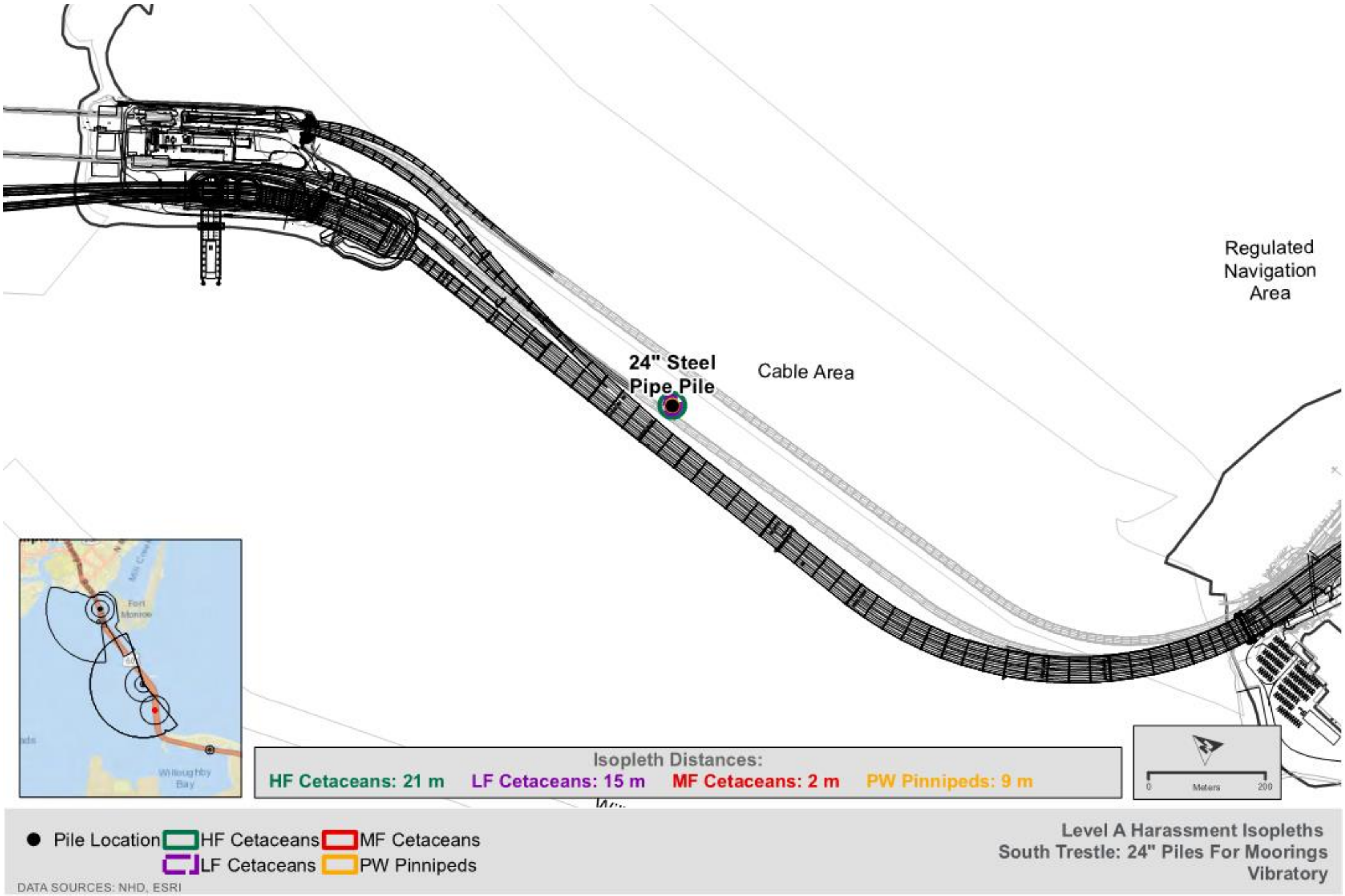
Attachment 2 Figure 12: Level A Harassment Isopleths South Island Jet Grout Trestle: Impact 36-inch Pile with Bubble Curtain



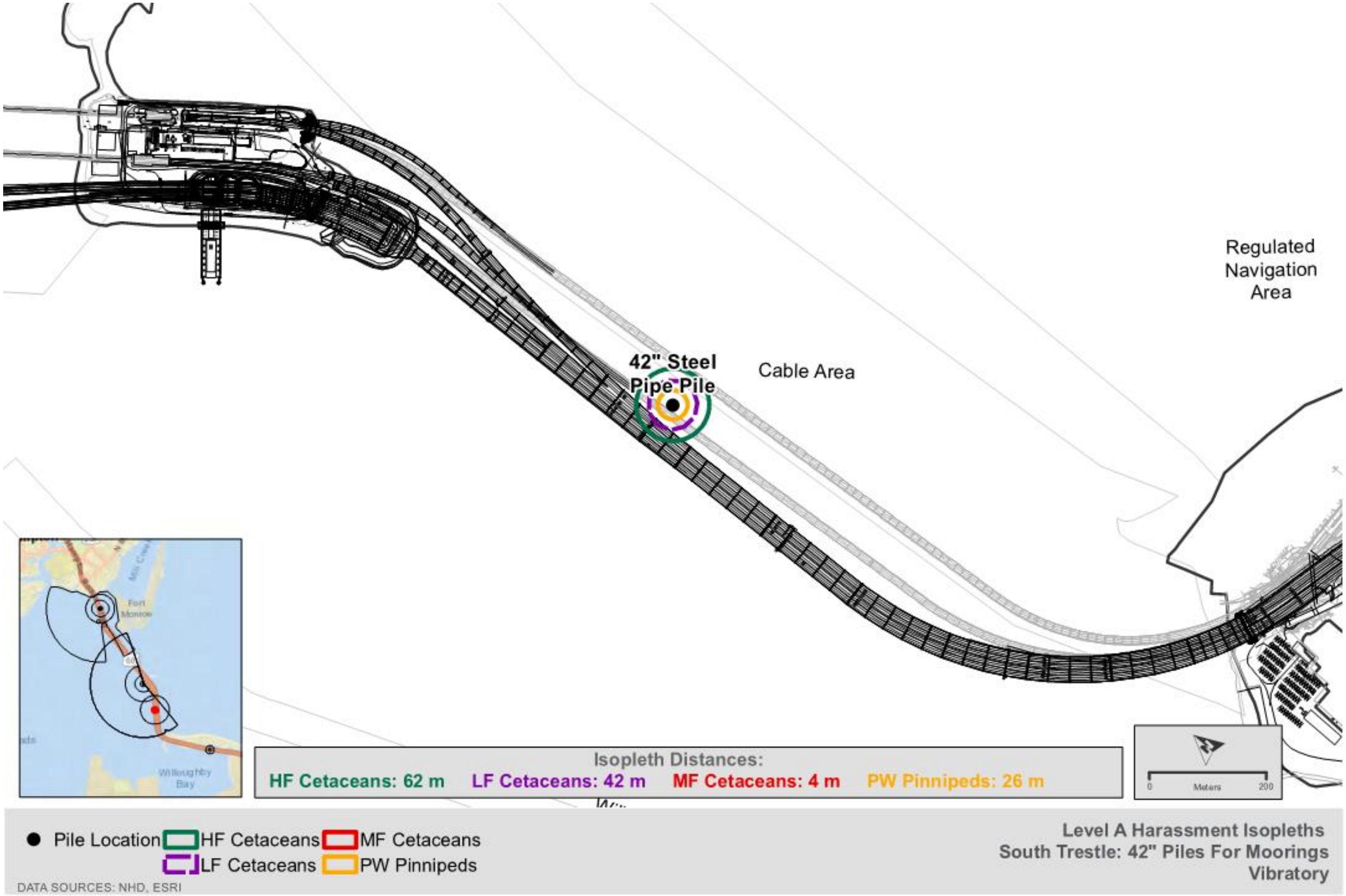
Attachment 2 Figure 13: Level A Harassment Isopleths South Island TBM Platform: Vibratory 36-inch Pile



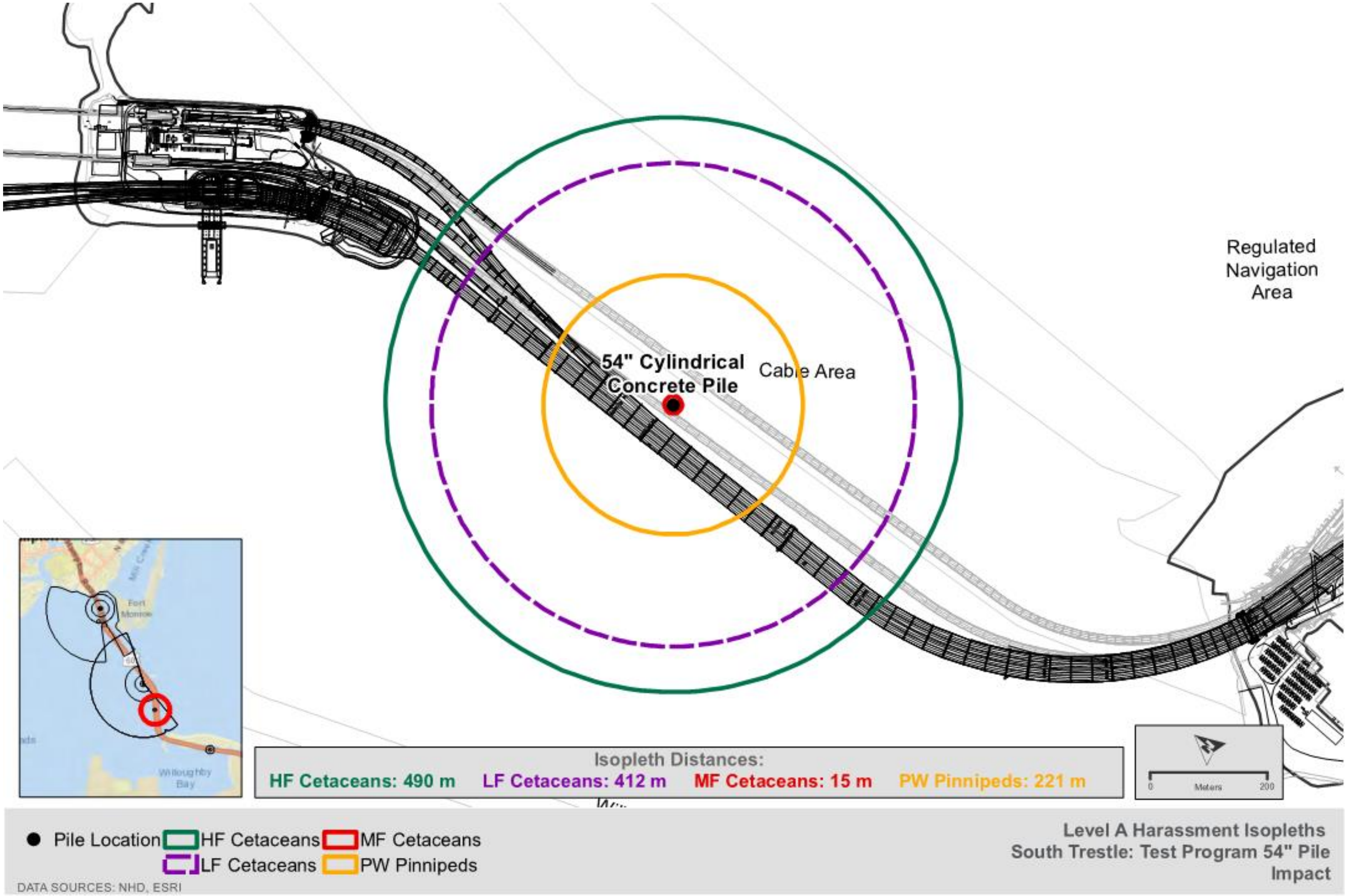
Attachment 2 Figure 14: Level A Harassment Isopleths South Trestle Moorings: Vibratory 24-inch Pile



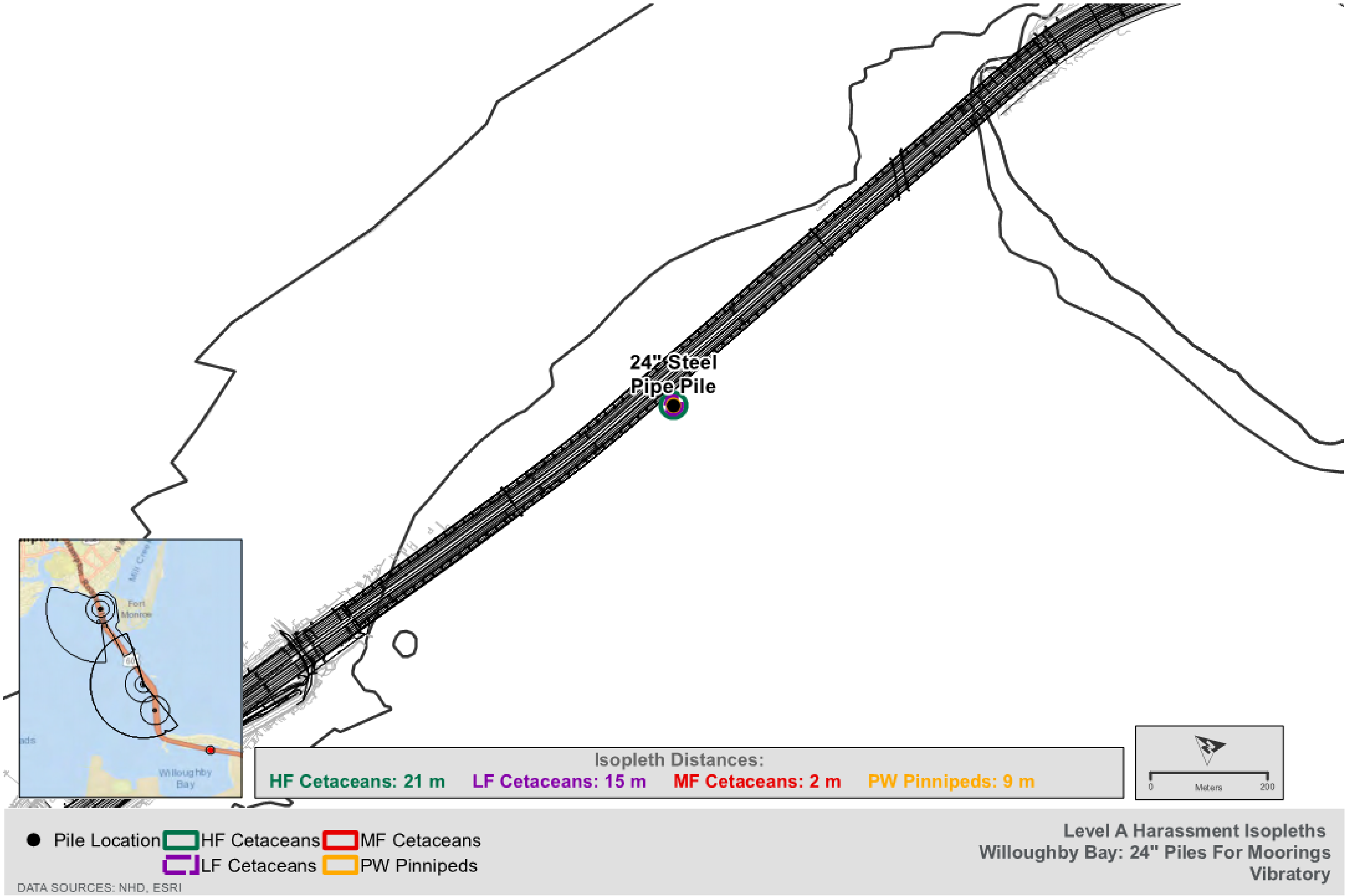
Attachment 2 Figure 15: Level A Harassment Isopleths South Trestle Moorings: Vibratory 42-inch Pile



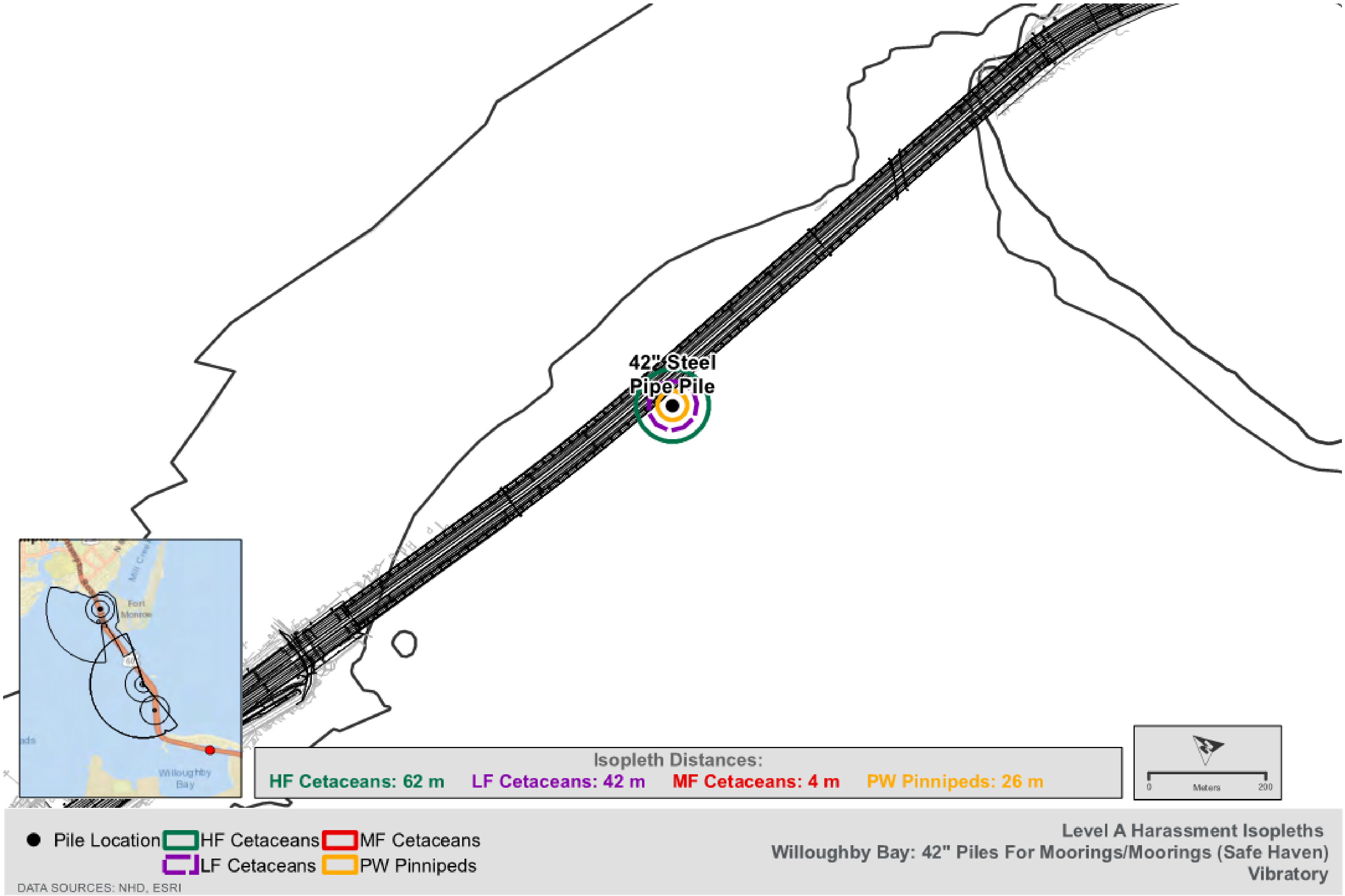
Attachment 2 Figure 16: Level A Harassment Isopleths South Trestle: Test Program 54-inch Concrete Impact Pile



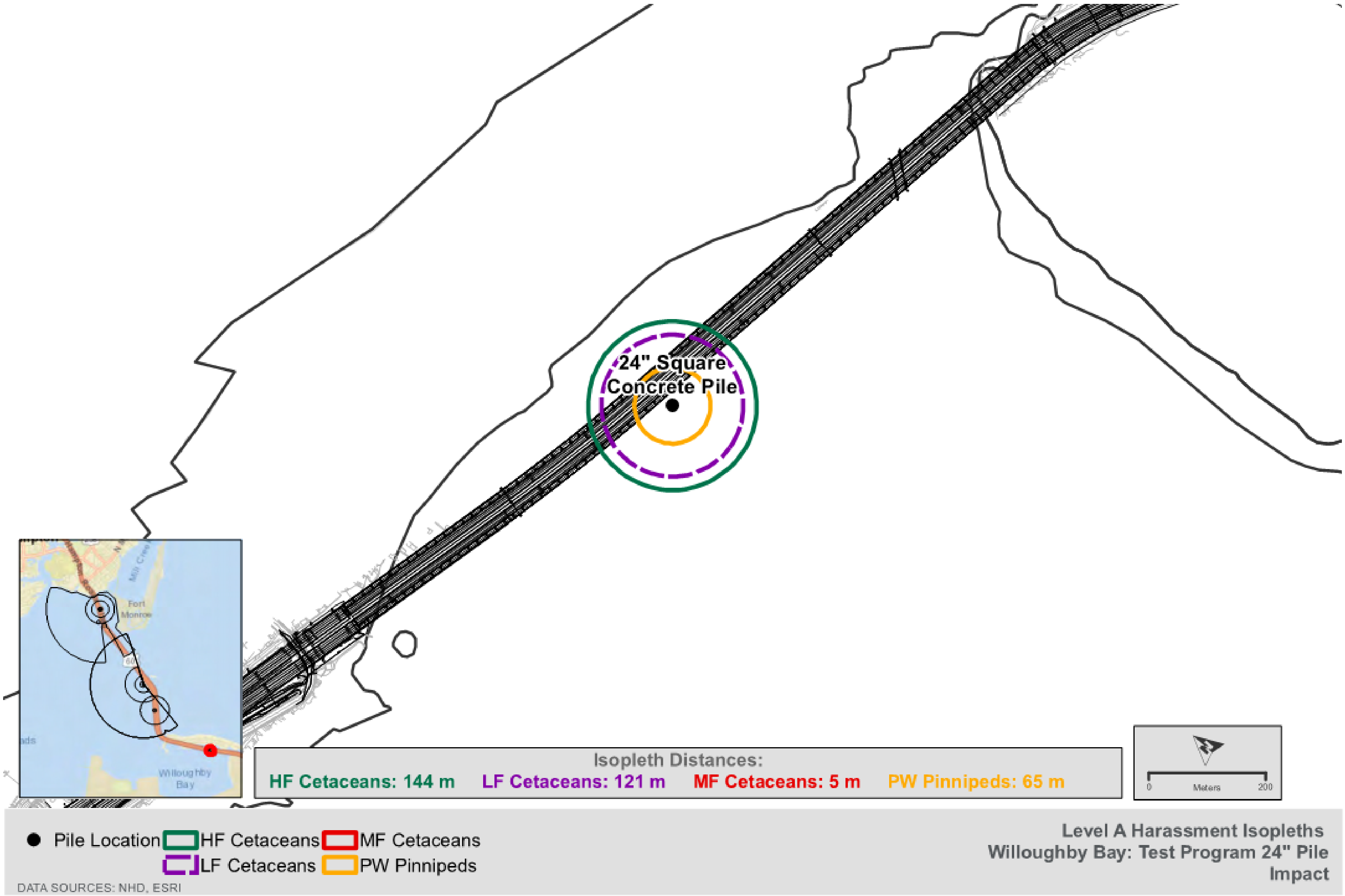
Attachment 2 Figure 17: Level A Harassment Isopleths Willoughby Bay Moorings: Vibratory 24-inch Pile



Attachment 2 Figure 18: Level A Harassment Isopleths Willoughby Bay Moorings/Moorings (Safe Haven): Vibratory 42-inch Pile

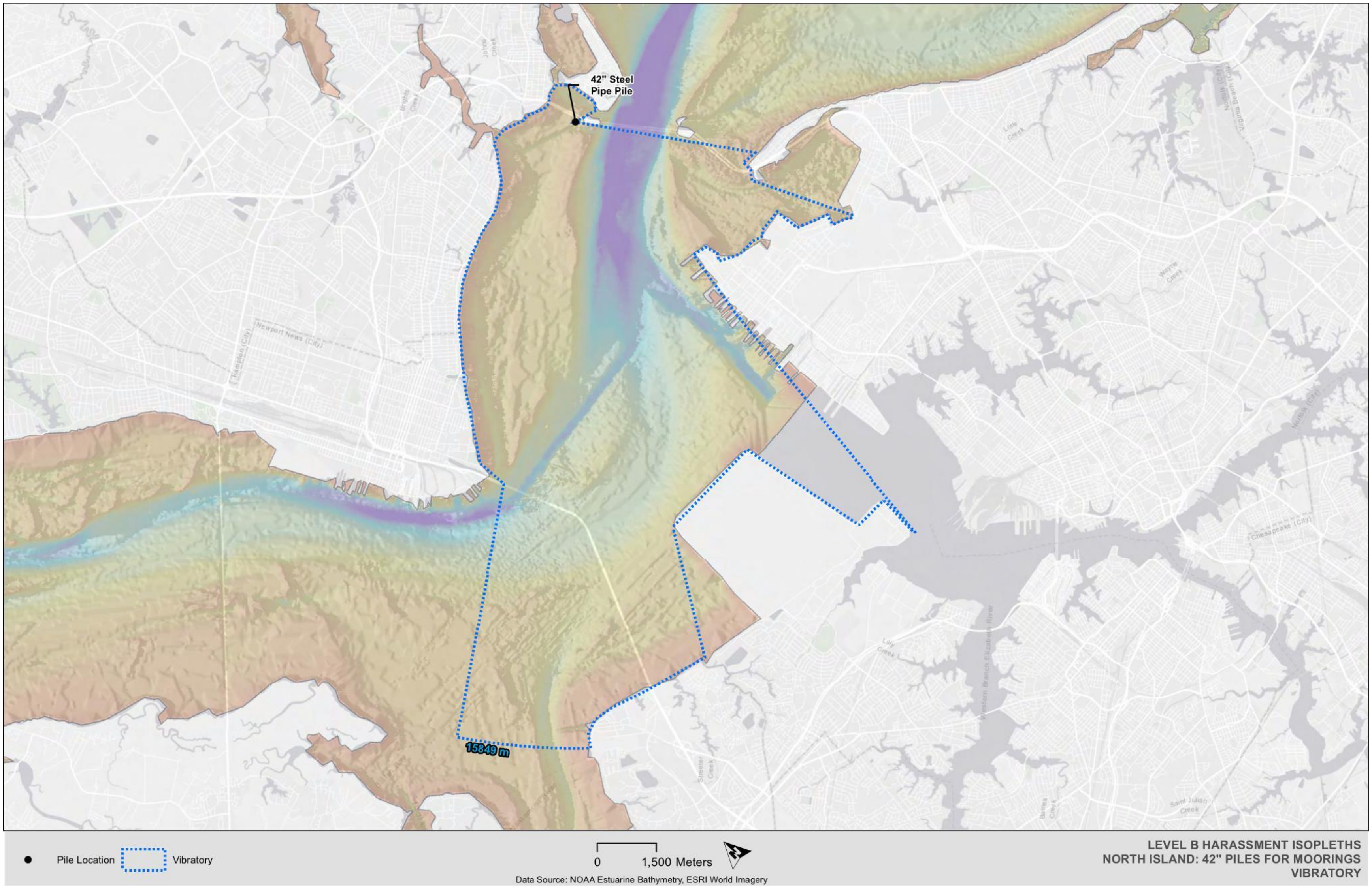


Attachment 2 Figure 19: Level A Harassment Isopleths Willoughby Bay: Test Program 24-inch Square Concrete Impact Pile

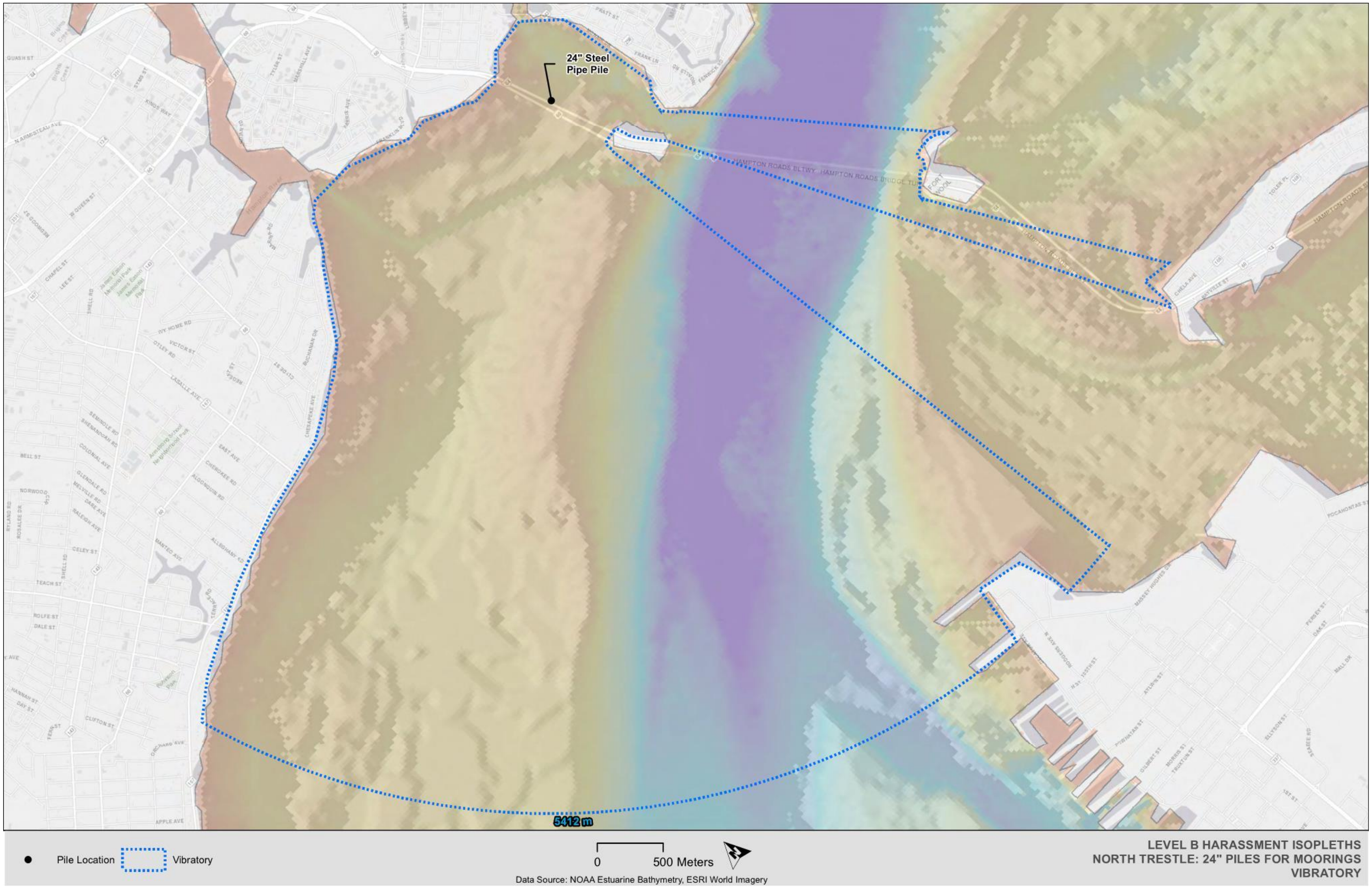


LEVEL B

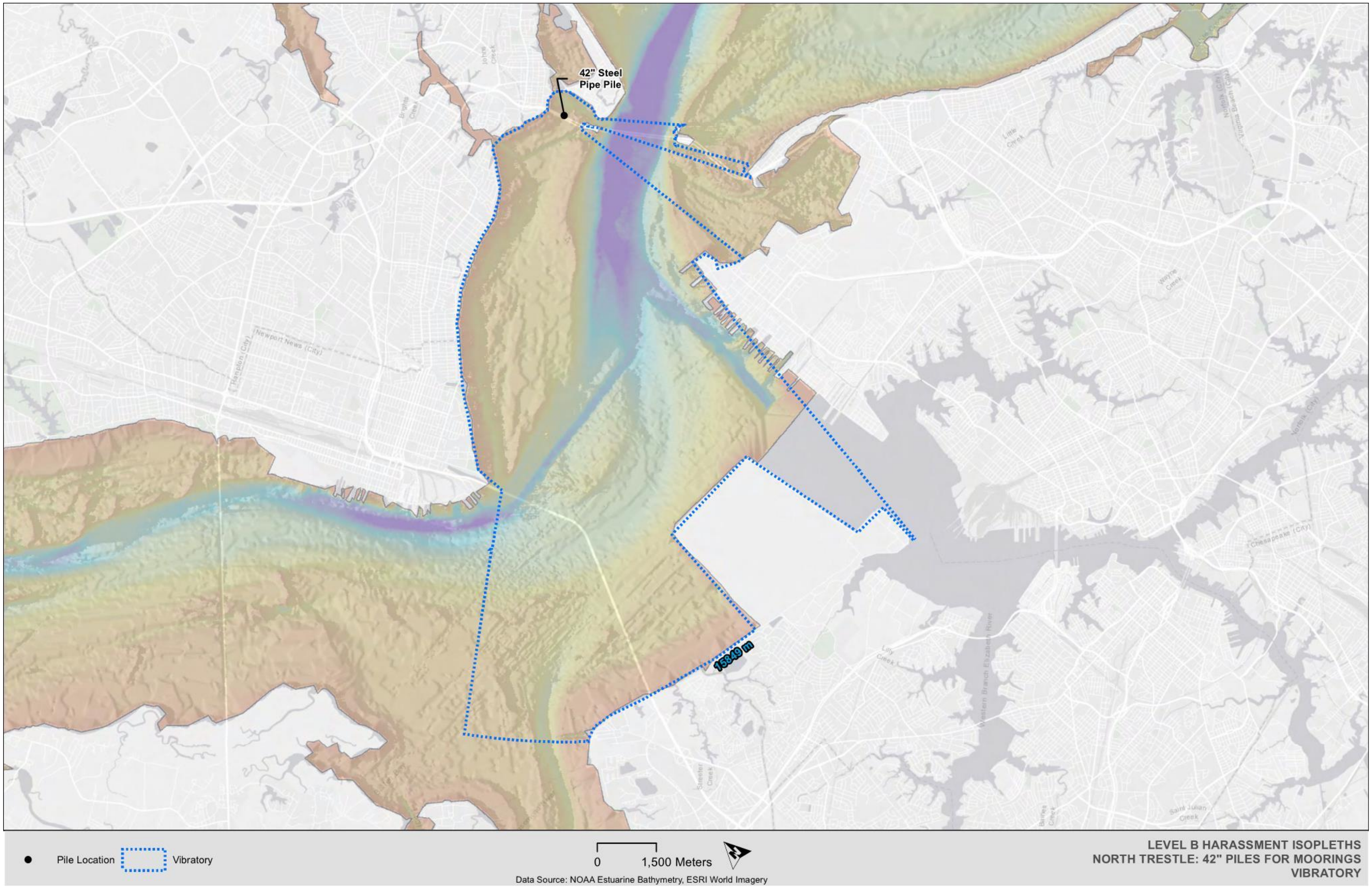
Attachment 2 Figure 20: Level B Harassment Isopleths North Island Moorings: Vibratory 42-inch Pile



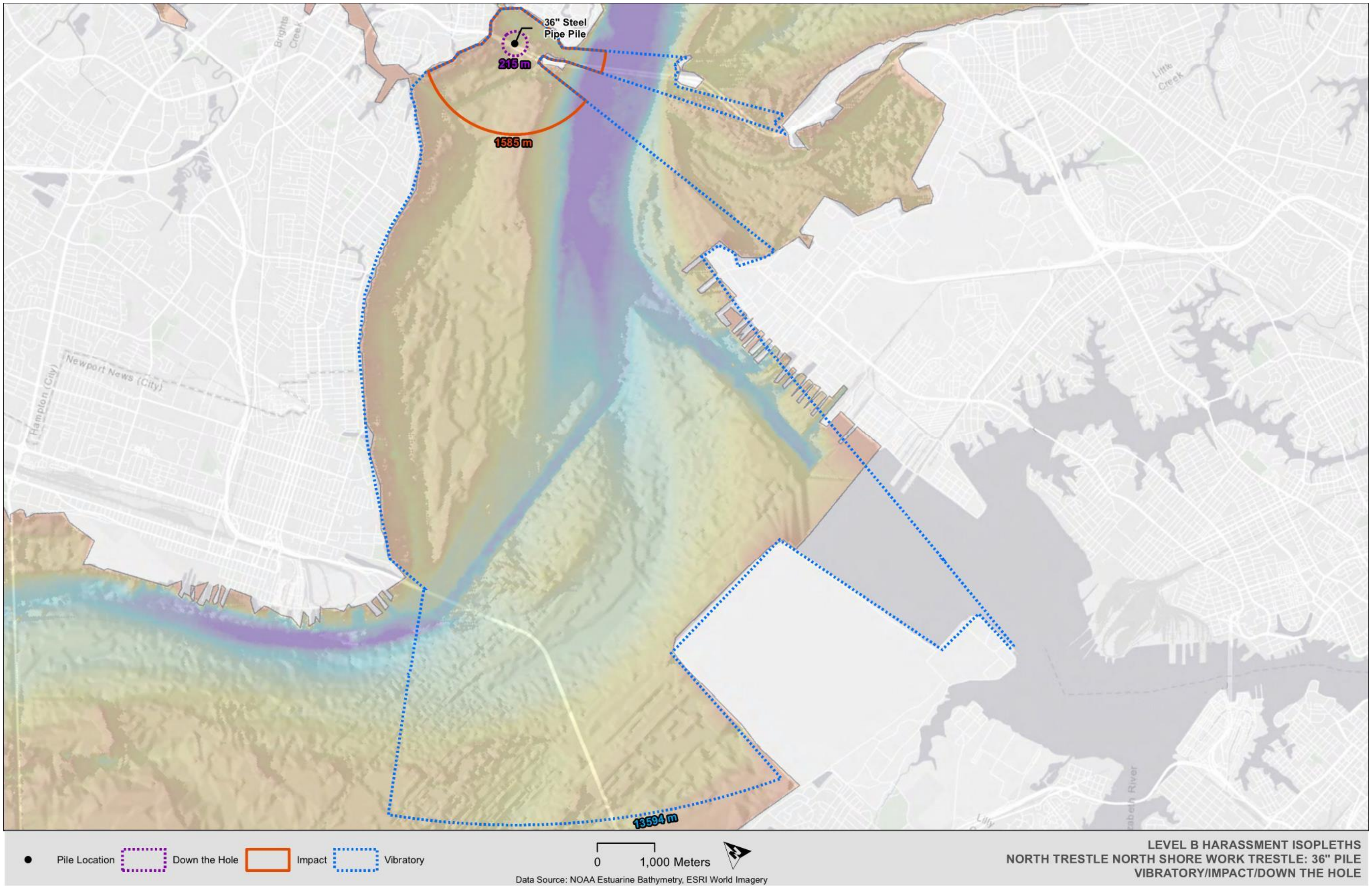
Attachment 2 Figure 21: Level B Harassment Isopleths North Trestle Moorings: Vibratory 24-inch Pile



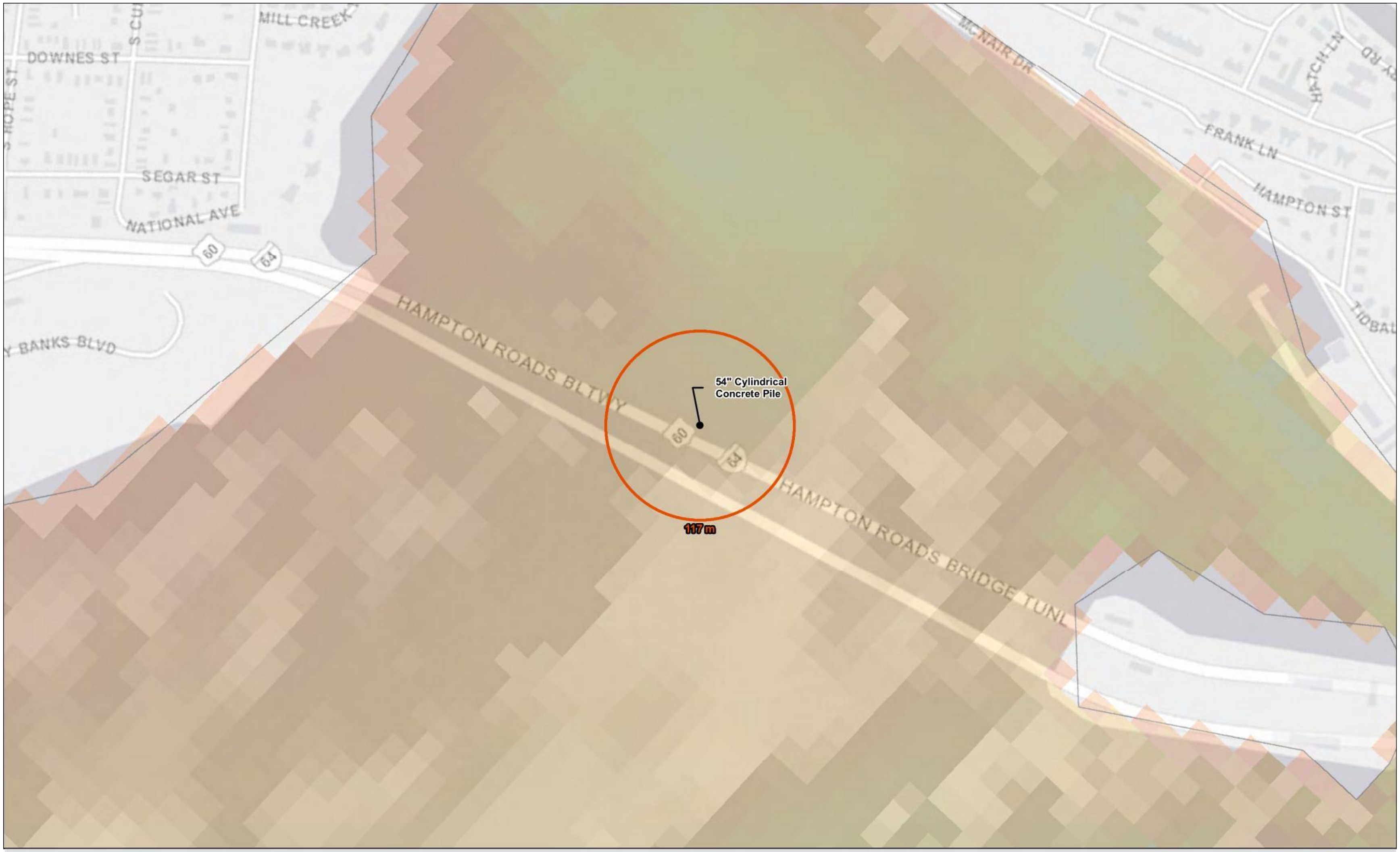
Attachment 2 Figure 22: Level B Harassment Isopleths North Trestle Moorings: Vibratory 42-inch Pile



Attachment 2 Figure 23: Level B Harassment Isopleths North Trestle North Shore: 36-inch Pile



Attachment 2 Figure 24: Level B Harassment Isopleths North Trestle: Test Program Impact 54-inch Pile



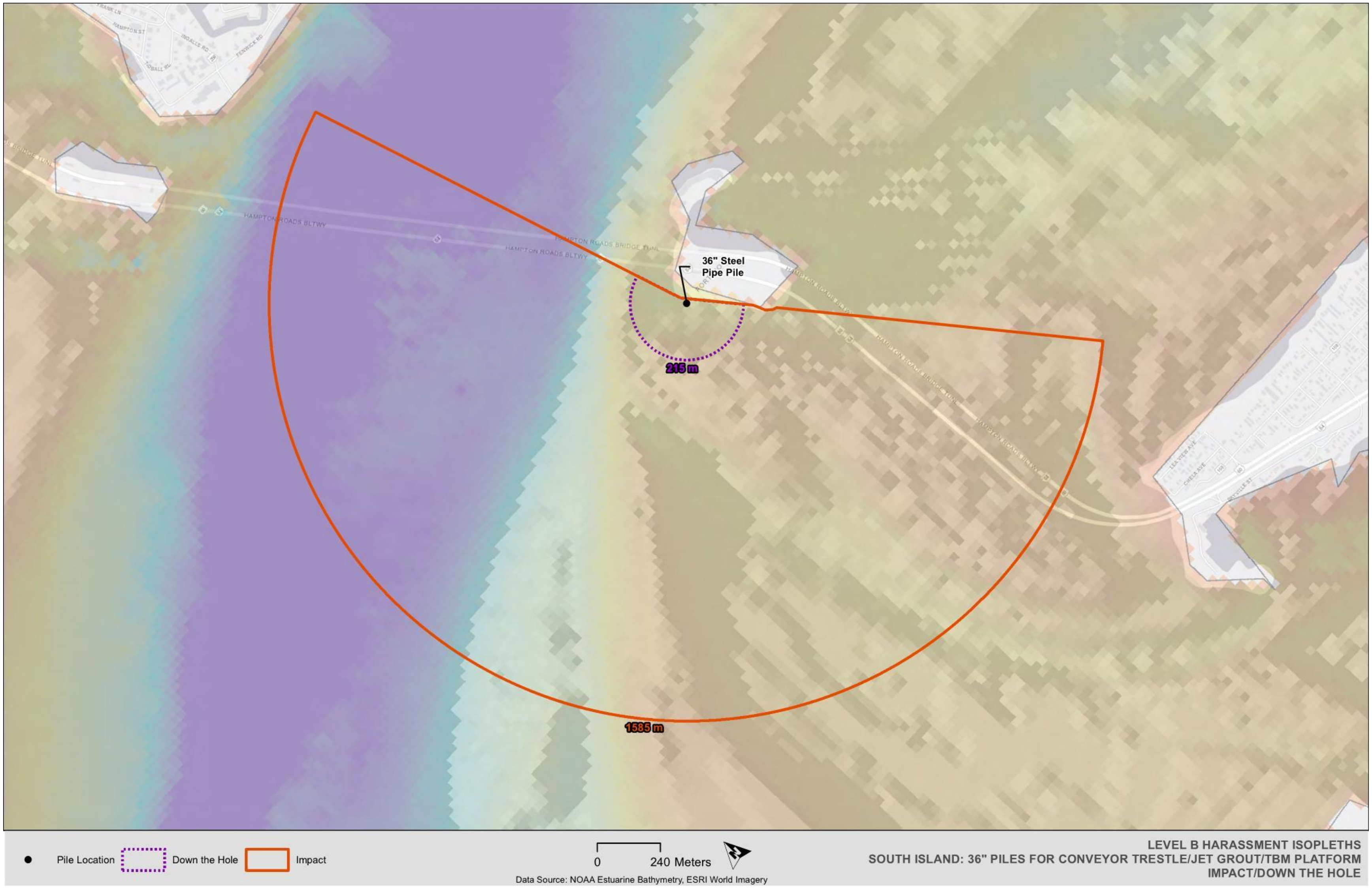
● Pile Location ▭ Impact

0 80 Meters

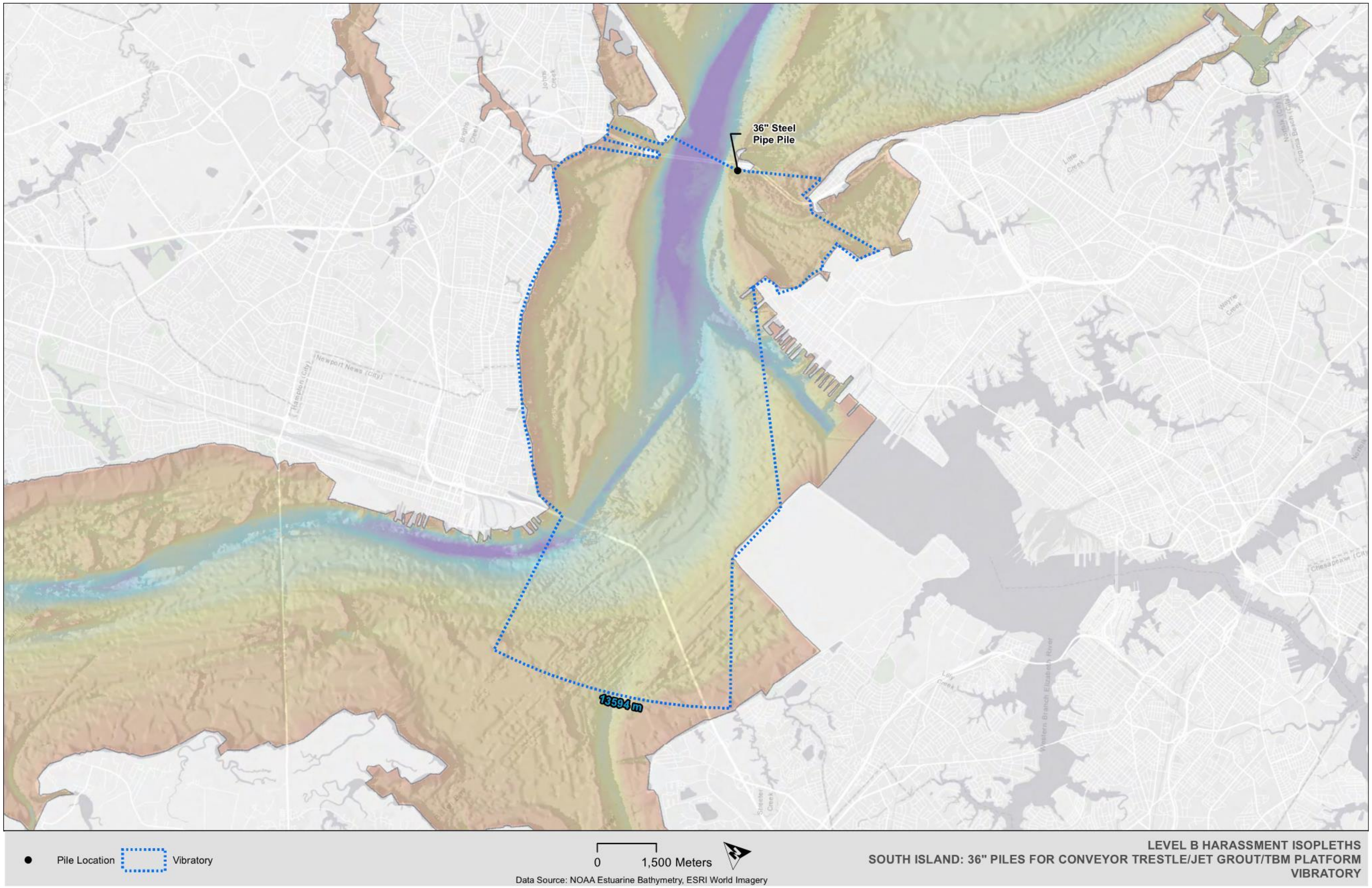
Data Source: NOAA Estuarine Bathymetry, ESRI World Imagery

LEVEL B HARASSMENT ISOPLETHS
NORTH TRESTLE: TEST PROGRAM 54" PILE
IMPACT

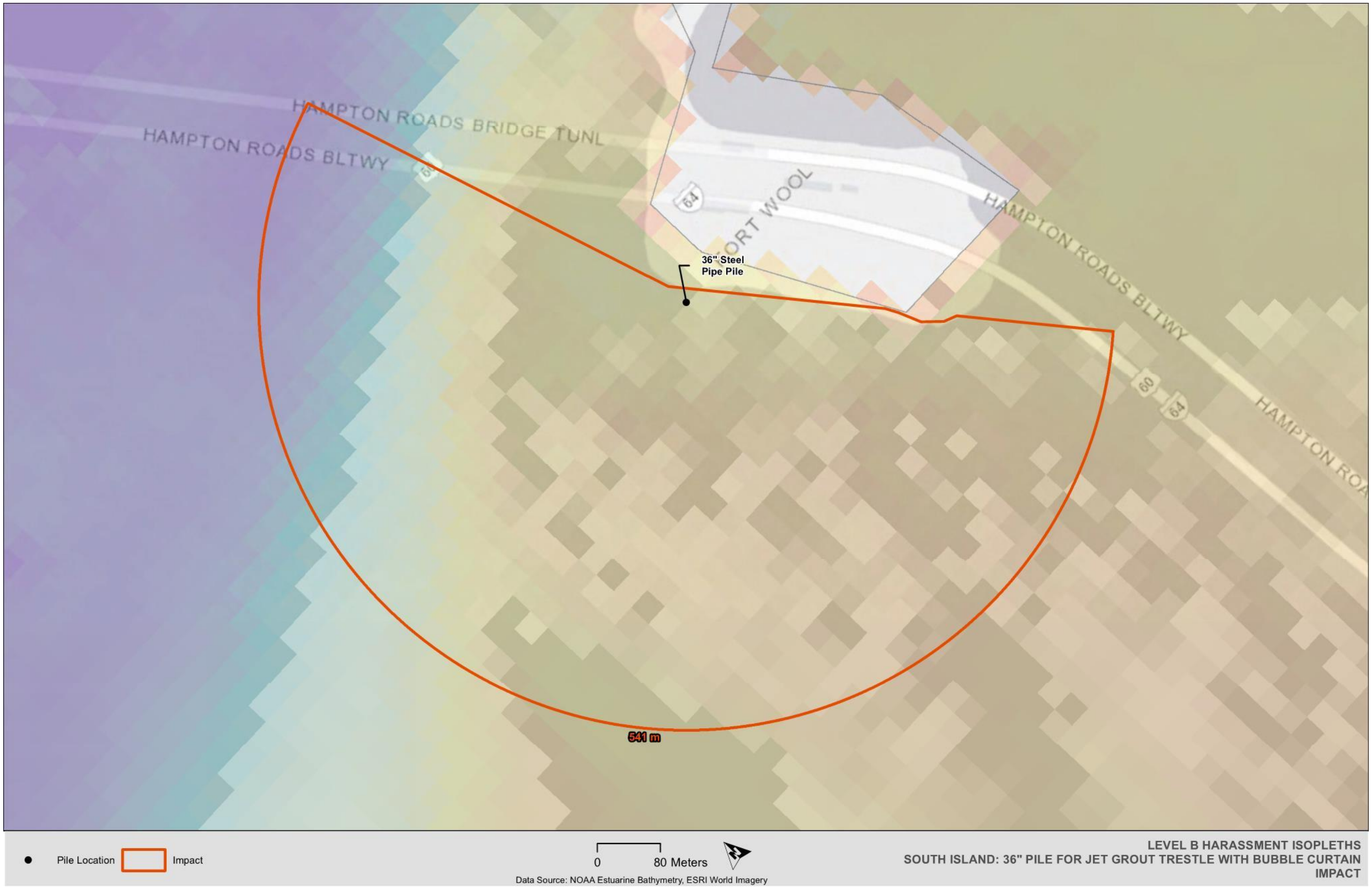
Attachment 2 Figure 25: Level B Harassment Isopleths South Island: Conveyor/Jet Grout/TBM Platform: 36-inch Pile Impact/Drilling with a Down-the-Hole Hammer



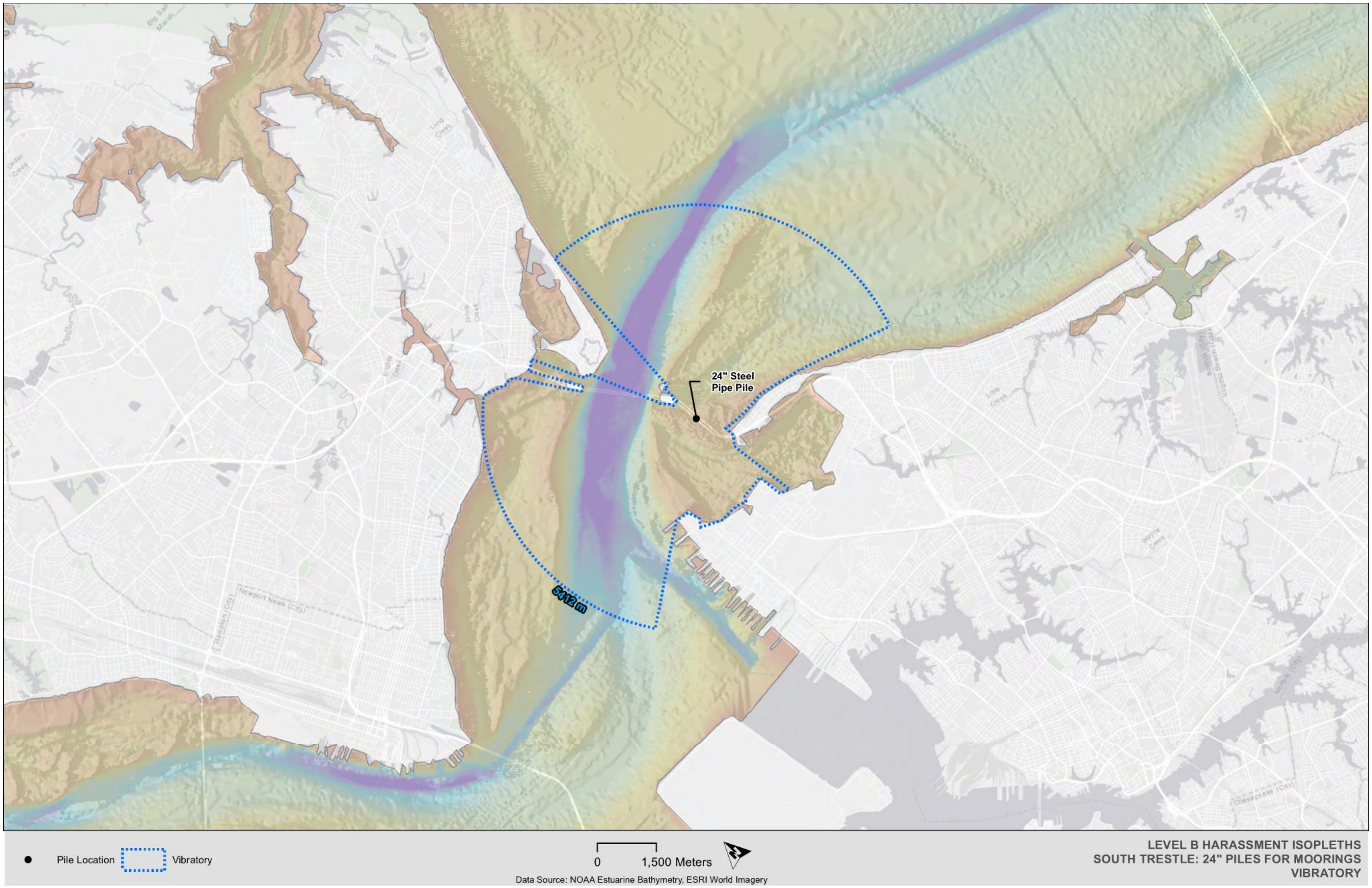
Attachment 2 Figure 26: Level B Harassment Isopleths South Island: Conveyor/Jet Grout/TBM Platform: 36-inch Pile Vibratory



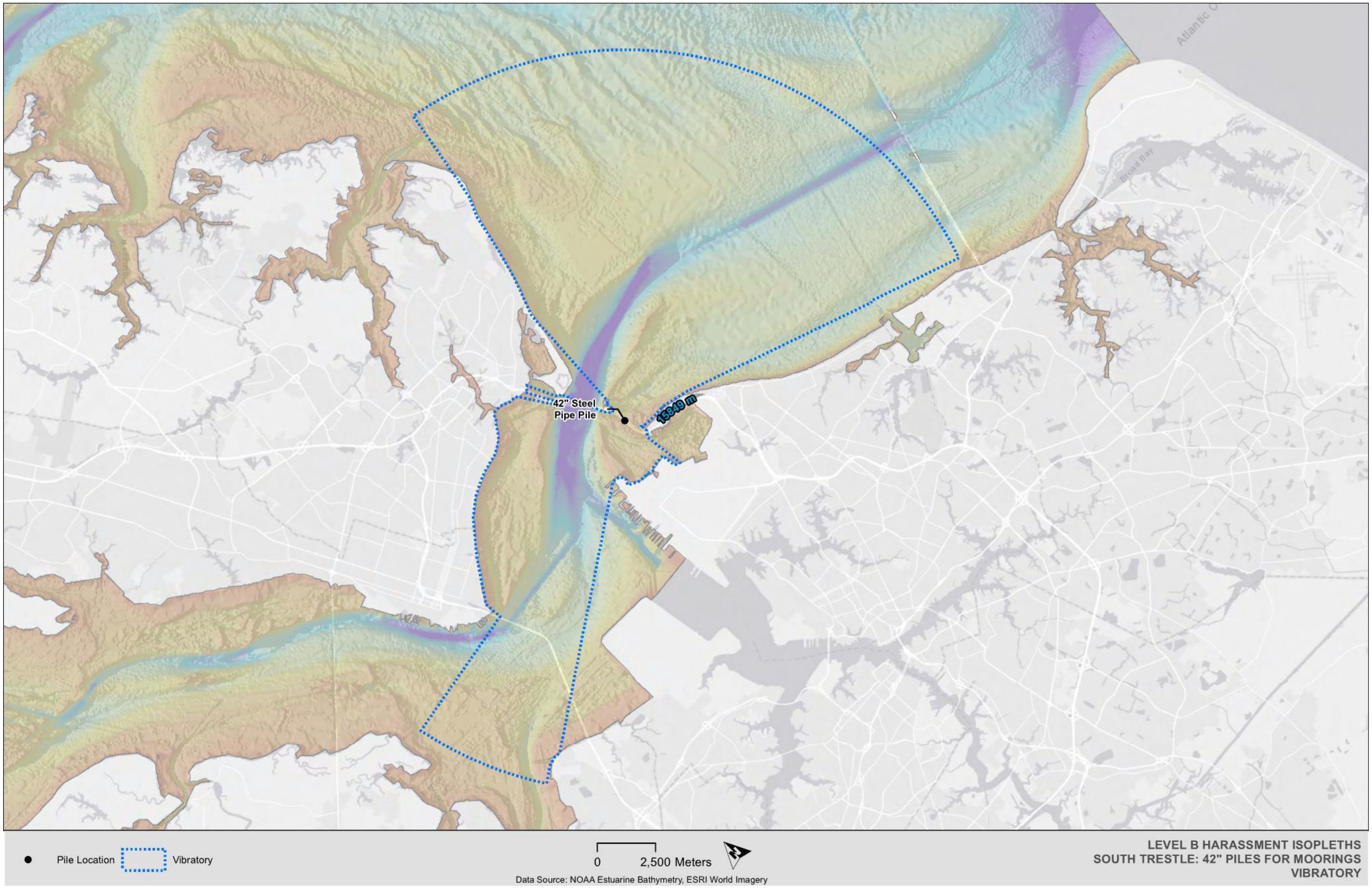
Attachment 2 Figure 27: Level B Harassment Isopleths South Island: Jet Grout: 36-inch Pile Impact with Bubble Curtain



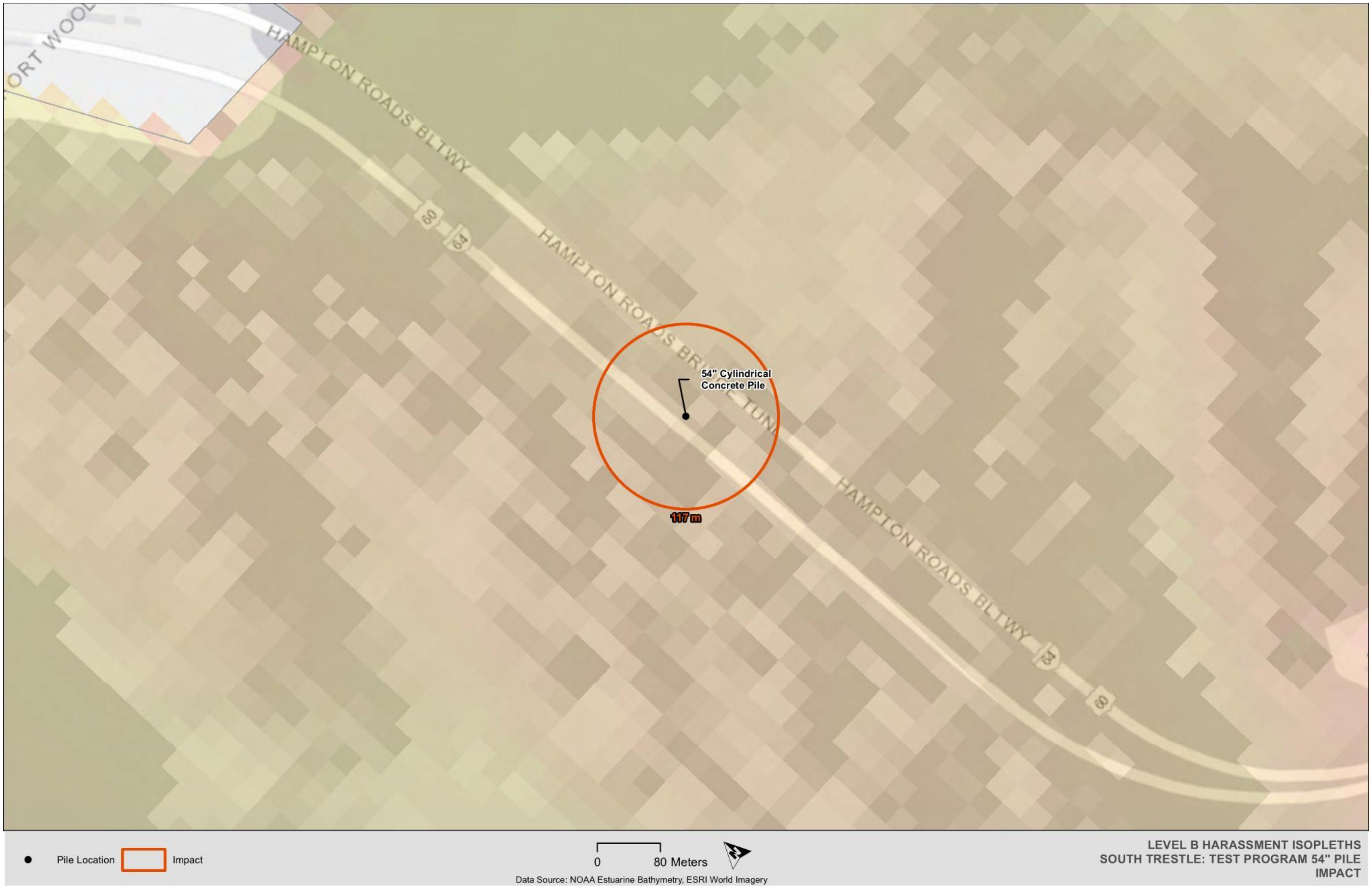
Attachment 2 Figure 28: Level B Harassment Isopleths South Trestle Moorings: Vibratory 24-inch Pile



Attachment 2 Figure 29: Level B Harassment Isopleths South Trestle Moorings: Vibratory 42-inch Pile

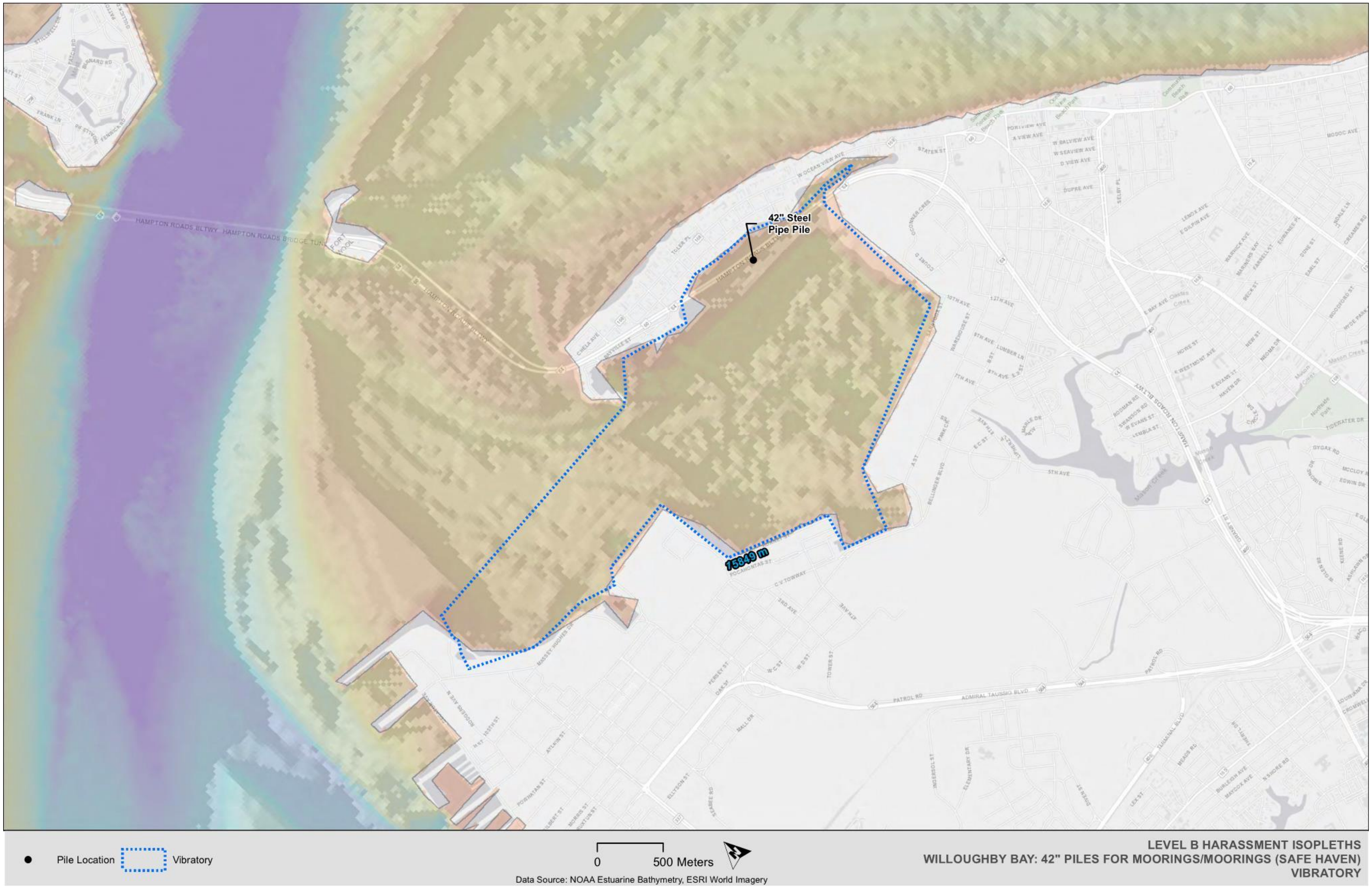


Attachment 2 Figure 30: Level B Harassment Isopleths South Trestle: Test Pile Program Impact 54-inch Pile



Attachment 2 Figure 31: Level B Harassment Isopleths Willoughby Bay Moorings: Vibratory 24-inch Pile

Attachment 2 Figure 32: Level B Harassment Isopleths Willoughby Bay Moorings/Moorings (Safe Haven): Vibratory 42-inch Pile



Attachment 2 Figure 33: Level B Harassment Isopleths Willoughby Bay: Test Pile Program Impact 24-inch Square Pile